Do subjects contribute more when they can sign binding agreements?

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This version, March 2006

Abstract :

We investigate whether "binding agreements" offer a solution for solving the social dilemma that arises in the presence of pure public goods. A binding agreement is defined as an agreement of agents who agree to contribute a fixed level of their endowment to the provision of the public good. In our setting, the individual level of contribution to the public good in theory increases in the size of the agreement and the complete agreement is always the socially optimal agreement structure. Agreements form sequentially and the equilibrium outcome is an asymmetric structure, which consists of two agreements of which the smaller one forms first. Our experimental results show that the formation of binding agreements frequently leads to inefficient agreement structures, with even a lower performance than at the theoretical equilibrium. We explore two possible explanations for such an unexpected outcome: inequality avoidance and myopic best reply.

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1. **Introduction**

It is a standard result of economic theory that public goods will generally be underprovided even though the socially optimum level of public good would be Pareto superior. In the absence of well-designed incentives, agents try to free ride on the contribution of the others. If this behaviour is widespread in a community of agents, voluntary contributions will generally be insufficient to produce the optimal amount of public goods. However it has been shown in experiments that the outcome might be less dramatic than predicted by the theory.

Experiments on voluntary contributions to a public good have produced robust stylised facts about the average level of contribution and its evolution with repetition. On average subjects contribute a larger share of their endowment to the public good than predicted under the assumptions of rational and selfish behaviour. Yet, most of the available experimental evidence has been obtained for quite particular environments, for which the amount of public good is the output of a linear production technology, i.e. exhibiting constant marginal returns. In particular, public goods games with a unique dominant strategy equilibrium, assume that the amount of public good is a linear function of the total contribution of the group. The standard observation for this type of environment is that the average contribution is about half the endowment in the first period, and declines with the repetition of the game towards the equilibrium level of contribution, though without reaching this level (see Ledyard (1995) for a survey on this literature).

While cooperation appears to be quite strong in the beginning of the game, many subjects seem to be less cooperative over time and even end up free riding completely on the contributions of the others. Individual contribution behaviour appears therefore to be largely determined by the observation of past contributions by other group members as well as their own past contributions. Indeed, a large fraction of subjects appear to contribute conditionally (Keser & van Winden, 2000). Only a few subjects who act unconditionally do not change their behaviour over time, and remain either always cooperative or always free riding. In recent years research has focused on ways to improve or sustain cooperation in public goods games. Fehr & Gächter (2000) made an important step by showing that, if free riding behaviour can be punished, there is a marked increase in the average level of contribution increases strongly. Therefore the threat of individual sanctions, might create sufficient discipline to remove the temptation for agents to free ride.

While this opens an important research avenue, in practice individual contributions are often unobservable. For example, many donators to charities prefer to remain anonymous, a fact that is well accepted. More important is the fact that complete observability of individual contributions might be too costly to be implemented. For example tax evasion cannot be eliminated completely since costly inspections are limited by the authorities' budget constraint. Even in situations where individual contributions are observable at a reasonable cost, punishment is not necessarily feasible. For these reasons it is worth exploring other tools that can improve the level of cooperation and contribution to the public good within a community of agents.

In this paper we investigate a new mechanism that can lead to higher contribution levels in an experimental game of contribution to a pure public good : binding agreements. In contrast to voluntary contributions, under a binding agreement players have to make a commitment to a fixed level of contribution. The commitment can be made by several players who decide to sign an agreement. The international environmental treaties in constitute obvious examples. However, we know that in the case of the negotiation on global warming, there is still a debate opposing the arguments in favour of voluntary contributions from the different countries developed by the United States and the developing countries like China and those in favour of a binding agreement which specifies targets and time table, developed by the European Union.

In this paper we rely on the model of Ray & Vohra (2001), which implies, when the game is symmetric, that all agents who accept to sign an agreement have to contribute the same amount to the public good. Furthermore, this amount increases with the number of agents who sign an agreement. Individual contributions are therefore more costly in large agreements and the total amount of public good provided depends on the structure of agreements. For this reason the social dilemma is not completely eliminated since there is an incentive for small agreements to free ride on larger ones. The underlying game which determines the structure of agreements is an agreement formation game which is played sequentially. At each period of time, one player can propose an agreement involving each of whom would be required to sign. If the proposed agreement is accepted by all (randomly chosen) potential members the agreement is definitely created. If one of the potential members rejects the offer, he will have to make a new proposal. The process continues until each agent belongs to an agreement. Since the individual level of contribution is increasing with the size of the agreement, there is an incentive for players to stay alone, and to free ride on existing agreements. On the other hand, since the amount of public good depends on the size distribution of the agreements, there is an incentive to build up larger groups. There are two extreme structures which could emerge: the complete agreement and the set of singletons. In this setting the complete agreement corresponds to a social optimum in the sense that it leads always to the most efficient outcome. In contrast, the set of singletons leads to the worst social outcome. However, Ray and Vohra show that, at the equilibrium of their game, several agreements can co-exist. Given the parameters we have chosen, the equilibrium structure of agreements is an asymmetric structure with two agreements, in which the smaller group free rides on the larger one. Since the equilibrium structure of agreements differs from the set of singletons, the fact that binding agreements can be made increases the level of cooperation in the population.

We present the result of an experiment whose treatments are very close to Ray and Vohra’s (2001) game of endogenous agreement formation for the provision of a pure public good. It appears that the equilibrium outcome is hardly realized in the experiment. In contrast, most observed agreement structures correspond either to the complete agreement or to a structure that incorporates many singletons. We give two different interpretations of these results: inequality avoidance and myopic best reply.

In section 2 of the paper we present the theoretical background: the extensive game of coalition formation and the payoff function which exhibits positive externalities. We show different ways to solve the game, depending on the rationality of players. We consider two cases: when the players are farsighted and when there are myopic. Section 3 introduces the experimental design of the Veto treatment. Section 4 presents the results. We first consider the coalition structures chosen by the subjects. Then we analyse their proposals, included those which have been rejected. In Section 5 we discuss an additional treatment, called the Dictatorial treatment and compare the results with those obtained in the previous treatment. Section 6 concludes.

2. Theoretical background

2-1 The sequential game of agreement formation

We consider a two-stage model of sequential formation of binding agreements. In a first stage, n identical players have the possibility to sign binding agreements. The outcome is a partition of the set of players. In the second stage of the game, the players voluntary contribute to a public good. The players who have signed the same agreement choose the contributions which maximize the sum of the utilities of the agreement's signatories, given the decision taken by the members of the other agreements.

The first stage of the agreement formation game is drawn from Bloch (1995), (1996) and Ray and Vohra (1999), (2001). They propose a sequential game of agreement formation based on a bargaining game à la Rubinstein (1986) and Stähl (1972). Let N denote a set of players. A protocol designs the order in which the players in N enter into the game to make a proposal or to give an answer to somebody else's proposal. A proposal by player $i \in N$ is an agreement $S \subset N$ to which she belongs and which is characterized by the members' names and a sharing of the agreement's payoff. The agreement can only be formed if the different members have sequentially accepted the proposal. If one member refuses, she has to make another proposal. If they have all accepted, the agreement is formed and the game continues with the players who are not yet in a agreement. Once a agreement is formed it cannot be dismantled; in other words, there is no renegotiation. The outcome is a agreement structure $\pi = (S_1, \ldots, S_m)$, or, in other words, a partition of the set of players, which means that each player belongs to one and only one agreement. Formally, $\forall k, l = 1, \ldots, m,\ k \neq l,\ S_k \cap S_l = \emptyset$.

This game is an extensive form game whose sub-games start each time a player has to make a proposal. Therefore, for each partition of each sub-set of players $T \subset N$, denoted by $B(T)$, and for each player who has to make a proposal $i \in N \backslash T$, we can define a sub-game denoted by $G^i_{B(T)}$. Players in $N \backslash T$, which are not assigned to coalitions yet, are the "active" players in this sub-game: among them, the player i who is going to make a proposal and his potential partners.

When the game is symmetric and the players all identical, the payoff for a given agreement $S_k \subset N$, in a given agreement structure $\pi = (S_1,...,S_m)$, only depends on the number of members of each agreement, element of the structure. Bloch (1996) proved that, in that case, the sequential game of agreement formation is equivalent to a simpler game in which each player designated by the protocol chooses an agreement size which is immediately formed. Indeed, the interests of the player who makes a proposal coincide with those of the partners she chooses and who are in the same position. The outcome of the game is then an ordered sequence of agreement sizes which sum to n, the total number of players. Ray and Vohra (1999) proved that the endogenous sharing rule in each agreement is then the equalitarian sharing of the agreement's payoff.

2.2 Positive externalities

Payoffs are generated in the second stage of the game. Ray and Vohra (2001) refer to a model of pollution control. Think for example that different parties have signed a binding agreement to improve the quality of air. In order to decrease pollution, they have to decrease their production or to adopt new technologies and this is costly. Let z denote the public benefit of control activity pursued by any particular party. Let $c(z)$ be the private cost generated by this control activity. We assume that this cost function is quadratic: $c(z)=(1/2)z^2$. The payoff to a party i is then:

$$u_i(z_1,...,z_n) = \sum_{j=1}^{n} z_j - c(z_i)$$

For a given partition of the set of parties into m binding agreements $\pi = (S_1,...,S_m)$, the signatories of each agreement S_i of size s_i decide the amount of pollution control each member has to produce z_i, given the effort of the other agreements' signatories:

$$\underset{z_i}{Max}\, s_i \left(s_i z_i - c(z_i) + \sum_{\substack{j=1 \\ j \neq i}}^{m} s_j z_j \right)$$

This is a non-cooperative game in which the players are the m binding agreements. At the Nash equilibrium of this game, each party of an agreement of size s_i produces an amount s_i of pollution control and enjoys a payoff:

$$u_i(s_1,\ldots,s_m) = \sum_{j=1}^{m} s_j^2 - \frac{1}{2} s_i^2$$

This payoff function generates positive externalities. This means two things. First, for a given structure of agreements, the members of small agreements get more than the members of large agreements. Secondly, for a given agreement, its signatories are better off if other agreements “merge”. As a consequence, for a given player, the best situation is the agreement structure in which she does not sign any agreement while all the other players sign a unique agreement of size $n - 1$. When the complete agreement is formed, the different players share equally the collective optimum which is $n^3/2$. However, in this situation, each player would prefer not to sign the agreement in order to free ride on the other signatories. Two opposite forces are at stake. Players have an incentive to sign agreements with many signatories in order to efficiently control pollution. In the same time, each player has an incentive to free ride and would prefer the other players to sign the agreement without her participation.

2.3 Farsighted players

If the players are farsighted, as it is assumed in Ray and Vohra (2001), a unique Nash equilibrium of the sequential model of agreement formation is determined by backward induction. Let us again consider the symmetrical case. Ray and Vohra show that the largest agreement signed by all the players does not necessarily form. Furthermore, if several agreements emerge, they appear in size-increasing order. Consider for example, an original set of seven players. At the unique equilibrium, an agreement of two players is signed first, followed by the signature of an agreement of five players. The smaller group "free rides" therefore on the contributions of the larger group.

Let us see how this happens. Players are farsighted and the game is solved by backward induction. The simplicity of the following argument is a consequence of the linearity of the payoff function. Each decision about the size of the agreement to sign does not depend on the agreements already signed, but depends only on the number of players who did not take a decision yet.

Consider a sub-game $G^i_{B(T)}$ such that a structure of agreements *B* has already formed. Then, we denote by g(B) the public good contributed by the agreements in *B*. If there is only one player remaining, $N\backslash T = \{i\}$, of course she forms a singleton and gets: $u_i(B,1) = g(B) + 1/2$. If there are two players left, $N\backslash T = \{i,j\}$, the first player required to take a decision compares two possibilities:

1) Staying alone, in which case her payoff will be $u_i(B, 1,1) = g(B) + 3/2$.
2) Signing an agreement with another player to get $u_i(B, 2) = g(B) + 2$

and she signs an agreement with another player.

If there are three players remaining, the first player who needs to take a decision compares three possibilities:

1) Staying alone and anticipating that the two other players will sign an agreement, in which case her payoff will be $u_i(B, 1,2) = f(B) + 4,5$.
2) Signing an agreement with another player, $u_i(B, 2, 1) = f(B) + 3$
3) Signing an agreement with the two other players, $u_i(B, 3) = f(B) + 4,5$

and she proposes an agreement to the two other players (assuming that the larger agreement will be chosen whenever there is payoff equality between several agreement structures). The same reasoning applies until the first player who is perfectly farsighted and anticipates the decisions of the following players as previously described. If $n = 7$, the equilibrium outcome is an agreement structure $B^* = (2, 5)$.

2.4 Myopic players

In this subsection, we examine other assumptions about the players' behaviour. How would myopic players behave in this game? In general, myopic behaviour is understood as to be the behaviour of a player who takes his decision by reacting to the existing situation without anticipating the other players' reactions to his own choice. Given that she anticipates no response, she plays her best response. In our framework, however, myopic behaviour has to be defined more carefully for two reasons. The first is that the behaviour will depend on the player's position at the outset. Does she have to make a proposal or to respond to a proposal? But the behaviour depends also on the myopic players' conjectures when they consider the consequences of their choices. Indeed, in our framework, we cannot say that myopic players have no conjectures at all. They do have conjectures but they are myopic, and we have to define them. In order to define myopic behaviour then, we have to take two variables into account: the position of the player in the game and her conjecture.

The myopic behaviour is characterized by the following assumptions A1:

- A player who makes a proposal does not anticipate the possibility of other subsequent counter-proposals by other players.
- A player who has to respond to a proposal also does not anticipate any other counter-proposal, except her own counter-proposal if she decides to reject.

What would constitute an equilibrium under the foregoing assumptions? The first player to make a proposal chooses the size of coalition which maximizes her payoff as a member. Therefore, in each sub-game $G^i_{B(N/T)}$, her objective is to solve:

$$Max_{s_i} u_i = g(B) + s_i^2 + t - s_i - \frac{1}{2} s_i^2$$

The solution to this is always to propose the coalition of the *t* remaining players in the sub-game. If a myopic player has to respond to a proposal, for the same reason she will accept a coalition of all the remaining players and will reject every other proposal in order to propose that coalition herself. Obviously, if all the players are myopic, the grand coalition is proposed and formed immediately.

Now, consider than one player is farsighted and know that the other players are myopic. She will always refuse every proposal and will always propose the singleton. Indeed, in each sub-game $G^i_{B(N/T)}$, she maximizes:

$$Max_{s_i} u_i = g(B) + s_i^2 + (t - s_i)^2 - \frac{1}{2} s_i^2$$

As a result, at the equilibrium, whatever the first proposal is, the farsighted player first forms a singleton and then, the myopic players form the unique coalition. What happens when there is more than one farsighted player? We will assume that each farsighted player believes that all the others are myopic. This is Assumption A2. Then, if *k* players are farsighted and *n – k* myopic, the following result holds:

Proposition 1: If k players are farsighted in the sense defined in A2 and n – k are myopic in the sense defined in A1, at the equilibrium the coalition structure is formed by k singletons which form first followed by a unique coalition of size n – k.

This was the simplest case to consider. But we could also have allowed the players' conjectures to evolve. For example, myopic players could become farsighted or farsighted players could learn that there are not isolated. The characterization of the equilibrium is less obvious in this case but this is not the purpose of this paper. Therefore, without going through a precise determination of the equilibrium, we can deduce that, if the players' behaviours correspond to one or the other of the two types described previously the only proposals would be, in each sub-game, the singleton or the coalition of all the remaining players.

Proposition 2: If the players are either myopic in the sense defined in A1 or farsighted as defined in A2, in each sub-game each proposal is either the singleton or the coalition of all the players of the associated sub-set.

3. Experimental design

The following Table of payoffs is presented to the subjects. It summarizes subjects' payoffs according to their group size and agreement structure. The total payoff of the agreement structure is indicated in the last column.

#	Structure	s_1	s_2	s_3	s_4	s_5	s_6	s_7	Total payoff
1	(7)	24,50							172,00
	(1,6)	36,50	19,00						151,00
2	(2,5)	27,00	16,50						137,00
	(4,3)	20,50	17,00						130,00
3	(1,1,5)	26,50	26,50	14,50					126,00
	(1,2,4)	20,50	19,00	13,00					110,50
	(1,3,3)	18,50	14,50	14,50					106,00
	(2,2,3)	15,00	15,00	12,50					97,50
	(1,1,1,4)	18,50	18,50	18,50	11,00				99,50
4	(1,1,2,3)	14,50	14,50	13,00	10,50				86,50
	(1,2,2,2)	12,50	11,00	11,00	11,00				78,50
	(1,1,1,1,3)	12,50	12,50	12,50	12,50	8,50			75,50
5	(1,1,1,2,2)	10,50	10,50	10,50	9,00	9,00			67,50
	(1,1,1,1,1,2)	8,50	8,50	8,50	8,50	8,50	7,00		56,50
7	(1,1,1,1,1,1,1)	6,50	6,50	6,50	6,50	6,50	6,50	6,50	45,50

Table 1 : Payoff per subject according to the size of the agreement and the agreement structure.

In each period, one of the subjects who did not yet accepted any agreement is randomly selected to make a new proposal. A proposal consists simply in stating an agreement size. The members assigned to the agreement are chosen randomly among the players who did not belong to an agreement yet. Once the assigned members are informed, they must state privately if they agree or not to sign the agreement. If all of them accept the proposal, the agreement is signed. On the other hand, if one of the assigned players rejects the offer, he will have to submit a new proposal. If more than one player rejects the offer, one of them will be selected randomly to make a new proposal.

Note that this procedure differs slightly from the theoretical procedure, where the proposed members are asked sequentially whether or not they accept to become a member of the proposed agreement. Under this sequential protocol the first player who rejects the offer is the one that makes a new proposal. We chose to ask all proposed member to answer simultaneously because we wanted to gather all data on the subjects attitude towards the proposed agreements. In case of a rejection, subjects only knew that the proposed agreement was rejected without knowing by how many subjects[1]. Although this protocol differs from the theory it does not affect the subjects' incentives in the game. For simplicity we shall call "player 1" the subject who makes the first proposal, "player 2" the subject who makes the second proposal, and so on.

Each session involved 14 subjects. Subjects were told at the beginning that they would be randomly assigned to a group of 7 subjects. Each period started by allocating randomly to each subject a "name" chosen from a list of seven names {A, B, C, D, E, F, G}. Then, one of the names was selected randomly to be "player 1", i.e. the subject who proposes the first group. The decision task was simply to choose an integer number between 1 and 7. If the chosen number was equal to one, a singleton was formed. If the chosen number was larger than one, the members of the group were randomly selected among the 6 remaining subjects to be potential members of the first group. Once subjects were selected for group 1, they were asked individually whether they accepted or not to become a member of the first group. In case all proposed players accepted, the first group was definitely constituted. In the opposite case, if one or more subjects rejected the offer, the group was not created. Then one of the subjects who decided to reject was selected (randomly) to make a new proposal. This process

[1] Of course a subject who did reject but was not selected to make a new proposal could easily infer that there was at least one other subject who rejected.

was repeated until all the subjects were assigned to a group. A group was definitely created if none of the proposed members rejected the proposal. Once all subjects were assigned to a group, the period ended and the gains were announced to the subjects on their computer screen. The gains were displayed according to group size.

We considered two treatments: a partners’ treatment where subjects were assigned to the same population of 7 subjects for all rounds of the experiment, and a strangers’ treatment, in which the composition of the two subpopulations of 7 subjects changed after each round. Actually we could not realise a re-matching on a larger basis since the experimental room could only handle two groups of 7 subjects simultaneously. Therefore, if the difference between the two treatments is not significant, it might be due to the fact that population composition did not vary much according to the subjects.

4. Results

4.1 Realized agreements

Result 1 : The most frequently realized "agreement" is the singleton.

Figure 1 displays the frequency distribution of accepted agreements over all sessions, for the random matching condition and the fixed group condition. Under both conditions the singleton appeared at least 70% of the cases. Since there are many agreement structures containing at least one singleton (11 out of 15 possibilities) of course singletons are more likely to emerge if subjects had decided on a random basis. We need therefore to take a closer look into the frequencies of realized agreement structures. Furthermore, since smaller groups contribute less, and if subjects have a tendency to free ride, they will be tempted to propose small groups.

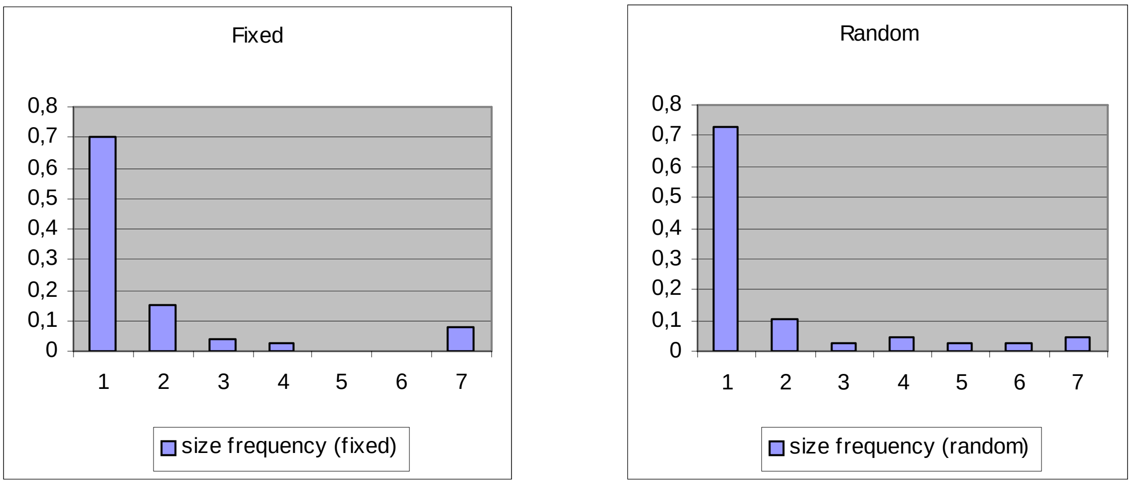

Figure 1 : Frequency distribution of accepted agreements (averaged per period)

Result 2 : There is a large heterogeneity of realized agreement structures. The equilibrium structure (2,5) is never observed. The modal structure is the complete agreement (25% overall). More than 50% of the agreement structures contain three or more singletons.

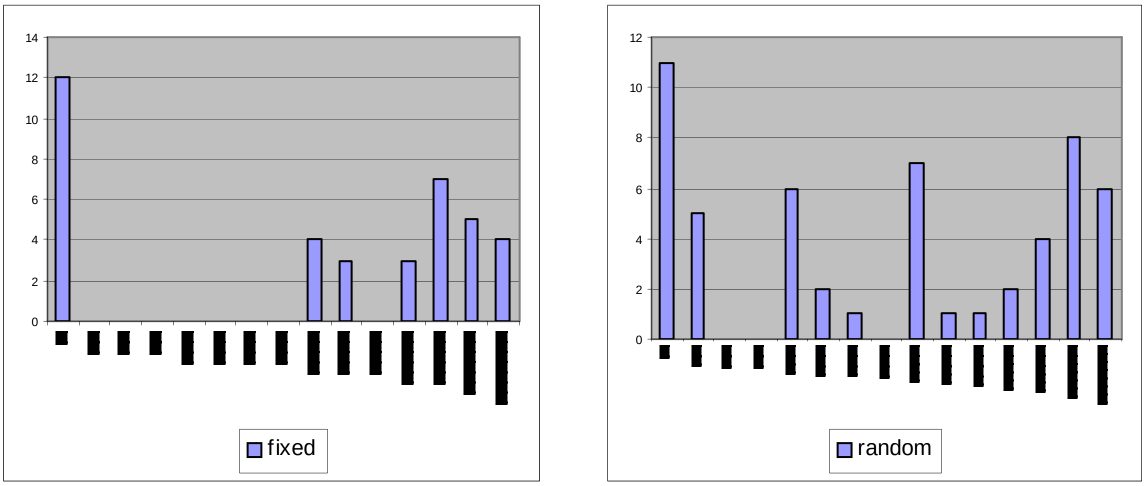

Figure 2 : Frequency distribution of agreement structures

Figure 2 shows that many different structures emerged in the experimental sessions. Very few structures (5%) involved only two agreements in contrast to the theoretical prediction and the equilibrium structure (2,5) was never observed. The total payoff of the structure has no significant effect on the frequency of appearance (OLS). Furthermore, low payoff structures are quite frequent.

Result 3 : The average performance is equal to 104.6 which corresponds to 64.6% of the normalized predicted performance.

According to result 3, the possibility to sign agreements is not efficiently exploited. First the observed level of performance is far below the equilibrium performance (equal to 137), which itself is far below the optimal performance (172). Our results therefore suggest that binding agreements do not provide a powerful tool for solving the social dilemma. Indeed, binding agreements increase the gap between the optimum and the actual level of public good provision because of over-free riding.

Result 4 : Agreement structures with low payoff disparity among members are more likely to emerge.

Table 2 indicates the Gini index associated with each agreement structure together with the observed frequency. The table clearly shows that the frequencies are not related to the total payoff of the agreement structure. Rather, extreme agreement structures, for which the Gini index is close to zero have a higher frequency. This is confirmed by the regression reported in table 3 which shows that the Gini coefficient has a negative impact on the frequency. Furthermore there is a second order effect of the squared Gini index[2] which suggests that the relation is non-linear. The second order effect implies that the frequency of agreement structures increases for high payoff disparities in the population of players. This can be seen from figure 3, where the two agreement structures with the highest Gini index have a relatively high frequency. For one of these structures (1,1,5) two singletons were able to free ride on a relatively large agreement, therefore obtaining a relatively high individual payoff.

Agreement structure	Total payoff	Gini index	Frequency
(7)	172,00	0,00	0,25
(1,6)	151,00	0,10	0,05
(2,5)	137,00	0,11	0,00

(4,3)	130,00	0,05	0,00
(1,1,5)	126,00	0,14	0,07
(1,2,4)	110,50	0,10	0,02
(1,3,3)	106,00	0,03	0,01
(2,2,3)	97,50	0,04	0,00
(1,1,1,4)	99,50	0,13	0,12
(1,1,2,3)	86,50	0,07	0,04
(1,2,2,2)	78,50	0,02	0,01
(1,1,1,1,3)	75,50	0,09	0,05
(1,1,1,2,2)	67,50	0,04	0,12
(1,1,1,1,1,2)	56,50	0,04	0,14
(1,1,1,1,1,1,1)	45,50	0,00	0,11

Table 2 : Gini index and frequency distribution of agreement structures

	Coefficient	Std Err	t	P > t
Gini index	-3.32	1.36	-2.43	0.031
Gini index^2	21.32	9.80	2.17	0.050
constant	.15	.04	4.00	0.002

Prob > F= 0.0781

R-squared = 0.3462

Adj R-squared = 0.2372

Root MSE = .0613

Table 3 : Ordinary Least Square for the frequency of agreement structure according to payoff disparity

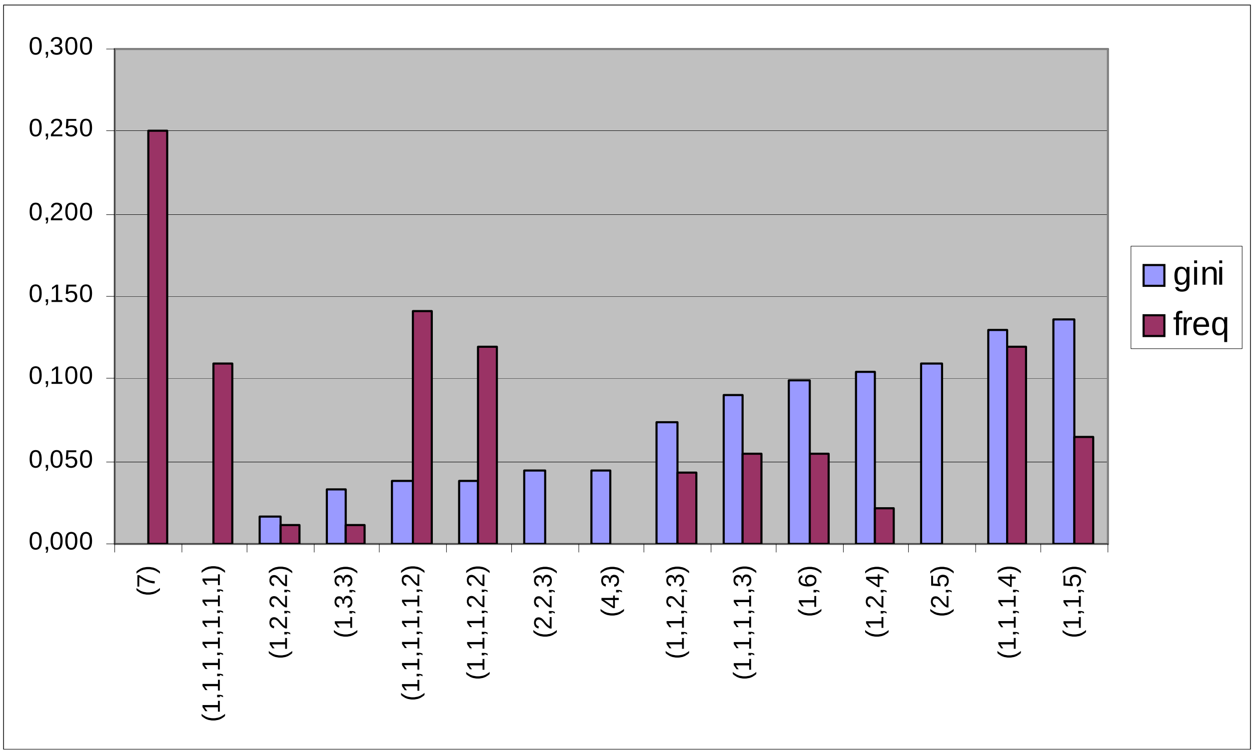

Figure 3 : Frequency of agreement structures ranked according to the Gini coefficient

Result 5

Over the 3 last periods the frequency of the complete agreement increases, while the frequency of the agreement structures containing three or more singletons decreases.

In table 4, we aggregated all agreement structures that have at least three singletons. We compare the frequencies of these agreements with the frequency of complete agreements and the remaining agreement structures (others). The table compares all periods with respect to the three last periods. Clearly the frequency of the complete agreement increases while the frequency of agreement structures containing at least 3 singletons decreases.

	All periods	3 final periods
complete agreement	25%	42%
at least 3 single	54%	46%
others	21%	13%

Table 4 : Aggregated frequencies for types of agreement structures

4.2 Proposed agreements

We discuss first the initial agreements proposed in each round. Then, we investigate what happened in each sub-game. This will allow us to evaluate the free riding behaviour and to test the myopic player assumptions.

4.2.1 Initial proposals

Result 6: The complete agreement is the most frequently proposed agreement in the beginning of rounds (56% of the time) followed by the singleton (23% of the time).

Initial proposals in each round reveal the subjects' intentions to cooperate or to act strategically. Clearly the cooperative intention is the strongest. However since singletons are often formed, result 6 illustrates the conflict between the collective interest and the individual interest. In the beginning of the rounds the complete agreement was proposed more often in the partner treatment (66% of the time) than in the stranger treatment (50% of the time). On the other hand the singleton was formed only 10% of the time in the partner treatment compared to 33% of the time for the stranger treatment. Subjects therefore act in a more cooperative way in the partner treatment than in the stranger treatment. Furthermore, the tendency to propose the complete agreement in the beginning of the round, increases with the repetition.

However, a total of 76% of the (non-singleton) initial proposals were rejected. Since agreement sizes between 2 and 6 were very rarely proposed at the beginning of rounds, rejection rates across agreements sizes cannot be compared. Note also that larger agreements are more likely to be rejected, even if only a few subjects act myopically. However complete agreements as initial proposals are less frequently rejected under the partner treatment (64% rejected) than under the stranger treatment (81% rejected). If we consider all proposals of complete agreements during the game, only 31% were accepted.

Since the complete agreement was the most frequently proposed and rejected agreement, of course a rejection was followed most of the time by a proposal of a smaller agreement. This happened overall more than 80% of the time. Note that the rejection of the complete agreement was frequently followed by the formation of a singleton: in 50% of the cases in the partner treatment and 73% of the cases in the stranger treatment.

4.2.2 Later proposals and myopic behaviour

The following Table gives us the composition of proposals in the different sub-games. Each category of sub-games is characterized by the number of subjects who do not belong to a coalition yet (row numbers). Thus the row labelled 5 corresponds to situations in which the first two players have formed a coalition or where they have both chosen to remain singletons. The first remark which can be made is that, for each given size of the sub-game, the most frequently observed proposals are, either the set of all remaining subjects in the sub-game (more than 32% of the proposals in all sub-games), or the singleton (more than 34% of the proposals in all sub-games).

Proposal / Size of sub-game	7	6	5	4	3	2	1	Total
7	39,31%	4,62%	4,62%	2,89%	6,94%	7,51%	34,1%	100%
6	-	36,61%	2,68%	1,79%	6,25%	9,82%	42,86%	100%
5	-	-	36%	5,33%	2,67%	9,33%	46,67%	100%
4	-	-	-	37,33%	4%	20%	38,67%	100%
3	-	-	-	-	32,69%	15,38%	51,92%	100%
2	-	-	-	-	-	45,71%	54,29%	100%
1	-	-	-	-	-	-	100%	100%

Table: Proposals in sub-games

From sub-section 4.1 as well as from sub-section 4.2.1, we deduce that the subjects do not try to play the Ray and Vohra’s (2001) equilibrium. There could be two explanations for this. Either the subjects are not farsighted and are therefore unable to “find” the Nash equilibrium (2, 5). Or, they are not strategic in the non-cooperative sense. In the latter case, they must have a more sophisticated objective than the maximization of their individual payoff. For example, we discussed the “inequity aversion” hypothesis when we presented the first results about realized agreements. Here, we focus on the first explanation and try to answer the following question: Do the results of these experiments allow us to maintain the hypothesis that the subjects are essentially payoff maximizers, but do not implement the equilibrium because there are not farsighted?

Of course, we cannot give a general answer to this question but we would like at least to test the hypothesis that the subjects are myopic. Under the assumptions and the definitions of myopic behaviour given in sub-Section 2.4.1, in each sub-game each proposal is either the singleton or the grand coalition of the sub-set of players. We analyse the frequency of occurrence of these proposals. First, for each Group in each Session, we count the total number of proposals and the number of proposals which do not correspond to the previous definition. It appears that these proposals represent less than 26% of the total (except for Session 3 Group 2); 74% of the total are either the singleton or the coalition of all the subjects left in the current sub-game and could be generated by a myopic behaviour.

Session 2 Group 1	69	4	5.80%
Session 2 Group 2	71	10	14.08%
Session 3 Group 1	48	8	16.67%
Session 3 Group 2	67	24	35.82%
Session 4 Group 1	79	13	16.45%
Session 4 Group 2	63	16	25.39%
Session 5 Group 1	85	20	23.53%
Session 5 Group 2	88	19	21.59%
	T = Total number of proposals	P = Proposals not consistent with Proposition	P/T

To be sure that our results are not the result of pure chance we have to compare them with a random draw of sizes. In order to do this, it is useful to sort data by sub-games. Note that it is not worth considering the sub-games of sizes 1 and 2 since, by construction in that case, there is no difference between a random choice and a myopic player's choice.

Number of players in the	Frequency of not consistent	Frequency of consistent	Frequency of not consistent	Frequency of consistent

sub-game	Proposals Random	Proposals Random	Proposals Data	Proposals Data
7	71.43%	28.57%	46/173= 26.59%	127/173=73.41%
6	66.67%	33.33%	23/112=20.54%	89/112=79.46%
5	60%	40%	13/75=17.33%	62/75=82.67%
4	50%	50%	18/75=24%	57/75=76%
3	33.33%	66.67%	8/52=15.38%	44/52=84.62%

Table 3: Veto treatment

In Table 3 above, the second and third columns correspond to data that would be generated by a random draw. The two last columns correspond to the experimental data (veto treatment). First, note that the theoretical equilibrium with myopic behaviour would correspond to 100% everywhere in the last column. Now, consider for example the second row of Table 3. It concerns the sub-games with six players. Following Proposition 1, under assumptions A1 and A2, proposals in these sub-games must be the singleton “1” or “6”. Drawn at random “1” and “6” would appear with probability 2/6 = 0.3333, while “2”, “3”, “4”, “5” together would appear with probability 4/6 = 0.6667. In Session 3 Group 1 and Session 5 Group 1 (cf. Appendix), we count 21 sub-games of six players. In only four of them, the proposal to appear is “2”, “3”, “4” or “5”. In 17 others, the proposal is “1” or “6”.
Consider the general results in Table 3. More than 73 percent of the agreement structures are consistent with myopic behaviour. Furthermore, this high percentage is not a decreasing function of the sub-game size, as would be the case under a random draw.

This leads us to an even more pessimistic conclusion that the one we gave at the beginning of this Section. At that point, we said that Result 6, such that the complete agreement is the most frequently proposed agreement, followed by the singleton, illustrates the conflict between the collective interest and individual interests. We should add now that another interpretation is that there is no collective interest at all, just the incapability of subjects to anticipate all the consequences of their choices. Under this last interpretation the choice of the complete agreement is just a failed attempt to pursue individual interests.

5. Dictatorial treatment

This new treatment is similar to the previous one, except that, once a subject who has been drawn randomly has made a proposal, the partners, in the coalition she proposes, have no veto power. In other words, the subject who makes the proposal acts as a "dictator" who can impose the agreement on her partners. From a theoretical point of view, this modification is not relevant. As it has been discussed in Section 2, a consequence of Bloch's (1996) Proposition is that the partners always accept the proposal when they are all identical. However, we will see that there is, in the experiments, a significant difference between the results under the veto treatment and the dictatorial treatment.

There are two principle observations to be made when comparing the following Table to Table 2. First, the grand coalition is much more frequent in the dictatorial treatment. It represents between 40 and 50 percent of the agreements formed. The frequency was only 25 percent in the veto treatment. However, this result is consistent with Result 6 in the veto treatment, which said that the complete agreement is proposed 56 percent of the time in the beginning rounds.This is obviously because, in the dictatiorial treatment proposal is synonymous with formation. It is also interesting to note that there is not a big difference between the treatment with fixed groups (50%) and the treatment with random matching (40%).

The second main point is that the equilibrium (2, 5), which was never chosen in the veto treatment, is one of the most frequent agreement structures to appear here: 16 percent of all realized structures.

Agreement structure	Total payoff	Gini index	Frequency Fixed groups	Frequency Random matching	Frequency Total
(7)	172,00	0,00	0.50	0.40	0.46
(1,6)	151,00	0,10	0.13	0.10	0.12
(2,5)	137,00	0,11	0.10	0.25	0.16
(4,3)	130,00	0,05	0.03	0.05	0.04
(1,1,5)	126,00	0,14	0.06	0.00	0.04
(1,2,4)	110,50	0,10	0.03	0.00	0.02
(1,3,3)	106,00	0,03	0.00	0.00	0.00
(2,2,3)	97,50	0,04	0.00	0.00	0.00

(1,1,1,4)	99,50	0,13	0.03	0.10	0.06
(1,1,2,3)	86,50	0,07	0.10	0.05	0.08
(1,2,2,2)	78,50	0,02	0.00	0.05	0.02
(1,1,1,1,3)	75,50	0,09	0.00	0.00	0.00
(1,1,1,2,2)	67,50	0,04	0.00	0.00	0.00
(1,1,1,1,1,2)	56,50	0,04	0.00	0.00	0.00
(1,1,1,1,1,1,1)	45,50	0,00	0.00	0.00	0.00

It is also interesting to note that the evidence of the existence of myopic behaviour is even stronger than in the veto treatment. In more than 72 percent of the sub-games, the subjects' decisions are consistent with myopic behaviour.

Proposal / Size of sub-game	7	6	5	4	3	2	1	Total
7	46%	2%	6%	4%	0%	16%	26%	100%
6		38,46%	0%	0%	7,69%	0%	53,85%	100%
5			38,46%	7,69%	0%	23,08%	30,77%	100%
4				75%	25%	0%	0%	100%
3					60%	0%	40%	100%
2						100%	0%	100%
1							100%	100%

Table Sub-games in the Dictatorial treatment (%)

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	14/50 = 28%	36/50 = 72%
6	66.67%	33.33%	1/13 = 8%	12/13 = 92%
5	60%	40%	1/17 = 6%	16/17 = 94%

4	50%	50%	0/1 = 0%	1/1 = 100%
3	33.33%	66.67%	0/6 = 0%	6/6 = 100%

Table 3: Myopic behaviour in the Dictatorial treatment

It is worth making two other remarks about the Dictatorial treatment. The subjects seem to have the same conflict between cooperation and individual interest that we described in the Veto treatment. But here again, this conflict may simply be the result of myopic behaviour. However, the new result in this Dictatorial treatment is that the subjects "find" the equilibrium from time to time. Furthermore, as a consequence of the structure of the treatment, the grand coalition appears much more frequently, even though, when players are farsighted, the two treatments are not different from a theoretical point of view.

6. Conclusion

In this paper we have explored the capacity of binding agreements to mitigate the social dilemma which arises in pure public good provision. The agreement formation model that we use predicts that at the equilibrium two asymmetric agreements coexist. Furthermore, the smaller agreement is constituted before the larger one and free rides on the latter to obtain a larger benefit for each of its members.

In our experiments, in the veto treatment, the theoretical equilibrium is never observed. The complete agreement is frequently proposed, especially in the first round, but it is also very frequently rejected. However, the frequency of realization of the complete agreement increases over time. On average, our data reveal a large proportion of complete agreements, therefore providing an optimistic point of view on the capacity of binding agreements to mitigate the social dilemma. On the other hand, we also observe contrary evidence, since the singleton is the second most frequent "agreement".

How can we explain that the subjects do not play Ray and Vohra's (2001) equilibrium? We explored two possible explanations for such an unexpected outcome: inequity aversion and myopic behaviour. Indeed, it may be that players are not selfish strategic maximizers, as is generally assumed in the definition of rationality in game theory. In this case, they must have a more sophisticated objective function than the maximization of their individual payoff. For example, we discussed the inequity aversion hypothesis when we presented the first results as to which agreements were realized. An interesting finding is that the frequency of appearance of agreement structures is correlated with the Gini index which measures payoff disparities between coalitions of players. The two most extreme agreement structures, the complete agreement and the set of singletons have a null payoff disparity and are among the most frequently observed agreement structures.

The other explanation of the non occurrence of the theoretical equilibrium is that the subjects are not farsighted and are therefore unable to “find” the Nash equilibrium. Do the results of these experiments allow us to sustain the hypothesis that the subjects are mainly payoff maximizers, but do not implement the equilibrium because there are not farsighted? We proposed a definition of myopic behaviour specific to our framework. The analysis of proposals in sub-games provides strong evidence that this definition is a good proxy for the subjects’ behaviour. As a consequence of this behaviour, subjects focus on two extreme proposals: the coalition of all remaining subjects and the singleton.

The final conclusion about the utility of binding agreements to mitigate the social dilemma is ambivalent. On average, they do worse than in the theoretical framework with farsighted players. They try to free ride but are unable to find the most efficient way to do it. They do not find the equilibrium and end up in inefficient coalition structures[2]. However, and this is the optimistic conclusion, it seems that they learn to cooperate since the frequency of the grand coalition increases over time. This last result is in contradiction with a systematic feature of the results in the experimental literature on games of voluntary contribution to a public good: contributions are high at the beginning but decrease over time, ending above the equilibrium level. In our experiment in which subjects can sign binding agreements to contribute more, contributions increase over time. It is as if subjects learned to cooperate because they were unable to “learn to play Nash” and to free ride efficiently. The final, dictatorial, treatment sheds further light on this last observation. In this treatment the grand coalition forms much more often and furthermore, the equilibrium solution now occurs whereas in the previous treatment it was absent. One interpretation of the difference between the two treatments is the subjects are not so much faced with a computational problem as with a problem of coordination.

[2] Note that the grand coalition corresponds to the social optimum but the theoretical equilibrium like the grand coalition are both efficient outcomes.

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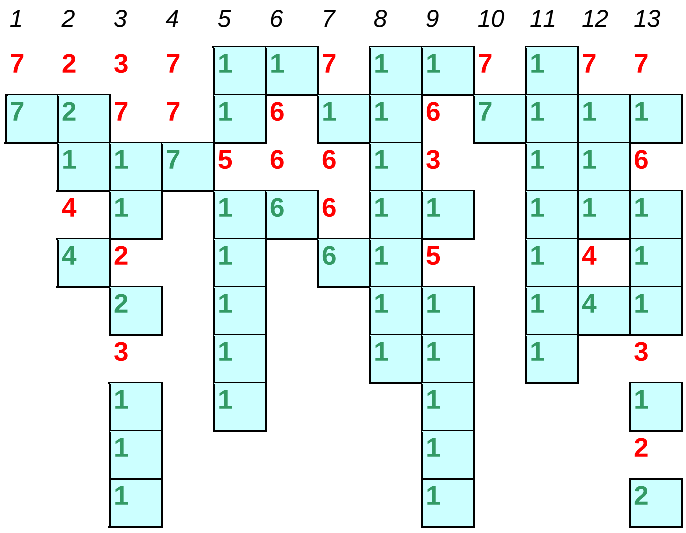
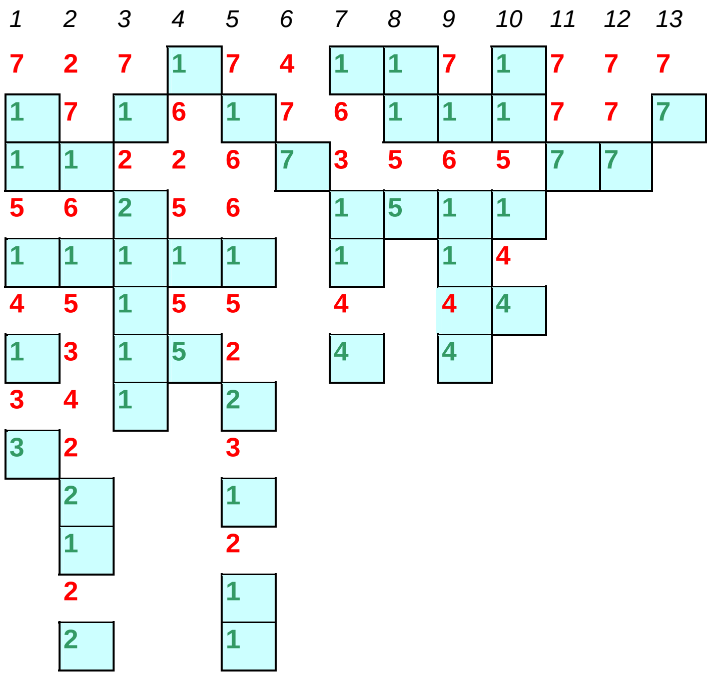
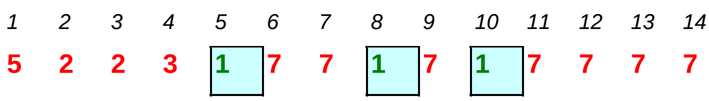
Session 2 group 1 (random)



Session 2 Group 2 (random)



Session 5 groupe 1 (random)



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3	1	7	7	1		2	1	5	5	6	6	6	1
4	2	7	3	4		1	5	1	5	1	6	1	1
2	2		2	5		3	5	1	5	1		5	1
2	2		6	5		1	5	1		2		1	1
1	2		1			1		3		1		2	1
1			6			1		3		3		4	1
			2			1				1		4	
			2							2			
			4							2			
			1										
			1										
			2										
			2										

Session 5 group 2 (random)

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
7	3	7	7	7	1	7	7	1	1	1	7	1	1
5	3	5	1	1	6	1	7	6	6	6	1	4	1
7	1	1	2	6	2	6		1	1	1	1	6	1
2	3	6	3	1	2	2		1	1	4	5	5	4
6	3	3	3	5	4	6		4	1	1	5	6	2
7		6	3	2	4	3		4	2	4		6	4
3		1	3	2		6			1	1			4
7		1	1	1		6			2	1			
7		2	1	2					2	1			
		2	1	2						1			
		2											
		2											

Session 3 group 1 (fixe)

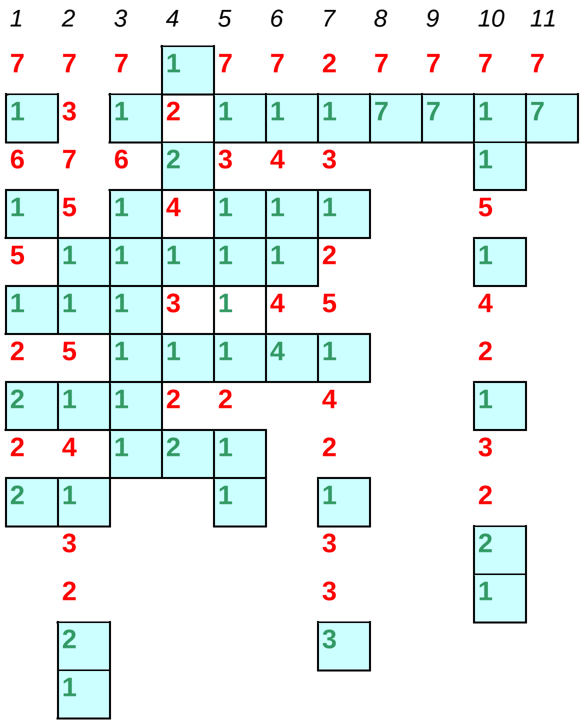
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*

7	2	7	1	7	7	7	7
7	7	7	2	2	1	4	5
	1		6	7	6	7	7
	6		1	1	1	7	7
	1		5	6	5		
	1		1	1	5		
	1		4	1	2		
	2		4	4	5		
	2			2	1		
	1			1	4		
				1	4		
				2			
				1			
				1			

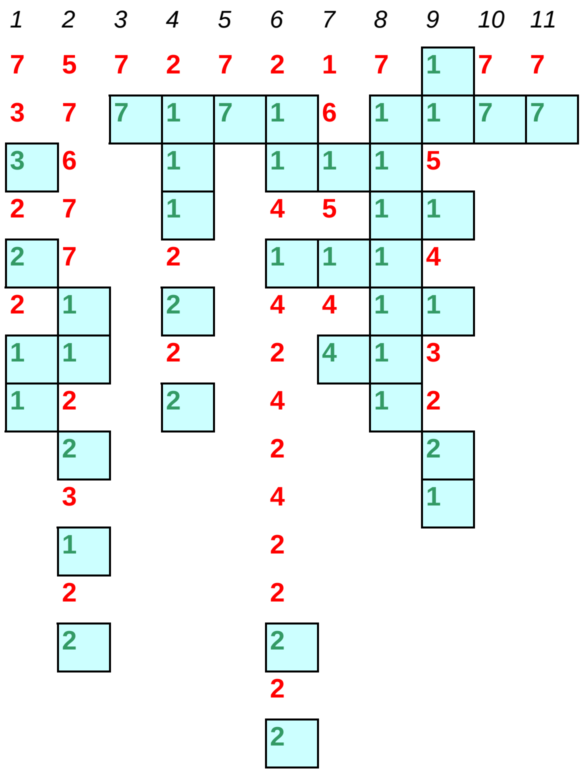
Session 3 group 2 (fixe)

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
5	7	7	7	6	4	3	7
4	6	4	1	1	5	1	6
3	1	2	6	6	3	6	7
6	6	7	2	2	3	1	7
1	2	3	3	2	4	1	
6	2	3	3	1	3	1	
1	1	4	3	2	1	1	
5	2	3	2	2	1	2	
3	2	1	1	1	1	2	
3	1	3	2		1		
2		1	2				
1		2					
1		2					

Session 4 group 1 (fixe)



Session 4 group 2 (fixed)



ANNEX Sub-games

Proposal / Size of sub-game	7	6	5	4	3	2	1	Number of sub-games
7	68	8	8	5	12	13	59	173
6	-	41	3	2	7	11	48	112
5	-	-	27	4	2	7	35	75
4	-	-	-	28	3	15	29	75
3	-	-	-	-	17	8	27	52
2	-	-	-	-	-	16	19	35
1	-	-	-	-	-	-	25	25

Proposal / Size of sub-game	7	6	5	4	3	2	1	Total
7	39,31%	4,62%	4,62%	2,89%	6,94%	7,51%	34,1%	100%
6	-	36,61%	2,68%	1,79%	6,25%	9,82%	42,86%	100%
5	-	-	36%	5,33%	2,67%	9,33%	46,67%	100%
4	-	-	-	37,33%	4%	20%	38,67%	100%
3	-	-	-	-	32,69%	15,38%	51,92%	100%
2	-	-	-	-	-	45,71%	54,29%	100%
1	-	-	-	-	-	-	100%	100%

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	2/16 = 12.5%	14/16 = 87.5%
6	66.67%	33.33%	1/14 = 7%	13/14 = 93%

5	60%	40%	1/10 = 10%	9/10 = 90%
4	50%	50%	6/7 = 0%	7/7 = 100%
3	33.33%	66.67%	0/8 = 0%	8/8 = 100%

Table 3: Session 2 Group 1

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	2/22 = 9%	20/22 = 91%
6	66.67%	33.33%	4/18 = 22%	14/18 = 78%
5	60%	40%	4/14 = 28.5%	10/14 = 71.5%
4	50%	50%	0/6 = 0%	6/6 = 100%
3	33.33%	66.67%	0/5 = 0%	5/5 = 100%

Table 3: Session 2 Group 2

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	5/7 = 71.43%	2/7 = 28.57%	4/20 = 20%	16/20 = 80%
6	4/6 = 66.67%	2/6 = 33.33%	1/9 = 11.11%	8/9 = 88.89%
5	3/5 = 60%	2/5 = 40%	1/9 = 11.11%	8/9 = 88.89%
4	2/4 = 50%	2/4 = 50%	1/6 = 16.67%	5/6 = 83.33%
3	1/3 = 33.33%	2/3 = 66.67%	½ = 50%	½ = 50%

Table Session 3 Group 1

Number of players in the	Frequency of not consistent	Frequency of consistent	Frequency of not consistent	Frequency of consistent

sub-game	Proposals Random	Proposals Random	Proposals Data	Proposals Data
7	71.43%	28.57%	14/25 = 56%	11/25 = 44%
6	66.67%	33.33%	4/11 = 36.4%	7/11 = 63.6%
5	60%	40%	1/3 = 33%	2/3 = 67%
4	50%	50%	2/9 = 22%	7/9 = 78%
3	33.33%	66.67%	3/9 = 33%	6/9 = 67%

Table 3: Session 3 Group 2

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	4/21 = 19%	17/21 = 81%
6	66.67%	33.33%	4/13 = 31%	9/13 = 69%
5	60%	40%	1/12 = 8.3%	11/12 = 91.7%
4	50%	50%	3/14 = 21.4%	11/14 = 78.6%
3	33.33%	66.67%	2/10 = 20%	8/10 = 80%

Table 3: Session 4 Group 1

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	6/22 = 27%	16/22 = 73%
6	66.67%	33.33%	1/7 = 14%	6/7 = 86%
5	60%	40%	2/9 = 22%	7/9 = 78%
4	50%	50%	6/13 = 46%	7/13 = 54%
3	33.33%	66.67%	1/5 = 20%	4/5 = 80%

Table 3: Session 4 Group 2

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	11/29 = 37.93%	18/29 = 62.07%
6	66.67%	33.33%	3/12 = 25%	9/12 = 75%
5	60%	40%	1/13 = 7.69%	12/13 = 92.31%
4	50%	50%	5/13 = 38.46%	8/13 = 61.54%
3	33.33%	66.67%	0%	100% (5/5)

Table 2 Session 5 Group 1

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	4/25 = 16%	21/25 = 84%
6	66.67%	33.33%	8/27 = 29.6%	19/27 = 70.4%
5	60%	40%	2/9 = 22%	7/9 = 78%
4	50%	50%	3/9 = 33.3%	6/9 = 66.6%
3	33.33%	66.67%	1/8 = 12.5%	7/8 = 87.5%

Table 3: Session 5 Group 2

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	46/173= 26.59%	127/173=73.41%
6	66.67%	33.33%	23/112=20.54%	89/112=79.46%

5	60%	40%	13/75=17.33%	62/75=82.67%
4	50%	50%	18/75=24%	57/75=76%
3	33.33%	66.67%	8/52=15.38%	44/52=84.62%

Table 3: Veto treatment

Proposal / Size of sub-game	7	6	5	4	3	2	1	Number of sub-games
7	15	0	1	1	0	4	9	30
6	-	4	0	0	0	0	5	9
5	-	-	2	0	0	2	3	7
4	-	-	-	2	1	0	0	3
3	-	-	-	-	2	0	0	2
2	-	-	-	-	-	1	0	1
1	-	-	-	-	-	-	1	1

Table Sub-games in the Dictatorial treatment (fixed groups)

Proposal / Size of sub-game	7	6	5	4	3	2	1	Number of sub-games
7	8	1	2	1	0	4	4	20
6	-	1	0	0	1	0	2	4
5	-	-	3	1	0	1	1	6
4	-	-	-	1	0	0	0	1
3	-	-	-	-	1	0	2	3
2	-	-	-	-	-	4	0	4
1	-	-	-	-	-	-	2	2

Table Sub-games in the Dictatorial treatment (random matching)

Proposal / Size of sub-game	7	6	5	4	3	2	1	Number of sub-games
7	23	1	3	2	0	8	13	50

6	-	5	0	0	1	0	7	13
5	-	-	5	1	0	3	4	13
4	-	-	-	3	1	0	0	4
3	-	-	-	-	3	0	2	5
2	-	-	-	-	-	5	0	5
1	-	-	-	-	-	-	3	3

Table Sub-games in the Dictatorial treatment

Proposal / Size of sub-game	7	6	5	4	3	2	1	Total
7	46%	2%	6%	4%	0%	16%	26%	100%
6		38,46%	0%	0%	7,69%	0%	53,85%	100%
5			38,46%	7,69%	0%	23,08%	30,77%	100%
4				75%	25%	0%	0%	100%
3					60%	0%	40%	100%
2						100%	0%	100%
1							100%	100%

Table Sub-games in the Dictatorial treatment (%)

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	6/15 = 40%	9/15 = 60%
6	66.67%	33.33%	0/2 = 0%	2/2 = 100%
5	60%	40%	1/6 = 17%	5/6 = 83%
4	50%	50%	1/2 = 50%	1/2 = 50%
3	33.33%	66.67%	0/2 = 0%	2/2 = 100%

Table 3: Group A fixed

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	0/15 = 0%	15/15 = 100%
6	66.67%	33.33%	0/7 = 0%	7/7 = 100%
5	60%	40%	1/3 = 33%	2/3 = 67%
4	50%	50%	0/1 = 0%	1/1 = 100%
3	33.33%	66.67%	0/1 = 0%	1/1 = 100%

Table 3: Group B fixed

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	5/10 = 50%	5/10 = 50%
6	66.67%	33.33%	0/1 = 0%	1/1 = 100%
5	60%	40%	0/5 = 0%	5/5 = 100%
4	50%	50%	0/1 = 0%	1/1 = 100%
3	33.33%	66.67%	0/1 = 0%	1/1 = 100%

Table 3: Group A, random matching

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	3/10 = 30%	7/10 = 70%
6	66.67%	33.33%	1/3 = 33%	2/3 = 67%

5	60%	40%	1/5 = 20%	4/5 = 80%
4	50%	50%	-	-
3	33.33%	66.67%	0/2 = 0%	2/2 = 100%

Table 3: Group B, random matching

Number of players in the sub-game	Frequency of not consistent Proposals Random	Frequency of consistent Proposals Random	Frequency of not consistent Proposals Data	Frequency of consistent Proposals Data
7	71.43%	28.57%	14/50 = 28%	36/50 = 72%
6	66.67%	33.33%	1/13 = 8%	12/13 = 92%
5	60%	40%	1/17 = 6%	16/17 = 94%
4	50%	50%	0/1 = 0%	1/1 = 100%
3	33.33%	66.67%	0/6 = 0%	6/6 = 100%

Table 3: Dictatorial treatment