Inequality, social norms and cooperation: Strategy choice in the infinitely repeated prisoners' dilemma*

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Abstract

Our societies currently face important challenges of cooperation which is needed among individuals who interact at a non-regular frequency. In this context, cooperation can be sustained if the social norm pushes in this direction. We design an online experiment where participants make strategic choices in an infinitely repeated prisoner's dilemma. We examine the effects of inequality on social norms of cooperation and how norm compliance in turn affects cooperation. Inequality exists when the two participants defect and cooperation gives equal payoffs in one treatment or keeps the unequal payoffs in the other. The results show that inequality weakens the social norm by limiting first- and second-order normative beliefs of cooperation as well as descriptive beliefs about other participants' cooperation. Inequality reduces the likelihood of cooperation mainly driven by the change in the social norm. Overall, the mere existence of inequality causes these changes instead of specific behaviors depending on the participants' type.

Keywords: inequality, social norm, cooperation, prisoner's dilemma, infinite games, experiment.

JEL Classification: C92, H41, D63.

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1 Introduction

The role of inequality in power, status, income or wealth on long-term economic efficiency has often been discussed (Stiglitz, 2012). Recent evidence supports that inequality leads to an inefficient allocation of resources and lower investment and innovation that undermine economic growth (Philippe, Williamson et al., 1998; Ostry, Berg and Tsangarides, 2014; Piketty, 2013; World Bank, 2006, 2013). Furthermore, inequality is suggested as leading to the erosion of social cohesion which undermines social norms of cooperation on the long run (Putnam et al., 2000; United Nations Development Programme, 2013). Cooperation in infinitely repeated games may depend on such social norms. Social norms are informal rules of behavior in groups and societies that individuals conform to if they believe that most people conform to it and also believe that most people believe that people ought to conform to it (Bicchieri, 2006). On the one hand, inequality may alter such beliefs and undermine the existence of the norm (Xiao and Bicchieri, 2010). On the other hand, a weakened norm may render sustaining cooperation more difficult (Bicchieri, 2016; Ostrom, 2009).

In daily life, people interact with many others at a non-regular frequency and nevertheless contribute to the same shared common good. This is for instance the case for inhabitants of a neighborhood who contribute to the well-being of the neighborhood or colleagues from the same firm or department who contribute to the global profit by contributing to various smaller projects, or more generally, the citizens of a country who contribute to the country revenues and well-being. In such context, cooperation can be sustained if there is a social norm that is to cooperate, pushing all actors to contribute to the shared common good (Fehr and Schurtenberger, 2018).[1] However, actors

[1]Using the elicitation method of the social norms as appropriate behaviors introduced by (Krupka and Weber, 2013), it has been found that social norms explain a large series of phenomena such

are not all equal and this questions the relevance of the power of the social norm and thus the level of cooperation that can be expected.

The economic literature on finite cooperation games shows that inequality negatively impacts cooperation (Ahn et al., 2007; Anderson, Mellor and Milyo, 2008; Beckenkamp, Hennig-Schmidt and Maier-Rigaud, 2007; Buckley and Croson, 2006; Cherry, Kroll and Shogren, 2005; Fischbacher, Schudy and Teyssier, 2014; Sheposh and Gallo Jr, 1973; Zelmer, 2003).[2]. The efficiency of instruments such as punishment and communication is also reduced in the presence of inequality (Gangadharan, Nikiforakis and Villeval, 2017; Koch, Nikiforakis and Noussair, 2021; Nikiforakis, Noussair and Wilkening, 2012; Reuben and Riedl, 2013). The role of inequality on long-term cooperation has been rather under-investigated. Whereas it has been shown that long-term cooperation can be sustained in infinitely repeated games with stranger matching in case of repeated interactions of the same pair (Dal Bó and Fréchette, 2011, 2018; Duffy and Ochs, 2009) as well as in anonymous settings (Camera and Casari, 2009; Camera, Casari and Bigoni, 2012), only Camera, Deck and Porter (2020) study the role of inequality in this context. Camera, Deck and Porter (2020) find that inequality undermines efficient cooperation in donor–recipient pairs.

In this paper, we empirically examine the effects of inequality on social norms of cooperation and how norm compliance in turn affects cooperation in infinitely repeated

as, reciprocity (Gächter, Nosenzo and Sefton, 2013; Nikiforakis, Oechssler and Shah, 2014), fair sharing (Gächter, Gerhards and Nosenzo, 2017), promise keeping (Krupka, Leider and Jiang, 2017), lying (d'Adda et al., 2017), ethical conduct of financial advisers (Burks and Krupka, 2012), corruption (Banerjee, 2016), discrimination (Barr, Lane and Nosenzo, 2018), and gendered occupational choices (Gangadharan et al., 2016). See also Fallucchi and Nosenzo (2022) for a discussion of the robustness of the Krupka-Weber elicitation method of social norms when other points are made salient for the coordination of the group. They find that the method is indeed robust, in particular when beliefs about the appropriate behavior are clear. More recently, (d'Adda et al., 2020) explain all behaviors in a dictator game with personal values and social norms perception.

[2]Chan et al. (1996) and Visser and Burns (2015) are rare evidence showing that inequality increases cooperation.

games. We conducted an online experiment where participants made strategy choices in an infinitely repeated prisoner's dilemma game. A fairly large group of persons made choices for repeated interactions in pairs with a stranger matching protocol, which reflects interactions of people in societies as a succession of interactions in small groups without individual reputation effects. Theoretically, based on the folk theorem, cooperation can be sustained over time with anonymous random matching (Deb, González-Díaz and Renault, 2016; Deb, Sugaya and Wolitzky, 2020; Ellison, 1994; Kandori, 1992). Two participants cooperating or two participants defecting are both subgame perfect Nash equilibria. The norm perception could be a method of equilibrium selection in this context (Burke and Young, 2011).[3] We elicited norms by asking for the participants' first- and second-order normative expectations as well as their descriptive expectations (Bicchieri, 2006, 2016).

Achieving cooperation generates additional benefits to be shared between the participants. An equal share of these benefits is obvious when the participants have the same amount available to invest in cooperation. When they are instead unequal, the distribution of the benefits is questionable: the benefits may either be equally shared or distributed proportionally according to their available investment. These two distribution rules imply different motives. We therefore compare settings that differ by inequality when the two participants defect or the two cooperate. In two treatments the participants are equal, either all are advantaged or all are disadvantaged. In two other treatments the participants are unequal with an equal share of advantaged and disadvantaged participants. In one treatment, the benefits from cooperation are equally shared between the participants whereas in the other treatment, the benefits are pro-

[3]See also Bicchieri (2006) and Cialdini, Reno and Kallgren (1990) for a discussion on the role of norms to select non-equilibrium behavior as part of Bayesian strategies.

portionally distributed. The comparisons between treatments allow for the identification of the impact of inequalities on norms of cooperation and strategies in the infinitely repeated prisoner's dilemma game.

The results show that the large majority of the participants believe that the decision that should be chosen and that will be chosen is cooperation. Inequality weakens the social norm by decreasing these expectations of cooperation. For both unequal treatments, the mere presence of inequality changes first- and second-order normative beliefs as well as descriptive beliefs, whatever the type of the participant and the type of her expected playmate. In turn, the social norm impacts the decision to cooperate with higher beliefs leading to a higher likelihood of choosing cooperation. The strategy to always cooperate on the long-run is less chosen while the always defect strategy is instead more chosen in unequal treatments as compared to the equal treatments. Interestingly, the type advantaged or disadvantaged of the participant does not affect choices. It is the mere existence of inequality that causes the changes instead of specific behaviors depending on the participants' type.

Our contribution to the literature is twofold. First, we study the impact of inequality on long-term cooperation in a controlled framework. On the one hand, in most previous studies, the introduction of inequality is distorting the trade-off between equality and efficiency that introduces normative conflict, changes incentives to cooperate and bias the evaluation of the role of inequalities (Gangadharan, Nikiforakis and Villeval, 2017). Our study aims to identify the pure effect of inequality on cooperation prohibiting changes in trade-off between equality and efficiency. On the other hand, inequalities and cooperation have mainly been studied in finite games while long-term strategies of cooperation can only be studied in infinite games. Our study aims at filling this gap. Second, we directly elicit social norms perception with normative and descriptive beliefs. Our study aims to explain whether inequality changes the perception of the social norm as well as whether strategies are affected by social norms perception.

The rest of the paper is organized as follows. Section 2 presents the experiment. Section 3 shows the results. Section 4 discusses the results and concludes.

2 The experiment

Participants in the experiment were in groups of 50 individuals. They had to make strategy choices in a repeated game where they are randomly matched in pairs at each period. The number of interactions is finite but uncertain, that makes the game similar to an infinitely repeated game.[4] At the end of each period, a random draw decides whether a new period starts or not with a continuation probability equal to 0.95. Participants could not identify the other player in their pair. In this section, we detail the game, the different treatments that the participants play in a between-subjects design, the elicitation of the social norm, the elicitation of decisions and strategies as well as the experimental procedures.

2.1 The game

Participants play an infinitely repeated prisoner's dilemma game with two possible actions: cooperate (C) or defect (D).

[4] We use the random termination period firstly introduced by Roth and Murnighan (1978). See Dal Bó and Fréchette (2018) for a survey of experiments using infinitely repeated games to study cooperation in this context and discussion of the methods used to induce infinitely repeated games in the laboratory.

Payoffs Gains of player i are calculated based on her voluntary contributions, g_i, and on her playmate j's, g_j, to a public good that has a return of $a = 1.6$. Individual contributions are supposed to be either 0 (D) or the player's entire endowment (C), i.e. $g_i \in \{0, E_i\}$ and $g_j \in \{0, E_j\}$. Cooperation from the two players generates benefits. The distribution of these benefits can be either egalitarian, i.e. player i's gains are $\Pi_i = E_i - g_i + 0.8(g_i + g_j)$, or proportional to the players' endowments, i.e. player i's gains are $\Pi_i = E_i - g_i + 0.8(g_i + \frac{E_i}{E_j} g_j)$. In these two settings, cooperation does not increase relative inequality, that avoids any normative conflict between efficiency and equality (Gangadharan, Nikiforakis and Villeval, 2017).

The payoffs depend on the two players' actions. When the distribution of the benefits of cooperation is egalitarian, payoffs are as follows.

		Player j	
		Cooperate	Defect
Player i	Cooperate	$0.8(E_i + E_j)$; $0.8(E_i + E_j)$	$0.8E_i$; $E_j + 0.8E_i$
	Defect	$E_i + 0.8E_j$; $0.8E_j$	E_i ; E_j

Table 1: Egalitarian distribution of the benefits of cooperation

When the distribution of the benefits of cooperation is proportional, payoffs are as follows.

		Player j	
		Cooperate	Defect
Player i	Cooperate	$1.6E_i$; $1.6E_j$	$0.8E_i$; $1.8E_j$
	Defect	$1.8E_i$; $0.8E_j$	E_i ; E_j

Table 2: Proportional distribution of the benefits of cooperation

When endowments are equal, the payoffs are the same in the egalitarian and proportional distribution of cooperation. However, when endowments are unequal, the two types of distribution lead to different payoffs.

Equilibria Two subgame perfect equilibria exist for a sufficiently high probability of continuation, δ, when the game is infinitely repeated. On the one hand, players defecting in all periods is an equilibrium because of their individual interest that drives them to best respond to defection by choosing defection as well. On the other hand, for sufficiently high δ, if the player assumes that her playmate is adopting the grim trigger strategy, i.e. the cooperative strategy providing the strongest punishment when observing defection, she best responds by playing the grim trigger strategy as well (Camera and Casari, 2009; Camera, Casari and Bigoni, 2012; Dal Bó and Fréchette, 2018; Ellison, 1994; Kandori, 1992). The threshold of the probability of continuation that makes cooperation an equilibrium action, δ^{SPE}, is identical for all players when endowments are equal or when they are unequal with a proportional distribution of the benefits of cooperation. However, δ^{SPE} differs depending on the relative endowments of the players in the egalitarian distribution: δ^{SPE} is higher for advantaged players and lower for disadvantaged players.

The choice of cooperation does not only depend on whether cooperation is an equilibrium action (Dal Bó and Fréchette, 2018). Indeed, a player may worry about her low payoff when cooperating while her playmate chooses to defect, that is not included in the calculation of δ^{SPE}. Assuming the always defect strategy and a cooperative strategy such as grim trigger in the infinitely repeated prisoner's dilemma game, Blonski and Spagnolo (2015) and Dal Bó and Fréchette (2018) define cooperation as risk dominant in the sense of Harsanyi, Selten et al. (1988) if the grim trigger strategy is risk dominant, i.e. the best response to the strategy of the other player that is to randomize with equal probability between always defect and grim trigger. Cooperation is part of a risk dominant equilibrium if the player's payoff when she chooses the grim trigger strategy is higher than her payoff when she chooses the always defect strategy, that is the case for a sufficiently high continuation probability. The threshold for cooperation to be part of a risk-dominant equilibrium, δ^{RD}, is identical for all players when endowments are equal or when they are unequal with a proportional distribution of the benefits of cooperation. However, as for δ^{SPE}, δ^{RD} differs depending on the relative endowments of the players in the egalitarian distribution: δ^{RD} is higher for advantaged players and lower for disadvantaged players. Details of calculations are provided in Appendix A.

The parameters in the experiment verify $\delta > \delta^{SPE}$ and $\delta > \delta^{RD}$ in order to have both defect and cooperate as equilibrium actions.

2.2 Experimental treatments

We conducted four treatments: two equal treatments where all the 50 players have the same endowment that is either high or low, and two treatments where half of the

50 players have the high endowment, and the other half the low endowment. The treatments are between-subjects that means that each participant takes part in only one treatment.

2.2.1 Equal treatments

In the Equal treatments, we assume $E_i = E_j$. We consider two levels of endowment: the two players in the pair are either disadvantaged, i.e. $E_i = E_j = E_d = 10$ (*Equal-D treatment*), or advantaged, i.e. $E_i = E_j = E_a = 20$ (*Equal-A treatment*).

Equal-D The 50 participants have the low endowment $E_d = 10$. Applying the players' gains defined in the previous section, the payoffs matrix is as follows.

		Player j	
		Cooperate	Defect
Player i	Cooperate	16 ; 16	8 ; 18
	Defect	18 ; 8	10 ; 10

Table 3: Payoffs in the Equal-D treatment

Equal-A The 50 participants have the high endowment $E_a = 20$. The payoffs matrix is as follows.

		Player j	
		Cooperate	Defect
Player i	Cooperate	32 ; 32	16 ; 36
	Defect	36 ; 16	20 ; 20

Table 4: Payoffs in the Equal-A treatment

We calculate a range of δ^{SPE} and δ^{RD} with the lower bound corresponding to a punishment for defection directly at the next period and the upper bound corresponding to an equal probability to face cooperation at each period for 25 periods.[5] δ^{SPE} ranges from 0.25 to 0.866 and δ^{RD} ranges from 0.4 to 0.88. These two thresholds are identical in the two treatments and are lower than the continuation rate of 0.95 that applies in the experiment. To defect and to cooperate are thus two equilibrium actions in the equal treatments.

2.2.2 Unequal treatments

Inequality is introduced assuming that 25 players are disadvantaged with endowment $E_d = 10$ and 25 other players are advantaged with endowment $E_a = 20$. The matching in pairs can either be among players with the same endowment or with unequal endowments. If endowments of the players in the pair are equal, the payoffs matrices are the same as in the equal treatments. We present below the payoffs matrices if endowments are unequal.

Unequal-Egalitarian When player i in the pair is advantaged, i.e. she receives $E_a = 20$, and player j is disadvantaged, i.e. she receives $E_d = 10$, the payoffs matrix is as follows.

[5] The upper bound is calculated under the assumption that gives important incentives to the player to defect.

		Player j	
		Cooperate	Defect
Player i	Cooperate	24 ; 24	16 ; 26
	Defect	28 ; 8	20 ; 10

Table 5: Payoffs in the Unequal-E treatment

Unequal-Proportional When player i in the pair is advantaged, i.e. $E_a = 20$, and player j is disadvantaged, i.e. $E_d = 10$.

		Player j	
		Cooperate	Defect
Player i	Cooperate	32 ; 16	16 ; 18
	Defect	36 ; 8	20 ; 10

Table 6: Payoffs in the Unequal-U treatment

The range of δ^{SPE} and δ^{RD} are identical in the Unequal-Proportional treatment and the equal treatments: δ^{SPE} ranges from 0.25 to 0.866 and δ^{RD} ranges from 0.4 to 0.88. In the Unequal-Egalitarian treatment, these thresholds are changed when in the pair one player is advantaged and the other is disadvantaged. δ^{SPE} ranges from 0.125 to 0.759 and δ^{RD} ranges from 0.222 to 0.792 for disadvantaged players whereas these thresholds are higher for advantaged players with δ^{SPE} ranging from 0.5 to 0.942 and δ^{RD} from 0.667 to 0.947. In all cases, δ^{SPE} and δ^{RD} are lower than the continuation rate of 0.95 that is used in the experiment. However, Dal Bó and Fréchette (2018) emphasize that the distance to these thresholds matter in the equilibrium selection. Advantaged players are therefore less likely to cooperate than disadvantaged players when the players in the pair have different endowments.

2.3 Procedures

The online sessions were conducted during 2021. In total, 500 US located participants were recruited through Amazon Mechanical Turk to participate in the experiment. 35.6% were women, 21% were less than 30 years old, 56% between 30 and 45, 19.8% between 45 and 60 and 3.2% above 60, 19.4% had a degree lower than the bachelor, 61.4% had a bachelor degree and 19.2% had a master degree. In the three-item IQ test (Oechssler, Roider and Schmitz, 2009), 38.8% of the participants gave a correct answer to the three questions, 16.6% to two questions, 16.4% to one question and 28.2% gave no correct answer.[6] Participants had also to answer to a question about trust toward other people ("Generally speaking, would you say that most people are trustworthy or that you can never be too careful with people?") and 56.4% indicated that "most people are trustworthy". The distribution of these variables are not different between the treatments (ranksum Mann-Whitney tests: $p > 0.1$). In the econometric analysis, we controlled for the individual characteristics aforementioned.

Each participant took part in a single treatment: 50 participants in Equal-D, 50 in Equal-A, 200 in Unequal-Egalitarian and 200 in Unequal-Proportional. In each unequal treatment, 50 participants received endowment E_d and were matched with participants with endowment E_d as well, 50 participants received endowment E_a and were matched with participants with endowment E_a as well, 50 participants received endowment E_d and were matched with participants with endowment E_a and 50 participants received endowment E_d and were matched with participants with endowment E_a.

[6]The questions are given in the instructions in Appendix B.

Instructions were formulated in a neutral way (see instructions in Appendix B). The experiment was performed with oTree (Chen, Schonger and Wickens (2016)). The experiment lasted for about 5 minutes. Once all participants in a treatment had completed the experiment, we formed groups of 50 participants to implement their strategic decisions and thus calculate the payoffs. We randomly drawn the number of periods using the continuation rate of 0.95 for each group. The participants earned additional earnings based on the elicitation of their beliefs. The ex-post implementation was done in Python with Jupyter. The average earnings were about $5.

The participants started by answering questions about their beliefs regarding the decision that should or would be made and then reported their decisions and strategy for the game.

2.3.1 Social norm elicitation

The social norm consists in three dimensions: first-order normative beliefs, second-order normative beliefs and descriptive beliefs (Bicchieri, 2006). The first-order normative beliefs were evaluated asking the participants what decision, in their opinion, participants should make. The second-order normative beliefs were measured asking the participants what share of the participants of their group they think would indicate that participants should choose to cooperate (paths of 10%). The descriptive beliefs were measured asking the participants what share of the participants of their group they think would choose to cooperate in period 1.[7] In the unequal treatments, the number of questions for each dimension is multiplied depending on the type of the participants. At this social norm elicitation stage, subjects only know the framework of the game and their own type.

[7] See Bicchieri and Xiao (2009) for the first use of this elicitation method.

2.3.2 Decisions and strategy elicitation

The participants made their strategy choices in the prisoner's dilemma game and the matching was done ex-post following Dal Bó and Fréchette (2019) who validated the method with dynamic experimental data.[8] This procedure allows to directly address strategy choices instead of simulating strategies from observed actions (Camera, Casari and Bigoni, 2012; Dal Bó and Fréchette, 2011; Engle-Warnick, McCausland and Miller, 2004; Engle-Warnick and Slonim, 2006).

The participants learned the type of their future playmates in the experiment after having answered questions about their beliefs but before choosing their strategy. In period 1, the participant had to choose between cooperate and defect while in period 2, she had to choose a decision conditionally on the decision of her playmate in period 1, i.e. cooperate or defect if the playmate had chosen to cooperate in period 1 and cooperate or defect if the playmate has chosen to defect in period 1.

After period 2, strategies were elicited. First, we elicited the *memory-one strategy* that corresponds to choosing to cooperate or defect after choices of the two playmates in the previous period, i.e. cooperate or defect if, in the previous period, the participant chose to cooperate or defect and her playmate chose to cooperate or defect. Second, we elicited more complex strategies that participants choose among a *menu of strategies*. From this menu, we identify the following main strategies: always cooperate, always defect, tit-for-tat, and grim-trigger (see Appendix C that indicates how strategies are grouped). Always cooperate, tit-for-tat and grim trigger are cooperation strategies while always defect is a defection strategy. One of these two strategies elicitation method was randomly selected for implementation for the ex-post computation

[8] Another way to elicit strategies in the indefinitely repeated prisoner's dilemma game is provided in Romero and Rosokha (2018).

of payoffs.

2.4 Theoretical predictions

In any prisoner's dilemma game, the action to defect is an equilibrium. Additionally to this, the action to cooperate is an equilibrium and also part of a risk-dominant equilibrium in all equal and unequal treatments, for both disadvantaged and advantaged players. Strategies then should not be different between the treatments. Nevertheless, the perceived social norm, N, may help the players to select one of the two equilibria (Burke and Young, 2011). We suppose $N \in \{0, 1\}$, with $N = 0$ if the social norm is to defect and $N = 1$ if it is to cooperate. Following d'Adda et al. (2020), the social norm is expressed as $N = r + \alpha(E(r) - r) + \beta(E(g) - r)$ with $r \in \{0, 1\}$ the player's first order normative beliefs, $E(r) \in \{0, 0.1, ..., 1\}$ her second-order normative beliefs and, $E(g) \in \{0, 0.1, ..., 1\}$ her descriptive beliefs. The coefficients α and β are the weights the player attributes to her second-order normative beliefs and descriptive beliefs, respectively, with $\alpha, \beta > 0$ and $\alpha + \beta < 1$. Previous experimental work suggest that inequality decreases the social norm of cooperation (Reuben and Riedl, 2013; Fischbacher, Schudy and Teyssier, 2014; Xiao and Bicchieri, 2010). The first hypothesis we test is the following:

Hypothesis 1: The social norm, based on first-order and second-order normative beliefs and descriptive beliefs, is lower in the unequal treatments than in the equal treatments.

If we assume that the choice of the strategy depends on the social norm, the second hypothesis we test is:

Hypothesis 2: The likelihood to choose a cooperative strategy is increasing with the social norm of cooperation.

If the social norm is lower in the unequal treatments than in the equal treatments, the cooperative strategy would be less likely to be chosen in the unequal treatments than in the equal treatments. Also, the weight the player attributes to the social norm may differ between the unequal and equal treatments. If it is lower in the unequal treatments than in the equal treatment, the cooperative strategy would be even less chosen in the former than in the latter.

Although the thresholds of the continuation rate are lower than 0.95 in any situation of the experiment, we may observe different decisions in the Unequal-Egalitarian treatment because the levels of δ thresholds are different than in Equal-D, Equal-A or Unequal-Proportional: δ thresholds for disadvantaged players are lower while they are higher for advantaged players. The δ thresholds are perfectly identical in Unequal-Proportional, Equal-D and Equal-A. Differences between Unequal-Proportional and the equal treatments would reflect the pure effect of inequality, keeping identical incentives for cooperation.

3 Results

In this section, we will answer two questions: (i) How does inequality change the participants' beliefs and the social norm? (ii) How do inequality and changes in beliefs influence the participant's strategy choices?

3.1 Social norms

First-order normative beliefs represent the participant's personal value regarding the action that she thinks should be made in the game. This value is the individual reference of the social norm (d'Adda et al., 2020). In the equal treatments, 78% of the participants think that the decision that should be made is to cooperate whereas the frequency decreases to about 63% in the Unequal-Egalitarian treatment and 58% in the Unequal-Proportional treatment (see Table 12 in appendix for detailed statistics by type).

Second-order normative beliefs represent the participant's beliefs about the other participants' opinion regarding the action that should be made. These beliefs range between 0 when the participant believes that 0% of the other participants think that the decision that should be made is to cooperate and 1 when they believe 100% of the other participants think that the decision that should be made is to cooperate. Steps are of 0.1. On average, in the equal treatments, the participants believe that 74% of the participants think that the decision that should be made is to cooperate. This share decreases to 63% and 60% in the Unequal-Egalitarian and Unequal-Proportional treatments, respectively (see Tables 13 and 14 in appendix). The distribution of second-order beliefs is represented in Figure 1.

Descriptive beliefs provide the participant's beliefs about the decision other participants will make. These beliefs range between 0 when the participant believes that 0% of the other participants will choose to cooperate and 1 when they believe 100% of the other participants will cooperate. Steps are of 0.1. In the equal treatments, participants believe that, on average, 66% of the participants will decide to cooperate instead of defect. In the unequal treatments, this share is about 63% in the Unequal-Egalitarian treatment and 57% in the Unequal-Proportional treatment (see Table 15 in appendix). The distribution of descriptive beliefs is represented in figure 2.

We now test whether these beliefs differ between the treatments. We account for

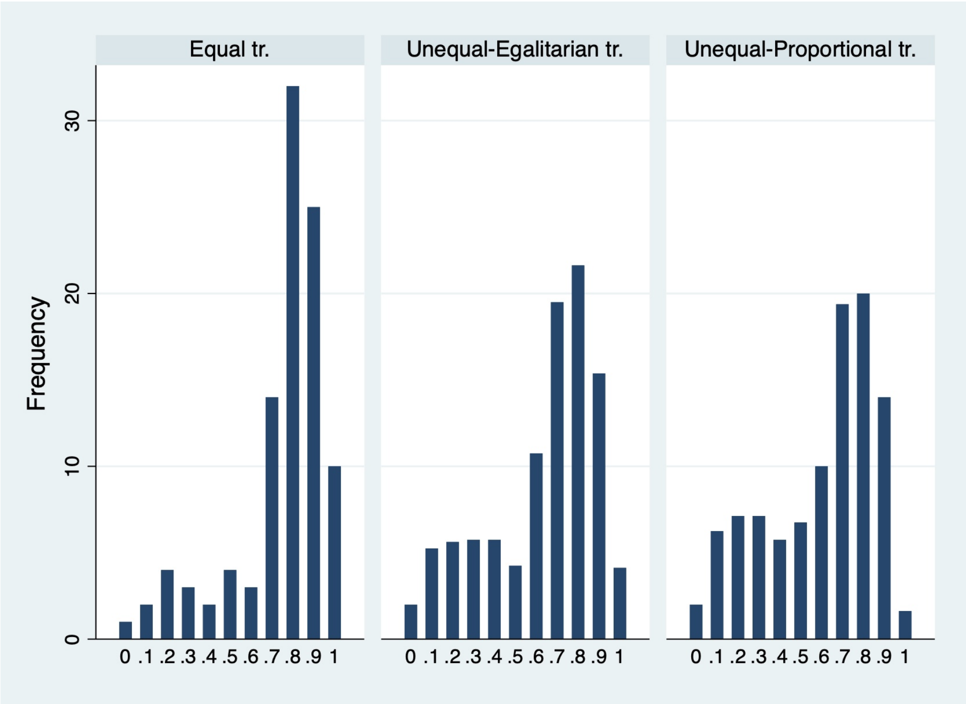

Figure 1: Distribution of second-order normative beliefs

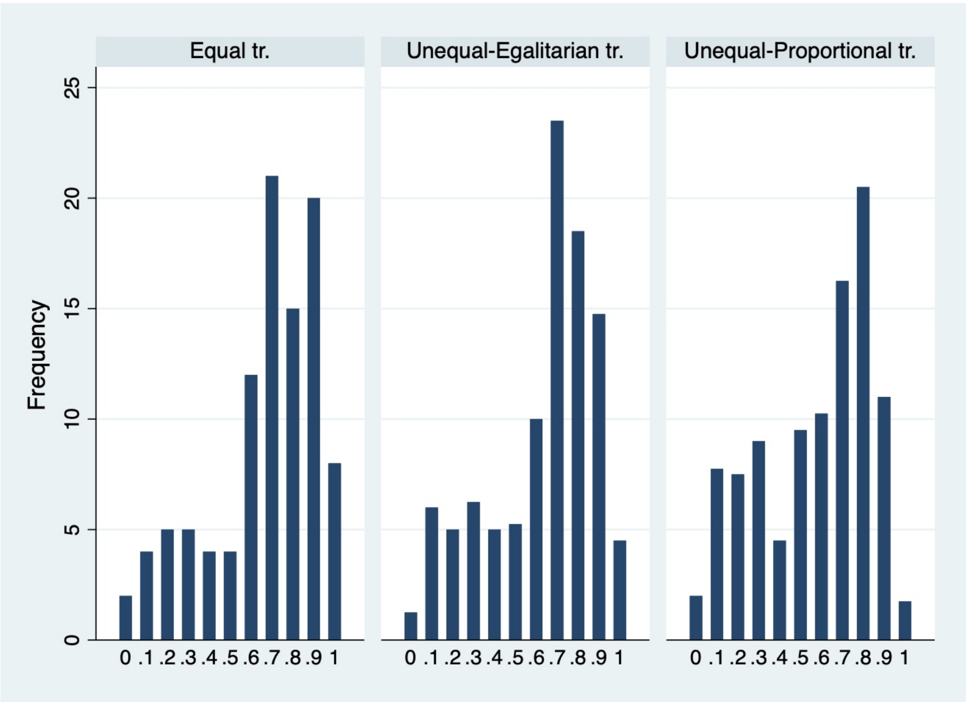

Figure 2: Distribution of descriptive beliefs

the type of the participant as well as for the fact that the participant gives her beliefs regarding the same type as herself (homogeneous) or the other type (heterogeneous). Table 7 gives the results.

	First-order normative beliefs		Second-order normative beliefs		Descriptive beliefs	
	(1)	(2)	(3)	(4)	(5)	(6)
UE	-0.326***	-0.338***	-0.525***	-0.492***	-0.305***	-0.302***
	(0.046)	(0.069)	(0.021)	(0.028)	(0.024)	(0.033)
UP	-0.371***	-0.285***	-0.563***	-0.501***	-0.368***	-0.351***
	(0.044)	(0.070)	(0.025)	(0.035)	(0.023)	(0.033)
UE $\times$ Heterogeneous		-0.018		-0.010		-0.016
		(0.042)		(0.015)		(0.018)
UP $\times$ Heterogeneous		-0.159***		-0.051***		-0.027
		(0.044)		(0.017)		(0.024)
Advantaged	0.025	-0.002	-0.013	0.041	-0.003	-0.004
	(0.028)	(0.085)	(0.018)	(0.024)	(0.020)	(0.036)
UE $\times$ Advantaged		0.055		-0.054		0.010
		(0.095)		(0.039)		(0.049)
UP $\times$ Advantaged		0.006		-0.071*		-0.007
		(0.094)		(0.036)		(0.047)
Intercept			1.231***	1.203***	1.000***	1.000***
			(0.036)	(0.036)	(0.040)	(0.040)
N	1000	1000	2000	2000	1000	1000
Clusters	500	500	500	500	500	500
pseudo R^2	0.070	0.082	0.480	0.486	0.272	0.274

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Models (1) and (2) are logit models, reporting average marginal effects; Models (3) to (6) are tobit model left-censored at 0 and right-censored at 1.

Table 7: Beliefs, by treatment

The social norm of cooperation is weakened in the two unequal treatments with a decrease of first- and second-order normative beliefs as well as descriptive beliefs. The type of the participant has no significant impact of her beliefs, whatever the treatment. Interestingly, normative beliefs are significantly lower when the participant's is asked her beliefs about the action that should be made for other participants of the other type. This gives result 1.

Result 1: The existence of inequality weakens the social norm of cooperation by a decrease in first- and second-order normative beliefs and descriptive beliefs, whatever the type of the participants.

When the benefits of cooperation are proportionally shared between the participants, incentives to cooperate are kept exactly constant when inequality is introduced as compared to equality in endowments. Changes in beliefs in this game are then uniquely driven by inequality in endowments. The presence of inequality changes participants' beliefs that are not related to changes of incentives to cooperate. Compliance to the social norm of cooperation is lower in the presence of inequality.

3.2 Decisions and strategies

Inequalities weaken the social norm of cooperation. We analyze now whether inequalities or changes in the social norm affect decisions and strategies of cooperation.

3.2.1 Decisions in periods 1 and 2

In period 1, 74% of the participants decide to cooperate in the equal treatments. This share is 67% and 65% in the unequal treatments, Unequal-Egalitarian treatment and Unequal-Proportional treatment, respectively (see Table 16 in Appendix for detailed statistics). In period 2, in equal treatments, 70% of the participants cooperate if her playmate has cooperated in period 1 and 63% cooperate if her playmate defected. These rates are 62% and 56% in the Unequal-Egalitarian treatment and 59% and 50% in the Unequal-Proportional treatment (see Table 17 in Appendix for detailed statistics).

Table 8 presents the impact of the treatments and of the social norm on the decisions in periods 1 and 2. In period 2, the decision of the playmate in the previous period as well as the participant's decision in period 1 are also estimated.[9]

	Decision in period 1		Decision in period 2		
	(1)	(2)	(3)	(4)	(5)
UE	-0.078	-0.041	-0.079	-0.059	-0.048
	(0.057)	(0.055)	(0.049)	(0.049)	(0.048)
UP	-0.090	-0.035	-0.120**	-0.084*	-0.076
	(0.057)	(0.054)	(0.048)	(0.048)	(0.048)
Advantaged	0.022	0.023	0.014	0.012	0.006
	(0.041)	(0.038)	(0.036)	(0.034)	(0.032)
r		0.617***		0.400***	0.204***
		(0.081)		(0.079)	(0.075)
$E(r) - r$		0.138		-0.012	-0.055
		(0.107)		(0.106)	(0.100)
$E(g) - r$		0.370***		0.314***	0.198**
		(0.094)		(0.093)	(0.088)
Playmate cooperated in period 1			0.072***	0.072***	0.072***
			(0.025)	(0.025)	(0.025)
Participant cooperated in period 1					0.267***
					(0.031)
N	500	500	1000	1000	1000
Clusters	500	500	500	500	500
pseudo R^2	0.045	0.143	0.024	0.061	0.113

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Logit models, reporting average marginal effects.

Table 8: Decisions in periods 1 and 2

In period 1, as well as in period 2, inequality decreases the likelihood of cooperation by a change in beliefs: first-order normative beliefs and descriptive believes have a positive impact on the decision to cooperate. However, second-order normative beliefs have no significant impact. In period 2, the decision to cooperate also strongly depends on past behaviors, from her playmate and from herself. The existence of inequality decreases the likelihood of cooperation only through a change in beliefs. Besides, the intensity of the effect of the social norm on the decisions is not related to inequality.

[9]We also conducted regressions with crossed effects between heterogeneity and the unequal treatments and between the type of the participant and the treatments. We find no significant effect and then, we do not report the coefficients in the table.

3.2.2 Strategies

Memory-one strategies imply four decisions from the participants based on choices in the previous period: whether the participant and her playmate chose to cooperate or to defect. In equal treatments, when the participant chose to cooperate in the previous period, 88% of the participants cooperate if the playmate also cooperated and 46% cooperate if the playmate defected. When the participant chose to defect in the previous period, 70% of the participants cooperate if the playmate also cooperated and 50% cooperate if the playmate defected. These shares are 81%, 43%, 57% and 43% in the unequal-egalitarian treatment and 79%, 49%, 50% and 43% in the unequal-proportional treatment (see Table 18 in Appendix).

Table 9 presents the marginal effects of the estimation of the participant's likelihood to cooperate depending on the hypothetical decision of herself and her playmate in the previous period. Model (1) does not include normative and descriptive expectations whereas Model (2) does.

	Model (1)	Model (2)
UE	-0.075**	-0.053*
	(0.032)	(0.031)
UP	-0.080**	-0.047
	(0.032)	(0.031)
Advantaged	-0.001	-0.005
	(0.024)	(0.023)
r		0.335***
		(0.060)
$E(r) - r$		0.042
		(0.063)
$E(g) - r$		0.196***
		(0.055)
Participant cooperated in previous period	0.011	0.011
	(0.024)	(0.024)
Playmate cooperated in previous period	0.111***	0.111***
	(0.026)	(0.026)
Participant cooperated $\times$ Playmate cooperated in previous period	0.259***	0.259***
	(0.0364)	(0.0364)
N	2000	2000
Clusters	500	500
pseudo R^2	0.079	0.104

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Logit models, reporting average marginal effects.

Table 9: Memory-one strategies

We find that the likelihood of choosing to cooperate is significantly lower when there is inequality. The previous choice to cooperate of the playmate, whatever the participant did or did not cooperate increases this likelihood. The increase is stronger when the previous choice of the participant was also to cooperate. Interestingly, additional regressions show that the role of the impact of past cooperation by the playmate is significantly lower in the unequal proportional treatment, i.e. observing cooperation from others plays a lower role in the unequal proportional treatment as compared to the equal treatments. When beliefs related to the social norm are introduced, dummies for unequal treatments are not significant anymore while first-order normative beliefs and descriptive beliefs significantly explain the likelihood of cooperating. The effect of beliefs is not different between the treatments. Result 2 is as follows.

Result 2. The existence of inequality decreases the likelihood of the decision to cooperate because of a change in the social norm, whatever the type of the participant.

Four main strategies are elicited from the menu of strategies: always cooperate, always defect, Grim-trigger and Tit-for-Tat. On average, in the equal treatments, always cooperate is chosen by 51% of the participants, always defect by 11%, grim-trigger by 23% and tit-for-tat by 15%. In the unequal treatments, these shares are 34%, 24%, 23% and 20% in the Unequal-egalitarian treatment and 33%, 24%, 21% and 23% in the Unequal-proportional treatment, respectively.

The results show a lower share of participants who choose to always cooperate and a higher share who choose to always defect in the unequal treatments than in the equal treatments. Table 10 gives marginal effects of multinomial logit models that compare the effects of treatments, type of the participant, beliefs and previous behavior on the participant's likelihood to adopt each strategy.

	Always defect			Always cooperate		
	Model (1)	Model (2)	Model (3)	Model (1)	Model (2)	Model (3)
UE	0.16***	0.14***	0.13***	-0.16***	-0.13***	-0.12***
	(0.029)	(0.028)	(0.027)	(0.028)	(0.028)	(0.027)
UP	0.14***	0.12***	0.11***	-0.17***	-0.12***	-0.12***
	(0.029)	(0.028)	(0.027)	(0.028)	(0.028)	(0.027)
Advantaged	-0.029	-0.025	-0.023	0.036*	0.027	0.023
	(0.018)	(0.017)	(0.017)	(0.021)	(0.021)	(0.021)
r		-0.31***	-0.16**		0.43***	0.31***
		(0.051)	(0.053)		(0.51)	(0.53)
$E(r) - r$		0.049	0.086*		0.14**	0.12*
		(0.047)	(0.045)		(0.63)	(0.62)
$E(g) - r$		-0.24***	-0.15***		0.14**	0.065
		(0.055)	(0.055)		(0.43)	(0.42)
Participant coop.			-0.19***			0.16***
in period 1			(0.016)			(0.024)
	Grim-trigger			Tit-for-Tat		
	Model (1)	Model (2)	Model (3)	Model (1)	Model (2)	Model (3)
UE	0.022	0.014	0.014	-0.013	-0.026	-0.027
	(0.019)	(0.019)	(0.019)	(0.029)	(0.029)	(0.029)
UP	-0.030	-0.031	-0.031	0.055**	0.037	0.037
	(0.020)	(0.021)	(0.020)	(0.028)	(0.028)	(0.028)
Advantaged	-0.046***	-0.044***	-0.043***	0.039*	0.042**	0.044**
	(0.015)	(0.015)	(0.014)	(0.020)	(0.020)	(0.020)
r		0.028	0.015		-0.15***	-0.16***
		(0.033)	(0.035)		(0.047)	(0.049)
$E(r) - r$		-0.086**	-0.091**		-0.11*	-0.11**
		(0.043)	(0.043)		(0.058)	(0.058)
$E(g) - r$		0.13***	0.12***		-0.030	-0.035
		(0.040)	(0.040)		(0.052)	(0.053)
Participant coop.			0.011			0.014
in period 1			(0.016)			(0.023)
N				500	500	500
pseudo R^2				0.0387	0.0740	0.0982

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Multinomial logit models, reporting average marginal effects.

Table 10: Menu of strategies

Constant strategies that are independent from other players' decisions, like choosing to always cooperate or always defect, depend on inequality: inequality decreases the likelihood of choosing to always cooperate but increases the likelihood of choosing to always defect. First-order normative beliefs and the participant's cooperation in period 1 are found to negatively influence the choice to always defect and positively influence the choice to always cooperate. Descriptive beliefs also negatively influence the choice to always defect. The impact of the treatment is still significant once controlling for beliefs and the participant's past decision in period 1. This leads to result 3.

Result 3. The existence of inequality decreases the likelihood of choosing to always cooperate and increases the likelihood of choosing to always defect because, partially, of a change in the social norm, whatever the type of the participant.

Strategies that are directly linked to the participant's playmate behavior do not depend on inequality and are not related to the participants' decision in period 1. First-order normative beliefs negatively influence the choice of the tit-for-tat strategy while descriptive beliefs positively influence the choice of the grim-trigger strategy.

Inequality changes normative and descriptive beliefs weakening the social norm of cooperation. Such changes reduce in turn the decision to cooperate and the choice of the always cooperate strategy while rising the choice of the always defect strategy. The intensity of the impact of the social norm does not appear to impact differently behavior in the equal and unequal frameworks.

4 Discussion and conclusion

Cooperation in moving social interactions is essential to face the main challenges of today such as the reduction of greenhouse gas emissions or water conservation and also to improve general well-being. Interactions with many others at a non-regular frequency makes the situation complex to study and renders the role of the social norm central. An important stake in this context is the consideration of inequality. Indeed, many people benefit from the same common good but do not have the same possibilities to contribute to it. The experiment we conducted tackles these two dimensions: infinitely repeated interactions and the existence of inequality. We elicit the participants' beliefs about the social norm and their decision to cooperate or not in an infinitely repeated prisoner's dilemma that either gives equal payoffs to the participants, or unequal payoffs when they defect but equal payoffs when they cooperate or unequal payoffs when they defect or cooperate.

The results show that the existence of inequality weakens the social norm of cooperation by decreasing first- and second-order normative beliefs as well as descriptive beliefs. Such changes in first-order normative beliefs and descriptive beliefs lower the likelihood of choosing to cooperate. The long term strategy of always cooperating is also more likely for higher first-order normative expectations. Always defecting is more chosen for lower levels of first-order normative beliefs and descriptive beliefs. According to the results of the experiment, while the incentives for cooperation are not changed, the existence of inequality is detrimental to cooperation because of a weakened social norm. Interestingly, the level of the participants' endowment does not appear to influence neither beliefs nor behaviors. We do not observe different influence of the social norm depending on whether there exists inequality or not. It is the very existence of inequality that lead to the changes in the choice of cooperation.

An opposite effect could have been expected if assuming inequity aversion of the participants (Fehr and Schmidt, 1999). The payoffs in the unequal treatments have been determined to guarantee that cooperation would not lead to inequality in order to avoid any conflicting norms (Gangadharan, Nikiforakis and Villeval, 2017). Therefore, some participants might be willing to cooperate to avoid the inequality. This is not what is observed in the experiment: the detrimental effect of inequality on the social norm of cooperation appears to be much stronger that the wish to reduce inequality by cooperating.

The results of the experiment emphasize the importance of transparency about the normative behavior to adopt and the adoption of this behavior by other people. Indeed, a main driver of lower cooperation in the presence of inequality is the change in beliefs. Transparency about the social norm should be disseminated to limit the negative effects of inequality on cooperation. The question of the sustainability of the common good in the presence of inequality needs to be further investigated (Bardhan et al., 2007). Future research should address interactions between the participants in a dynamic setting and ask for the role of various instruments in this context.

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Appendix

A Equilibrium continuation probabilities

A.1 Calculation of δ^{SPE}

We calculate the minimum continuation rate that allows cooperation to be an equilibrium.

Egalitarian distribution of the benefits of cooperation In each round, if the playmate is adopting the grim trigger strategy, the player would receive $\frac{1}{1-\delta}0.8(E_i + E_j)$ as payoff if she chooses any cooperative strategy and $\frac{1}{1-\delta}E_i + 0.8E_j$ if she chooses to defect. In a stranger matching protocol, the player who defects is not necessarily directly punished in the next round by the other player because the latter may not have already experienced defection and then adopting the grim trigger strategy leads him to choose to cooperate. Accounting for this stranger matching, the player would receive $\sum_{t=1}^{n} \rho_t \left[(E_i + 0.8E_j)\frac{1-\delta^t}{1-\delta} + E_i \frac{\delta^t}{1-\delta} \right]$ as expected payoff if she chooses to defect, with ρ_t being the probability of being paired with a player choosing to cooperate in period t, $\sum_{t=1}^{n} = 1$, $\rho_1 \geq \rho_2 ... \geq \rho_n$, and n being the total number of periods played. Indeed, the diffusion of defection may take several rounds to spread in the group and the player would benefit from defecting for more than only one round but with a decreasing probability (see Camera and Casari (2009) and Camera, Casari and Bigoni (2012) who have the same reasoning assuming a specific matching with four players in the group). Players choosing to cooperate in each round is then an equilibrium if $\delta > \delta^{SPE}$ with δ^{SPE} such that $\frac{1}{1-\delta}0.8(E_i + E_j) = \sum_{t=1}^{n} \rho_t \left[(E_i + 0.8E_j)\frac{1-\delta^t}{1-\delta} + E_i \frac{\delta^t}{1-\delta} \right]$. The grim trigger strategy is then an equilibrium strategy if $\delta > \delta^{SPE}$. As an example, if the player who defects is matched only once with a playmate choosing to cooperate ($n = 1$ and $\rho_1 = 1$), the player chooses to cooperate only if $\frac{1}{1-\delta}0.8(E_i + E_j) > E_i + 0.8E_j + \frac{\delta}{1-\delta}E_i \Leftrightarrow \delta > \frac{E_i}{4E_j}$, i.e. $\delta^{SPE} = \frac{E_i}{4E_j}$. Cooperation is an equilibrium action more easily (lower δ^{SPE}) when the relative weight of one player's endowment compared to her playmate's endowment is low.

Proportional distribution of the benefits of cooperation In each round, if the playmate is adopting the grim trigger strategy, the player would receive $\frac{1}{1-\delta}1.6E_i$ as payoff if she chooses any cooperative strategy and $\frac{1}{1-\delta}(1.8 - 0.8\delta)E_i$ if she chooses to defect. Because of the stranger matching, the player would receive $\sum_{t=1}^{n} \rho_t \left[1.8E_i \frac{1-\delta^t}{1-\delta} + E_i \frac{\delta^t}{1-\delta} \right]$ as expected payoff if she chooses to defect. Players choosing to cooperate in each round is an equilibrium if $\delta > \delta^{SPE}$ with δ^{SPE} such that $\frac{1}{1-\delta}1.6E_i = \sum_{t=1}^{n} \rho_t \left[1.8E_i \frac{1-\delta^t}{1-\delta} + E_i \frac{\delta^t}{1-\delta} \right]$. As an example, if the player who defects is matched only once with a playmate choosing to cooperate ($n = 1$ and $\rho_1 = 1$), the player chooses to cooperate only if $\frac{1}{1-\delta}1.6E_i >$

$1.8E_i + \frac{\delta}{1-\delta}E_i \Leftrightarrow \delta > \frac{1}{4}$, i.e. $\delta^{SPE} = \frac{1}{4}$. The level of δ^{SPE} does not depend on the players' endowment.

A.2 Calculation of δ^{RD}

We calculate the minimum continuation rate that allows cooperation to be part of a risk dominant equilibrium.

Egalitarian distribution of the benefits of cooperation The stranger matching protocol implies the following expected payoff for the player who chooses the always defect strategy: $\frac{1}{2}\frac{E_i}{1-\delta} + \frac{1}{2}\sum_{t=1}^{n}\rho_t\left[(E_i + 0.8E_j)\frac{1-\delta^t}{1-\delta} + E_i\frac{\delta^t}{1-\delta}\right]$. If the player chooses the grim trigger strategy, her expected payoff is: $\frac{1}{2}\frac{1}{1-\delta}\left[(1.6 + 0.2\delta)E_i + 0.8E_j\right]$. Cooperation is then part of a risk dominant equilibrium if $\delta > \delta^{RD}$ with δ^{RD} such that $\frac{1}{1-\delta}\left[(1.6+0.2\delta)E_i + 0.8E_j\right] = \frac{E_i}{1-\delta} + \sum_{t=1}^{n}\rho_t\left[(E_i + 0.8E_j)\frac{1-\delta^t}{1-\delta} + E_i\frac{\delta^t}{1-\delta}\right]$. As an example, if the player who defects is matched only once with a playmate choosing to cooperate ($n = 1$ and $\rho_1 = 1$), the player chooses to cooperate only if $\frac{1}{1-\delta}\left[(1.6 + 0.2\delta)E_i + 0.8E_j\right] > \frac{1}{1-\delta}2E_i + 0.8E_j \Leftrightarrow \delta > \frac{2E_i}{E_i+4E_j}$.

Proportional distribution of the benefits of cooperation If the player chooses the always defect strategy, her expected payoff is: $\frac{1}{2}\frac{E_i}{1-\delta} + \frac{1}{2}\sum_{t=1}^{n}\rho_t\left[1.8E_i\frac{1-\delta^t}{1-\delta} + E_i\frac{\delta^t}{1-\delta}\right]$. If she chooses the grim trigger strategy, her expected payoff is: $\frac{1}{2}\frac{1}{1-\delta}\left[(2.4 + 0.2\delta)E_i\right]$. Cooperation is part of a risk dominant equilibrium if $\delta > \delta^{RD}$ with δ^{RD} such that $\frac{1}{1-\delta}\left[(2.4 + 0.2\delta)E_i\right] = \frac{E_i}{1-\delta} + \sum_{t=1}^{n}\rho_t\left[1.8E_i\frac{1-\delta^t}{1-\delta} + E_i\frac{\delta^t}{1-\delta}\right]$. As an example, if the player who defects is matched only once with a playmate choosing to cooperate ($n = 1$ and $\rho_1 = 1$), the player chooses to cooperate only if $\frac{1}{1-\delta}\left[(2.4 + 0.2\delta)E_i\right] > \frac{1}{1-\delta}2E_i + 0.8E_i \Leftrightarrow \delta > \frac{2}{5}$.

B Instructions in the unequal-egalitarian treatment

Welcome to the Grenoble Applied Economics Laboratory

The duration of the experiment is about 20 minutes. **In this experiment, you will be matched with other participants who are real persons and whose earnings may depend on your decisions as it is explained in the next pages.**

You will receive a flat fee of $2 for your participation to the experiment. **You will also earn a bonus up to about $8**. During the experiment, you will make decisions. Your decisions will be matched with other participants' decisions to determine your bonus as well as the other participants' bonus. You will receive your payment within the next two weeks.

The experiment consists in two parts that we will detail next and a short questionnaire. You must complete both parts of the experiment in one sitting to receive your payment (flat-fee and bonus); if one part is not complete, you will not receive your payment.

Remember to **NEVER CLOSE THE WINDOW**: if you close the window, you will be disconnected from the experiment, you will not be able to reconnect to participate to the experiment and you will be excluded from payment.

Thank you for your participation!

Instructions read

Part 1

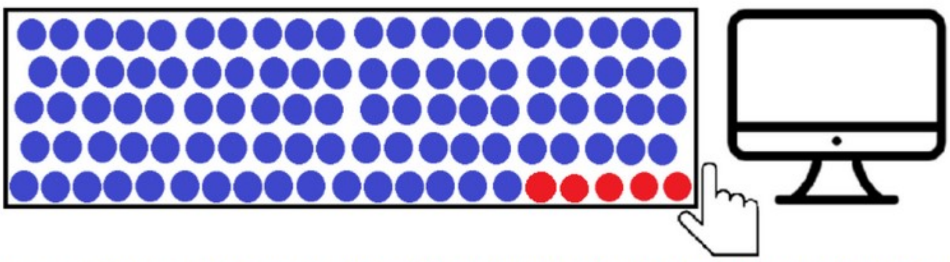
At the beginning of the experiment, you will be randomly assigned to a group of 50 participants. 25 participants have role Lambda and 25 participants have role Delta. You will learn your role at the beginning of the experiment and keep this role for the entire experiment. The experiment consists in several periods. In each period, you will be randomly paired with a participant of your group. This means that you will not be paired with the same participant for all the periods.

In this part **you will be asked to specify a plan of action for the periods of the experiment.** You must make your choice in period 1, period 2, and the periods after period 2.

You will also have to answer questions about others' choices.

The number of periods is not fixed in advance and is instead randomly selected: after each period, there is a 95% probability that another period will start. This probability is the same at any period of the experiment. In other words: After each period, the computer randomly draws one ball among 95 blue balls and 5 red balls, as you can see in the picture below:

- If the computer draws a blue ball, you will be randomly paired with a participant of your group and you will start another period paired with him.
- If the computer draws a red ball, this part will stop and you will be automatically directed to the second part of the experiment.



In each period, **your choice and the choice of the individual with whom you will be paired give the earnings that are presented in the following tables**, depending on your role and on the role of the participant you will be paired with. The first entry in each cell represents your earnings, while the second entry represents the earnings of the person you are paired with. At the end of the period, the two individuals in the pair learn their earnings as well as the choice and earnings of the other individual in the pair.

- If you have role **Lambda** and the other participant you are paired with has role **Lambda**, the table of earnings if as follows:

		The other's decision (Role Lambda)	
		K	**P**
Your decision (Role Lambda)	**K**	**32** ; 32	**16** ; 36
	P	**36** ; 16	**20** ; 20

With this table, the earnings are as follows:
- If you and the other choose K, you will earn **32** ECUs and the other will earn 32 ECUs.
- If you choose K and the other chooses P, you will earn **16** ECUs and the other will earn 36 ECUs.
- If you choose P and the other chooses K, you will earn **36** ECUs and the other will earn 16 ECUs.
- If you and the other choose P, you will earn **20** ECUs and the other will earn 20 ECUs.

- If you have role **Lambda** and the other participant you are paired with has role **Delta**, the table of earnings if as follows:

		The other's decision (Role Delta)	
		K	**P**
Your decision (Role Lambda)	**K**	**24** ; 24	**16** ; 26
	P	**28** ; 8	**20** ; 10

With this table, the earnings are as follows:
- If you and the other choose K, you will earn **24** ECUs and the other will earn 24 ECUs.
- If you choose K and the other chooses P, you will earn **16** ECUs and the other will earn 26 ECUs.
- If you choose P and the other chooses K, you will earn **28** ECUs and the other will earn 8 ECUs.
- If you and the other choose P, you will earn **20** ECUs and the other will earn 10 ECUs.

- If you have role **Delta** and the other participant you are paired with has role **Lambda**, the table of earnings if as follows:

		The other's decision (Role Lambda)	
		K	**P**
Your decision (Role Delta)	**K**	**24** ; 24	**8** ; 28
	P	**26** ; 16	**10** ; 20

With this table, the earnings are as follows:
- If you and the other choose K, you will earn **24** ECUs and the other will earn 24 ECUs.
- If you choose K and the other chooses P, you will earn **8** ECUs and the other will earn 28 ECUs.
- If you choose P and the other chooses K, you will earn **26** ECUs and the other will earn 16 ECUs.
- If you and the other choose P, you will earn **10** ECUs and the other will earn 20 ECUs.

- If you have role **Delta** and the other participant you are paired with has role **Delta**, the table of earnings if as follows:

		The other's decision (Role Delta)	
		K	**P**
Your decision (Role Delta)	**K**	**16** ; 16	**8** ; 18
	P	**18** ; 8	**10** ; 10

With this table, the earnings are as follows:
- If you and the other choose K, you will earn **16** ECUs and the other will earn 16 ECUs.
- If you choose K and the other chooses P, you will earn **8** ECUs and the other will earn 18 ECUs.
- If you choose P and the other chooses K, you will earn **18** ECUs and the other will earn 8 ECUs.
- If you and the other choose P, you will earn **10** ECUs and the other will earn 10 ECUs.

Instructions read

Part 1

The plan of action you will specify will take all decisions for you. At the end of the experiment, **we will play the game based on your plan of action and the plan of action of the other persons in your group.** The pairs between individuals and the number of periods will be determined based on the procedures detailed above: in each period, you will be randomly paired with a participant of your group, and the number of periods is not fixed in advance and is instead randomly selected (after each period, there is a 95% probability that another period will start).

You will receive the sum of the earnings you make in every period of the game (based on your plan of action and the plan of action of the other persons in your group). **You will also have to answer questions, which will give you the opportunity to earn 50 additional ECUs for each correct answer** (only 2 questions with an asterisk (*) do not give you additional ECUs). The exchange rate is 200 ECUs = $1.

Instructions read

Questions

Let us recall that you will be randomly assigned to a group of 50 participants. 25 participants have role Lambda and 25 participants have role Delta. Each participant keeps the same role for the entire experiment. The experiment consists in several periods. In each period, you will be randomly paired with a participant of your group. This means that you will not be paired with the same participant for all the periods. The number of periods is not fixed in advance and is instead randomly selected (after each period, there is a 95% probability that another period will start).

You have role Lambda.

The tables of earnings are as follows: Hide all tables

		The other's decision (Role Lambda)	
		K	P
Your decision (Role Lambda)	K	**32** ; 32	**16** ; 36
	P	**36** ; 16	**20** ; 20

		The other's decision (Role Delta)	
		K	P
Your decision (Role Lambda)	K	**24** ; 24	**16** ; 26
	P	**28** ; 8	**20** ; 10

		The other's decision (Role Delta)	
		K	P
Your decision (Role Delta)	K	**16** ; 16	**8** ; 18
	P	**18** ; 8	**10** ; 10

		The other's decision (Role Lambda)	
		K	P
Your decision (Role Delta)	K	**24** ; 24	**8** ; 28
	P	**26** ; 16	**10** ; 20

In your opinion, what decision participants in role Lambda should make?(*)

◯ - K ◯ - P

In your opinion, what decision participants in role Delta should make?(*)

◯ - K ◯ - P

In your opinion, what share of the participants in role Lambda of your group will indicate that participants in role Lambda (your role) should make decision K or P? *(you will earn 50 additional ECUs if your guess is correct, we accept a 10% error rate)*

-- % will indicate P -- % will indicate K

In your opinion, what share of the participants in role Lambda of your group will indicate that participants in role Delta should make decision K or P? *(you will earn 50 additional ECUs if your guess is correct, we accept a 10% error rate)*

-- % will indicate P -- % will indicate K

In your opinion, what share of the participants in role Delta of your group will indicate that participants in role Delta should make decision K or P? *(you will earn 50 additional ECUs if your guess is correct, we accept a 10% error rate)*

-- % will indicate P -- % will indicate K

In your opinion, what share of the participants in role Delta of your group will indicate that participants in role Lambda (your role) should make decision K or P? *(you will earn 50 additional ECUs if your guess is correct, we accept a 10% error rate)*

-- % will indicate P -- % will indicate K

In your opinion, what share of the participants in role Lambda of your group will make decision K or P in period 1? *(you will earn 50 additional ECUs if your guess is correct, we accept a 10% error rate)*

-- % will choose P -- % will choose K

In your opinion, what share of the participants in role Delta of your group will make decision K or P in period 1? *(you will earn 50 additional ECUs if your guess is correct, we accept a 10% error rate)*

-- % will choose P -- % will choose K

Submit

Decision - Period 1

Recall that you have role Lambda.
In each round, you will be randomly paired with a participant who has role Delta.

In each round, **because you have role Lambda and you will be randomly paired with a participant of your group who has role Delta**, your table of earnings is as follows:

		The other's decision (Role Delta)	
		K	**P**
Your decision (Role Lambda)	**K**	**24** ; 24	**16** ; 26
	P	**28** ; 8	**20** ; 10

In your opinion, what decision the other participant you will be paired with in period 1 will make? *(you will earn 50 additional ECUs if your guess is correct)*

- K - P

What is your choice in period 1?

- K - P

Submit

Decision - Period 2

Recall that you have role Lambda.
In each round, **because you have role Lambda and you will be randomly paired with a participant of your group who has role Delta**, your table of earnings is as follows:

		The other's decision (Role Delta)	
		K	**P**
Your decision (Role Lambda)	**K**	**24** ; 24	**16** ; 26
	P	**28** ; 8	**20** ; 10

In case the choice of the other participant you were paired with in period 1 was : K
Recall, your choice in period 1 was : P

In your opinion, what decision the other participant you will be paired with in period 2 will make? *(you will earn 50 additional ECUs if your guess is correct)*

○ - K ○ - P

What is your choice in period 2?

○ - K ○ - P

In case the choice of the other participant you were paired with in period 1 was : P
Recall, your choice in period 1 was : P

In your opinion, what decision the other participant you will be paired with in period 2 will make? *(you will earn 50 additional ECUs if your guess is correct)*

○ - K ○ - P

What is your choice in period 2?

○ - K ○ - P

Submit

Plan of action - period 3 and after

Recall that you have role Lambda.
In each round, **because you have role Lambda and you will be randomly paired with a participant of your group who has role Delta**, your table of earnings is as follows:

		The other's decision (Role Delta)	
		K	P
Your decision (Role Lambda)	K	**24** ; 24	**16** ; 26
	P	**28** ; 8	**20** ; 10

What is your plan of action for period 3 and after (period 3, period 4... until the game ends)?

We propose two different lists of plans of action. You will choose a plan of action in each list. At the end of the experiment, we will randomly select one of the two lists (**each list has a 50% chances of being selected**) to apply your choices to determine the earnings of individuals in the group.

List 1 (4 choices)

- If in the previous period you chose K and the other chose K, then choose -------- for the new matching

- If in the previous period you chose K and the other chose P, then choose -------- for the new matching

- If in the previous period you chose P and the other chose K, then choose -------- for the new matching

- If in the previous period you chose P and the other chose P, then choose -------- for the new matching

List 2 (1 choice)

- Choose K in every period
- Choose P in every period
- Choose K for X periods, then choose P until the end
- Choose K X% of the time and P 1-X% of the time
- Choose K for the new matching if both always chose K in the previous periods ; otherwise choose P
- Choose K for the new matching if the other chose K in the previous period; Choose P for the new matching if the other chose P in the previous period
- Choose K for the new matching if both made the same choice (both chose K or both chose P) in the previous period; otherwise choose P
- Choose P for the new matching if in X consecutive periods either the others or myself chose P; otherwise Choose K
- Choose P for the new matching if the others chose P in all of the previous X periods; otherwise Choose K
- Start by choosing K and do so until one of the others or myself chooses P, in that case Choose P for X rounds. After that go back to the start

Submit

Survey

Please answer the following questions.

How confident are you about your answers in the first part regarding the questions that can give you 50 additional ECUs?

When you chose which decision a participant should make in the first part, what was the most important criterion for your answers?

- Maximization of the group's profit
- Equality of individual profits
- Justice
- Maximization of individual profit
- Ethics
- Equity

Next

Survey

Please answer the following questions.

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? (in cents)

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? (in minutes)

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? (in days)

Next

Survey

Please answer the following questions.

What is your age?

What is your gender?

- Male
- Female

Do you have any brothers or sisters?

- Yes
- No

Please write a word of more than 7 letters?

Are you a student?

- Yes
- No

Discipline studied (currently or when you were a student)?

- Economics-Management
- Law
- Political Science
- Psychology
- Other social sciences
- Mathematics
- Sciences
- Others

What is your level of education or equivalent?

- Before High School
- High School
- Bachelor
- Master
- PhD
- Others

Generally speaking, would you say that most people are trustworthy or that yo

- I do not know
- You can never be too careful
- Most people are trustworthy

Next

C Classification of the menu of strategies

Menu of strategies	Final strategies
Choose K in every period	Always cooperate
Choose P in every period	Always defect
Choose K for X periods, then choose P until the end	Always defect if X<10 Always cooperate if $X \geq 10$
Choose K X% of the time and P 1-X% of the time	Always defect if X<50 Always cooperate if $X \geq 50$
Choose K for the new matching if both always chose K in the previous periods; otherwise choose P	Grim-trigger
Choose K for the new matching if the other chose K in the previous period; Choose P for the new matching if the other chose P in the previous period	Tit-for-Tat
Choose K for the new matching if both made the same choice (both chose K or both chose P) in the previous period; otherwise choose P	Tit-for-Tat
Choose P for the new matching if in X consecutive periods either the others or myself chose P; otherwise choose K	Tit-for-Tat
Choose P for the new matching if the others chose P in all the previous X periods; otherwise choose K	Tit-for-Tat
Start by choosing K and do so until one of the others or myself chooses P, in that case choose P for X rounds. After that go back to the start	Tit-for-Tat if X<5 Grim-trigger if $X \geq 5$

Table 11: Classification of the menu of strategies

D Descriptive statistics

D.1 Normative beliefs

	Beliefs about a participant of type:		
	L	H	Average
Equal tr.			
Equal-L	0.78	-	0.78
Equal-H	-	0.78	0.78
Average Equal	*0.78*	*0.78*	**0.78**
Unequal-E tr.			
Unequal-E Participant L	0.56	0.62	0.59
Unequal-E Participant H	0.62	0.72	0.67
Average Unequal-E	*0.59*	*0.67*	**0.63**
Unequal-U tr.			
Unequal-U Participant L	0.68	0.48	0.58
Unequal-U Participant H	0.49	0.66	0.58
Average Unequal-U	*0.59*	*0.57*	**0.58**

Table 12: Share of participants who believe that the decision a participant should make is to cooperate (first-order normative beliefs)

	Beliefs about a participant of type:		
	L	H	Average
Equal tr.			
Equal-L	0.72	-	**0.72**
Unequal-E tr.			
Unequal-E Type L	0.65	0.65	0.65
Unequal-E Type H	0.61	0.60	0.61
Average Unequal-E	*0.63*	*0.62*	**0.63**
Unequal-U tr.			
Unequal-U Type L	0.65	0.59	0.62
Unequal-U Type H	0.56	0.57	0.57
Average Unequal-U	*0.61*	*0.58*	**0.59**

Table 13: Share of participants who believe that low-endowed participants believe that the decision a participant should make is to cooperate (second-order normative beliefs for low-endowed participants)

	Beliefs about a participant of type:		
	L	H	Average
Equal tr.			
Equal-H	-	0.77	**0.77**
Unequal-E tr.			
Unequal-E Type L	0.63	0.62	0.63
Unequal-E Type H	0.62	0.67	0.64
Average Unequal-E	*0.63*	*0.64*	**0.63**
Unequal-U tr.			
Unequal-U Type L	0.60	0.61	0.60
Unequal-U Type H	0.53	0.65	0.59
Average Unequal-U	*0.57*	*0.63*	**0.60**

Table 14: Share of participants who believe that high-endowed participants believe that the decision a participant should make is to cooperate (second-order normative beliefs for high-endowed participants)

D.2 Descriptive beliefs

Type of other participant:	L	H	All
Equal-L	0.68	-	0.68
Equal-H	-	0.65	0.65
Average Equal	*0.68*	*0.65*	**0.66**
Unequal-E Type L	0.64	0.62	0.63
Unequal-E Type H	0.63	0.64	0.63
Average Unequal-E	*0.63*	*0.63*	**0.63**
Unequal-U Type L	0.57	0.59	0.58
Unequal-U Type H	0.53	0.60	0.56
Average Unequal-U	*0.55*	*0.60*	**0.57**

Table 15: Descriptive beliefs

D.3 Decisions in period 1

Type of the other participant:	L	H	Average
Equal-L	0.7	-	0.7
Equal-H	-	0.78	0.78
Average Equal	*0.7*	*0.78*	**0.74**
Unequal-E Type L	0.66	0.7	0.68
Unequal-E Type H	0.68	0.64	0.66
Average Unequal-E	*0.67*	*0.67*	**0.67**
Unequal-U Type L	0.62	0.62	0.62
Unequal-U Type H	0.72	0.62	0.67
Average Unequal-U	*0.67*	*0.62*	**0.65**

Table 16: Decision to cooperate in period 1

D.4 Conditional decisions in period 2

In period 1 if the other participant:	Cooperates			Defects		
Type of the other participant:	L	H	Average	L	H	Average
If cooperates in period 1						
Equal-L	0.8	-	0.8	0.63	-	0.63
Equal-H	-	0.74	0.74	-	0.72	0.72
Average Equal	*0.8*	*0.74*	**0.77**	*0.63*	*0.72*	**0.68**
Unequal-E Type L	0.70	0.83	0.76	0.55	0.66	0.60
Unequal-E Type H	0.79	0.72	0.76	0.85	0.72	0.79
Average Unequal-E	*0.75*	*0.78*	**0.76**	*0.70*	*0.69*	**0.69**
Unequal-U Type L	0.84	0.55	0.69	0.65	0.65	0.65
Unequal-U Type H	0.69	0.71	0.70	0.61	0.65	0.63
Average Unequal-U	*0.76*	*0.63*	**0.70**	*0.63*	*0.65*	**0.64**
If defects in period 1						
Equal-L	0.53	-	0.53	0.33	-	0.33
Equal-H	-	0.45	0.45	-	0.73	0.73
Average Equal	*0.53*	*0.45*	**0.5**	*0.33*	*0.73*	**0.5**
Unequal-E Type L	0.41	0.33	0.38	0.47	0.13	0.31
Unequal-E Type H	0.31	0.22	0.26	0.44	0.11	0.26
Average Unequal-E	*0.36*	*0.27*	**0.32**	*0.45*	*0.12*	**0.29**
Unequal-U Type L	0.53	0.37	0.45	0.21	0.26	0.24
Unequal-U Type H	0.14	0.42	0.30	0.14	0.32	0.24
Average Unequal-U	*0.36*	*0.39*	**0.38**	*0.18*	*0.0.29*	**0.24**

Table 17: Conditional decision to cooperate in period 2

D.5 Memory-one strategies

Strategy:				
Participant past choice	Cooperate	Cooperate	Defect	Defect
Playmate past choice	Cooperate	Defect	Cooperate	Defect
Equal-D tr.	88%	48%	68%	48%
Equal-A tr.	88%	44%	72%	52%
Unequal-Egalitarian tr.	81%	42.5%	57%	43%
Unequal-Proportional tr.	79%	48.5%	50%	43%
Average	*81.6%*	*45.6%*	*56.8%*	*44.4%*

Table 18: Distribution of Memory-one strategies

D.6 Menu of strategies

Strategy:	AC	AD	Grim	TFT
Equal-D tr.	48%	18%	14%	20%
Equal-A tr.	54%	4%	8%	34%
Unequal-Egalitarian tr.	34%	23.5%	14.5%	28%
Unequal-Proportional tr.	33%	23.5%	9%	34.5%
Average	*37%*	*21%*	*11.6%*	*30.4%*

Table 19: Distribution of strategies in the menu of strategies