Redistributive Inequality in Cooperation Dilemmas: An Economic Experiment on Fear and Greed[1]

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Abstract:

This work explores experimentally the role of asymmetric outcomes in cooperation dilemmas. Participants face three different games where the dimensions of "greed" and "fear" are controlled exogenously. Greed corresponds to the difference between the payoffs commonly known as temptation and reward, while Fear to the difference between punishment and sucker's payoff. Our findings indicate that Fear dimension reduces the probability of cooperation considerably more than the Greed dimension. This asymmetry is held even under fixed matching, where subjects are more aware of the opponent's previous movements under Fear than under Greed. Another finding is that the order in which dilemmas are faced is important: the increase in cooperation when switching to a less unequal dilemma is higher than the decrease in cooperation when switching to a more unequal dilemma.

JEL Classification: C91, D03, D31.

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1. Introduction

1.1. Introducing Fear and Greed into cooperation dilemmas

Individual choice facing a cooperation dilemma involves the internalization of others' expected behavior. The decision of cooperation may be affected by feelings of Fear and Greed given the coexistence of material and non-material payoffs, as well as by the possibility of updating beliefs about the population's behavior in a dynamic environment. On the one hand, Fear favors defection when, given an expected short fraction of cooperators, the investment cost in cooperation seems higher compared to the reduced benefits attainable in the dilemma. On the other hand, Greed favors defection when, given an expected long fraction of cooperators, the benefits from leaving cooperation result more profitable than adopt it.

A simplified version of a cooperation dilemma is the two-person Prisoner's Dilemma (PD). The strategic form of this well-known and extensively studied game is shown in Table 1. The four possible payoffs correspond to temptation (T) to defect when the other player cooperates, reward (R) when both players cooperate, punishment (P) when both players defect, and "sucker's payoff" (S), received in case of cooperation while the other individual defects.

Table 1. Prisoner's Dilemma in its strategic form

P1 / P2	Cooperate	Defect
Cooperate	R, R	S, T
Defect	T, S	P, P

Constructing a PD involves two conditions, as are mentioned in Frohlich and Oppenheimer (1996): The suboptimality condition and the "externality larger than internality" condition. The suboptimality condition, shown in expression (1), implies that cooperation is a dominated strategy given that, no matter the other's strategy, defection is always the best individual response. The other condition, which guarantees that the externality cost imposed on the other player will be larger than internality derived from the benefits of the own defection, is shown in expression (2)[3]. This condition implies that in a PD the social welfare, defined as the sum of all players' payoffs, is maximized under mutual cooperation.

$$T > R > P > S \quad (1)$$

$$2R > T + S \quad (2)$$

The definition of the payoff parameters allows introducing the inequality dimensions of Fear and Greed in the PD. The cost of cooperation when is expected that the other player defects is associated with the Fear dimension, and is defined as $(P - S)$. The benefit of defection when is expected that the other player cooperates corresponds to $(T - R)$ and is associated to the

[3] In Frohlich and Oppenheimer (1996) this inequality is expressed as *R-S > T-R* to differentiate the externality from the internality. However, in this work is more useful written as in (2).

dimension of Greed. These dimensions are introduced in Komorita *et al.* (1980). However, these payoff differences were previously mentioned in Rapoport and Chammah (1965).

A manipulation of the dimensions of Fear and Greed leads to the introduction of two different cooperation dilemmas. These games share with the PD the suboptimality condition, but now the condition related to the social welfare obtained in the asymmetric outcomes is subject to modifications. The inequality shown in (2) is held for moderate levels of Greed, but once the difference $(T - R)$ is increased considerably, the "externality larger than internality" condition is no longer held. A shift of the inequality in (2) implies that the social welfare will be maximized under asymmetric cooperation, and now mutual cooperation turns into the second best. If the internality exceeds the externality, the defector could compensate the cooperator with an *ex-post* transfer and preserve the larger share of the total output. Considering that this dilemma appears after a significant augmentation of the difference$(T - R)$, it is defined as Cooperation Under Greed (CUG) (See Mantilla, 2012).

If the enlargement of the Greed dimension introduces another cooperation dilemma, it is expected an analogous derivation manipulating the Fear dimension. As is shown in Mantilla (2012), another condition –not commonly mentioned- constrains the PD. Expression (3) leads to another "externality larger than internality" condition, given that the own costs of leaving defection are lower than the benefits from the defector. In other words, this inequality implies that in the PD the minimum value of social welfare is obtained under mutual defection.

$$2P < T + S \qquad (3)$$

Now, if the difference $(P - S)$ is increased high enough, the condition in (3) is no longer held and the remaining dilemma appears. Analogously to CUG, the Cooperation Under Fear (CUF) game is defined according to the augmentation of the corresponding Fear dimension $(P - S)$.

The three cooperation dilemmas -CUF, PD and CUG- share the suboptimality condition, hence, defection is the dominant strategy in all games. The "externality larger than internality" conditions are both held only in PD, while the other couple of dilemmas held just one of these conditions (See Table 2). When one of the conditions is no longer held, the hull generated by the payoffs of the four possible outcomes in the PD losses its convexity.

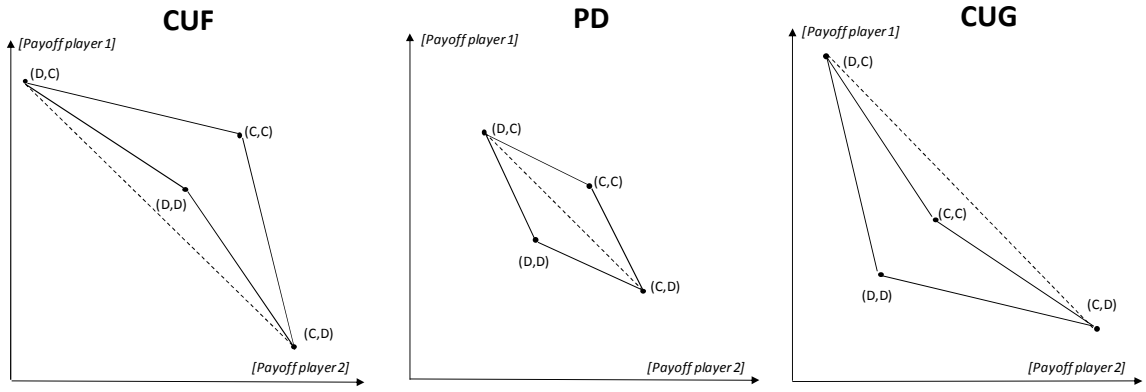
Table 2. Classification of Cooperation Dilemmas

	2R > T + S **Mutual cooperation maximizes social welfare**	**2P < T + S** **Mutual defection minimizes social welfare**	**Loss of convexity**
Cooperation Under Fear	Yes	No	Below (D,D)
Prisoner's Dilemma	Yes	Yes	Convex hull
Cooperation Under Greed	No	Yes	Above (C, C)

Figure 1 shows graphically the violation of expressions (2) and (3) in CUG and CUF respectively, their consequences on the social welfare reached as well as the origin of concavities in the payoff hull. The social welfare generated in an outcome can be measured as the distance from the origin of the graph to the point corresponding to this outcome: the farthest the point, the largest the sum of individual payoffs. In this way, the convexity in PD guarantees that the social welfare is maximized under mutual cooperation and minimized under mutual defection because the point

(C, C) is the farthest from the origin while (D, D) is the closest. However, as is remarked in Table 2, the asymmetric outcomes in the most unequal dilemmas correspond to the minimum social welfare in the CUF and the maximum social welfare in the CUG. Furthermore, the loss of convexity broadens the attainable payoffs through mixed strategies. In the CUG dilemma, it means that if both players use a mixed strategy they maximize the expected payoff without mutual cooperation; while in the CUF dilemma a mixed strategy leads to lower expected payoffs, reducing the chances of leaving defection.

Figure 1. Graphical representation of Prisoner's Dilemma variations



1.2. The importance of experiments to understand the effects of Fear and Greed

The dimensions of Fear and Greed are defined as two basic motivational pressures in the decision of cooperation (Rapoport and Chammah, 1965 and Komorita *et al.*, 1980). Given the belief that the opponent will cooperate, the Greed dimension increases the incentives to defection based on the player's own material interest. Given the opposite beliefs, when the player expects that his opponent defects, the Fear dimension also increases the incentives to defection but now based on the opponent's material interests.

When differences between these two motivational pressures can be exogenously controlled, we are able to analyze the willingness to cooperate under two different environments: On the one hand, when the costs of cooperation if the other player defects are very high. On the other hand, when benefits from defection if the other player cooperates are very high. Asymmetries in the levels of cooperation reached under these two environments may be explained by differences in how subjects are affected by Fear and Greed in cooperation dilemmas.

Bowles (2011) discusses how liberal societies are able to insure its citizens against worst-case outcomes and the correlation of this ability with strong social preferences. In this context, the Fear represents the level of the worst-case outcome, while Greed may be more related to the individual preferred outcome, although not necessarily the best social outcome. If Fear has a greater effect reducing cooperation than Greed, policy design should be more focused in providing a better worst-case outcome, not only making efforts to control that the preferred individual outcomes do not reach undesirable inequality levels. However, we do not intend to state that cooperation dilemmas under higher levels of Greed are irrelevant; in fact we show that reduction in inequality, whether it is associated to Fear or Greed, is strongly correlated with increases in cooperation.

Classical game theory predicts that in one-shot games, and similarly for random matching games, there are no differences between cooperation dilemmas and the result will be mutual defection for the three games. Under fixed matching, where players face the same opponent during the entire game, higher levels of Greed implies a higher number of periods to establish intertemporal cooperation. Meanwhile, Fear is not affecting directly the expected number of rounds to cooperate indefinitely. The explanation is that Greed gives incentives to defect when mutual cooperation is expected, and Fear is irrelevant given these expectations.

Under evolutionary game theory, where the analysis is based on populations' behavior instead of individual decisions and we suppose random interactions in each round, the basic replicator equation predicts that the incentives of all cooperation dilemmas leads to mutual defection, independently of the initial composition of the population. However, the rate of convergence to defection is higher in CUF than in CUG for the same levels of corresponding Fear and Greed (Mantilla, 2012).

The experiment will be useful to test if these theoretical predictions are able to explain the subjects' behavior; or if alternative theories including other regarding preferences and inequity aversion (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000) are more likely to provide answers to the experimental data.

Also, CUG represents a particular case of cooperation dilemmas where a coordinate alternation between cooperation and defection maximizes the intertemporal payoff for both players. However, it requires that both players are willing to start receiving the sucker's payoff with a probability of 0.5 and that they accept the alternation until the last round in the case of finitely repeated games. We intend to test if players are able to implement the alternation strategy under a finitely repeated game for two different number of total periods.

1.3. Experimental evidence on cooperation dilemmas

A vast experimental literature has been focused in the standard PD (Sally, 1995; Davis and Holt, 1993). However, the most part of these works are focused in the transitions from mutual defection to mutual cooperation, leaving mostly unexplored the asymmetric outcomes where payoff inequality may have an important role in the decisions of cooperation. An exception in this trend is the work from Ahn *et al.* (2001), where participants are subject to four different payoff structures, all of them corresponding to PD, in which the dimensions of Fear and Greed varies across games. The findings of this work show that history of play has higher explanatory power than the dimensions of Fear and Greed [4].

Our work introduces two cooperation dilemmas that cannot be defined as PD given the levels of Fear and Greed that are reached, violating restrictions (2) and (3). We intend to determine if, when increased enough, the dimensions of Fear and Greed are affect consistently the decision to cooperate. Also, we analyze if these motivational pressures have any effect under fixed matching, showing that in more unequal cooperation dilemmas are as relevant as the history of the game.

[4] The history of play is defined by the results in a previous coordination game during the same experimental session. For similar results on how a precedent of cooperation affects the result in a PD see Knez and Camerer (2000).

Shinada and Yamagishi (2007) conducted a public goods experiment with punishment, but one of the participants of each group was informed privately that he won't be punished. These conditions provide incentives to cooperate given the reduction in Fear by the existence of a mechanism to prevent free-riding. Recalling that public good games are equivalent to n-person prisoner's dilemmas, this result suggests that reductions in the Fear of being exploited by free-riders leads to higher levels of cooperation.

Blonski *et al.* (2007) provides another work where the hypotheses tested are derived from the asymmetrical outcomes of the dilemma, specifically from the consequences over cooperation from a variation in the "sucker's payoff". They conduct an infinitely-repeated PD, which consists of a repeated PD with a probability of termination after each round[5], to test the role of the "sucker's payoff" in the cooperation decision through variation of payoff matrices and discount rates. Two of these payoff structures correspond to CUF dilemmas; however, the authors do not mention the existence of condition (3) to define cooperation dilemmas different from the PD.

Other infinitely-repeated PD experiments sharing a fixed matching protocol are reported in Dal Bó (2005), Dal Bó and Fréchette (2011), Dreber *et al.* (2008) and Fudenberg *et al.* (2011). Dal Bó (2005) focuses on the effects of expected future rounds or the "Shadow of the Future", finding significant changes in behavior towards cooperation in final rounds in a comparison with finitely repeated games. Dal Bó and Fréchette (2011) analyze the effect of learning in future cooperation, separating the effects of structural elements, like the payoff matrix, from changing elements like the length of the game and the opponent's previous behavior. Dreber *et al.* (2008) find that participants with higher earnings are less likely to punish defectors. Fudenberg *et al.* (2011) introduce noise in the infinitely-repeated PD[6], finding that error prone environments favor cooperation and remarking the role of forgiveness in human decisions.

Also, an experiment designed to compare fixed matching and random matching protocols in an infinitely-repeated PD was conducted by Duffy and Ochs (2009), finding no evidence of the development of a social convention that promotes cooperation under random matching, contrary to theoretical results presented in Kandori (1992).

The experimental design presented here includes random matching and fixed matching treatments and, differing from the most recent related literature, the thirty rounds are played under a finitely-repeated protocol. The main reason for the finitely-repeated game is the introduction of the three different cooperation dilemmas, controlling that all players face the same number of rounds per payoff matrix in the within subjects treatment cells.

The use of surveys that individuals must complete after their participation in the experiment provides useful information about social preferences, political ideologies and motivations that affect the cooperation levels reached in the experiment. Dreber *et al.* (2010) and Fudenberg *et al.* (2011) measure prosocial behavior with surveys and a dictator game, concluding that other-regarding preferences do not explain the experimental results for cooperation. Fehr *et al.* (2004) use a three-person dictator game to contradict Engelmann and Strobel (2004) results, showing that actually individuals do have inequity aversion preferences. Also, their concern was extended

[5] The game is continued with probability δ, which also corresponds to the discount rate in the whole session.
[6] With a given probability, the intended strategy is changed to the opposite for any of the players.

to which other human characteristics affects cooperation, including in the survey questions to infer individuals' political preferences. However, they report that political ideology is not correlated with preferences between efficiency and equality.

In our post experimental survey we include seven questions[7] to determine their political ideologies (See Appendix C for a review of these questions). Our interest in introducing political attitudes in the post experimental analysis is mainly motivated by the redistributive concerns in the CUG, where exists an explicit trade-off between efficiency and equity. But also to explore the psychological foundations over which liberals and conservatives construct their moral systems (Graham *et al.,* 2009), mainly the differences across games in terms on harm/care and fairness/reciprocity.

2. Experimental Design

2.1. Experimental procedures and treatment cells

The experimental sessions were conducted at Universidad de los Andes in Bogotá between September and October 2011. The 204 participants were selected from a total of 349 applicants who were initially contacted by e-mail and become interested in the experiment. The participants were undergraduate and graduate students from different careers, mainly economics and engineering. Descriptive statistics of the participants are shown in Table A1 in Appendix A.

A total of seventeen sessions were conducted, each one of them with twelve players. Each session lasts between sixty and eighty minutes, and each player received on average 20,921 Colombian pesos (cop), corresponding to approximately 11 usd[8]. There was no show-up fee and the participants were initially informed that they will receive the sum of the payoff from their decisions in the thirty rounds at the end of the game.

The experiment was conducted using the software z-Tree (Fischbacher, 2007). At the beginning of each session, all participants were randomly assigned to a laptop where the instructions of the experiment were ready to be read individually. After reading the instructions, participants were asked to sign the informed consent. Then, they proceeded to a practice round to get familiarized with the decision procedure on the screen. During the practice round they played a coordination game, which means that defection was not a dominant strategy. The practice period is followed by the 30 rounds where players faced the cooperation dilemmas. Finally, participants completed a short survey and receive their corresponding payoff. A detailed description of the experiment instructions are presented in Appendix B.

The experimental design has six original treatment cells, plus two extra which were implemented to test the alternation in the CUG dilemma. The order in which games are faced, the matching type and the number of periods played in each dilemma are displayed in Table 3 for the eight treatment cells.

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[7] These questions were took from the website The Political Compass (http://www.politicalcompass.org/)

[8] October 2011 exchange rate: 1 usd equivalent to 1,903 cop. Minimum daily wage in Colombia for 2011 was approximately 9.3 usd.

The main treatment cells, listed in the first two columns of Table 3, correspond to a within subjects design where each player faces the three cooperation dilemmas during ten consecutive periods, for a total of thirty rounds. In treatment cells 1, 3 and 5 players faced the same opponent all the time; while in treatment cells 2, 4 and 6 the opponent changed after each round. The aim of these cells is to determine the presence of different behaviors across the three dilemmas for the same individual, providing answers on how perception of inequality affects the decision of cooperation.

The two additional treatment cells were implemented to test if the coordinated alternation in the CUG was more likely to emerge under longer periods of interaction. In these cells players interact during thirty periods under the same dilemma and with the same opponent. These treatments allow us to compare the behavior only between the players, but provide us from answers to how long horizons in the cooperation dilemmas favor new strategies, especially in the CUG game.

Table 3. Treatment cells of the experimental design

Within Subjects (Original cells)		**Between subjects** (Additional cells)
Fixed Matching	Random Matching	Fixed Matching
Cell No.1 CUF - PD - CUG (10) - (10) - (10)	*Cell No.2* CUF - PD - CUG (10) - (10) - (10)	*Cell No.7* PD (30)
Cell No.3 PD - CUG - CUF (10) - (10) - (10)	*Cell No.4* PD - CUG - CUF (10) - (10) - (10)	*Cell No.8* CUG (30)
Cell No.5 CUG - CUF - PD (10) - (10) - (10)	*Cell No.6* CUG - CUF - PD (10) - (10) - (10)	

The payoff matrices corresponding to the three cooperation dilemmas are displayed in Table 4, the values correspond to the potential earnings in Colombian pesos for each round. The outcomes corresponding to mutual defection and mutual cooperation are the same in the three games. The distance between these outcomes, commonly known as the "Cooperator's gain", will be constant across dilemmas.

The asymmetric outcomes will be defined based on the dimensions of Fear and Greed, obtaining the three payoff matrices displayed in Table 4. In the PD, which corresponds to the cooperation dilemma used as baseline, the dimensions of Fear and Greed are identical, with a value of 100 units. The payoff matrix corresponding to the CUF is obtained reducing the sucker's payoff from 500 to 100 units, which represents an increase four times the Fear dimension. Analogously, the temptation payoff in the CUG is increased from 900 to 1300 units, which corresponds to an augmentation of four times the Greed dimension.

Table 4. Payoff matrices for the three cooperation dilemmas

CUF		
	Cooperate	Defect
Cooperate	800, 800	100, 900
Defect	900, 100	600, 600

PD		
	Cooperate	Defect
Cooperate	800, 800	500, 900
Defect	900, 500	600, 600

CUG		
	Cooperate	Defect
Cooperate	800, 800	500, 1300
Defect	1300, 500	600, 600

In the CUG and CUF were modified only the payoffs corresponding to temptation and the sucker's payoff respectively, hence the three games held the suboptimality condition. Furthermore, the

number of rounds is fixed and commonly known by all players; hence the discount factor is very close to unity. These conditions imply that the Nash equilibrium of the game corresponds to full defection for all three dilemmas.

2.2. Main hypotheses

Classical game theory predicts full defection during all thirty rounds given the reduced number of periods and that the final round of each game is common knowledge between players. However, previous experimental results have shown a positive rate of cooperation. This behavior can be explained by other-regarding preferences like altruism, reciprocity and inequity aversion. Under all three explanations, we expect that higher levels of Fear and Greed increase the probability of defection.

We proposed three hypotheses to assess based on our experimental results. The main hypothesis involves the effects of Fear and Greed, but especially the asymmetry between these motivational pressures to defect. The second hypothesis recalls that the order in which the cooperation dilemmas are faced is relevant in the participant's behavior. The third hypothesis is focused in the player's ability to implement a coordinate alternation between cooperation and defection when this strategy maximizes both players' total payoffs.

Hypothesis 1: In the reduction of cooperation, the effect of the Fear dimension is higher than the effect of the Greed dimension.

Our main hypothesis aim to prove that the Fear of incur in a considerable cost of being betrayed or exploited in a cooperation dilemma is much more effective reducing cooperation than the opposite effect, the Greed induced by an increase in the benefits of defection when facing a cooperative opponent.

The second hypothesis is related to the order effects of the game. In other words, to determine if the increase in cooperation due to a reduction in the perception of inequality, i.e. passing from CUF or CUG to PD, is similar to the increase in defection associated to the opposite switch across dilemmas, i.e. passing from PD to CUF or CUG. Our experimental design includes a Latin square[9], guaranteeing that the cooperation dilemmas are faced in three different orders to test the changes in perception of inequality based on the order effects.

Hypothesis 2: A reduction in the perception of inequality has a larger positive effect than the negative effect derived from an increase in the perception of inequality.

The remaining hypothesis remarks the inclusion of the between subjects cells into the experiment. As was early mentioned, in the CUG appears a coordinated alternation strategy that maximizes total profits. The last hypothesis considers the player's ability to implement this strategy under a finitely repeated game, and most important, given the lack of enforcement mechanisms guaranteeing that his opponent is willing to receive the sucker's payoff once he got the temptation payoff the previous round.

[9] The Latin Square is a nxn matrix array that guarantees that numbers from 1 to n are not repeated in the rows or columns in the array. In this experimental design is used to control that each cooperation dilemma appears in different positions for the different "within subjects" cells.

Hypothesis 3: Individuals are not able to alternate coordinately between cooperation and defection in the CUG, even when it is a profit-maximizing strategy in this dilemma.

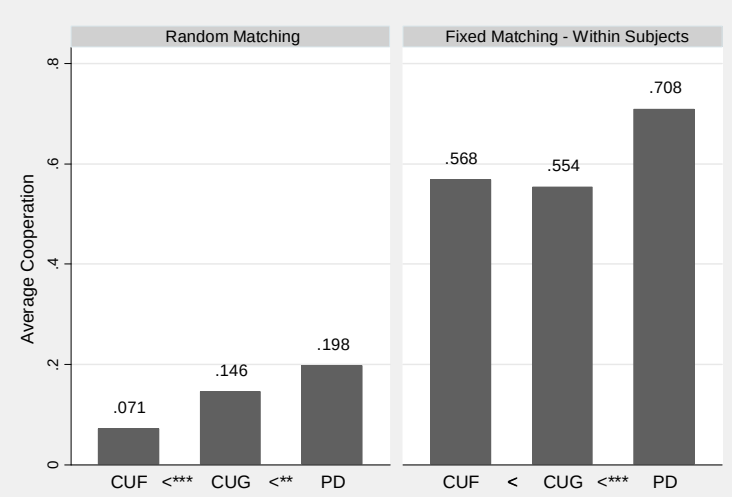
3. Results

3.1. Descriptive data and statistical tests: Initial comparisons between Fear and Greed

Variations in the dimensions of Fear and Greed were previously introduced by Ahn *et al.* (2001), but restrictions (2) and (3) were held in the games conducted. This work extends the analysis to other cooperation dilemmas where Fear and Greed are considerably increased. Our findings indicate that these motivational pressures are as much as important as the history of game, even for the case of fixed matching.

In Figure 2 is displayed the average level of cooperation for each dilemma under random and fixed matching. A comparison between panels show that the levels of cooperation reached when the opponent changes round by round are smaller than when the opponent remains fixed all the thirty rounds.

Figure 2. Average cooperation by matching protocol

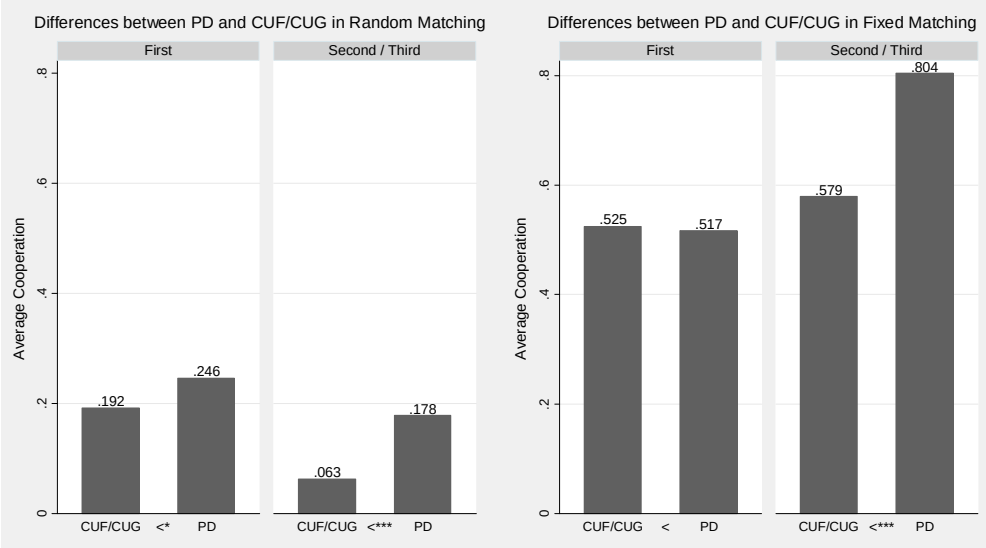


The left panel, corresponding to random matching, shows the differences in the level of cooperation for the three dilemmas. According to the prediction, the lowest level of cooperation corresponds to CUF, followed by the CUG and finally, the game with the highest level of cooperation was PD. These differences are statistically significant at the levels shown at the bottom of the same figure.

The right panel shows the cooperation levels reached in the three games under fixed matching. In this case cooperation in PD is statistically higher than in CUF and CUG, although differences between the two most unequal games are negligible. At first sight, this result is similar to Ahn *et al.* (2001) findings. However, in the next subsections we will use a regression analysis to show that asymmetries between Fear and Greed are consistent even under fixed matching. For both panels, detailed statistical tests can be found in Table A2 in Appendix A.

The differences between games can also be extended to an analysis of the order effects of the game. Based on Figure 3, we state that the benefits from reducing the potential inequality, i.e. switching from CUF or CUG to a PD, are higher than the costs from increasing the potential inequality in the opposite direction, i.e. switching from PD to one of the other cooperation dilemmas. The figure shown below has two panels that correspond to the random and fixed matching cases. In each panel are displayed the cooperation levels separately for the PD and the CUF/CUG by stages of the game. The first stage corresponds to the initial ten rounds, while the following two stages correspond to rounds 11 to 20 and 21 to 30 respectively.

Figure 3. Cooperation level according to the order in which dilemmas are faced



The left panel corresponds to the random matching case, where lower levels of cooperation in the posterior stages can be attributed to the response of reciprocal players to the lack of cooperation in absence of reputational mechanisms. If order effects do not matter, we will expect that the difference in the level of cooperation between the PD and the CUF/CUG, that initially is 0.054, remain constant in the subsequent stages despite the expected reduction in cooperation explained by the reciprocal players' behavior. However, our findings indicate that the difference between games increases to 0.115, which is more than twice the original distance.

On the right panel, which represents the observations from fixed matching protocols, this behavior is even stronger. When the opponent faced did not change during the whole experiment, increases in the level of cooperation in subsequent rounds may be explained by a learning process in their ability to coordinate and the appearance of trust or implicit agreements based on threats concerning future plays. Having this in mind, we will expect that the difference between PD and CUF/CUG will be the same despite the increase of cooperation in both cases. However, we are finding that the difference reaches a level of 0.225 and initially was -0.008 (The cooperation level was slightly higher in the CUF/CUG).

For both panels, the statistical significance in the differences is displayed at the bottom of the figure. Under random matching, the difference was initially significant at the 90% level and in the subsequent stages at the 99% level. Similarly, under fixed matching the difference was statistically

non significant in the first stage and in the posterior stages the difference was significant at the 99% level.

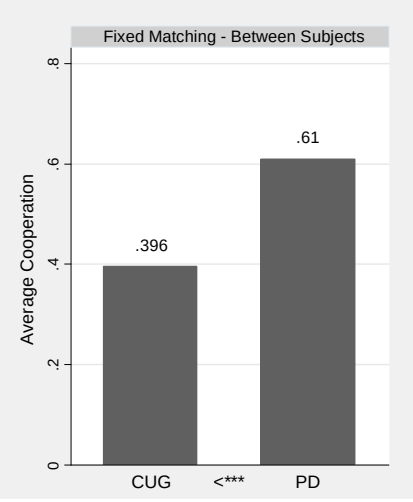
An alternative explanation for the cooperation level obtained in the CUG dilemma under fixed matching will be that players were able to implement a coordinate alternation strategy. An analysis at the dyad level shows that from the seventy two couples that face the three dilemmas under fixed matching, only two of them were capable to alternate between cooperation and defection during at least four periods. One of them achieved the alternation between rounds 17 to 20 after two unsuccessful attempts between rounds 12 to 15. The other one between rounds 3 to 6, but suddenly they switched to defection in round 7. Only two couples were able to implement this strategy under CUG, and during a reduced number of periods, giving us a first insight into the difficulties to establish the coordinate alternation. Also, we observe the alternation strategy during the same number of rounds in a PD, suggesting that instead of coordinating the couples are trying to establish another joint strategy like mutual cooperation.

We introduce now the results of the remaining cells, which correspond to the between subjects treatments, where players face only one cooperation dilemma during the thirty rounds. The introduction of these cells in the experimental design aims to test if longer periods playing CUG favor the emergence of the coordinate alternation.

Despite the increase in the percentage of couples that were capable of follow an alternation strategy during at least four consecutive periods, the emergence of this strategy in absence of coordination mechanisms is not convincing. Only three of twelve couples reach this strategy: one of them during twenty one periods (10 to 30), another one for twelve periods (18 to 29) and the remaining one during four periods (15 to 18).

Figure 4 shows the level of cooperation reached in the between subjects cells by the participants that faced the CUG compared to the participants that faced the PD. The difference between dilemmas is 0.214. This difference is statistically significant as is shown at the bottom of the figure below (and in Table A2). Excluding the rounds where we observe coordinate alternation the level of cooperation in CUG is reduced to 0.372, confirming the reduced effect of the players who were capable of implement it partially.

Figure 4. Average cooperation in the between subjects cells



3.2. Regression analysis

We estimate the probability of cooperation for any single round using a logit model in a non-linear panel to test that the dimensions of Fear and Greed have asymmetric effects. The marginal effects of these regressions are reported on Table 5. Despite that the results correspond to marginal effects, the coefficients reported are considerably elevated. This fact can be explained by the abundance of dichotomous variables, and the large negative coefficients from the CUF and CUG marginal effects arte balancing the large positive coefficient from the fixed matching dummy.

Model (1) includes control variables from the experimental design like matching type and the within subjects/between subjects protocol, as well as some players' characteristics like age, gender and career.

Table 5. Marginal effects from the probability of cooperation in different cooperation dilemmas

	(1)	(2)	(3)	(4)
VARIABLES	choice	choice	choice	choice
CUG	-0.821***	-0.621***	-0.435***	-0.0771***
	(0.101)	(0.115)	(0.161)	(0.0146)
CUF	-1.108***	-1.045***	-1.551***	-0.128***
	(0.106)	(0.126)	(0.209)	(0.0153)
Period	-0.00833**	-0.0209***	-0.0205***	-0.00196***
	(0.00415)	(0.00505)	(0.00511)	(0.000603)
Within cell	0.845**	0.608**	0.482*	0.271**
	(0.341)	(0.280)	(0.281)	(0.137)
Fixed matching	3.255***	1.898***	1.811***	
	(0.302)	(0.269)	(0.299)	
Political score (standardized)	-0.227*	-0.195*	-0.192*	
	(0.136)	(0.113)	(0.112)	
Opponent choice in t-1		1.478***	1.441***	0.267***
		(0.172)	(0.174)	(0.00915)
Opponent choice in t-1 * Fixed matching		1.269***	1.292***	
		(0.214)	(0.215)	
CUG * Fixed matching			-0.315	
			(0.227)	
CUF * Fixed matching			0.815***	
			(0.270)	
Player's fixed effects	No	No	No	Yes
Test CUG = CUF (χ2 statistic)	7.30***	11.24***	26.99***	10.76***
Observations	6120	5604	5604	4618

Participant's age, gender, career and amount of academic periods in university are included as controls (Although these are not statistically significant).
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

To control for reciprocal behaviors, model (2) also includes for the opponent's previous choice as an explanatory variable. And given that players under fixed matching may react differently to their

previous movement than players under random matching, we have included the interaction of this variable with the fixed matching dummy. For both variables, the marginal effects are significant and their magnitude is not negligible, confirming the important role of the history of the game as was previously reported in Ahn *et al.* (2001).

Considering again the comparison displayed in Figure 2 between CUG and CUF under fixed matching, model (3) also introduces the interactions of the most unequal dilemmas, CUG and CUF, with the fixed matching variable. The results indicate that there exist some asymmetries between the CUG and CUF under fixed matching, otherwise their coefficients should be similar, but the mechanisms that define the differences in behavior remain considerably unexplored.

These three models were estimated using a non-linear panel with random effects. Finally, in model (4) we introduce fixed effects for each player in a logistic regression to test once more the asymmetries between Fear and Greed. The results obtained are satisfactory, the marginal effects from CUG and CUF are significant at the 99% level and statistically different, but especially, when the inclusion of individual fixed effects the coefficients of CUF and CUG are more conservative, given the absence of the fixed matching dummy.

Results in Table 5 show that for all the specifications the marginal effects from the dummy variables corresponding to the CUF and CUG dilemmas are negative and significant at the 99% level. Moreover, the χ^2 statistic from the comparison between the marginal effects from CUF and CUG ratify the asymmetric effects of Fear and Greed over the decision of cooperation, where the former has a more negative effect than the latter.

Table 6. Probability of cooperation (marginal effects) under fixed matching for the within subjects cells

	(1)	(2)
VARIABLES	choice	choice
CUG	-0.761***	-0.536**
	(0.178)	(0.267)
CUF	-0.732***	-1.501***
	(0.180)	(0.312)
Period	0.0109	0.0101
	(0.00834)	(0.00859)
Political score (standardized)	-0.502***	-0.471**
	(0.190)	(0.187)
Opponent choice in t-1	2.824***	2.621***
	(0.164)	(0.277)
CUG * Opponent choice in t-1		-0.419
		(0.358)
CUF * Opponent choice in t-1		1.346***
		(0.415)
Test CUG = CUF (χ2 statistic)	0.03	11.46***
Observations	1944	1944

Participant's age, gender, career and amount of academic periods in university are included as controls (Although these are not statistically significant).
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

After the initial estimations, we focus on the comparison between CUG and CUF under fixed matching, where the asymmetries between Fear and Greed are not convincing yet. We examine separately the subsample of players that faced the three dilemmas with the same opponent, to explore in depth how Fear and Greed affect differently the decision process. In Table 6 are presented the marginal effects of the probability of cooperation obtained for two different models, which were estimated considering a non-linear panel with random effects.

Model (1) corresponds to an initial estimation where the explanatory variables correspond to characteristics of the experimental design and the participant's characteristics listed in the footnote in Table 6. Marginal effects corresponding to the dichotomous variables for CUF and CUG are similar, confirming the result from the right panel in Figure 2.

In model (2) we introduce an additional explanatory variable, the interaction between the opponent's previous decision and the CUF and CUG variables, to capture differences in the participant's reactivity based on the different levels of Fear and Greed. Marginal effects reported in Table 6 show that the asymmetry between Fear and Greed also exists under fixed matching, but it is necessary to control how players respond differently to their opponent's previous movement in the CUF compared to the CUG. After this incorporation the asymmetry between both dilemmas appear in the fixed matching case, their coefficients are statistically different and also, we observe a behavioral difference induced by Fear compared to Greed: players are more likely to cooperate only if a precedent of cooperation exists.

In the regression analysis we discuss again the existence of order effects estimating two models which includes dummy variables for the stages of the experiment, and also the interaction of each stage with an indicator function that is equal to unity when the observation comes from a CUF or CUG dilemma and zero otherwise. These interactions are the key variables of the models we estimate using again a non-linear panel with random effects. These variables, denoted as $Second\ stage \cdot CUG/CUF$ and $Third\ stage \cdot CUG/CUF$, take a value equal to unity only when the observation belongs to periods 11 to 20 or 21 to 30 respectively, and the dilemma faced is different from the standard PD. Given that we are controlling for the single dummy variables corresponding to the stage of the observation and the dilemma faced, when these interactions equal zero we are calculating the effect of facing the PD in the corresponding stage, second or third.

Marginal effects for both estimations are reported in Table 7 and, as we can see, these key interactions are always negative and statistically significant at the 99% level. This negative value confirms our hypotheses that switching from CUG or CUF to PD has a greater effect over cooperation than the negative effect when the dilemma faced is switched in the opposite sense, from PD to CUG or CUF.

Previous results and our findings indicate that the type of matching is determinant in players' behavior. In model (2) we also include the interaction to the matching type dummy with the posterior stages of the game as a robustness check of our findings. The key interactions remain negative and significant at the same level under the new specification.

It is important to discuss the loss of significance from the CUG and CUF marginal effects in both models. Our main explanation for this result is that now that we control for the stages of the experiment, we have that during the first ten rounds the effects of the dimensions of Fear and

Greed are reduced because the participants have faced only one cooperation dilemma, and the effects of the potential inequality are stronger when participants are able to compare the Fear and Greed dimensions among dilemmas.

Table 7. Marginal effects in the probability of cooperation to test order effects

	(1)	(2)
VARIABLES	choice	choice
CUG	0.118	0.124
	(0.224)	(0.222)
CUF	-0.200	-0.0988
	(0.229)	(0.231)
Period	-0.0962***	-0.101***
	(0.0174)	(0.0177)
Fixed matching	2.641***	1.807***
	(0.283)	(0.314)
Political score (standardized)	-0.334**	-0.342**
	(0.144)	(0.149)
Opponent choice in t-1	2.155***	1.998***
	(0.111)	(0.114)
Second stage (rounds 11-20)	2.245***	1.735***
	(0.316)	(0.338)
Third stage (rounds 21-30)	2.380***	1.700***
	(0.425)	(0.440)
Second stage * CUG/CUF	-1.723***	-1.820***
	(0.347)	(0.357)
Third stage * CUG/CUF	-0.926***	-1.451***
	(0.337)	(0.360)
Second stage * Fixed matching		1.153***
		(0.241)
Third stage * Fixed matching		1.919***
		(0.270)
Observations	4524	4524

Participant's age, gender, career and amount of academic periods in university are included as controls (Although these are not statistically significant).
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, we propose a different model to test the player's capability to establish the coordinate alternation strategy in the CUG. In a specification including only the last opponent's movement, we cannot identify separately players who are trying to alternate between cooperation and defection from reciprocators. In both cases players' response to the previous action can be described as "Do what your opponent did last round". It means that variations between these two strategies must rely on differences in the opponent's decision two periods ago. To identify "alternators" separately from reciprocators we propose the specification shown in equation (4). In this equation, the probability that player i cooperates in period t is a function of a vector of X_i of participants' characteristics and four indicator functions of our interest. The indicator functions

have the form $I\left(S_{t-1}^{j}, S_{t-2}^{j}\right)_i$ where $S_{t-\tau}^{j} = \{C_{t-\tau}^{j}, D_{t-\tau}^{j}\}$ corresponds to the strategy of the opponent j in period $t-\tau$, cooperation or defection. The indicator function is equal to one if the condition is satisfied, and zero elsewhere. The indicator functions $I\left(C_{t-1}^{j}, D_{t-2}^{j}\right)_i$ and $I\left(C_{t-1}^{j}, C_{t-2}^{j}\right)_i$ correspond to the cases when we expect that an alternator and a reciprocator cooperates respectively. Conversely, $I\left(D_{t-1}^{j}, C_{t-2}^{j}\right)_i$ and $I\left(D_{t-1}^{j}, D_{t-2}^{j}\right)_i$ correspond to the cases when is expected that each type of players described above defect in their next move.

$$\Pr\left(C_t^i | X\right) = X_i\beta + \delta_1 I\left(C_{t-1}^{j}, D_{t-2}^{j}\right)_i + \delta_2 I\left(C_{t-1}^{j}, C_{t-2}^{j}\right)_i + \gamma_1 I\left(D_{t-1}^{j}, C_{t-2}^{j}\right)_i + \gamma_2 I\left(D_{t-1}^{j}, D_{t-2}^{j}\right)_i + \varepsilon_i \qquad (4)$$

Following the specification shown in equation (4), for the CUG subsample we expect that if players are more likely to be alternators than reciprocators, then we must have that $\delta_1 \geq \delta_2$ and $\gamma_1 \leq \gamma_2$. If now we took the whole sample of sessions under fixed matching and add an interaction term between each indicator function and the CUG variable, we can check the emergence of alternation in the CUG game, even if it is not as common as pure reciprocity. The difference between δ_2 and δ_1 will be identical for the CUG and the CUF/PD subsamples if and only if coordinate alternation is not likely to appear in the CUG. If $\delta_2 - \delta_1$ is different in each subsample, more specifically if it is lower in the CUG case, then we have evidence that this strategy may emerge under the incentives of this game. A similar argument can be developed for the term $\gamma_2 - \gamma_1$, that will be higher for the CUG subsample only if alternation have a positive probability to emerge in this dilemma. In the table below the statistical tests are expressed as a function of the interaction terms only, the reasoning behind these expressions is presented in Appendix D.

Marginal effects from this estimation are presented in Table 8, as well as the hypotheses proposed to test the emergence of coordinate alternation in the CUG. Model (1) corresponds to the specification proposed in equation (4). The coefficients corresponding to the four indicator functions have the expected direction and they are statistically significant. At the bottom of the table is shown the p-value of the two hypotheses proposed to test if alternation is more likely to emerge than pure reciprocity in a CUG. The first of these tests corresponds to a comparison between δ_1 and δ_2, and indicates that we reject the hypothesis just mentioned when is expected that players cooperate. The second test, which analyze the significance of the term $\gamma_1 \leq \gamma_2$, we cannot reject the hypothesis when is expected that players defect.

In model (2) are introduced the four interactions mentioned above, as well as the CUF and CUG variables to determine if their effect is preserved under this analysis. As is shown in Table 8, these coefficients are negative and statistically significant, preserving the result transmitted in previous regressions about the role of fear and greed in the decision to cooperate. Although only two of the four interaction terms are significant, we are interested in the difference between the first two and the last two and its significance. The p-value of the proposed tests is displayed again at the bottom of the table and, as is shown, we reject the hypothesis that these differences are the same for the CUG and CUF/PD subsamples. In other words, the coordinate alternation strategy has a positive probability of emergence in a CUG dilemma, even if it is not as likely to appear as pure reciprocity.

4. Discussion

The main hypothesis of this research was to test that dimensions of Fear and Greed have asymmetric effects in the reduction of the probability of cooperation. Results reported in Table 5

confirm that the marginal effects are systematically different, with a CUF coefficient more negative that the CUG coefficient, even controlling for individual fixed effects. When included one dummy variable for each one of the participants, the effects from the Fear and Greed dimensions are considerably lower than in the precedent estimations, but yet they are statistically different.

Table 8. Probability of cooperation (marginal effects) to test emergence of alternation

	(1)	(2)
VARIABLES	CUG Only	Full sample
CUG		-0.811***
		(0.233)
CUF		-0.690***
		(0.184)
Within cell	0.698**	0.188
	(0.325)	(0.425)
$\delta 1$	0.816***	0.274
	(0.264)	(0.277)
$\delta 2$	1.188***	1.835***
	(0.252)	(0.203)
$\gamma 1$	-0.758***	-1.025***
	(0.272)	(0.282)
$\gamma 2$	-1.024***	-2.351***
	(0.238)	(0.214)
$\delta 1$*CUG		0.302
		(0.368)
$\delta 2$*CUG		-0.725**
		(0.298)
$\gamma 1$*CUG		-0.00891
		(0.380)
$\gamma 2$*CUG		1.135***
		(0.305)
(H0: $\delta 1 \geq \delta 2$) p-value	0.0694*	
(H0: $\gamma 1 \leq \gamma 2$) p-value	0.1199	
(H0: $\delta 1$*CUG=$\delta 2$*CUG) p-value		0.0050
(H0: $\gamma 1$*CUG=$\gamma 2$*CUG) p-value		0.0021
Observations	1,440	3 600

Participant's age, political ideology, gender, career and amount of academic periods in university are included as controls. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

For a given payoff's difference between the defector and the cooperator, players are less reluctant to cooperate when the asymmetric outcomes are rewarding the defector than in the case where the asymmetric outcomes are punishing the cooperator. In other words, this result suggests that players are more likely to tolerate inequality if they perceive it as an extra benefit from the other than an extra cost to itself.

At first sight, this result might be explained by another economic behavioral phenomenon known as prospect theory (Kahneman and Tversky, 1979). This theory points out that players valuate differently their potential losses and earnings, weighting less the latter than the former. We argue that our results are not explained directly by prospect theory and that Fear and Greed dimensions

are relevant by two different reasons. In first place, prospect theory describes human behavior facing expected gains and losses. In the three cooperation dilemmas shown here all the outcomes represent gains to both players, hence they do not weight differently gains and losses.

Our second argument appears given the objection that players may take one of the outcomes as a reference point, and earnings below that point are considered as losses. Considering this, we argue that Fear and Greed dimensions are relevant only according to the own belief about the opponent's action. If a player expects that his counterpart defects, only the dimension of Fear is relevant; while if a player expects that his counterpart cooperates, the relevant dimension is Greed. In this way, when gains and losses are weighted, only Fear or Greed is affecting player's decision, but not both at the same time. Hence, they have an effect independent of the behavior suggested by prospect theory and can be measured especially for players that faced the three cooperation dilemmas.

In terms of policy implications, this difference between Fear and Greed is relevant to determine how to enhance cooperation when asymmetric outcomes may induce considerable levels of inequality among players. If the Fear dimension has a greater effect than the Greed dimension, the state may have an active role raising the earnings from the worst-case outcome to promote cooperation.

Strict controls over the best attainable outcome are less effective, however, this policy may be considered as a complement rather than a substitute from the increase in the earnings of the worst-case outcome. An augmentation of 1 unit in the worst case outcome (the suckers's payoff) has, approximately, the same effect than a decrease in 1.68 units of the best attainable outcome (the temptation payoff). The combination of both policies, i.e. transferring 1 monetary unit from the defector to the cooperator, will reduce the potential inequality of the asymmetric outcomes and this will derive in an increase in the probability of cooperation by a reduction in both dimensions, without leaving the suboptimality condition characterizing a cooperation dilemma.

When participants face a different opponent in each round the effect of Fear is directly observed. In the CUF dilemma under random matching, the level of cooperation is reduced round after round, with an increasing proportion of defectors more pronounced than in the CUG dilemma. On the opposite case, when the opponent is fixed during the whole experiment, the emergence of reciprocity and trust may reduce the extra effect of Fear compared to Greed. The disutility generated by the probability of being betrayed (or exploited) can be controlled if the player is capable of establish a threat over future plays in case the opponent prefers defection instead of cooperation or if previous plays promotes the apparition of trust between these players.

In this way, we may be able to disentangle the asymmetry between Fear and Greed under fixed matching analyzing how players react to their opponent's previous movements differently according to the cooperation dilemma faced. We expect that only players that receive a positive signal about their opponent's past behavior would overcome the effects of Fear, leading them to establish a mutual cooperation strategy.

The initial regression analysis was not satisfactory to show that asymmetries between CUF and CUG were preserved under fixed matching; hence, we estimate an additional model that incorporates explicitly an interaction term which goes in line with our hypotheses of how Fear affects cooperation when reputational mechanisms are present. Results from model (3) in Table 5

confirm the mentioned asymmetry in general, but also suggest that the difference between CUF and CUG under fixed matching is negligible. For a different estimation with the fixed matching subsample, whose marginal effects are presented in Table 6, we include the interaction of the opponent's previous choice with the different cooperation dilemmas. We have obtained two important results. First, the coefficients from CUF and CUG are negative and its difference is statistically significant when we introduce the interaction between the opponent's previous choice and the dichotomous variables from each game. Secondly, and perhaps most important, we have confirmed that players are more aware of their opponent's previous action when they are facing a CUF dilemma compared to the other cooperation dilemmas.

Ahn *et al.* (2001) previously stated that under fixed matching the history of the game is more relevant that the dimensions of Fear and Greed. However, our findings show that a combination of both factors is in fact more relevant for the dimension of Fear than just the history of the game. Given our experimental design, we consider that the history of the game is related to the opponents' past choices and not to a precedent of coordination as in Ahn *et al.* (2001). In addition, we have ten rounds for each one of the three different dilemmas instead of single-shot games for four different payoff structures. Despite the differences in our indicator of the history of the game, we confirm the importance of the learning process concerning the opponent's previous decisions, but we also found that history of the game is more important when the costs of leaving mutual defection are considerable, as in the CUF game.

The purpose of our second hypothesis is to test if the order in which cooperation dilemmas are faced is important in the decision to cooperate. We are concerned about how the perception of an increasing inequality may lead to a greater reduction in cooperation than the analogous rise in cooperation caused by a decrease in inequality of the same magnitude. In the same way that individuals weights differently losses and gains (Kahneman and Tversky, 1979), our findings suggest a similar behavior in terms of the reduction or augmentation of the potential inequality from asymmetric outcomes.

To test the order effects with a regression analysis, we pooled the observations from CUG and CUF to compare the cooperation levels in the three different stages of the experiment with the levels obtained in the standard PD. In Table 7 are reported the marginal effects corresponding to these estimations. Here are included dummy variables that indicate the stage of each observation and the interaction of the stage with the dummy variable that groups CUF and CUG. These variables, denoted in Table 7 as $Second\ stage \cdot CUG/CUF$ and $Third\ stage \cdot CUG/CUF$, are negative and significant. The interpretation of these interactions is that when the dilemma faced in the second or third stage is CUF or CUG, the probability of cooperation is significantly lower than if in the same stage were faced the standard PD. This effect is robust to the introduction of the interaction between the number of the stage and the matching condition.

We also find that the coefficients from CUF and CUG have no explanatory power in the estimations whose results are reported in Table 7. This implies that the effects of Fear and Greed appear in posterior stages, when players are able to compare the incentives between two different cooperation dilemmas. This result goes in line with Figure 3, where was initially suggested that, for the first stage, the difference in the level of cooperation between CUF/CUG and PD is statistically non-significant under fixed matching, and is significant only at 90% under random matching. We can consider this result as another proof for the existence of order effects,

because Fear and Greed dimensions gain their explanatory power when players are able to compare the incentives from two different cooperation dilemmas.

Our third objective was focused on testing if players were able to alternate coordinately between cooperation and defection under a CUG dilemma, where alternation will maximize the player's total payoff. We aim to test if for a fixed number of periods, with a discount factor equal (or close) to unity and without coordination devices or mechanisms, players establish the strategy of our interest.

An initial descriptive analysis gives us a first insight into the player's ability to reach the coordinate alternation. An elevated number of periods favor the apparition of this strategy, although the number of couples capable of develop is not considerably high. We propose a regression analysis using the subsample of fixed matching observations, given that under random matching the alternation does not make sense. Given that the opponents' previous movement does not allow us to identify separately alternators from reciprocators, we introduced indicator functions that describe the four possible outcomes of the opponents' two previous movements combined. Two of these indicator functions reflect the emergence of alternation, while the remaining two correspond to reciprocal players' responses.

The results from the estimations, as well as the corresponding hypotheses tests, are reported in Table 8. The first specification, including the four indicator functions with the CUG subsample, was useful to confirm that coordinate alternation is less likely to emerge than pure reciprocity. The second specification, which also includes an interaction term for each indicator function with the CUG game, shows that even if alternation is not as popular as pure reciprocity, it emerges in a CUG with a positive probability.

In the first model, the difference between the within subjects and the between subjects treatments suggests that the probability of emergence of a coordinate alternation strategy strongly depends on the expected number of interactions between both players. An explanation for this result is that players recognize the difficulties to implement this strategy in absence of coordination mechanisms, and only incur in the cost of alternating to signal to the other player this possibility if there are enough rounds to recover the cost. Two couples that successfully attempted this strategy started alternating from rounds 10 and 18 respectively, in both cases the predominant strategy before alternation was defection. Although we have no statistical evidence due to the reduced number of couples that coordinated effectively, experimental data suggests that this strategy is more likely to appear as an alternative to defection; while players that have established mutual cooperation are not tempted to abandon this strategy.

Finally, we have included the political score to determine if preferences over the trade-off between efficiency and equity in the CUG dilemma were relevant in the participant's choices. Although the political score variable is systematically negative and significant, we do not find evidence that political score influences differently the decisions in the CUG compared to the CUF. In fact, Table A3 in Appendix A shows that these marginal effects are very similar and statistically non-significant for these two dilemmas, but still relevant when players are facing the standard PD.

The correlation between political ideologies and probability of cooperation may be explained following the classification of moral foundations proposed by Graham *et al.* (2009). They are divided in *individualizing foundations* (Harm/care and Fairness/Reciprocity) and *binding*

foundations (Ingroup/loyalty, Authority/respect, and Purity/Sanctity). They state that left-wing ideologies are constructed over the former principles, while right-wing moral foundations are constructed over both groups of principles. Liberal subjects are more likely to cooperate than conservative subjects, which may be obey to the role of reciprocal altruism (Fairness/reciprocity foundation) and the evolution of empathy (Harm/care foundation) that may motivate left-wing players to establish cooperation.

5. Conclusions

We explored the motivational pressures defined as the Greed and Fear dimensions and how they affect the outcomes on cooperation dilemmas. Ahn *et al.* (2001) previously explored this dimensions without leaving the restrictions that bind the level of potential inequality to a Prisoner's Dilemma; which is a potential reason to the lack of explanatory power of Fear and Greed in their work. Our findings provide evidence that considerable higher values of Greed and Fear reduce the probability of cooperation when the payoff disparity of asymmetric outcomes is high enough. In other words, Greed is important when the condition guaranteeing that mutual cooperation maximizes the payoff's sum is no longer held. Analogously, Fear is important when the condition that binds mutual defection as the outcome that minimizes the social welfare is violated.

Our findings suggest that Fear has a worst effect than Greed in the reduction of the probability of cooperation. This asymmetry is explicitly manifested when players are randomly matched after each experimental round. The impossibility to update their beliefs about the opponent's strategy and the lack of reputational information lead to an explicit effect of Fear than result higher than Greed, increasing the probability of defection. When players are matched with the same opponent the entire experiment, the difference between Fear and Greed is not explicit. The reputational mechanisms have an effect, and the asymmetry between these dimensions is displaced to the learning process. Participants are more aware of their opponent's previous choices facing the CUF than facing the CUG. This means that the importance that players give to the history of the game reveals the differences between Fear and Greed when players are able to update their opponent's beliefs.

Our experimental design allows us to explore the existence of differences in behavior based on the order in which cooperation dilemmas were played. We find that a reduction in the potential inequality generates an increase in cooperation that is consistently higher that the increase in defection caused by an increase in the potential inequality of the same magnitude. This means that redistributive actions that project a reduction in inequality may be effective promoting cooperation, even if the order of incentives preserves the cooperation dilemma.

A profit maximizing strategy in the CUG dilemma is the coordinate alternation between cooperation and defection. Our findings indicate that the number of periods is determinant in the apparition of this strategy and that is more likely to appear as a substitute of mutual defection than as an alternative for mutual cooperation. In addition, our findings indicate that coordinate alternation have a positive probability to emerge but it's not as likely as pure reciprocity.

In sum, Fear and Greed reduce the probability of cooperation, but assimetrically. Redistributive concerns should be more focused on the enhancement of the worst-case scenarios, remarking the

importance of the perception of a more egalitarian allocation of resource, even when the incentives for defection do not disappear.

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Appendix A. Tables and Regressions

Table A1. Participant's descriptive statistics

	Mean	Standard dev.
Male	0.583	0.494
Age	20.461	2.697
Academic periods	5.794	3.031
Economics	0.348	0.478
Business	0.108	0.311
Engineering	0.279	0.450
Natural Sciences	0.127	0.334
Art / Design	0.157	0.365
Social Sciences	0.137	0.345
Payoff (USD)	11.023	1.246

Table A2. Wilcoxon rank sum tests between cooperation dilemmas

Games Compared	Random Matching		Fixed Matching - Within Subjects		Fixed Matching - Between Subjects	
	Difference	p-value	Difference	p-value	Difference	p-value
PD and CUG	0.0512	0.0055	0.1542	0.0000	0.2139	0.0000
PD and CUF	0.1262	0.0000	0.1403	0.0000	-	-
CUG and CUF	0.0750	0.0000	-0.0139	0.5955	-	-

Table A3. Interactions between political score and cooperation dilemmas (Marginal effects)

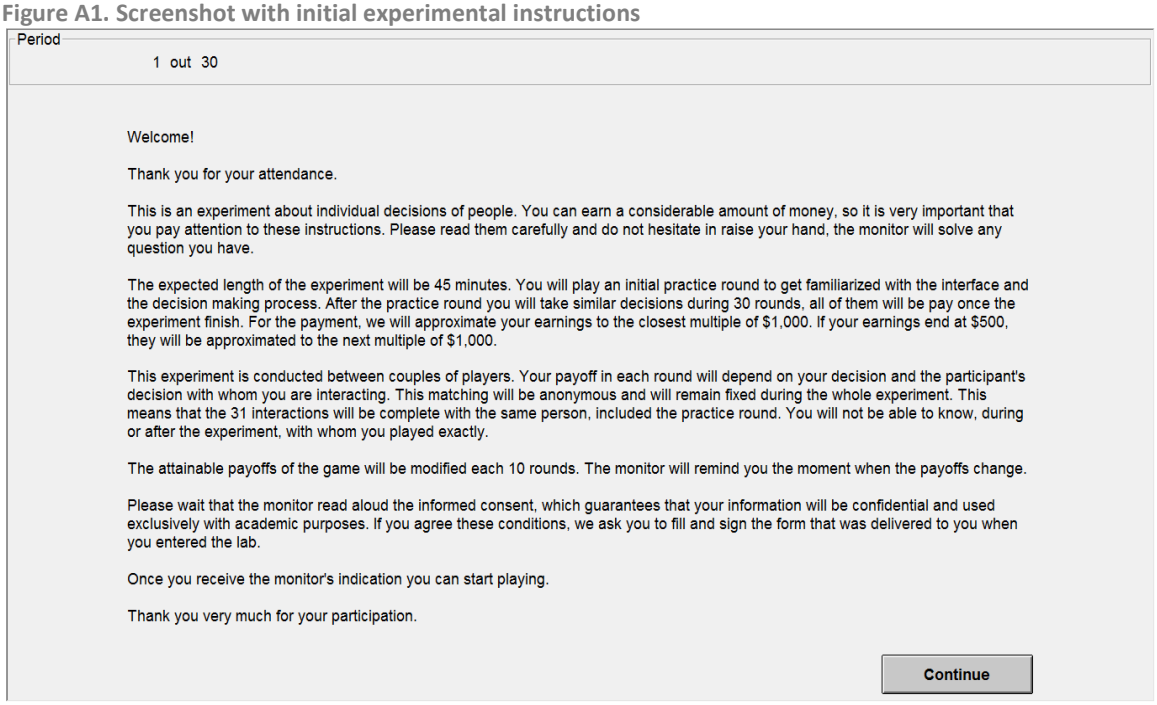
VARIABLES	(1) choice
CUG	-0.614***
	(0.116)
CUF	-1.041***
	(0.127)
Period	-0.0217***
	(0.00509)
Within cell	0.619**
	(0.285)
Fixed matching	1.922***
	(0.273)
Political score (standardized)	-0.358***
	(0.130)
Opponent choice in t-1	1.481***
	(0.173)
Opponent choice in t-1 * Fixed matching	1.265***
	(0.215)
CUG * Political score	0.248*
	(0.132)
CUF * Political score	0.293**
	(0.118)
Observations	5604

Participant's age, gender, career and amount of academic periods in university are included as controls (Although these are not statistically significant).
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix B. Experiment instructions translated (Within subjects and fixed matching sample)

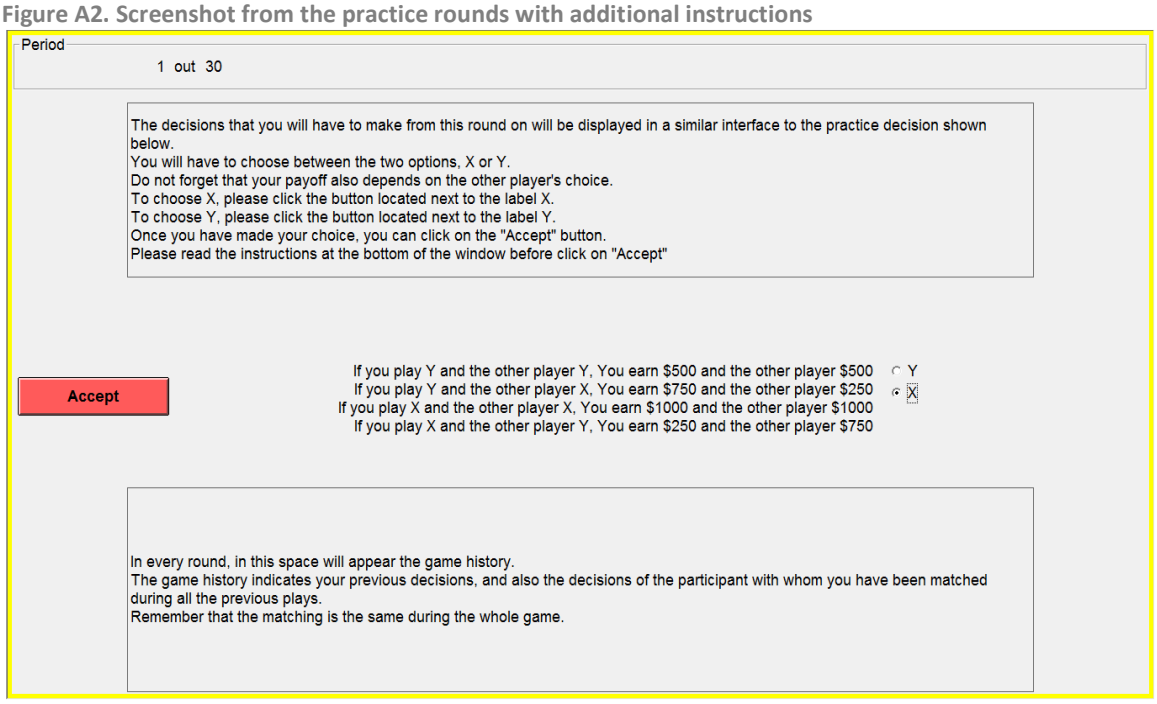
I. Instructions

Figure A1. Screenshot with initial experimental instructions



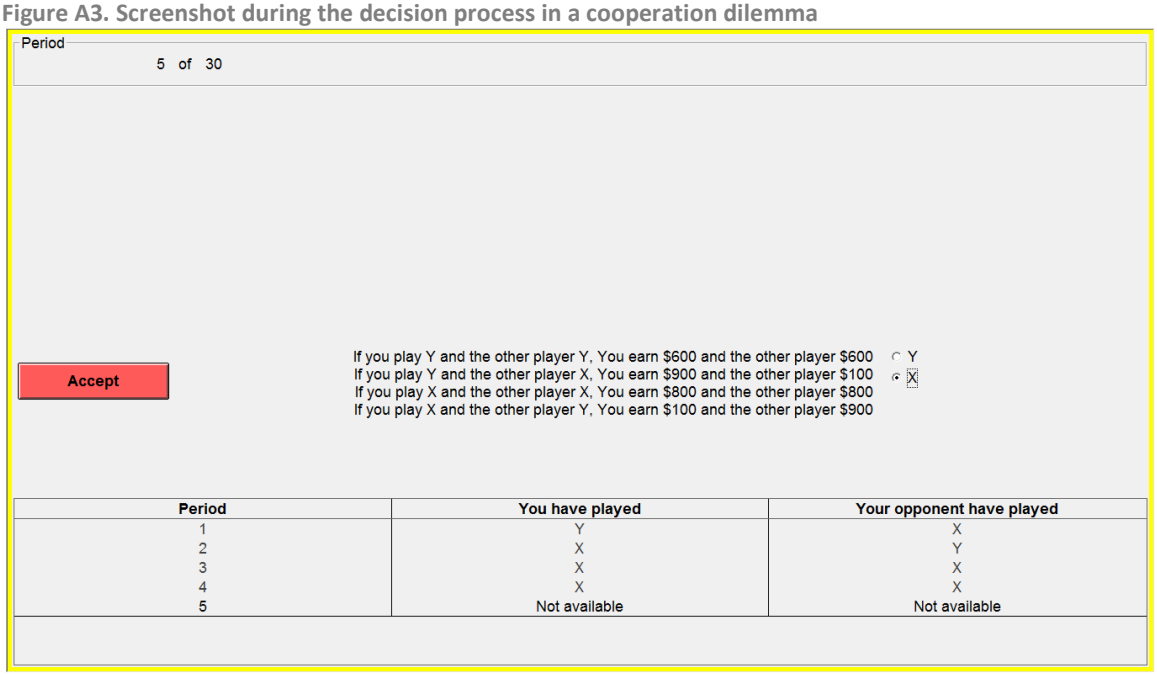
II. Practice Round

Figure A2. Screenshot from the practice rounds with additional instructions



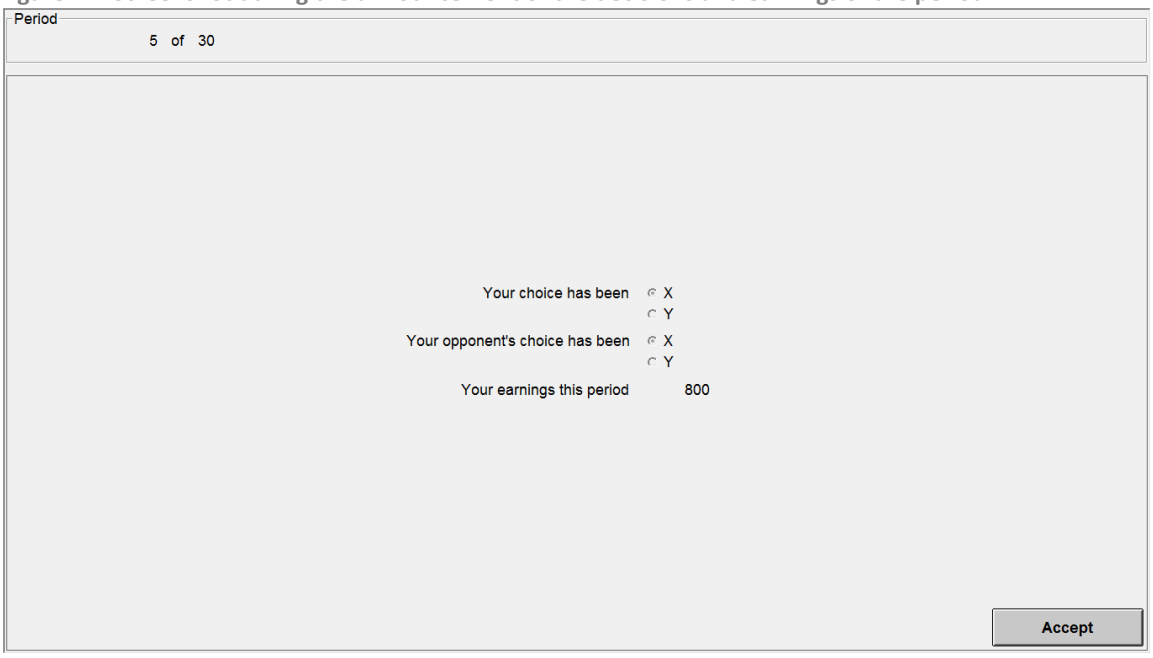
III. Period: Decision

Figure A3. Screenshot during the decision process in a cooperation dilemma



IV. Period: Results

Figure A4. Screenshot during the announcement of the decisions and earnings of the period



Appendix C. Questions to Determine Political Preferences

The following seven questions were adapted from "The Political Compass" webpage (http://www.politicalcompass.org/) to determine the political preferences of the participants in the experiment.

1. If economic globalization is inevitable, it should primarily serve humanity rather than the interests of trans-national corporations.
2. Controlling inflation is more important than controlling unemployment.
3. "from each according to his ability, to each according to his need" is a fundamentally good idea.
4. It is regrettable that many personal fortunes are made by people who simply manipulate money and contribute nothing to their society.
5. The freer the market, the freer the people.
6. What's good for the most successful corporations is always, ultimately, good for all of us.
7. Making peace with the establishment is an important aspect of maturity.

Appendix D. Hypotheses Testing for the Emergence of Coordinate Alternation

To test the emergence of coordinate alternation we will compare the coefficients corresponding to the indicator functions, $\delta_1, \delta_2, \gamma_1$ and γ_2, for the CUG and the CUF/PD subsamples. We will introduce in our specification the interaction terms between each indicator function and a dichotomous variable corresponding to the CUG dilemma.

Having in mind that $\delta_1$and δ_2 correspond to alternators and reciprocators that will cooperate in the current round, we expect that the difference $\delta_2 - \delta_1$ be smaller in the CUG than in the CUF/PD subsample. In other words, we expect to reject the hypothesis that this distance is the same in both cases.

$$H_0: (\delta_2 - \delta_1)_{CUG} = (\delta_2 - \delta_1)_{CUF/PD}$$

We can write the same expression in terms of the regression's coefficients. As is shown below, this specification allows us to write our null hypothesis in terms of the interactions between δ_1, δ_2 and the CUG variable.

$$H_0: (\delta_2 + \delta_2 CUG) - (\delta_1 + \delta_1 CUG) = (\delta_2 - \delta_1)$$

$$H_0: \delta_2 CUG - \delta_1 CUG = 0$$

The argument to test the presence of alternators that will defect in the current round is similar. Given that the gamma coefficients are negative the difference $\gamma_2 - \gamma_1$ must be smaller under the CUG than in the CUF/PD subsample (i.e. because the gamma coefficients are negative).

$$H_0: (\gamma_2 - \gamma_1)_{CUG} = (\gamma_2 - \gamma_1)_{CUF/PD}$$

$$H_0: (\gamma_2 + \gamma_2 CUG) - (\gamma_1 + \gamma_1 CUG) = (\gamma_2 - \gamma_1)$$

$$H_0: \gamma_2 CUG - \gamma_1 CU = 0$$