The Context Determines Who Leads: Cooperative Initiative through Pre-Play Communication in One-Shot Games

Pablo Hernandez-Lagos*

This version: February 2015

Abstract

This paper considers two games, a stag hunt and a prisoners' dilemma. Each game features non-binding, costless, and free-form pre-play communication. I focus on players who verbally first suggest cooperation in each game. I study experimentally whether the frequency of verbal initiative-taking for cooperation varies across games and whether initiative-taking induces cooperation in each game. In the stag hunt, I find that initiative-taking is ubiquitous and initiators cooperate more often than non-initiators. In the prisoners' dilemma, initiative-taking is less frequent relative to the stag hunt and initiators cooperate remarkably more often than non-initiators. In this case, initiators who cooperate are also more altruistic, averse to lying, and believe others are likely to cooperate compared to initiators who defect. Thus, initiating a suggestion to cooperate signals propensity to cooperate even when monetary incentives encourage defection. Moreover, optimistic and intrinsically motivated initiators are essential in attaining mutual cooperation when the best response is to defect from it.

JEL: C9, D8, C7.

Keywords: Cooperation, Communication, Leadership.

*Assistant Professor of Economics New York University Abu Dhabi; pablo.hernandez@nyu.edu. I am grateful to Ernesto Dal Bó, John Morgan, Rui de Figueiredo, Steven Tadelis and Noam Yuchtman for their support. I am also indebted to Cameron Anderson, Juan Atal, Roland Bénabou, Olivier Bochet, José Guajardo, Shachar Kariv, Dylan Minor, Don Moore, Denis Nekipelov, Salvatore Nunnari, Anisa Shyti, Dana Sisak, Daniel Snow, Joel Sobel, Mike Toffel, Santiago Truffa, Felix Várdy, Richard Wang, Leeat Yariv and participants in the Oliver E. Williamson Seminar (Berkeley-Haas), the Institutions & Innovation Conference (HBS), the 2012 ESA meeting (NYU), and 2014 CESS (NYU) for comments and discussions. I gratefully acknowledge financial support from Xlab grant IRB #2011-11-3772.

1 Introduction

The decision to speak first responds to the underlying strategic context. The peace talks to end the Korean War serve as an example. In August 10, 1951, US Admiral Charles Turner Joy and North Korean General Nam Il waited in silence, staring at each other, for 2 hours and 11 minutes for the counterpart to first suggest a path of action regarding the 38th parallel as line of demarcation between North and South Korea (United States Department of State, 1983). Even though most observers expected a rapid agreement on this and other issues, talks (and consequently war) extended for more than two years. Both, the opportunistic incentives the US faced if North Korea would have agreed to cooperate and withdraw their armed forces to the 38th parallel, and the opportunistic incentives North Korea faced if it would have been allowed to keep its military positions beyond the 38th parallel, partly explain the stalemate (Xia, 2006; Matray, 2011/2012).

This paper studies the effect of the underlying game on the decision to take the initiative and on subsequent actions.[1] The experimental design consists of a baseline condition in which individuals play a stag hunt simultaneously, but have the chance to communicate through a message window ("chat box") for a fixed period of time before doing so. The stag hunt serves as a baseline because there is little tension between first suggesting cooperation and following through. The treatment condition is a prisoners' dilemma with pre-play communication. This prisoners' dilemma differs from the stag hunt only in the payoffs for unilateral defection. The tension between the efficient outcome and individual incentives in the prisoners' dilemma undermines the effectiveness of verbal initiative suggesting cooperation. My design allows game partners 30 seconds preceding the start of the game to send non-binding, costless, and free-form on-line messages through a chat box, and initiators are identified by any such messages that first suggest cooperation. Communication ends when actual play begins.

The literature covering the effect of communication on cooperation is vast. We know little, however, about the influence of strategic context on the messages individuals decide to send, in particular initiating a suggestion to cooperate, and about which messages relate to actual cooperation.[2] Does the frequency of initiative vary with strategic context? Does initiative signal propensity to cooperate or is it irrelevant? Are such initiatives more relevant in particular strategic contexts? And if so, who are the initiators who cooperate?

[1] Van Vugt (2006) points out that taking the initiative is one of the most salient aspects of leadership, which he defines as "a process of influence to attain mutual goals" (p. 355). Other aspects of leadership he highlights are: cognitive and non-cognitive (social) intelligence, emphasizing good communication skills; competency in a specific domain; and generosity and fairness. In the present stylized setting, I incorporate communication and other-regarding concerns to advance the economic analysis of leadership.

[2] Exceptions are Dale and Morgan (2010), and Dal Bó and Dal Bó (2014).

In this paper, I take a direct approach to answer those questions. In a broad outline, the experiment records individuals' pre-play messages and subsequent actions in each game. By comparing the frequency of verbal initiative-taking for cooperation across games, I can determine whether the underlying strategic context determines the incidence of initiative. By observing cooperation rates by players who first suggest cooperation, I can determine whether initiative signals propensity to cooperate. By comparing cooperation rates conditional on initiative across games, I am able to assess whether the relationship between words and deeds depends on the strategic environment. And finally, by measuring individual attributes of initiators who cooperate across contexts, I can assess the extent to which they possess different characteristics.

I find the frequency of initiative depends on the underlying game. In the stag hunt, 93% of the groups feature an individual taking the initiative, while in the prisoners' dilemma this proportion is 76%. We find, however, that although 90% of those who first suggest cooperation also cooperate in the stag hunt, only half of those who initiate end up cooperating in the prisoners' dilemma. In other words, half of the initiators are truthful, while the other half suggest cooperation deceitfully.

In any case, those who decide to take the initiative cooperate significantly more often than those who do not, with the greatest differential in the prisoners' dilemma. In the stag hunt, initiators cooperate roughly 30% more often than non-initiators. In the prisoners' dilemma, initiators cooperate 60% more often. Moreover, with repeated play (each time with an unknown and different partner) the rate of cooperation conditional on initiative rises in the stag hunt and it declines, but remains positive, in the prisoners' dilemma. As anonymity among participants is assured, reputation concerns do not play a role in this outcome. Hence, the decreasing but positive rate of cooperation conditional on initiative in the prisoners' dilemma is explained by individual heterogeneity in the disposition to initiate and cooperate. I find that those who first suggest cooperation and actually cooperate are different from those who initiate and defect only in the prisoners' dilemma; they are more altruistic, averse to lying and optimistic about others' cooperation than are non-initiators. Altruism is the idea that initiators value other people's payoffs and lying aversion reflects a cost associated with breaking one's word. Thus, this aspect of truthful leadership—taking the initiative to suggest cooperation and actually cooperate—does not hinge on a universal attribute; rather, it reflects an interplay between individual characteristics, beliefs and context.[3]

This paper considers initiators' non-pecuniary motivations for two reasons. First, under standard preferences, pre-play communication is fruitless in prisoners' dilemma situations. Initiative-

[3] I estimate altruism using a method borrowed from Andreoni and Miller (2002) and use Gneezy's (2005) method to elicit lying-aversion. I also perform a battery of tests to measure a host of characteristics that have been found to be indicative of initiative and cooperation.

taking through speech, therefore, should be of no use. However, there exists enough evidence in the literature that communication fosters cooperation even in these situations. Second, altruism provides incentives to cooperate when payoffs favor defection. As a result, altruism coupled with lying-aversion, may render verbal initiative credible. Thus, the heart of the study is to place subjects in pairs where they have an opportunity to take the initiative through a chat box, perhaps advocating for cooperation, and decide whether to cooperate in the simultaneous play.

The rest of the paper is divided as follows. Section 2 provides a literature review on leadership and communication relevant to this study. In Section 3, I describe the experimental design, in Section 4 the hypotheses, and in Section 5 the results. Section 6 shows a discussion and Section 7 concludes.

2 Literature

Economics has shown an increasing interest in initiative-taking, especially the variety known as leading by example. Hermalin (1998) shows that exogenously imposed leaders can alleviate the free-rider problem in a public-good game through leading by example, that is, by signaling private information about the value of the good. Hermalin's theory has been applied in a number of studies.[4] Overall, these papers find mixed evidence on the role of leaders in signaling reciprocity and triggering it in non-leaders.

Economists have also devoted attention to endogenous leading by example—leadership by those without pre-imposed authority. Some papers have compared contributions to a public good arising from exogenously imposed versus endogenously emerging leaders and have found a higher level of contribution when leaders emerge endogenously.[5] These results highlight the importance of endogenous leading by example for coping with the free-rider problem, even in the absence of private information.

Given the documented importance of endogenously emerged leaders by example in public goods games, scholars have also investigated those leaders' traits. Bruttel and Fischbacher (2010) find that they are characterized by generosity, strong preferences for efficiency, above-average cognitive skills, internal locus of control and patience. Arbak and Villeval (2013), using a two stage public goods experiment with endogenous timing, find leaders are more altruistic and concerned about their social image.[6] Similarly, Préget, Nguyen-Van and Willinger (2012) find that leadership

[4]Meidinger and Villeval (2002), Güth, Levati, Sutter and van der Heijden (2006), Potters, Sefton and Vesterlund (2007), Moxnes and van der Heijden (2007) and Gätcher and Renner (2006).

[5]For example, Potters, Sefton and Vesterlund (2005), Haigner and Wakolbinger (2010) and Rivas and Sutter (2011).

[6]The authors elicited generosity by asking individuals to give a portion of their show-up fee to a charity, and

emergence is pervasive and conditional cooperators are more likely to emerge as leaders. In short, these studies find that leaders often have preferences for giving and efficiency.

Apart from public-good settings and other situations that pose a dilemma to individuals, leadership has been found by researchers from several different fields to be important in situations that require coordination. In political science, for instance, Calvert (1992) argues that leaders are needed, invented, and accepted as solvers of coordination problems. In social psychology, Van Vugt (2006) and others have noted that leadership evolves as the dominant channel through which groups cope with coordination problems. In economics, the role of leaders as coordinators was first addressed theoretically in Kreps (1990), which posits leaders as coordinators in the presence of multiple equilibria (see Hermalin, 2012a). Foss (2001), however, argues that more needs to be done in economics to understand leadership in coordination games.

Overall, the empirical literature has focused on leading by example in the context of public good (dilemma) games but has not paid special attention to the role of context in conditioning leadership.[7] This paper contributes to the literature in that it investigates initiators' behavior and attributes when the strategic context (rewards to unilateral defection) varies exogenously between a prisoners' dilemma game and a stag hunt (a coordination game).

This paper also studies initiative-taking through communication, perhaps the most pervasive channel through which to exert influence. Extant theory of pre-play communication considers it a "device" by which individuals can coordinate in some (correlated) equilibrium (Forges 1986, Barany 1992) of a given normal-form game. The theoretical literature provides an account of how communication can extend the set of equilibrium outcomes, and it successfully explains coordination when it constitutes an equilibrium. It fails, however, to explain the common observation of cooperation in social dilemmas. In effect, experimental studies both of social dilemmas and of coordination games deliver robust findings that pre-play communication increases the frequency of the efficient outcome.[8] Alignment of incentives makes coordination through communication a reasonable explanation in coordination games. In social dilemmas, scholars have proposed behavioral explanations in line with altruism and lying-aversion to explain the success of pre-play communication.

Altruism may lead to cooperation even in the absence of communication. Kreps, Milgrom, Roberts and Wilson (1982), for example, provide a theoretical explanation for cooperation in

---

personality traits through the Big 5 personality test (John, Naumann and Soto 2008).

[7]Context has been considered to be crucial in effective leadership, e.g., Fiedler (1994) and Rotemberg and Saloner (1993).

[8]For social dilemmas, see, for example, Ledyard (1994); Sally (1995); Cooper, DeJong, Forsythe and Ross (1996); Crawford (1998); and Bochet, Page and Putterman (2006). For coordination games, see Cooper, DeJong, Forsythe and Ross (1992); and Brandts, Cooper and Weber (2011).

a finitely repeated prisoners' dilemma based on the existence of individuals who enjoy a non-monetary gain when mutual cooperation occurs. Andreoni and Miller (1993) label this non-monetary gain "reciprocal altruism" and find support for the theory in Kreps et al. (1982) using an experimental procedure.[9]

In terms of lying-aversion, Ellingsen and Johannesson (2004) aim to explain, among other things, why communication enhances outcomes by developing a model that assumes preferences for equality and the assessment of a fixed cost for being caught lying. Gneezy (2005) argues that individuals may also experience an internal (intrinsic) cost of lying. In his experimental design, Gneezy asks individuals to send, at their option, a truthful or a deceitful message to another person about two possible splits of a pie; he then asks them to play a dictator game with the same options in the message. He finds that a considerable proportion of his sample sent a truthful message in the first exercise but chose the selfish allocation in the dictator game, suggesting they experienced some intrinsic cost of lying.[10] The present paper contributes to this literature by relying on altruism and lying-aversion to explain initiative-taking in the prisoners' dilemma.

In sum, the contribution of this paper to the literature is twofold. First, as noted earlier, it examines initiative-taking and cooperation in different strategic contexts—a prisoners' dilemma and a stag hunt. Second, it explores the characteristics of those who initiate and cooperate. This study thus contributes by providing evidence of a suspected but seldom explored determinant of mutual cooperation: Leadership by initiative-taking through communication.

3 Experimental Procedure

The heart of the design consists of varying the underlying context for potential initiative-taking and to randomly match individuals into groups. The experiment consists of two main treatments of three sessions each and two secondary treatments of two sessions each. The difference between the main and the secondary treatments is that pre-play communication in the form of on-line

[9] Bolton and Ockenfels (2000) provides a model based on other regarding preferences (that imbeds a taste for reciprocity and for fairness) to explain the positive correlation between wage offers and subsequent effort found in the literature (among other non-standard economic behavior). Moreover, Fischbacher, Gächter and Fehr (2001) find evidence that 50% of their subjects are conditional cooperators in a public goods game. In sum, cooperation in social dilemmas has been found experimentally even without communication (Andreoni and Miller 1993; Cooper et al. 1996).

[10] In this paper we assume individuals have an intrinsic cost of lying. The literature, has explored the nature of that cost. Charness and Dufwenberg (2006), for example, provide a mechanism through which guilt aversion leads individuals to reciprocate in a trust game: individuals face a cost if they believe they are letting others down. Similarly, Miettinen and Suetens (2008) measure guilt (through self-reported emotional reaction) when individuals do not honor their word in social dilemma games with pre-play communication. The authors find that their measure of guilt is positively correlated with cooperation in a prisoners' dilemma game.

1\2	**D**efect	**C**ooperate
Defect	4, 4	**8**, 0
Cooperate	0, **8**	9, 9

1. SH

1\2	**D**efect	**C**ooperate
Defect	4, 4	**14**, 0
Cooperate	0, **14**	9, 9

2. PD

Table 1: Games in the Stag Hunt and Prisoners' Dilemma

messaging is allowed in the former but not in the latter. The written instructions for the experiment (Appendix A) were given to the participants and read aloud before the session began. Participants were not allowed to interact with the experimenter, except to ask questions immediately after the instructions were read and before the experimental tasks began. The experimental currency was the Berkeley Buck ($) and the rate of exchange with the U.S. dollar is 12 Berkeley Bucks per dollar. This section describes the procedure to elicit the relevant behaviors and characteristics.

The procedure is designed to elicit initiative-taking by first suggesting cooperation as well as actual cooperation. It is also intended to ascertain proxies for non-pecuniary motivations such as altruism and lying aversion, as well as beliefs about overall cooperation (Hereafter "optimism"). Standard traits such as risk aversion, the "Big 5," internal locus of control, cognitive reflection and demographics are also elicited.

3.1 Initiative and cooperation

Initiative and cooperation are elicited from the two main treatment conditions (144 subjects in total, 72 in each treatment). In the baseline treatment subjects play a stag hunt with pre-play communication ("SH"); in they play a prisoners' dilemma with pre-play communication ("PD"). The secondary treatments (96 subjects in total, 48 in each treatment) are the same as the main treatments except that they are conducted with no pre-play.

At the beginning of each main treatment, participants see a display of the game's payoff matrix (Table 1, panel 1, for SH; and Table 1, panel 2, for PD). On the left side of each display is the chat box, which is an on-line messaging window (chat-box) through which subjects may communicate for 30 seconds prior to making choices. Once the 30 seconds elapse, both subjects are again directed to a display containing the payoff matrix, but now they have to simultaneously choose whether to defect or cooperate without the opportunity to exchange messages.[11]

The messaging portion of the design records any verbal initiatives, and the results of the

[11] I label A the Defect option and B the Cooperate option. Also, I do not randomize the order of these options as presented to subjects to make sure they are familiarized with the meaning of each option in case they want to communicate intentions to play to the other individual. Figure 7 in the Appendix C shows the screen shots corresponding to this section.

subsequent play portion indicate the verbal initiatives' effectiveness (or lack thereof). The proxy for a cooperative initiative comes from the first message that suggests mutual cooperation. For instance, messages such as "We both should choose B," "B and B," or "Shall we both go B" (in which B is cooperation) are all coded as taking the initiative. If the first message is irrelevant (such as "Hi"), or suggests defection, it is not coded as taking the initiative. An initial message suggesting defection occurs 1% of the time in the SH treatment and 6% of the time in the PD treatment. Finally, when both players suggest cooperation and their messages occur within 3 seconds of one another, both are coded as taking the initiative. Roughly, 15% of the games exhibited simultaneous initiative. I coded cooperation by each individual if they decide to play B in both games.[12]

I also record the instances in which an individual agrees to the initiator's suggestion. After an individual takes the initiative, the matched partner can either reply by agreeing to the suggestion to cooperate, or not (say nothing, say something unrelated to cooperation or suggest defection). Among those instances in which a subject faces a partner taking the initiative, 73% agree in the SH and 69% in the PD (Pearson's chi-squared p-value = 0.18). In the main treatments, subjects' interaction has immediate payoff consequences and feedback. The treatment is fixed over each session. This process is repeated 12 times, each time with a different stranger selected with a rotation matching protocol (see e.g. Cooper, DeJong, Forsythe, and Ross 1996).[13]

In the secondary treatments, the procedure for this part is exactly the same, except that individuals do not have the opportunity to chat in any of the 12 interactions. All the following experimental procedures were the same for all treatments.

3.2 Optimism

I elicit "optimism" by asking subjects to state the number of participant that they expect will cooperate in a one-shot prisoners' dilemma ("OSPD"), played before the main treatments. (see the instructions for Block 2, Appendix A). The OSPD is played before the main treatments, and participants receive no feedback about their performance until the end of the experiment (so participants cannot condition their actions in the main games on the outcomes in the OSPD).[14] Beliefs about overall cooperation are used as a proxy for optimism that serves to correlate with the decision to take the initiative and cooperate in the games in Table 1. This procedure allows the

[12] Dialogs and coding are available upon request.

[13] The rotation matching protocol consists of dividing participants in each session into two groups and then matches each subject in one group with one subject in the other group without repetition. This ensures that any pair of subjects are matched at most once and that one subject is not matched with a participant in her own group.

[14] With this procedure, I elicit a statistic for the median of the number of participants who would cooperate. In theory, a risk neutral agent i chooses y to maximize

proxy for optimism to vary and to capture individuals' beliefs about overall cooperation, rather than beliefs about the cooperation of one particular partner.

3.3 Characteristics

I elicit unconditional social preferences ("altruism") among participants of the SH and PD using a series of dictator games by separately issuing each subject 10 tokens and asking each to decide how many to keep and how many, if any, to give to a partner; the partner is randomly matched to the subject at the end of the experiment (see the instructions for Block 1, Appendix A). The exercise is conducted four times, with the value of each unit kept (X) remaining at 1 Berkeley Buck, and the Berkeley Buck value of each unit passed (Y) varying across iterations: (1.25, 1.00, 0.67 and 2.00).[15] Subjects that keep all the tokens in each iteration are categorized as selfish; otherwise the subject is non-selfish. Roughly 20% of the subjects were classified as perfectly selfish.[16]

I elicit a measure of participants' lying-aversion from the interaction of the results from a pair of related two-option games similar to those in Gneezy (2005). In the first version of the game (see the instructions for Block 2, Appendix A; and Figure 6, top panel, Appendix B), subjects face two options featuring different divisions of 20 Berkeley Bucks: Keep 15 and give 5 to the other participant, or keep 5 and give 15 to the other participant. Subjects then choose one of two designated advice messages—one untruthful and one truthful—to send to the other participant. The untruthful message reads "Option 1 will earn you more money than Option 2"; the truthful message reads "Option 2 will earn you more money than Option 1." The other participant does

$$8 - \sum_{n=1}^{23} |y-n| p_i(n)$$

where $p_i(n)$ is the probability (belief) agent i assigns to n participants cooperating. The optimal choice $y^* = median_i(n)$. Therefore, y^* gives us information about the individual $i's$ beliefs, $p_i(n)$, about overall cooperation.

[15]The exact text presented in the computer screen was:

> Divide 10 tokens. Allocate a number of tokens to yourself (hold) and a number of tokens to the other participant (pass).
>
> A token is worth $X to you and $Y to the other participant. Please choose a division (total 10 tokens).
>
> Hold (1 token = $X):____
> Pass (1 token = $Y):____

[16]This revealed preference elicitation procedure was introduced by Andreoni and Miller (2002) and subsequently extended by Fisman, Kariv and Markovits (2007). Andreoni and Miller (2002), found 23% of their subjects can be classified as perfectly selfish and Fisman et al. (2007) found that was the case for 26% of their sample.

not know which option corresponds to which set of payoffs and must simply decide whether to believe the message received, choosing option 1 or 2 accordingly.[17]

I also ask the subjects in this game to guess the probability that their matched partner will follow their advice. This permits us to distinguish between untruthful messages intended to deceive and those that are untruthful messages intended to counteract the partner's belief that the advice is deceitful, which I label as "white lies".

However, this procedure potentially confounds lying-aversion with altruism. A sufficiently altruistic subject who is not lying averse may still send a truthful message purely out of a desire to be generous. Therefore, following Gneezy (2005), I implement a non-strategic (dictator) version of the first game to untangle lying-aversion and altruism (see instructions for Block 3; and Figure 6, bottom panel, Appendix B). Here, every subject gives "advice" to a computer, which follows it with the same probability that, in the first game, the subject predicted for the other participant. However, subjects do not know that the probability in the second version is going to be the same as the probability guessed by the subject in the first version; they are told only that the computer will execute their decision with some probability. Since lying to a computer does not carry the same moral stigma as lying to another person, choices in this round should purely reflect the extent to which altruism is present.

Thus, individuals are classified as lying-averse if (1) in the first version of the game, they send a truthful message and declare that the other participant would follow it with at least a 50% chance, and (2) in the second version, they choose the selfish option. Moreover, I also classify as lying averse those who send a white lie in the first version (that is, send an untruthful message with the expectation that it would be implemented with a less than 50% chance), and, in the second version, choose the selfish option. Subjects who, in the first version of the game, send either the truthful message or a "white lie" and in the second version choose the altruistic outcome are categorized as not lying-averse. In the SH treatment 28 of 72 (39%) participants are coded as lying-averse. In the PD treatment 22 of 72 (31%) are coded as lying-averse by this criterion (Pearson chi-squared

[17]Subjects face two options featuring different divisions of $20. The options are: Option 1) keep $15 to herself and give $5 to the other participant or Option 2) keep $5 to herself and give $15 to the other participant. Subjects are asked to send a pre-codified message to another subject, who do not know which option corresponds to which set of payoffs. Participants could send a deceitful message reading "Option 1) will earn you [the subject the message was intended for] more money than Option 2);" or they could send a truthful message reading "Option 2) will earn you [the subject the message was intended for] more money than Option 1)." We randomize the order of Option 1) and Option 2) and use colors (Blue and Red) instead of numbers (Option Blue instead of Option 1), etc.) to avoid mechanical decisions. Participants are anonymously matched in pairs at the end of the experiment. Subjects are told the message will be delivered to another randomly matched participant at that time, and the amount of money they both will get depends on this other subject's decision. As a result, each subject received the payout from her decision after observing the matched participant's message and the payout from the matched participant's decision after reading her message.

p-value=0.29).

I also use questionnaires to measure intelligence (Cognitive Reflection Test, CRT, Frederick 2005), risk aversion (Holt and Laury 2002), the Big 5 personality traits (John, Naumann and Soto 2008), Internal Locus of Control test (Rotter 1966) and basic demographics (gender, major and ethnicity). Of these tests, only Risk Aversion is incentivized. The goal of these questionnaires is to elicit traits that have been found relevant to leadership in the social psychology literature and to link them to initiative and cooperation in our setting.

Altruism and lying aversion (Blocks 1 through 3) are elicited before the main treatments take place, and the questionnaires and tests are conducted after the treatments. I ran 10 sessions in total (six sessions with communication and four sessions without communication) from April 2012 to April 2013 at the Xlab of the University of California, Berkeley. The participants consisted of 240 UC Berkeley students from the Xlab subject pool. Sessions lasted approximately one hour, and payoffs averaged 16 US dollars. Each participant took part in only one session. All treatments were programmed and conducted using z-Tree (Fischbacher 2007). I sought to ensure anonymity throughout the experiment,. Participants were separated in workstations, and no communication took place except through the pre-play on-line messaging that was allowed for 30 seconds in each round of the main treatments. Table 2 provides a summary of the variables just described across treatments.

	Chat SH N	Chat SH mean	Chat PD N	Chat PD mean	t-test p	NoChat SH N	NoChat SH mean	NoChat PD N	NoChat PD mean	t-test p
CHARACTERISTICS										
Lying Aversion ∈{0,1}	72	0.39	72	0.31	0.30	48	0.42	48	0.40	0.84
Selfish	72	0.17	72	0.24	0.30	48	0.63	48	0.65	0.83
InternalLocusofControl	72	6.61	72	6.56	0.89	48	6.69	48	6.75	0.90
Extraversion	72	3.15	72	3.14	0.93	48	3.11	48	3.20	0.58
Agreeableness	72	3.66	72	3.60	0.55	48	3.68	48	3.55	0.33
Conscientiousness	72	3.42	72	3.51	0.37	48	3.44	48	3.59	0.20
Neuroticism	72	2.90	72	2.90	0.98	48	2.92	48	2.85	0.63
Openness	72	3.55	72	3.48	0.50	48	3.57	48	3.58	0.96
ScoreCRT	72	1.42	72	1.42	1.00	48	1.79	48	1.38	0.07
RiskAversion	65	3.29	69	3.39	0.59	45	2.87	45	3.13	0.21
female	70	0.71	69	0.67	0.55	46	0.48	45	0.56	0.47
Asian	72	0.68	72	0.63	0.49	48	0.60	48	0.63	0.84
White	72	0.18	72	0.22	0.54	48	0.27	48	0.21	0.48
OtherEthnicity	72	0.14	72	0.15	0.81	48	0.13	48	0.17	0.57
OPTIMISM AND BEHAVIOR										
Optimism (others cooperate)	864	0.44	864	0.41	0.01	576	0.34	576	0.32	0.19
Initiate	864	0.57	864	0.42	0.00	-	-	-	-	-
Cooperate	864	0.82	864	0.38	0.00	576	0.23	576	0.10	0.00

Table 2: Summary statistics.

4 Hypotheses

This paper focuses on initiative taking rather than communication as a whole.[18] It is intended to explore whether the strategic context affects the prevalence of initiative and cooperation and whether the characteristics of those who initiate and cooperate differ from those who initiate and defect in each context. Under purely monetary concerns, in the SH cooperation is a best response to cooperation. With communication, it may be a good strategy for any individual to state her intention to cooperate to incite her partner's cooperation. Such statements may help make this equilibrium focal.[19] Following this reasoning we should expect that an initiator exists in every group, that anyone who initiates also cooperates, and that every non-initiator who faces a leader cooperates in the SH.

This behavior reflects purely monetary concerns, but behavior consistent with non-monetary concerns is commonly observed in these games. I measure altruism and lying-aversion to test if they relate to initiative and cooperation across games. In the SH, having other-regarding concerns does not change the fact that cooperation is a best response to cooperation. To see this, consider the payoffs in panel 1 in Table 1. Let us also consider the simple version of the Charness and Rabin (2002) model of social preferences yo illustrate the argument. In that model, the utility of player 2 is given by $u_2(\pi_1, \pi_2) = w_1\pi_1 + (1 - w_1)\pi_2$, where π_i, $i = 1, 2$, represents monetary payoffs and w_1 the weight player 2 assigns to player 1's payoffs.

Using this model in the SH payoff matrix, if player 1 cooperates, player 2's utility is 9, if

[18]The extant theory addresses the effect of pre-play communication as a whole, rather than the endogenous sequence of messages. Pre-play communication offers the opportunity for players to jointly condition their actions on the messages exchanged rather than choosing their actions independently (Forges 1986). In other words, communication may make the set of correlated equilibria accessible to players. In a correlated equilibrium an external mediator or "correlation device" selects a profile of actions according to an equilibrium distribution, and informs each player only its corresponding equilibrium action. In two person games, however, the scope of communication is limited (Urbano and Vila, 2003). One of the most important results is Barany (1992). He shows that only a subset of correlated equilibrium outcomes of the normal form game coincides with the Nash equilibrium of an extended game with costless pre-play communication. In the games presented in this paper, these coincide with the convex combination of the pure strategy Nash equilibria in the one-shot game under purely pecuniary payoffs. That is, in the SH, both mutual defection and mutual cooperation can occur; in the PD, only mutual defection is predicted to happen.In Appendix D, I characterize these equilibria. Moreover, the sequence of messages, the identity of the communicator, and the particular arguments used are of no particular consequence either. Communication merely serves to partially replace a public randomizing device. Indeed, if a sufficiently rich set of such devices were available, communication would be irrelevant.

[19]Initiative taking and following through is, therefore, an equilibrium outcome in this game. Evidence that participants in laboratory experiments behave this way come from Charness (2000), Charness and Dufwenberg (2006) and Blume and Ortmann (2007). Aumann's conjecture (Aumann 1990), however, states that communication may not be used as a coordination device in this case because both players strictly prefer the other player to cooperate. An individual who decided to defect before sending the message will try to induce the other to cooperate anyways. Charness (2000) tests this conjecture and finds evidence against Aumann's conjecture: When communication precedes payoff relevant actions, individuals coordinate very often in the pareto-dominant outcome.

player 1 defects, player 2's utility is $(1 - w_1) \times 8 < 9$ (provided $w_1 \geq -1/8$).[20] As a result, we should expect anyone taking the initiative (to make cooperation focal) and following through in this setting, so lying-aversion should not change behavior relative to purely monetary concerns in the SH either.

Altruism and lying aversion, however, should play a role in the PD. Consider now the payoffs in the PD treatment from panel 2 in Table 1. In the PD, defection is the best response to cooperation under purely monetary concerns. Under Charness and Rabin's utility specification, however, cooperation is a best response to cooperation for a sufficiently altruistic player i, i.e. $w_j \geq 5/14$. If this is the case, we expect altruistic individuals to cooperate no matter what the other player does.

In this framework, initiative may be used by altruist and selfish participants to incite their partner too cooperate. As we should expect altruistic initiators follow through their verbal initiative, we should also expect selfish initiators try to exhort others deceitfully. The difference between a truthful and a deceitful initiator is that lying for the former is never a problem, because she plans to adhere to her word anyway. For the latter, however, lying might be a problem if lying is costly. As a result, we should observe that individuals who are selfish to abstain from initiating if lying is costly for them, but to initiating and subsequently defecting if lying is not a problem for them.

From this reasoning, I state four hypotheses. First, every group features someone taking the initiative suggesting cooperation in the SH, while only some of them do (every group except those in which both members are selfish and lying averse) in the PD. Second, every initiator cooperates in the SH, while only some of them do so in the PD. Third, only altruist initiators cooperate in the PD. Fourth, initiators cooperate more often than non-initiators only in the PD.

Now we turn to the experimental results.

5 Experimental results

The results concerning the main treatments are followed by those concerning all the treatments together.

[20]Charness and Rabin (2002) model also allows for $w_1 < -1/8$ (individuals have a preference for hurting their partners). Hence, $w_1 \geq -1/8$ seems to be a plausible assumption given our experiment ensures full anonymity and consists of one-shot interactions among strangers.

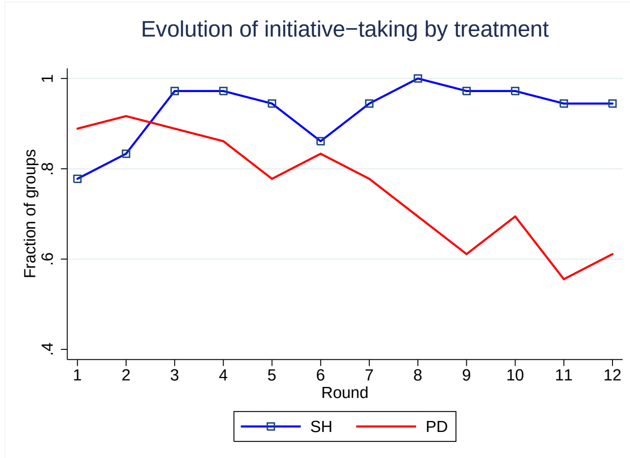


Figure 1: Fraction of groups in which at least one subject takes the initiative.

5.1 Initiative and cooperation in SH and PD

In both games, individuals frequently take the initiative to encourage others towards mutual cooperation. Initiative, however, is significantly more pervasive when there is no extra benefit for defecting when the other player cooperates. In the SH, at least one individual initiated in 93% of the pairings (401 out of 432), while in 76% of the pairings (328 out of 432) some one did so in the PD treatment. Treating each decision as an independent observation, a chi-square test rejects the null hypothesis of no treatment effect (chi-squared p-value < 0.01). Figure 1 shows this difference across treatments is explained by decreasing rates of initiative in the PD. This provides evidence consistent with our first hypothesis.

At the individual level, participants take initiative encouraging the other player to cooperate 57% of the time in the SH. Raising the rewards for defection when the other cooperates dampens this impulse considerably. Subjects take initiative proposing cooperation only 42% of the time (if treating each observation as independent, chi-squared p-value < 0.01). Are initiators different in terms of optimism, altruism and lying aversion across games? Considering each observation as independent for the sake of exposition, initiators are more optimistic only in the PD, and they are no different from non-initiators according to altruism and lying-aversion in neither of the games. This is, in the SH, the distribution of optimism is no statistically different between initiators and non-initiators (Kolmogorov-Smirnov equality of distribution test p-value $= 0.3$, means are 44% for initiators and 45% for non-initiators). In the PD, the distributions of optimism across initiators and non-initiators are statistically different (Kolmogorov-Smirnov equality of distribution test p-value < 0.01, means are 45% for initiators and 38% for non-initiators). In terms of altruism, 42% of the initiators are altruistic and 45% of the non-initiators in the SH (chi squared p-value $= 0.5$).

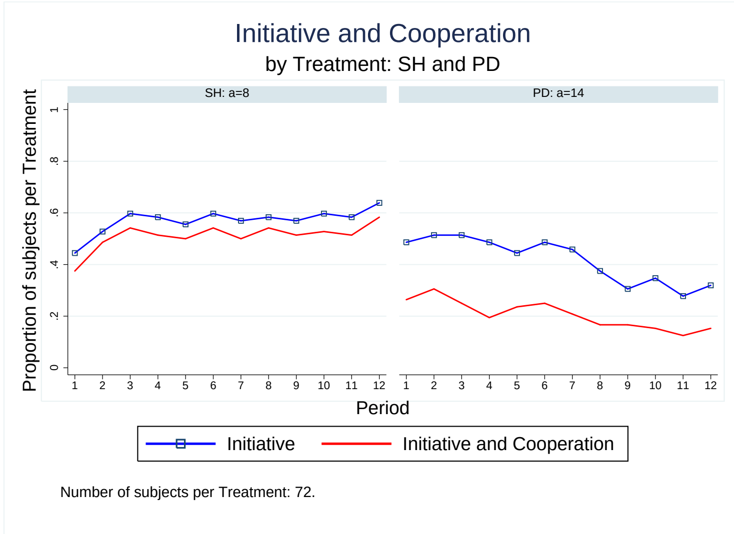


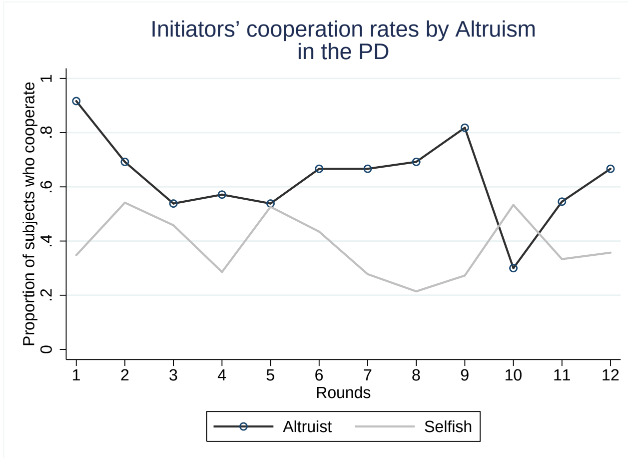
Figure 2: Rates of initiative taking and cooperation across period by treatment.

The equivalent proportions are 45% and 40% in the PD (chi squared p-value = 0.2). In terms of lying-aversion, 38% of the initiators are altruistic and 40% of the non-initiators in the SH (chi squared p-value = 0.4), and the equivalent proportions are 32% and 30% in the PD (chi squared p-value = 0.5).

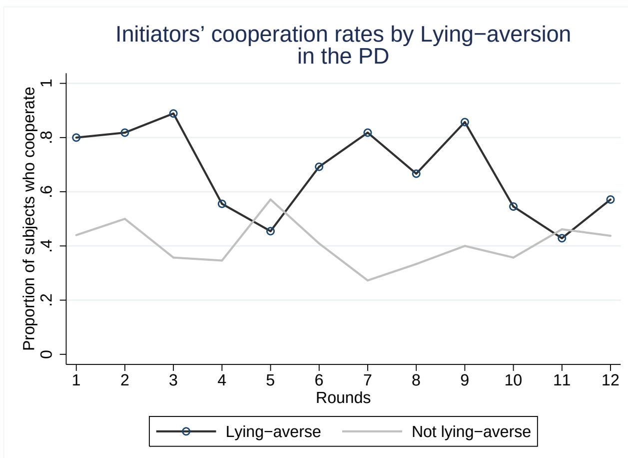
Initiative is only important if it is related to cooperation. Our second hypothesis states that, by making cooperation focal, every initiator in SH should cooperate, but some should defect in the PD. The data is consistent with this. Figure 2 shows the rates of initiative and cooperation across rounds by treatment. Although not everyone takes the initiative in the SH an immense majority of the initiators cooperate, 90% , while in the PD 49% of them do so (treating each observation as independent, chi-squared p-value < 0.01).

Regarding our third hypothesis (only altruist initiators cooperate in the PD): Is there any difference in terms of altruism between those initiators who cooperate and those who defect?

Initiators who end up cooperating are more altruistic (and lying-averse as well as more optimistic) than those who end up defecting. Figures 3 show the proportion of subjects who cooperate after taking the initiative. Panel a. shows the fraction of altruistic subjects who cooperate after taking initiative and the fraction of selfish subjects who do so after initiative. For all the rounds, except for one (round 10), a higher proportion of altruists initiators than selfish initiators ends up cooperating. This is consistent with our third hypothesis. Treating each decision as an independent observation, the difference is highly significant: 64% of altruists vs 40% of selfish (chi squared p-value < 0.01). Panel b. shows the fraction of lying-averse subjects who cooperate after taking the initiative. The pattern is similar: For all the rounds, except for two (rounds 5 and 11),



a. Altruism



b. Lying-aversion

Figure 3: Rates of initiative taking and cooperation by treatment for altruistic initiators (panel a.) and for lying-averse initiators (panel b.).

a higher proportion of lying-averse initiators than not lying-averse initiators ends up cooperating. Treating each decision as an independent observation the difference is highly significant: 68% of lying-averse vs 41% of not lying averse (chi squared p-value < 0.01).

I estimate a linear probability model clustering standard errors at the subject level, for the subsample of initiators to examine the these variables together. The dependent variable is cooperation and the explanatory variables are optimism, altruism and lying-aversion. Table 3 shows the results for both treatments for completeness. The first three columns feature the regression of cooperation on these characteristics for initiators in the SH. I find no significant correlation between characteristics and cooperation. On the contrary, these characteristics positively correlate

	(1) SH Cooperate	(2) SH Cooperate	(3) SH Cooperate	(4) PD Cooperate	(5) PD Cooperate	(6) PD Cooperate
Optimism	0.06	0.06	0.06	0.19***	0.18***	0.18***
	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)	(0.087)
Altruism		0.00	0.00		0.18*	0.13
		(0.06)	(0.06)		(0.09)	(0.09)
Lying-aversion			-0.01			0.20**
			(0.06)			(0.10)
_cons	0.86***	0.86***	0.86***	0.41***	0.34***	0.29***
	(0.04)	(0.04)	(0.05)	(0.06)	(0.07)	(0.07)
N	493	493	493	361	361	361
R^2(overall)	0.004	0.004	0.005	0.08	0.11	0.13

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$,
***$p < 0.01$

Table 3: Cooperation for those who take the initiative as a function of optimism, altruism and lying-aversion.

to cooperation among initiators in the PD. From column (4) optimism is significantly correlated to cooperation (on average, 10% increase in beliefs about cooperation is related to 1.8% increase in cooperation rates). From column (5) altruists individuals are also 18% more likely to cooperate if they initiate even controlling for optimism, although the relation is statistically weak. Finally, from column (6) lying-averse individuals are 20% more likely to cooperate provided they initiated, even when controlling for optimism and altruism.

It is worth noting that initiators' altruism is correlated to cooperation only in the PD when considered in isolation. When we control for beliefs about overall cooperation and lying-aversion, altruism is no longer significantly correlated to cooperation in this case.

The next section shows the data that is used to test our second hypothesis that, among non-initiators, everyone who faces an initiator cooperates in the SH; and those who face an initiator, and are optimistic and altruistic do so in the PD.

5.2 No initiative and cooperation in SH and PD

From Figure 4 we can observe that a greater proportion of non-initiators cooperate in the SH relative to the PD: 71% in SH versus 30% in PD on average (chi-squared p-value < 0.01). Are optimism, altruism and lying aversion associated to non-initiators' cooperation?

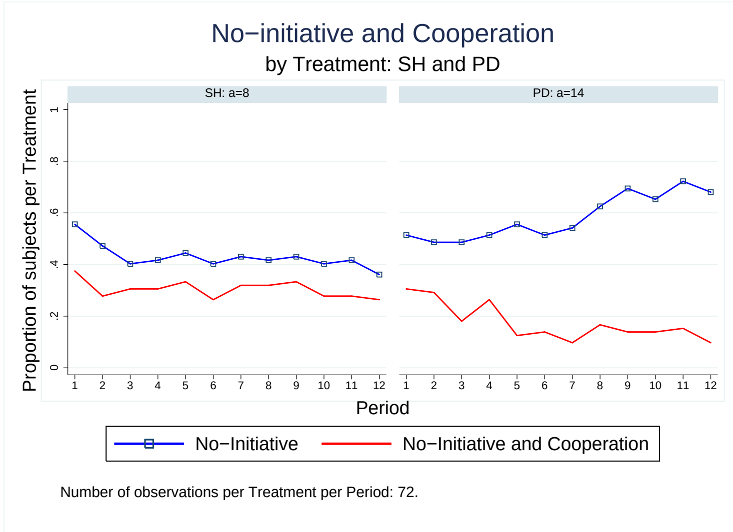


Figure 4: Rates of cooperation among no-initiators.

	$I_{-i} = 0$			$I_{-i} = 1$					
Treatment	Selfish	Altruistic	χ^2	Selfish	Altruistic	χ^2	$I_{-i} = 0$	$I_{-i} = 1$	χ^2
SH	18/32	10/30	3.28*	118/174	117/135	14.8***	28/62	235/309	23.9***
	56%	33%		68%	87%		45%	76%	
PD	8/116	14/92	3.8*	58/161	71/134	8.5***	22/208	129/295	63.8***
	7%	15%		36%	53%		11%	44%	

Note: $I_{-i} = 0$ and $I_{-i} = 1$ denote other player's no initiative and initiative, respectively. Pearson's χ^2 statistic.$**p < 0.05$ and $***p < 0.01$.

Table 4: Cooperation rates of non-initiators by partner's initiative and own altruism.

Initiative taking increases the chances the partner cooperates. Pooling observations together, among non-initiators', cooperation rates rise from 45% to 76% in the SH (chi-squared p-value $<$ 0.01) and from 11% to 44% in the PD (chi-squared p-value < 0.01) when the partner initiates. Conditional on the partner taking the initiative, non-initiators cooperate more often in the SH than in the PD (76% compared to 44%, chi-squared p-value < 0.01). Thus, also among those who experience partner's initiative, altruists cooperate more often in both games. 87% of non-initiators who are altruists cooperate, but 68% of selfish do so in the SH. The equivalent rates are 53% and 36% in the PD. Treating each decision as an independent observation, both chi-squared p-values are less than 0.01. Table 4 summarizes these results.

Taken together with the evidence in the previous section, these results show that initiators cooperate more in both games—not only in the PD. In the SH, Initiators cooperate 90% of the time, while non initiators do so 71% of the time. In the PD, the equivalent proportions are 49%

and 30% respectively. Although it is true initiators cooperate more often in the PD, which is consistent with our fourth hypothesis, initiators also cooperate more often in the SH.

In the next section we exploit the random allocation of participants into groups to study mutual cooperation. I explore whether groups comprised of intrinsically motivated partners cooperate more often than groups composed of individuals only motivated by pecuniary gains.

5.3 Initiative and mutual cooperation

As expected, mutual cooperation is more frequent in the SH than in the PD treatment. Groups cooperate in 70% (303 out of 432) of the interactions in the SH treatment. In the PD treatment, this occurs in 20% (87 out of 432) of the time (chi-squared p-value < 0.01). In the SH, when an initiator emerges, 74% (297 out of 401) of the groups end up with mutual cooperation, but only 19% (6 out of 31) when no one initiates (chi-squared p-value < 0.01). In the PD, the equivalent proportions are 26% (86 out of 328) and 1% (1 out of 104) respectively (chi-squared p-value < 0.01). Initiative increases cooperation regardless of the rewards for unilateral defection. Thus, initiative-taking is almost a necessary condition for mutual cooperation when incentives work against it (as in the PD).

We have seen there is an interplay between internal motivations and incentives when it comes to take the initiative and cooperate. Are groups formed by altruists more likely to achieve mutual cooperation? By exploiting the random matching between subjects, we are able to observe how group composition determines initiative-taking and cooperation at the group level. Figure 5 shows that initiative-taking and cooperation are pervasive regardless of group composition in the SH (panel (A)). Group composition reflects cooperation: Groups containing at least one reciprocal-altruistic member initiate and cooperate more often in the PD (panel (B)).

Table 5 shows the estimate of the probability to reach mutual cooperation as a function of at least someone taking the initiative and group composition. The underlying model is $Pr\{Cooperate_j\} = \Phi(\beta_0 + \beta_1 \mathbf{1}[Initiative_j = 1] + \sum_k \beta_k \mathbf{1}[Composition_j = k])$, where j denotes group and k denotes group composition:

$$k \in \Big\{ [(S,S)\&(S,S)]\,, [(S,LA)\&(S,S)]\,, ..., [(A,LA)\&(A,LA)] \Big\},$$

with A representing "altruism," S representing "selfish," LA representing "lying-aversion," and NLA representing "not lying aversion." In the SH, initiative is highly related to cooperation as well as groups with one altruistic lying-averse individual and one selfish and not lying averse individual, while in the PD, group initiative and composition are highly related to cooperation. In

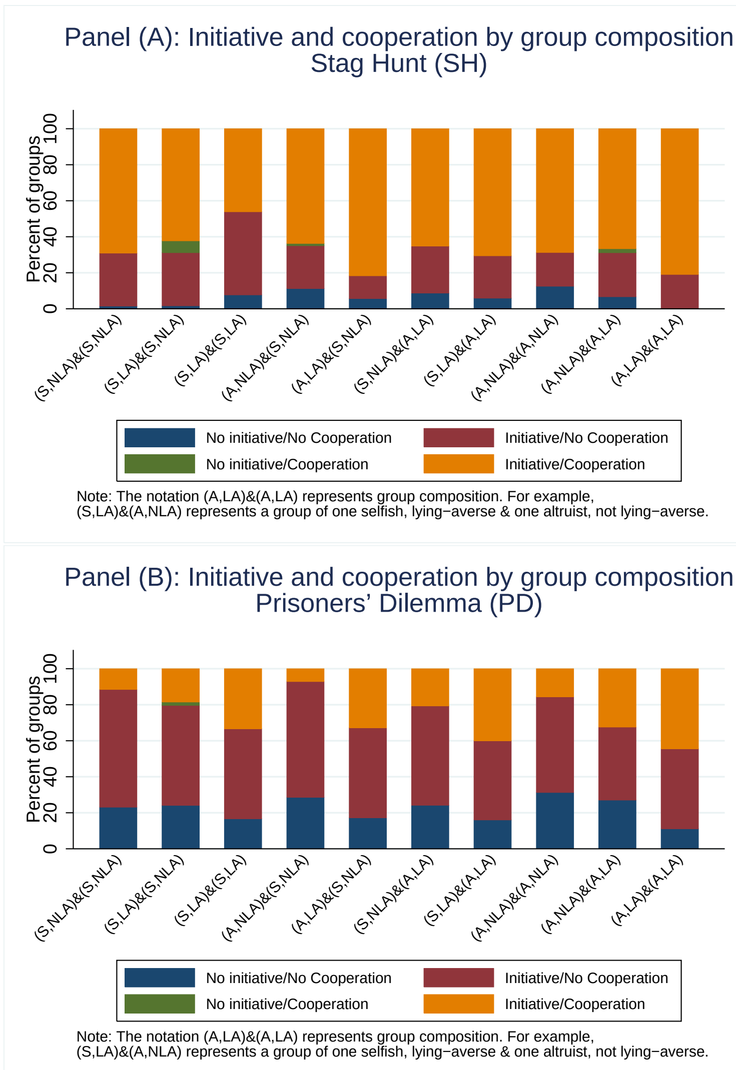


Figure 5: Outcomes by group composition.

particular, the existence of at least one altruistic lying-averse member is positively and significantly associated to cooperation in the PD, even controlling for the presence of an initiator.

Overall, these results give support to our third hypothesis that, in the SH, group composition in terms of altruism and lying-aversion is not related to mutual cooperation, while in the PD these two characteristics correlate to mutual cooperation.

Taken together, our results highlight the importance of considering initiative in context rather as an abstract quality to be called upon (or not) in all situations. Leaders were rarer in the high rewards for unilateral defection scheme (i.e. PD). Leaders also differ in their characteristics depending on the situation. All in all, leadership proves effective in inducing mutual cooperation.

5.4 No Communication

The last set of results shows that when communication is not allowed, mutual cooperation decreases. In the SH treatment without communication, 23% (131 of 576) of the time individuals cooperate (with communication this proportion is 82%). Cooperation occurs only in 10% of the individual decisions in the PD treatment without communication (the proportion with communication is 39%). In both treatments, cooperation rarely occurs without communication.

Table 6 presents evidence to support this result. The first columns in panel a. and b. replicate the results for the SH and PD treatments with communication. The second columns show the results for the treatments without communication. In the SH game, mutual cooperation decreases from 70% with chat to 5%; in the PD treatment, mutual cooperation decreases from 23% to 1% (chi-square p-value < 0.01 for each of both tables).

As expected, these results support the hypothesis that communication facilitates (and is almost a necessary condition for) mutual cooperation in both games. In particular, the SH features the highest rate of cooperation (70%), and the no communication prisoners' dilemma the lowest rate of cooperation (1.4%).

6 Discussion

Initiative-taking is not the only message sent during the communication stage. Non-initiators also send messages, often in the form of agreements. In what follows I explore whether agreement further induces cooperation. I also explore how characteristics such as the Big5 personality traits or gender relate to initiative and cooperation.

	SH Pr{Mutual Cooperation}	PD Pr{Mutual Cooperation}
BothCooperate		
An initiator exists	1.51***	1.74***
	(0.27)	(0.40)
Group Composition		
A : Altruism; S : Selfish;		
LA : Lying − aversion; NLA : Not lying − averse		
(S,LA) & (S,NLA)	0.11	0.47*
	(0.23)	(0.28)
(S,LA) & (S,LA)	-0.54	0.77
	(0.39)	(0.59)
(A,NLA) & (S,NLA)	0.05	-0.24
	(0.22)	(0.28)
(A,LA) & (S,NLA)	0.51**	0.76***
	(0.24)	(0.26)
(A,NLA) & (S,LA)	-0.00	0.42
	(0.32)	(0.34)
(S,LA) & (A,LA)	0.11	0.96***
	(0.28)	(0.33)
(A,NLA) & (A,NLA)	0.17	0.28
	(0.39)	(0.35)
(A,NLA) & (A,LA)	0.12	0.86***
	(0.26)	(0.31)
(A,LA) & (A,LA)	0.36	1.02**
	(0.35)	(0.48)
_cons	-0.99***	-2.79***
	(0.31)	(0.44)
N	432	432
pseudo R^2	0.089	0.177

Standard errors in parentheses. (0,0) & (0,0) - Base case
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Mutual cooperation as function of at least one individual taking the initiative and group composition.

Cooperate	SH-Chat	SH-NoChat
No one	30 (7%)	172 (60%)
One	99 (23%)	101 (35%)
Both	303 (70%)	15 (5%)

a.

Cooperate	PD-Chat	PD-NoChat
No one	190 (44%)	237 (82.3%)
One	155 (36%)	47 (16.3%)
Both	87 (20%)	4 (1.4%)

b.

Table 6: Cooperation with and without communication, by treatment

6.1 Initiative, agreement and cooperation

In both treatments, those who take the initiative cooperate more often than those who do not, and in the PD, they cooperate even more when they place a non-monetary value on cooperation and honesty. So we have seen initiative carries intention, but what about agreement? Those individuals who are willing to cooperate but reluctant to initiate, may end up cooperating because of someone else's initiative. Thus initiators' leadership gives non-initiators the opportunity to express their disposition to cooperate. In this sense, agreement—just as initiative-taking—may reveal an intention to cooperate by non leaders.

Among non-initiators who face a leading partner, 79% (245 out of 309) agrees in the SH and 72% does so in the PD (212 out of 295). Although small in magnitude, this difference in frequencies is statistically significant at the conventional levels (chi-squared p-value = 0.03). Non-initiators who agree follow through 85% of the time, and those who do not agree do so 42% of the time in the SH (chi-squared p-value < 0.01). We observe the same pattern in the PD: Those who agree cooperate 53% versus 21% (chi-squared p-value < 0.01). Given the importance of agreement, is there any difference in cooperation rates between initiators and non-initiators who agree (or "followers")?

Focusing only on groups with one initiator and an agreeing non-initiator (hereafter "follower"), initiators cooperate significantly more often only in the SH (94% versus 85%, Z test p-value $<$ 0.01). In the PD, those proportions drop to 55% and 53% respectively (Z test p-value = 0.63). This evidence suggests that once the group reaches an agreement, the differences in terms of propensity to cooperate disappear. So why do followers refrain from initiating? Are there any differences in terms of attributes between initiators and followers? I find followers are no more optimistic, altruistic, or lying-averse than initiators in both treatments. In terms of altruism, 45% of initiators in these groups are altruists and 46% of followers (chi-square p-value = 0.84) in the SH. The corresponding proportions are 39% and 44% in the PD (chi-squared p-value = 0.3). In addition, I find no differences in terms of lying aversion. In terms of optimism, I also find no significant differences between leaders and followers. Leaders' optimism is 0.44, and followers' 0.46 in the SH (two sided t-test p-value = 0.3). In the PD leaders' optimism is 0.45, and followers' 0.46 (two sided t-test p-value = 0.9). These evidence suggests there are other characteristics that may be differentiating initiators from followers (non-initiators who agree). I explore some of them in the next section.

	Non Initiator N	Non Initiator mean	Initiator N	Initiator mean	diff.	se	t test p-value
Extraversion	371	3.15	493	3.16	-0.01	0.06	0.82
Agreeableness	371	3.67	493	3.65	0.02	0.04	0.70
Conscientiousness	371	3.43	493	3.40	0.03	0.04	0.46
Neuroticism	371	2.89	493	2.92	-0.03	0.05	0.52
Openness	371	3.62	493	3.50	0.12***	0.04	0.00
RiskAversion	325	3.32	455	3.27	0.04	0.07	0.54
ScoreCRT	371	1.39	493	1.43	-0.04	0.08	0.59
InternalLocusofControl	371	6.88	493	6.41	0.48**	0.16	0.00
female	353	0.67	487	0.75	-0.08*	0.03	0.01
Asian	371	0.61	493	0.73	-0.13***	0.03	0.00
White	371	0.24	493	0.14	0.10***	0.03	0.00
OtherEthnicity	371	0.15	493	0.13	0.02	0.02	0.37
*p¡0.05,**p¡0.01,***p¡0.001							

Table 7: Characteristics by whether individual took the initiative, SH treatment.

6.2 Initiative and other characteristics

The vast literature on leadership contains a myriad of dimensions in which leaders distinguish themselves from the general population. In addition to optimism, altruism, and lying-aversion, this experiment elicits personality traits, and demographics from participants. Table 7 shows the differences in the mean for all these characteristics of initiators and non-initiators for the SH treatment and Table 8 for the PD treatment.

In the SH, initiators are less often white with a low score on the internal locus of control measure. Also in the SH, those who take the initiative are frequently female of Asian ethnicity, with low scores on the openness measure.

In the PD, the pattern is exactly the opposite—initiators are more open, but less likely to be Asian female. Moreover, those who take the initiative tend to be less risk averse. It is worth noting that the Big5 personality traits (Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness) tend to favor initiators only in the PD treatment, although these characteristics are not significant at conventional levels. This counters the findings in the meta-study by Judge et al. (2002) in which leaders tended to be more extroverted.

7 Conclusion

The key insight from these findings is that the rewards for unilateral defection, what I refer to as "context," make an enormous difference in the exercise of truthful initiative taking—which is an important aspect of leadership. One possible rationale for this difference is that leadership is, in a sense, less risky when rewards to unilateral defection are low. Cooperation is in the interest of

	Non Initiator N	Non Initiator mean	Initiator N	Initiator mean	diff.	se	t test p-value
Extraversion	503	3.12	361	3.18	-0.06	0.05	0.29
Agreeableness	503	3.58	361	3.63	-0.06	0.04	0.17
Conscientiousness	503	3.49	361	3.54	-0.05	0.05	0.26
Neuroticism	503	2.92	361	2.87	0.05	0.05	0.29
Openness	503	3.42	361	3.56	-0.14***	0.05	0.00
RiskAversion	480	3.46	348	3.30	0.16*	0.08	0.04
ScoreCRT	503	1.44	361	1.39	0.05	0.08	0.54
InternalLocusofControl	503	6.50	361	6.64	-0.14	0.17	0.41
female	476	0.72	352	0.60	0.12***	0.03	0.00
Asian	503	0.66	361	0.58	0.08*	0.03	0.02
White	503	0.20	361	0.25	-0.06	0.03	0.05
OtherEthnicity	503	0.14	361	0.17	-0.02	0.02	0.35
*p¡0.05,**p¡0.01,***p¡0.001							

Table 8: Characteristics by whether individual took the initiative, PD treatment.

both parties, so "coordinating" to undertake this action is not terribly difficult. The situation is more complicated when incentives to unilaterally defect are high. Cooperation might be proposed by an individual with pure motives, out of sincere desire to cooperate—or not. I find that an overture to cooperate is often genuine when monetary incentives favor mutual cooperation (as in the SH); and when it comes from intrinsically motivated individuals under conditions that favor defection (as in the PD).

One implication of these results is that the importance of proposing first a course of action in negotiations depends on the strategic context. The first message is not irrelevant. It can be used to achieve cooperation even in situations in which monetary payoffs favor opportunistic behavior.

Another implication is that societies (respectively firms) of mutually cooperative individuals are more likely to experience collective demonstrations (respectively change) than those with less mutually cooperative individuals. A special taste for mutual cooperation provides the intrinsic incentives to push for change, a necessary condition for change to occur.

Moreover, in light of these results, it is not surprising that governments seeking to undermine social movements, or companies attempting to hinder innovation, put obstacles on communication, regardless of the current policy of rewards to loyalists in the face of dissent. Communication allows the emergence of intrinsically cooperative leaders who will persuade others to implement change.

Thus, this analysis contributes to unpacking the black box of communication by providing evidence on (1) the interplay of leaders' characteristics and the context in which they emerge and (2) the influence of initiative-taking (and agreement) on mutual cooperation.

References

Andreoni, James and Miller, John H. (1993) ”Rational Cooperation in the Finitely Repeated Prisoner's Dilemma: Experimental Evidence.” *Economic Journal*, May, 103(418), pp.570-85.

Andreoni, James and Miller, John H. (2002) “Giving according to GARP: An experimental test of the consistency of preferences for altruism” *Econometrica*, 70 (2002), pp. 737–753

Arbak, E., & Villeval, M. C. (2013). Voluntary leadership: motivation and influence. Social Choice and Welfare, 40(3), 635-662.

Arrow, K. E. (1974). The limits of organization. The Fels lectures on public policy analysis. W. W. Norton & Company.

Brandts, J., Cooper, D., & Weber, R. (2011). Legitimacy, social distance, and leadership in the turnaround game. Department of Economics, Florida State University Working Paper.

Barany, I. (1992). “Fair Distribution Protocols or How the Players Replace Fortune,” *Mathematics of Operations Research*, 17, 327–340.

Bass, B. M., and Stogdill, R. M. (1990). Handbook of leadership. Theory, Research & Managerial Applications, 3.

Bochet, O., Page, T., & Putterman, L. (2006). Communication and punishment in voluntary contribution experiments. *Journal of Economic Behavior & Organization*, 60(1), 11-26.

Bolton, Gary, and A. Ockenfels, (2000) ”ERC: A Theory of Equity, Reciprocity, and Competition,” *American Economic Review*, XC (2000), 166-193.

Bruttel, L. and Urs Fischbacher, (2010). ”Taking the initiative. What motivates leaders?,” TWI Research Paper Series 61, Thurgauer Wirtschaftsinstitut, Universität Konstanz

Blume, A., & Ortmann, A. (2007). “The effects of costless pre-play communication: Experimental evidence from games with Pareto-ranked equilibria.” *Journal of Economic Theory*, 132(1), 274-290.

Calvert R. L. (1992) Leadership and Its Basis in Problems of Social Coordination. *International Political Science Review / Revue internationale de science politique* , Vol. 13, No. 1, Applications of Political Theory in the Study of Politics. Applications de la théorie politique à l'étude du politique (Jan., 1992), pp. 7-24

Charness, G. (2000). “Self-serving cheap talk: A test of Aumann's conjecture.” *Games and Economic Behavior*, 33(2), 177-194.

Charness G. and M Dufwenberg (2006) “Promises & Partnership” *Econometrica*, 74 (2006), 1579-1601.

Charness, G., & Rabin, M. (2002). Understanding social preferences with simple tests. *Quarterly journal of Economics*, 817-869.

Cooper, R., DeJong, D. V., Forsythe, R., and Ross, T. W. (1992). “Communication in coordination games.” *The Quarterly Journal of Economic*s, 107(2), 739-771.

Cooper, R., DeJong, D. V., Forsythe, R., & Ross, T. W. (1996). “Cooperation without reputation: experimental evidence from prisoner’s dilemma games.” *Games and Economic Behavior*, 12(2), 187-218.

Crawford, V., (1998). A survey of experiments on communication via cheap talk. *Journal of Economic Theory,* 78, 286–298.

Dal Bó, E., and Dal Bó, P. (2014). “Do the right thing:” The effects of moral suasion on cooperation. *Journal of Public Economics*, 117, 28-38.

Dale, D. J., and Morgan, J. (2010). “Silence is golden. Suggested donations in voluntary contribution games,” mimeo University of California, Berkeley.

Ellingsen, T., and M. Johannnesson (2004): “Promises, Threats and Fairness,” *Economic Journal*, 114, 397–420. [1582,1587,1593].

Farrell, J., and Rabin, M. (1996). “Cheap Talk,” *Journal of Economic Perspectives* 10, 103–118.

Fiedler, F. E. (1994) Leadership Experience and Leadership Performance, Alexandria, VA: US Army Research Institute for the Behavioral and Social Sciences

Fischbacher, Urs (2007). ”z-Tree: Zurich toolbox for ready-made economic experiments,” *Experimental Economics*, Springer, vol. 10(2), pages 171-178, June.

Fischbacher, U., Gächter, S., & Fehr, E. (2001). “Are people conditionally cooperative? Evidence from a public goods experiment.” *Economics Letters*, 71(3), 397-404.

Fisman, Raymond, Shachar Kariv, and Daniel Markovits. (2007) ”Individual Preferences for Giving.” *American Economic Review*, 97(5): 1858–1876

Foss N.J. (2001). Leadership, beliefs and coordination: an explorative discussion. *Industrial and Corporate Change*, 10(2): 357–388.

Forges, F. (1988): “Can Sunspots Replace a Mediator?” *Journal of Mathematical Economics*, 17, 347–368.

Frederick, S. (2005), "Cognitive Reflection and Decision Making". *Journal of Economic Perspectives.* Volume 19, Number 4, Fall 2005, pp. 24-42.

Gneezy, (2005) U. "Deception: The role of consequences," *American Economic Review*, March 2005, 384-394.

Gächter S., Nosenzo D., Renner E., Sefton M. (Forthcoming), "Who makes a good leader? Cooperativeness, optimism and leading by example." *Economic Inquiry.* DOI: 10.1111/j.1465-7295.2010.00295.

Gächter, S., Renner, E., (2005) Leading by Example in the Presence of Free Rider Incentives. University of Nottingham, CeDEx Discussion Paper.

Güth, W., Levati, M. V., Sutter, M., & Van Der Heijden, E. (2007). Leading by example with and without exclusion power in voluntary contribution experiments. *Journal of Public Economic*s, 91(5), 1023-1042.

Haigner, S. D., & Wakolbinger, F. (2010). "To lead or not to lead: Endogenous sequencing in public goods games." *Economics Letters*, 108(1), 93-95.

Harbaugh, W. T., Krause, K., & Berry, T. R. (2001). GARP for kids: On the development of rational choice behavior. *American Economic Review*, 91(5), 1539-1545.

Hermalin B. (1998), "Towards an Economic Theory of Leadership: Leading by Example." *American Economic Review*, 8 8(5): 1188-1206.

Hermalin, B. (2012a). "Leadership and Corporate Culture." Forthcoming in R. Gibbons and J. Roberts (eds.), Handbook of Organizational Economics. Princeton, NJ: Princeton University Press.

Holt, Charles A. and Susan K. Laury. (2002). "Risk Aversion and Incentive Effects," *American Economic Review*, 92:5, pp. 1644-55.

John, O. P., Naumann, L. P., and Soto, C. J. (2008) "Paradigm Shift to the Integrative Big-Five Trait Taxonomy: History, Measurement, and Conceptual Issues." In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), Handbook of personality: Theory and research (pp. 114-158). New York, NY: Guilford Press, 2008.

Kreps, D. (1990) "Corporate Culture and Economic Theory," in James Alt and Kenneth Shepsle, eds., Perspectives on Positive Political Economy. New York: Cambridge University Press, pp. 90-143.

Kreps, David M.; Milgrom, Paul; Roberts, John and Wilson, Robert. (1982) "Rational Cooperation in the Finitely Repeated Prisoner's Dilemma." *Journal of Economic Theory*, August, 27(2), pp. 245-52.

Ledyard (1994) Public Goods a Survey of Experimental Research. Kagel and Roth eds. Handbook of experimental economics.

Lewis, H. (1974). Leaders and followers: Some anthropological perspectives. Reading, MA: Addison-Wesley.

Levati, M. V., Sutter, M., & Van der Heijden, E. (2007). Leading by example in a public goods experiment with heterogeneity and incomplete information. Journal of Conflict Resolution, 51(5), 793-818.

Matray, J. I. (2011). Beijing and the Paper Tiger: The Impact of the Korean War on Sino-American Relations. *International Journal of Korean Studies* XV, (1), 160.

Matray, J. I. (2012). Mixed Message: The Korean Armistice Negotiations at Kaesong. *Pacific Historical Review*, 81(2), 221-244

Meidinger, C., Villeval, M.C., (2002). Leadership in Teams: Signaling or Reciprocating? GATE Working Paper, 10-03. Lyon.

Miettinen Topi and Sigrid Suetens (2008). "Communication and Guilt in a Prisoner's Dilemma" *The Journal of Conflict Resolution*, Vol. 52, No. 6 (Dec., 2008), pp. 945-960.

Moxnes, E., van der Heijden, E., (2003). "The Effect of Leadership in a Public Bad Experiment." *Journal of Conflict Resolution*, 47(6), 773-95.

Potters, J., Sefton, M., Vesterlund, L., (2005). "After You - Endogenous Sequencing in Voluntary Contribution Games." *Journal of Public Economics,* 89, 1399-419.

Potters, J., Sefton, M., Vesterlund, L. (2007). "Leading-by-example and signaling in voluntary contribution games: an experimental study." Economic Theory, 33(1), 169-182.

Préget, R., Nguyen-Van, P., & Willinger, M. (2012). Who are the Voluntary Leaders? Experimental Evidence from a Sequential Contribution Game (No. 12-34).

Rivas, M.F., Sutter, M., (2011). "The benefits of voluntary leadership in experimental public good games." *Economics Letters*, 112 (2), 176-8.

Rotemberg, J. J., & Saloner, G. (1993). Leadership style and incentives. Management Science, 39(11), 1299-1318.

Rotter, J.B. (1966). "Generalized expectancies of internal versus external control of reinforcements". *Psychological Monographs*, 80 (609).

Sally, D. (1995) "Conversation and Cooperation in Social Dilemmas: A Meta-Analysis of Experiments from 1958 to 1992," *Rationality and Society*, Jan. 1995, 7(1), pp. 58-92.

Sippel, R. (1997). "An Experiment on the Pure Theory of Consumer's Behavior," The Economic Journal, 107(444), 1431-1444.

Sosik, J. J., Kahai, S. S., & Avolio, B. J. (1998). Transformational leadership and dimensions of creativity: Motivating idea generation in computer-mediated groups. Creativity Research Journal, 11(2), 111-121.

United States Department of State (1983). Matthew B. Ridgway to Joint Chiefs of Staff (JCS), July 26 and 27, 1951, Foreign Relations of the United States (FRUS), 1951, Vol. 7: Korea and China (Washington DC: U.S. Government Printing Office, 1983), pp. 735-37, 739-45

Urbano, A., Vila, J.E., (2002). "Computational complexity and communication: Coordination in two-player games." *Econometrica,* 70, 1893–1927.

Van Vugt, M. (2006). "Evolutionary origins of leadership and followership." *Personality and Social Psychology Review*, 10 (4).

Xia, Y. (2006). Negotiating with the Enemy: US-China Talks during the Cold War, 1949-1972. Indiana University Press

Appendix

A. (For Online Publication) Instructions

This is an experiment in the economics of decision-making. If you follow these simple instructions carefully and make good decisions, you could earn a considerable amount of money. The currency we will use throughout the instructions and the experiment is the Berkeley Buck. We will denote it as "$" and the exchange rate is $ 12 per US$ dollar. Please be aware that we do not expect any particular behavior from you or any other participant.

This session will be divided in 4 blocks, each comprising a series of situations in which you will have to make decisions. In what follows we will describe these blocks in chronological order as they will appear in your computer screen.

In block 1, you will face 4 situations. In each situation you will have to allocate a total of 10 tokens between yourself and another participant. The tokens may have different values in each situation. The other participant will be selected randomly at the end of the experiment. Also, neither you nor the other participant will receive information about each other's identity and about your decision in each situation. The computer will randomly select 1 of the 4 situations (with equal chance) to compute your payout based on your decisions. Symmetrically, at the end of the experiment you will be randomly matched to the decision made by another participant. Thus, you will have two ways of earning money from these situations. The first is from your allocation decision, and the second is from the allocation decision of another randomly matched participant.

Block 2 consists of one situation. You will have to send a message to another participant. This message will be available to the other randomly assigned participant at the end of the experiment. After he/she reads the message in his/her screen, he/she will make a choice. Your payout from this situation depends on the choice of this other participant.

Block 3 consists of one situation. You will have to allocate a sum of money between yourself and another participant. The other participant will be assigned randomly at the end of the experiment. In this situation your allocation may be reversed by the computer with some probability specified in the corresponding screen. Neither you nor the other participant will be told about each other's identity and about your decision. Thus, you will have two ways of earning money from this situation. The first is from your allocation decision (depending on whether is reversed or not), and the second is from the allocation decision of the other randomly matched participant. <STOP READING HERE>

In block 4 you will face 12 situations. Each situation will contain two types of scenarios: a non-interactive and an interactive scenario. In the non-interactive scenario, your decisions will be matched at the end of the experiment. In the interactive scenario your decisions will be matched immediately with a different participant in each round.

In the non-interactive scenario you will choose between playing two alternatives, A or B. The following screen shot shows an example:

[ADD SCREENSHOT OSPD HERE]

Each of these scenarios will feature different combinations of possible payoffs. In every scenario, you will be the Row player so your payoffs are the ones on the left of each cell. Both you and the other participant will have two possible choices. You can choose A or you can choose B. In this example:

• If you both choose A you will both get a payoff of $5.

• If you both choose B you will both get a payoff of $9.

• If you choose A, but the other participant chooses B, you will get a payoff of $15, but the other player will receive $4.

• Likewise, if you choose B, but the other participant chooses A, then you receive $4 and the other participant receives $15.

When choosing your move, you will not know the decision of the other participant. The other participant will not know your decision. For each scenario, your decision will be matched with the decision of another randomly selected participant at the end of the experiment. <STOP READING HERE>

After you decide between A and B, you will have to make a prediction about other participants' decisions. You will have to forecast how many of the other 23 participants in the experiment will choose either A or B in each scenario. You will be rewarded for the accuracy of your predictions. The formula to compute your reward is:

Maximum{0 , 8 – 1 * (Distance Between Your Prediction and Actual Decisions Other Participants)}

To explain the formula, we will focus on the prediction about A (because the prediction about B is 23 minus the Prediction about A). If your prediction coincides with the actual value you will get $8. An amount of $1 will be deducted for each unit above or below the actual number of participants who chose A (or equivalently B). Thus, if your prediction is more than 7 units away from the actual number of participants choosing A, you will receive $0. This calculation will be performed for each of the 12 scenarios. <STOP READING HERE>

From these 12 choices and predictions of each scenario, the computer will randomly select 6 to calculate the payouts. We emphasize that all the decisions described so far will be matched at the end of the experiment, so your actions will not affect the actions of other participants.

In the interactive scenarios, you will be randomly matched with a new participant in each of the 12 scenarios. We call each of these scenarios an Interaction. In each Interaction you will be matched with a different participant, so you will interact with one participant only once. Also, this participant will never be matched with any of the participants you will be matched with.

Each Interaction consists of two screens. In the first screen you will see the payoffs of the game and you may use the chat box on the left to communicate with the participant you are matched with in that Interaction. This screen will be shown for 30 seconds:

[ADD SCREENSHOT OF CHAT HERE]

In the second screen, you will have the opportunity to select your action. There will be no chat and you will have 30 seconds to make your decision. This is an example of a screen shot:

[ADD SCREENSHOT OF SIMULTANEOUS GAME HERE]

After each Interaction you will observe your and the other participants' choice (A or B) as well as your and other participant's payoffs. Your payoff in each Interaction will be based on your decision and the decision of the matched participant you interacted with. Your final payout will be calculated by the computer using 6 randomly selected Interactions (with equal chance) out of the 12. Recall that each situation in this block 4, comprising one non-interactive and one interactive scenario, will be repeated 12 times. <STOP READING HERE>

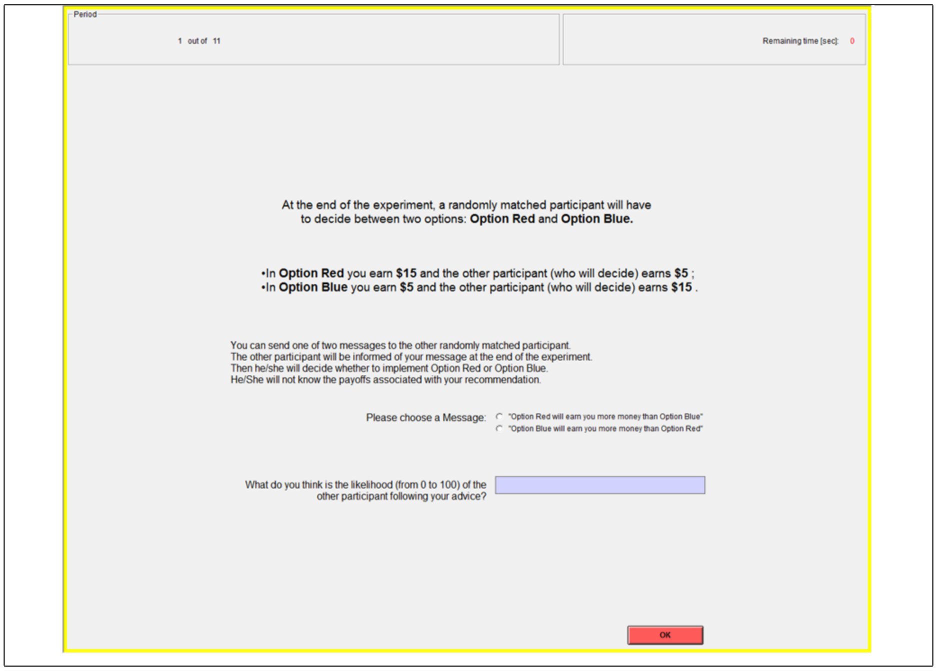
Finally, at the end of the experiment, you will read the message a randomly matched participant sent you, and you will have to make a choice. You will also be given questionnaires that can yield some additional payoffs. After all questionnaires are completed, the computer will match the decisions of all the situations except for the Interactions (which were already matched in each of the 12 scenarios), and final payments will be made to each of you.

Each screen you see throughout the experiment has all the instructions necessary for the decision on that screen. Recall, during the session, all payoffs are expressed in terms of Berkeley Bucks. However, at the end of the session, all of your Berkeley Bucks will be converted at 12 Berkeley Bucks to 1 US$. Thus, in US dollars, your final payment will be between $5 and $30, depending on how you do.

Recall that at no time your true identity nor your final payout will be revealed to the other participants in this experiment.

Thank you very much and good luck!

B. (For Online Publication) Screen shot Lying aversion elicitation



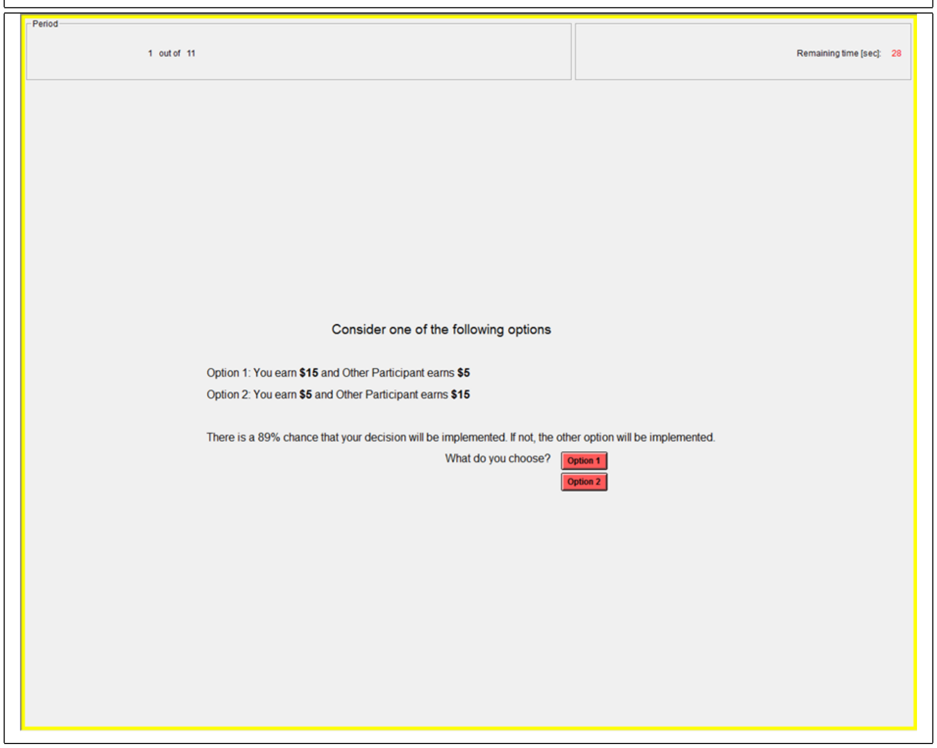
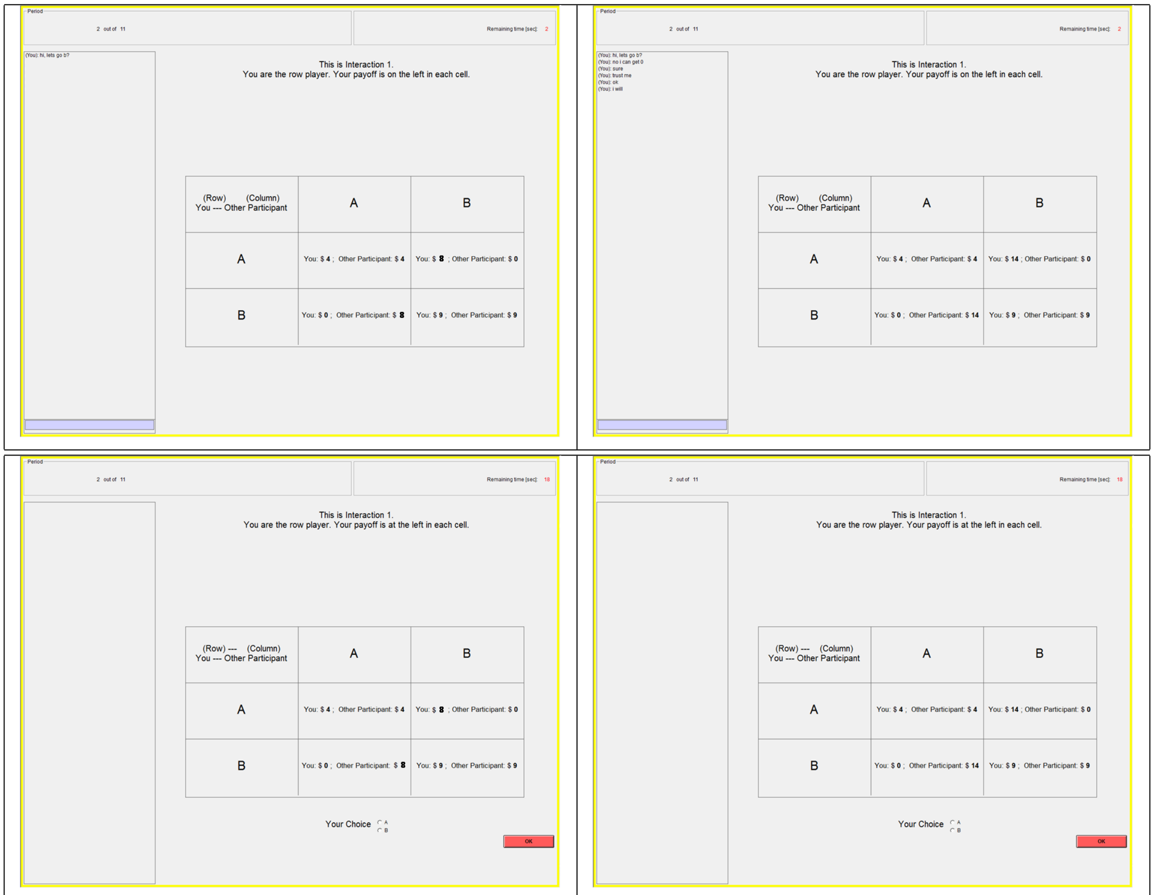


Figure 6: Screen shots lying-aversion elicitation.

C. (For Online Publication) Treatment screen shots



SH	PD

Figure 7: Screen shots, treatments.

D. Equilibrium with pre-play communication and purely monetary payoffs, SH and PD treatments

Proposition 1.

- *In the SH game with pre-play communication:*
  - *The probability of mutual cooperation* (C, C) *is* p *and of mutual defection* (D, D) *is* $1-p$*, with* $p \in [0, 1]$*. Outcomes* (D, C) *and* (C, D) *occur with* 0 *probability.*
  - *Every time player* $i = 1, 2$ *is prescribed to play* C *she plays* C *and when player* i *is prescribed to play* D *she plays* D*.*
- *In the PD game with pre-play communication:*
  - *The probability of mutual defection* (D, D) *is* 1*. Outcomes* (C, C)*,* (D, C) *and* (C, D) *occur with* 0 *probability.*
  - *Player* $i = 1, 2$ *plays defection* D *regardless of what she is prescribed to do.*

Proposition 1 describes the outcomes that can be attained in equilibrium with pre-play communication in the games we study.

In order to prove Proposition 1, we first introduce one useful construct and state and prove two lemmas. In technical terms, the subset of correlated equilibria corresponding to the convex combinations of pure strategy Nash equilibrium in the one shot game is the correlated equilibria in which the underlying distribution is "diagonal." A diagonal distribution means that knowledge of the corresponding action by one player perfectly determines the outcome of the game. We will use this concept, so we define it formally.

Definition 1 (Barany 1992).

In a two player game, let S_1 *and* S_2 *the action space in a normal form game. A distribution* π *is said to be diagonal if for each* $a_1 \in A_1$ *not strictly dominated, there is only one* $a_2 \in A_2$ *with* $\pi(a_1, a_2) > 0$*; and for each* $a_2 \in A_2$ *not strictly dominated, there is only one* $a_1 \in A_1$ *with* $\pi(a_1, a_2) > 0$*.*

A diagonal distribution can also be interpreted as a distribution in which the signals each player receives in a correlated equilibrium are perfectly correlated: conditional on being prescribed by the mediator to play a_i, individual i knows with certainty what individual j is prescribed to do, $i, j = 1, 2$.

In order to apply Barany's result, we need to characterize the subset of correlated equilibria with diagonal distributions for each of our simple games. We will focus on direct mechanisms, in the sense that the set of states correspond to the outcomes of the game (C for Cooperation, D for defection): $S = \{C, D\} \times \{C, D\}$, and the equilibrium partition associated to each individual $i = 1, 2$ is $P_i = \{\{(C, C), (C, D)\}, \{(D, C), (D, D)\}\}$. We first characterize the equilibrium for our SH game.

Lemma 1.

In the SH game without pre-play communication, the correlated equilibria with diagonal distribution is characterized as follows:

1. A probability space (S, π)*, such that* $\pi(C, C) = p$*,* $\pi(D, D) = 1-p$*, and* $\pi(C, D) = \pi(D, C) = 0$*, for* $p \in [0, 1]$.

2. An information partition for each player $i = 1, 2$ $P_i = \{\{(C, C), (C, D)\}, \{(D, C), (D, D)\}\}$.

3. Equilibrium actions for each player $i = 1, 2$*:* $\sigma_i(C, C) = \sigma_i(C, D) = C$ *and* $\sigma_i(D, C) = \sigma_i(D, D) = D$.

Proof. Fix $p \in [0, 1]$. This is a correlated equilibrium because when player 1 observes signal $\{(C, C), (C, D)\}$, the conditional probability player 2 plays C is equal to 1 and the conditional probability player 2 plays D is 0 (the distribution is diagonal, so the signals are perfectly correlated). Player 1's best response is to play C. When player 1 observes signal $\{(D, C), (D, D)\}$, then the conditional probability of player 2 playing C is 0 and the conditional probability of player 2 playing D is 1. Player 1's best response in this case is D. If $p = 0$, then player 1 will be informed only on $\{(D, C), (D, D)\}$, so his best response is D and if $p = 1$ player 1 will only receive the signal corresponding to $\{(C, C), (C, D)\}$, so his best response is C. Similarly for player 2.

The distribution π is diagonal by construction. The only thing we need to check is whether there is another diagonal distribution $\pi' \neq \pi$ for all $p \in [0, 1]$ that is also part of a correlated equilibrium. Let us assume there is one. For $\pi' \neq \pi$ for all $p \in [0, 1]$ to be diagonal, there must be $q \in [0, 1]$ such that $\pi'(C, D) = q$, $\pi'(D, C) = (1 - q)$, and $\pi'(C, C) = \pi'(D, D) = 0$ (that is, only the outcomes on the anti-diagonal occur with positive probability). If that is the case, then the best response of player 1 to the signal $\{(C, C), (C, D)\}$ is D, because the probability that player 2 plays C conditional on the signal prescribing player 1 to play C is equal to 0. This holds for any $q \in (0, 1)$. If $q = 0$, then player 1's best response to signal $\{(D, C), (D, D)\}$ is C instead of D and if $q = 1$, player 1's best response to signal $\{(C, C), (C, D)\}$ is D instead of C. This contradicts the fact π' is part of a correlated equilibrium.□

The next Lemma characterizes the correlated equilibrium with diagonal distribution for our PD game. In this case, only mutual defection obtains.

Lemma 2.

In the PD game without pre-play communication, the correlated equilibria with diagonal distribution is characterized as follows:

1. A probability space (S, π), such that $\pi(D, D) = 1$, and $\pi(C, C) = \pi(C, D) = \pi(D, C) = 0$, for $p \in [0, 1]$.

2. An information partition for each player $i = 1, 2$ $P_i = \{\{(C, C), (C, D)\}, \{(D, C), (D, D)\}\}$.

3. Equilibrium actions for each player $i = 1, 2$ $\sigma_i(C, C) = \sigma_i(C, D) = D$ and $\sigma_i(D, C) = \sigma_i(D, D) = D$.

Proof. This outcome coincides with the Nash equilibrium outcome and any Nash equilibrium is a correlated equilibrium. The distribution π is diagonal by construction. This is the unique correlated equilibrium (with respect to a direct mechanism), therefore is the unique correlated equilibrium (with respect to a direct mechanism) with diagonal distribution.□

Proposition 1.

- *In the SH game with pre-play communication:*
  - *The probability of mutual cooperation (C, C) is p and of mutual defection (D, D) is $1-p$, with $p \in [0, 1]$. Outcomes (D, C) and (C, D) occur with 0 probability.*
  - *Every time player $i = 1, 2$ is prescribed to play C she plays C and when player i is prescribed to play D she plays D.*
- *In the PD game with pre-play communication:*
  - *The probability of mutual defection (D, D) is 1. Outcomes (C, C), (D, C) and (C, D) occur with 0 probability.*
  - *Player $i = 1, 2$ plays defection D regardless of what she is prescribed to do.*

Proof. According to Barany (1992, Theorem 3 and Theorem 6), Lemma 1 implies the result for the SH game with pre-play communication and Lemma 2 the result for the PD game with pre-play communication.□

Notice that pre-play communication in our SH game may yield to any convex combination of the equilibrium outcomes in the one shot game, in particular mutual cooperation. Lemma 2, however, implies that in our PD game pre-play communication cannot yield mutual cooperation.

F. (For Online Publication) Screen shots Risk Aversion test

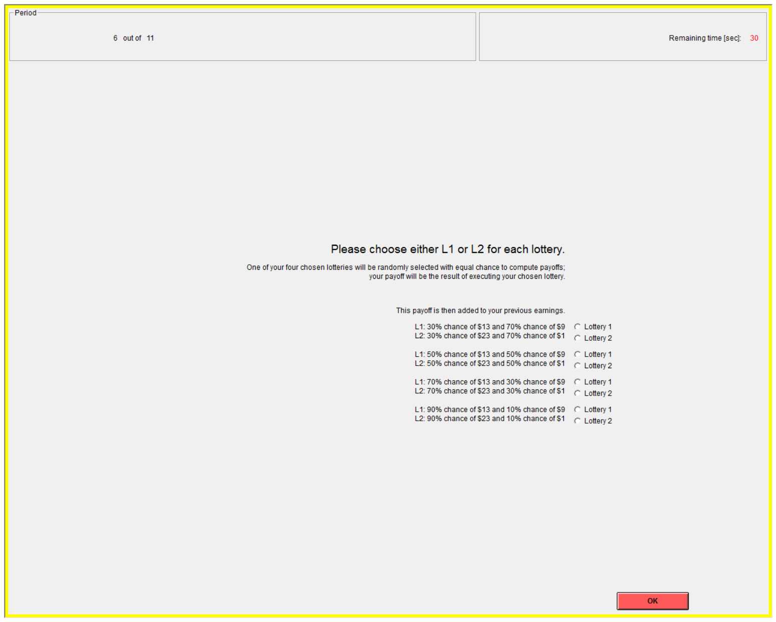


Figure 8: Screen shot, risk-aversion test.