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Resolute Choice in interaction: a qualitative experiment

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Abstract

The purpose of this paper is that of extending the model of Resolute Choice (McClennen 1990) to a situation of interaction and comparing its performance with the Sophisticated-subgame perfect equilibrium model in an experiment. A non-cooperative game in which two players with different preference orderings over outcomes move sequentially is adopted as a framework to compare the two models. I consider those combinations of the players' preference structures which generate the different plans and find those game situations where either one or two outcomes Pareto-dominant over Sophisticated Choice exist. Two definitions of Resolute Choice are therefore tested, which allow to discriminate choice between two different Pareto dominant outcomes.

In the experiment three games with the same structure but different payoffs are played. The design allows preliminary group discussion among the players about the decisions to be taken, which is taped and transcribed.

The results show support for Resolute Choice as Pareto dominance, while the ability of Resolute Choice as Nash bargaining to explain behaviour is quite limited. The subjects' motivations are very useful in interpreting the results. They show that choice for a Pareto dominant outcome is mainly driven by the idea of Pareto optimality itself. Motivations differ slightly according to which strategy is chosen to reach one of the Pareto dominant outcomes. A result to be noted is the relevance of the different payoffs of the games in motivating choice.

The method used in the experiment to elicit the subjects' responses is the strategy method. A direct consequence is that the results are all in terms of strategies chosen by subjects. In view of this, an alternative way to look at the experiment results has been tried, which consists in a simulation of the outcomes of the games that would have resulted from direct interaction among the players. The results have then been compared to the ones from the experiment.

JEL classifications: C91, C72, D80

Keywords: dynamic decision making, myopia, sophistication, resoluteness, non-cooperative game.

1. Introduction

In the context of dynamic individual decision making under risk and uncertainty the model of Resolute Choice (McClennen, 1990) plays a very important role: it offers a solution to the inconsistency problem of the dynamic choices of an agent whose preferences violate Expected Utility Theory, and thus challenges a very powerful argument against the normative validity of the non-expected utility models of choice.

The present work concerns the experimental investigation of the model of Resolute Choice in its extension to an interactive context.

The reason for considering resolute choice in an interactive perspective is to be found in the temporal structure of the dynamic decision problem, and in the possibility to interpret it as a problem of *intrapersonal* choice. In this perspective, the agent can be thought as divided in a series of time-defined selves, each with its own preference structure.

Following this line of argument, I found in a non-cooperative game - in which two players move sequentially and have different preferences over future actions - the structure where the model of Resolute Choice can be applied to interaction and compared it with the other models of Myopic and Sophisticated behaviour in an experiment.

In order to do this, I worked out all the combinations of the players' preferences which generated the different plans and all the game situations where there existed either one or two Pareto dominant outcomes over Sophisticated Choice.

The analysis and comparison of Resolute Choice in an interactive context opens the way to the consideration that the concept of Pareto optimality - which is the essential characteristic of Resolute Choice in interaction - is not sufficient to predict choice in game situations where there are two Pareto efficient outcomes. Therefore, there is a need to extend the definition of Resolute Choice in interaction beyond the characteristic of leading to a Pareto dominant outcome. One possible way of doing this is to make recourse to the concept of bargaining, which is also somehow intrinsic to the model: Resolute Choice presupposes the existence of a bargain between the different selves around the Pareto dominant outcome(s).

In the first part of this work an overview of the theory behind the experiment is given. It follows a description of the experiment, the games and the design, and an overview of the results.

2. The model of Resolute Choice

The model of Resolute Choice is introduced by McClennen (1990) in the context of the debate on the normative validity of expected utility theory and two of its axiomatic presuppositions, the principles of weak ordering and independence. The discussion concentrates on the possibility to justify these two axioms as prescriptive for preference and choice. McClennen's contribution to the debate focuses on the discussion of what he considers the most formal and complex of the pragmatic arguments in defence of the two axioms, Hammond's consequentialist argument (Hammond 1988a,b;1989).

According to this argument, violation of one of the two expected utility axioms makes the agent's preferences subject to dynamically inconsistent changes. If this occurs, the agent may find himself in a dynamic choice situation in which what at the present moment he prefers to choose at a later point in the decision tree is not what he will prefer to choose when he actually arrives at that decision point. The problem with dynamically inconsistent shifts in preferences is that they are not compatible with the agent always maximising with respect to his preferences for consequences. The agent may act according to a plan that is strictly dominated by another available plan with respect to preferences for outcomes.

McClennen shows that the two axioms can be recovered as theorems from the conjunction of a set of conditions for rational dynamic choice, which therefore provide a model for Hammond's consequentialist argument constructed in favour of the two axioms. Although at the basis of McClennen's argument, these principles for choice cannot be discussed in detail here[1]. Of interest is that they play an important role in a more general pragmatic approach, as they allow to evaluate from a pragmatic point of view different *approaches to choice* or *plans* or *strategies*.

In fact, even though an agent who does not conform to the two axioms of choice is liable to preference shifts, there exist strategies available to the agent which protect him from pragmatic difficulties. McClennen discusses the two approaches to choice which have traditionally been considered in the literature on dynamic choice and changing preferences (Strotz 1956; Hammond 1976): myopic choice and sophisticated choice.

According to the *Myopic Choice* (MC) approach the agent treats choice at each decision point as unconnected with anything he could project on the choices he will make in the future. He selects at each point those strategies which he judges acceptable from the perspective of that point. In this way, the myopic agent violates dynamic consistency, leaving ex post the plan adopted ex ante.

The agent can avoid this problem by anticipating how he will be disposed to choose in the future and act according to a *Sophisticated Choice* (SC) approach. The sophisticated agent

[1] The dynamic choice conditions are: dynamic consistency, separability and normal-extensive form coincidence.

anticipates his future choice and chooses the best plan among those he is ready to follow to the end, making ex post choice behaviour constrain ex ante choice. He rejects those plans which imply a choice he anticipates he will not make. By doing so, he avoids violating dynamic consistency.

However, sophistication is not the only possible alternative to myopia that the agent can adopt to avoid inconsistent behaviour. In fact, the condition of dynamic consistency only requires consistency between present and future choice, but it does not specify *how* this consistency is to be achieved. If for the sophisticated agent ex ante choice is constrained by ex post behaviour, the constraint may be thought to run the other way.

According to McClennen this is what characterizes a *Resolute Choice* (RC) approach: the agent is constrained ex post by what he judges ex ante to be the best available plan. The resolute agent resolves to act according to a plan judged best from an ex ante perspective, and intentionally acts on that resolve when the plan imposes on him ex post to make a choice he disprefers. By so choosing he avoids to act in a dynamically inconsistent manner[2].

2.1 From Resolute Choice to Resolute Choice in interaction

McClennen compares the different models of choice in terms of their pragmatic considerations, and shows that Resolute Choice is the only approach to choice which does not put the agent into pragmatic difficulties, and is therefore (pragmatically) superior to both myopic and sophisticated choice.

The argument on the pragmatic superiority of Resolute Choice is then connected to the problem of its 'feasibility': under what conditions can one expect the agent to really behave resolutely, that is to adopt a resolute approach to choice *and* implement it? In order to answer this question it is necessary to recall the relevance of the *temporal dimension* of the dynamic decision problem. The dynamic choice situation is interpreted as a problem of *intrapersonal choice*. The agent is decomposed into a sequence of time-defined selves, each with its own set of preferences and interests, and the dynamic problem viewed as a problem of coordination between these different selves. Sophisticated choice presupposes a separation between selves as deep as the separation between different individuals. Resolute choice presupposes the existence of a commitment or bargain between the different selves.

The problem of 'feasibility' can be solved by adopting the concept of *intrapersonal optimality*: the agent will adopt and implement the Resolute Choice plan if both the ex ante and ex post selves will gain prospects which are better for both of them. That is, Resolute Choice will be possible under the condition that failure to behave resolutely will cost both the ex ante and ex post

[2] Note that while the sophisticated approach relies on a condition of *separability* between future preferences among options and background of earlier preferences, the resolute approach overcomes *separability*, by treating choice within the context of the decision problem differently from the way he would treat the same choice abstractly from that context.

self. In this sense, the criterion of intrapersonal optimality may provide at least a partial solution to the problem of feasibility.

On the problem of feasibility one more consideration needs to be made. McClennen defines and evaluates the decision models available to the agent in a situation of potential inconsistency in terms of the rational dynamic choice conditions. An evaluation from a pragmatic perspective of the different models is related closely to the pragmatic evaluation of the dynamic choice conditions. Referring to Hume, McClennen considers a criterion of choice as rational if it induces the agent in a "choice of means sufficient to his ends". According to this view, no axiom qualifies as an axiom of rational choice, unless its violation induces the agent "to pursue his objectives less effectively than he could have under the same circumstances" (page 4) - then failing to maximise with respect to his preferences for outcomes.

As Resolute Choice – which is pragmatically superior - is characterised by violation of the condition of separability, violation of separability cannot be considered as irrational. Its violation gives the agent an approach to choice which creates no pragmatic difficulties[3].

[3] The implications for the debate on the normative validity of expected utility are substantial. Agents whose evaluation methods deviate from expected utility axioms - and are placed in a situation where they will violate one of the rational choice conditions – do not behave irrationally at least insofar as they act according to a resolute plan. Violation of separability by resolute choice is not irrational, as the plausibility of that principle as a condition on rational choice can be questioned.

3. Resolute Choice in interaction: the relevant game situations

The separation of selves indicates that an analogy exists between the intrapersonal problem in which a single agent faces a sequence of decisions to be taken over time, and that of different individuals who have different preference orderings over various possible outcomes, and face the problem of coordinating their actions. A two-person sequential game is the analogue of the strategic situation in which a single person makes a sequence of choices.

The normative model of sophisticated choice may be considered as the intrapersonal counterpart of a situation where two players move in sequence. The criterion of evaluation adopted in the context of interactive choice is the one of Pareto optimality, equivalent to the intrapersonal optimality principle in individual choice.

According to McClennen's formulation, the strategies that two players adopt can be said to be interpersonally optimal if and only if there exists no alternative way of interacting whose associated prospect would be judged preferable by each agent.

The temporal structure of the intrapersonal choice problem suggests, as the interactive situation analogous to the intrapersonal problem, a non-cooperative ultimatum game where one player selects a strategy, and the other player chooses with full knowledge of the first player's move.

Following these considerations, I have adopted as a framework to analyse and compare the myopic, sophisticated and resolute approach to choice in interaction a non-cooperative game in which players move sequentially and have different preferences over future actions.

The decision tree approach adopted is the one in Hammond (1976) and Grout (1982). The decision tree consists of a set of plans (branches of the tree), and preferences over plans are represented by a strict ordering over the set of plans. Decisions are taken in discrete time; at each period *t* an agent takes a decision at that time. As Grout states "it is possible that the same agent may reappear to make decisions at a later time" (page 83). A special case of this situation is the one in which the same agent makes decisions at every *t*, and preferences change over time as a result of endogenous or exogenous change of tastes[4].

I have considered a game where there are three decision nodes, with two players, player A, choosing at the two decision nodes $t=1$ and $t=3$ whether to go Up (U) or Along (A), and player B, choosing at $t=2$ whether to go Up or Along. The preference structure is equivalent to the case where decisions are taken by a different agent at each *t*, and the two agents who move at $t=1$ and $t=3$

[4] Note that a similar game structure - with fixed tastes but non-expected utility preferences - is adopted in a situation of risk by the behavioural consistency model of Karni and Safra (1989a,b;1990), where the decision maker is represented by a set of agents, each at a different decision node. In the situation of interaction of interest here, the same agent reappears to make decisions at a later date.

exhibit the same preference pattern. That is, the situation of a single agent's change of preferences is equivalent to the one of different preferences for different (in this case two) agents.

In all cases, the overall preference structure is one of dynamically changing preferences.

Consider the following game

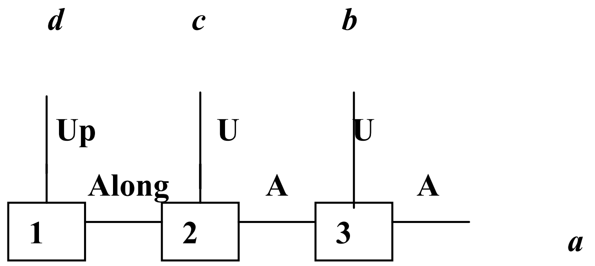


Figure 1 – Non-cooperative game with two players moving in sequence

Interaction between the two players will yield one of the four possible outcomes *a*, *b*, *c*, *d* depending on the plan the players choose at each decision node and on the players' preference structures. For example, suppose that myopic players choose at each *t* that plan which is most preferred at *t*; if the preference orderings are such that for A, $b \succ a \succ d \succ c$ and for B, $a \succ c \succ b \succ d$, the outcome of the plan would be *b*.

A situation of sequential choice with dynamically changing preferences is generally characterized by the possibility of essential inconsistency between the agents' preferences. In the case of a single player, the possibility of inconsistency arises as strict preferences change over time as a result of changing tastes. The concept of essential inconsistency between the agents' preferences, discussed by Grout, is introduced by Hammond (1976) in the "potential addict" example. Suppose there are three plans *a*, *b* and *c*, and the agent's preferences are such that at $t=1$ $a \succ b$, $a \succ c$ and $c \succ b$, while at $t=2$, $b \succ a$. Then, a contrast occurs between the preferences $a \succ b$ at $t=1$ and $b \succ a$ at $t=2$.

As discussed above, two outcomes have been analysed in the literature in this case, the <u>myopic or naive outcome</u>, and the <u>sophisticated or perfect equilibrium outcome</u>.

If the agent behaves according to Myopic Choice, he ignores that his preferences will change and chooses at each decision node the outcome that he considers as best at that point. If the agent behaves according to Sophisticated Choice he anticipates that his preferences will change and chooses the outcome that is more preferred at the initial decision node among those he knows he will be able to reach. If there is no inconsistency the myopic and sophisticated plans coincide

(Hammond 1976). In situations where myopic and sophisticated choice do not coincide the question of how the different outcomes compare in terms of Pareto efficiency may be addressed.

However, preference structures of the kind considered might give rise to another possible plan that, if adopted and carried out, will result in an outcome Pareto dominant over the sophisticated equilibrium. This may be referred to as a resolute plan: it requires the agent to act resolutely on his adoption, by choosing a dispreferred (non maximising) action at some decision node. If the agent behaves according to Resolute Choice he will choose to go for the outcome that is more preferred at the initial decision node even if it implies making at some future decision node a choice he dislikes.

According to Grout's results, in all decision trees with at least three choice nodes, there exist preference structures such that deviation from equilibrium behaviour by every agent results in a better outcome for all agents. In other terms, Grout finds that there exist preference structures such that the myopic outcome is Pareto superior to the sophisticated equilibrium.

However, Grout's results can be extended to the interpersonal decision problem in Figure 1, which is considered as analogous both to the decision problem where the same agent moves at every node and to the problem where there is a different agent at each node. The myopic, sophisticated and resolute choice models can be extended to a two-person game.

In the interpersonal version of the decision problem there can be preference structures for the two players such that myopic and resolute choice can lead the agent to outcomes that are Pareto dominant over the sophisticated choice-backward induction outcome.

In the case of the interpersonal game, the strategies can be interpreted as follows. if the agent is myopic, he will rank options at any given node only according to the most preferable outcome reachable by each option.

If the agent is sophisticated, he will take into account the behaviour of the other player, work through backward induction and choose the more preferred outcome he can reach given that behaviour.

If the agent is resolute, he will aim at the existing Pareto dominant outcome(s). The resolute choice outcome implies that both players coordinate their actions on the achievement of the Pareto dominant outcome(s), under the implicit agreement of performing actions that are dispreferred (non-maximizing) from each player's separate perspective.

In order to compare the outcomes of the myopic, sophisticated and resolute choice plans and to test how players choose among them, I have outlined those situations in which the players' preference structures are such that they generate the different plans.

Given the interaction situation represented by the non-cooperative game previously outlined, I have considered at first all the possible combinations of the preference orderings over the outcomes *a*, *b*, *c* and *d* between the two players A and B. Among all the possible combinations, I have considered only those cases (72) in which both players have either *a* or *b* as their first preference, so that both players will have a preference for moving up to the end of the tree. Among these cases, I have ruled out as irrelevant the ones in which the myopic, sophisticated and resolute plans coincide, that is, there is no outcome Pareto dominant over sophisticated choice. This occurs when:

(i) player B has either *a* or *b* as his second preference (24 cases);

(ii) player B's preferences are such that:

- $a \succ c$ in those cases where A's first preference is *a* (6 cases). In these cases, outcome *a*, which is the sophisticated outcome, is also the first preference for player A. Therefore, no outcome Pareto dominant over sophisticated choice exists, as it is not possible to increase player B's payoff without making A worse off.
- $b \succ c$ in those cases where A's first preference is *b* (6 cases). In these cases, outcome *b*, which is the sophisticated outcome, is also the first preference for player A. Therefore, no outcome Pareto dominant over sophisticated choice exists, as it is not possible to increase player B's payoff without making A worse off.

In the remaining cases (36), myopic and resolute choice do not coincide with sophisticated choice and it is possible to find four groups of cases:

1) SC = *c*; MC = *a* (9 cases);

(i) No outcome identifiable as RC exists; MC is not Pareto dominant over SC (6 cases);

(ii) RC = *b*; MC is not Pareto dominant over SC (3 cases).

2) SC = *c*; MC = *b* (9 cases);

(i) No outcome identifiable as RC exists; MC is not Pareto dominant over SC (6 cases);

(ii) RC = *a*; MC is not Pareto dominant over SC (3 cases).

3) SC = *d*; MC = *a* (9 cases);

(i) No outcome identifiable as RC exists; MC is not Pareto dominant over SC (4 cases);

(ii) RC = *b*; MC is not Pareto dominant over SC (2 cases);

(iii) MC is Pareto dominant over SC, and the RC outcome coincides with MC (2 cases);

(iv) There are two outcomes Pareto dominant over SC, *a* = MC and *b*; both are identifiable as RC (1 case).

4) SC = *d*; MC = *b* (9 cases)

(i) No outcome identifiable as RC exists; MC is not Pareto dominant over SC (4 cases);

(ii) RC = *a*; MC is not Pareto dominant over SC (2 cases);

(iii) MC is Pareto dominant over SC, and the RC outcome coincides with MC (2 cases);

(iv) There are two outcomes Pareto dominant over SC, *a* and *b* = MC; both are identifiable as RC (1 case).

A detailed description of the relevant preference combinations considered is given in Table 1 in the Appendix.

With reference to the problem of comparing the outcomes of the myopic, sophisticated and resolute plans, four possibilities occur from the cases considered in the groups above:

(i) There is no outcome which Pareto dominates Sophisticated Choice;

(ii) The outcome which Pareto dominates the sophisticated equilibrium coincides with the myopic outcome;

(iii) There are two outcomes which Pareto dominate Sophisticated Choice, the myopic outcome, and the possible resolute plan (*a* or *b*);

(iv) The only Pareto dominant outcome is the possible resolute choice outcome (*a* or *b*).

Let us consider now the games in groups (3) and (4). In these cases, A's preference structure ($d \succ c$) is such that player A's decision not to play the perfect equilibrium d is risky, i.e. A loses with respect to *d* if B decides to end the game and goes for *c*. A's decision to give the move to B might be interpreted by B as a signal that A intends to go for a resolute outcome.

In what follows, I will consider the cases in group (4).

From the analysis of the cases considered above, the following points emerge:

1) The situations in which no outcome Pareto dominates SC, also when MC does not coincide with SC are of no interest here. In fact, I did consider the MC outcome because from the analysis of Grout it emerged that *there existed* myopic outcomes Pareto dominant over sophisticated choice.

2) When considering all the different preference structures, it has emerged that there are *other* outcomes Pareto dominant over SC which are *not* MC. This not only offers a support to resolute choice, but also suggests that the myopic outcome might be reinterpreted as Resolute Choice when it is Pareto dominant over sophistication. The definition of resolute choice which identifies it with Pareto dominance allows to leave aside considerations about adoption of the myopic plan[5].

3) In both groups (3) and (4), adoption of a resolute plan leads to the only Pareto dominant outcome in cases under (ii) and (iii). However, interpretation of RC as the attempt to achieve a

[5] Besides, the results of the experiment show that myopia is never a motivation for choosing a Pareto dominant outcome.

Pareto dominant outcome is *not sufficient* to determine which of the two Pareto optimal outcomes will be chosen by the agent in the cases under (iv).

Therefore, I consider a more specific interpretation of Resolute Choice which might account for the cases where more than one outcome Pareto dominates the sophisticated equilibrium. Consequently, two definitions of Resolute Choice are given.

1) According to the first interpretation, adoption of Resolute Choice requires both players to coordinate on the achievement of the Pareto-dominant outcome, under the implicit agreement of performing actions that are non-maximising from each player's separate perspective.

2) When the above interpretation is not sufficient to determine which of two Pareto-dominant outcomes will be chosen, I have presumed that a resolute player will choose that Pareto dominant outcome which he would choose were he playing a bargaining game where agreements are binding. Namely, he will play according to the predictions of a <u>Nash bargaining model</u>.

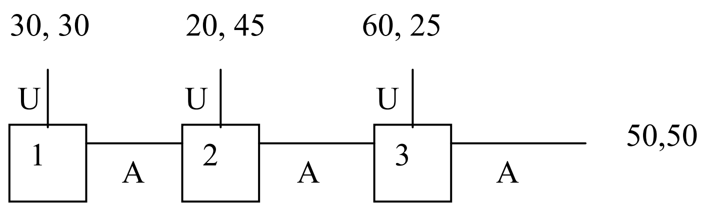
4. A qualitative experiment

In the experiment to be discussed in this section, the two interpretations of Resolute Choice are tested in three games, which have the same structure of the game in Figure 1, and their performance is compared to the Sophisticated Choice strategy. In these games there are three decision nodes and two players: player A, choosing at the first and third decision nodes whether to go Up or Along, and player B, choosing at the second decision node whether to go Up or Along. Interaction between the two players yields one of the four pair of outcomes (the first number is the payoff for player A, the second the payoff for player B).

In all games: (i) there exist Pareto dominant outcomes over the equilibrium; (ii) the sophisticated perfect equilibrium requires to end the game at the first move; (iii) both players have a preference for moving up to the last decision node; (iv) A's decision not to play the equilibrium is risky, as A loses with respect to *d* if B decides to end the game and goes for *c*. In particular, all games correspond to the players' preference combinations over outcomes *a, b, c* and *d* of group 4, summarized in table 1 in the Appendix.

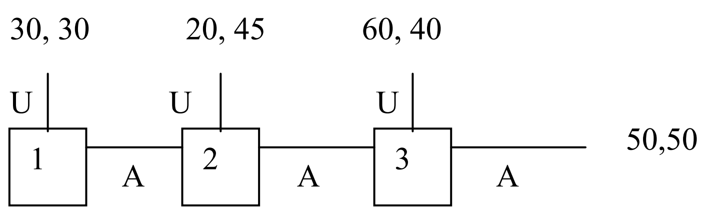
4.1 The games

GAME 1



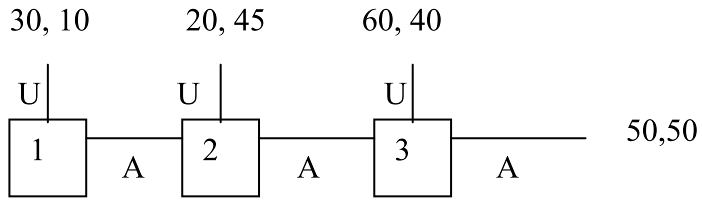
(50,50) is the only RC-Pareto Dominant outcome

GAME 2



(60,40) and (50,50) are the two Pareto dominant outcomes; both outcomes give the highest sum of 100 tickets to the two players;
(50,50) is the RC-Nash bargaining solution outcome and it also gives both players equal utility gains (equal increments) with respect to playing the sophisticated choice outcome.

GAME 3



(60,40) and (50,50) are the two Pareto dominant outcomes; both give the highest sum of tickets to the two players;
(60,40) is the RC-Nash bargaining +equal increments outcome

The payoffs of the games are given to each player in shares of 100 lottery tickets, which determine the probability that each player would win a given monetary price in a lottery to be held at the end of the experiment. Each outcome corresponds to a particular division of lottery tickets - that is, to a particular probability of winning the lottery - between the two players. For example, in game 2 the outcome (60,40) gives a probability of winning the lottery of .60 to player A, and of .40 to Player B.

The outcomes of the games also represent outcomes of a bargaining game. Consider for example game 2. If the two agents A and B played the game as a bargaining game, the two Pareto optimal outcomes (60,40) and (50,50) would represent the set of feasible outcomes of the bargaining; (20,45) would be out of the bargaining set, as non Pareto optimal; (30,30), the sophisticated choice-subgame perfect equilibrium, would represent the disagreement outcome[6].

In order to determine the Nash bargaining solution, the bargaining game has been given the structure of a "binary lottery game", so that the set of allowable divisions of lottery tickets turns out to be equal to the set of feasible utility payoffs, and it is then possible to determine the Nash bargaining solution to the game. The binary lottery games are a class of games introduced by Roth and Malouf (1979) to control for the bargainers' utilities. In order to interpret the set of feasible outcomes in each game in terms of each player's utility function for money, it has to be noted that if each player's utility function is normalised so that the utility of receiving the prize is 1, and the utility for not receiving it is 0, then the player's utility for any lottery between these two alternatives

[6] In a Nash bargaining game between two players, there exists a set of feasible outcomes, corresponding to Pareto optimal points, any of which will be the final outcome, if both the players agree to it. If an agreement is not reached, some fixed disagreement outcome will be the final outcome of the game. The Nash bargaining solution to such a game is the utility pair which maximises the product $(u_A-d_A)(u_B-d_B)$, subject to the constraint that $u_A \geq d_A$ and $u_B \geq d_B$, where u_A and u_B are respectively the utility of the decision outcome for player A and player B, and d_A and d_B are the utilities of the disagreement outcome.

is equal to the probability of winning the lottery[7]. Normalising is possible as the information about preferences conveyed by an expected utility function is represented meaningfully up to an arbitrary choice of origin and scale, and Nash bargaining theory is independent of such choice.

Therefore, an agreement that gives a player p% of lottery tickets, gives a utility of p. The set of feasible utility payoffs is equal to the set of allowable divisions of lottery tickets.

In the binary lottery version of a Nash bargaining game, the players bargain over outcomes that are probabilities of receiving a certain lottery prize, and are equal to the outcome utilities. In particular, they have to agree over two possible outcomes, which are two possible divisions of lottery tickets. They are Pareto optimal with respect to the sophisticated choice outcome representing the disagreement outcome - and therefore satisfying the above constraint. In case of disagreement, both players end up with a lower probability of winning the prize, the division of the payoff that corresponds to the SC outcome.

In GAME 1, (50,50) is the only Pareto dominant-resolute choice outcome, and can be reached by choosing, Along as player A in boxes 1 and 3, Along as player B in box 2 (AAA). The choice in this case is between the SC outcome (30,30) and the RC outcome (50,50), which has all the following properties: it is Pareto dominant, it is Nash, it yields equal increments, and corresponds to the maximum total number of tickets by definition of Pareto optimality.

In GAME 2, (60,40) and (50,50) are the two Pareto dominant-RC outcomes, and both sum to 100, so that the choice for one of the two Pareto dominant outcomes should not be influenced by this element. If choice is at all for the resolute outcome, one would expect (i) the players' choices to concentrate on these two outcomes; (ii) If Nash and equal increments is important, more choices should be for (50,50) than for (60,40). As outcome (60,40) is Pareto dominant, it should attract more choices than (60,25) in Game 1.

In GAME 3, (60,40) and (50,50) are the two Pareto dominant outcomes. (60,40) is Nash and equal increments, and therefore one would expect it to get more choices than (50,50). Moreover, more subjects should choose the outcome (60, 40) in Game 3 with respect to (60, 40) in Game 2.

Therefore, the following results are expected:

[7] Consider three alternatives a, b and c, such that a $\succ$ b $\succ$c. If u is a utility function representing the individual's preferences over the alternatives, it must be that u(a) $\succ$u(b) $\succ$u(c). By normalising u, so that u(a)=1 and u(c)=0, the problem of determining u(b) becomes the problem of finding that value for b which makes the individual indifferent between having b and playing a lottery over the most and least preferred alternatives a and c. Given L(p)=[p, a; (1-p), c], its utility is its expected utility pu(a)+(1-p)u(c)=p. But then, if p is the probability which makes the individual indifferent between b and the lottery L(p), their utilities must be equal, so that u(b)=p. Then, given normalisation of the player's utility function, the player's utility for any lottery between 1 and 0 is equal to the utility of winning the lottery, and any outcome which gives p% of lottery tickets gives a utility of p. In our case, outcome a is the prize of the lottery, outcome c is zero, and b is any share of lottery tickets given by the game payoff.

- in Game 1 if subjects are resolute, the AAA strategy should attract more choices; AUA (Along as player A in box 1 and Up in box 3, Along as player B in box 2) should not attract choices; if the subjects are sophisticated they should choose to go always Up (UUU)[8].
- in Game 2 if subjects are resolute, choices should concentrate on the strategies AAA and AUA; and out of these two on AAA, which leads to the NBS - equal increments outcome. The strategy AUA in Game 2 should attract more choices than AUA in Game 1; similarly, AAA should be chosen by less subjects than AAA in G1;
- in Game 3 if subjects are resolute, choices should concentrate on AAA and AUA; and out of these two on AUA, which leads to the NBS - equal increments outcome. The strategy AUA in Game 3 should attract more choices than AUA in Game 2; AAA should be chosen by less subjects than AAA in Game 2.

4.2. The design

The experiment consisted of 3 sessions of 8 players. All subjects were graduate and undergraduate students at the University of York. They were paid the eventual winning of the lotteries (up to £16) plus a fixed participation fee (£2). Each session has been run as follows.

The subjects were divided in two groups, each in a different room with a different experimenter.

The instructions (see the Appendix) which had been given at the moment of registration were read out to the subjects. Then the subjects were attributed a number which they had to speak out every time they entered the discussion. This allowed to individuate the different subjects in the taped discussion, at the same time preserving anonymity, and not impairing the discussion by making it too formal. Then, the discussion was opened and taped simultaneously in the two groups.

ROUND 1. The subjects were asked to decide their moves as both players A and B in the three games.

i. This prevented subjects from identifying themselves with one specific role.

ii. In this round the subjects decided only once. The process of getting familiar with the games was taken care of by the group discussion.

iii. The subjects were asked to decide their moves on one game at a time. In this way, the differences perceived by the subjects among the three games could emerge more clearly. As decisions on all the games have been taken before any interaction took place, differences in choices in Round 1 should be due only to differences in the payoff structure of

[8] It has to be recalled that in eliciting the subjects' responses the meaning of 'strategy' was used in a loose sense. By asking what player A would have chosen at the third node even when he had chosen Up at the first node and by reporting the UUU strategy – mainly for reasons of symmetry in the reporting of outcomes on the side of subjects - I went beyond the usual meaning of 'strategy'. Player A does not have to take any decision at the third node, if he has chosen to go Up at the first node.

the games. The order in which the games were played did not influence choice, because the subjects could modify their choices at any moment.

After all subjects had taken and recorded their decisions, the decision sheets were collected in the two groups, and each subject in one group was matched with a subject in the other group at random. In this way, the non-cooperative structure of the game was kept: each subject would know the opinions of the subjects in his own group, but not the opinions of his opponents.

The outcomes of decisions and interaction were given to the subjects in two stages:

STAGE 1. The subjects of one group played in the role of player A and their decisions were matched with those of the subjects of the other group, who played as B, and the outcomes recorded accordingly.

STAGE 2. The subjects switched roles: the A subjects played as B and the B subjects as A, and the results of the matching recorded accordingly. After the decision sheets with the results have been given back, each group was asked to discuss them, and the discussion recorded.

ROUND 2. Subjects were asked to decide their moves as A and B a second time, after they have seen the results of the matching. The players in each group were asked to discuss their moves, and the discussion recorded.

When all decisions had been taken and recorded, subjects in the two groups were matched again as before (but not with the same opponents), and the results recorded.

Each group was asked to discuss this second set of results. The discussion was taped.

LOTTERY. At the end of Round 2 one game was picked out at random, and the lottery was held twice on this game, once on the outcomes of stage 1, the second time on those of stage 2. In this way, each subject *did* actually play *both* as A *and* as B, and there was no uncertainty about which player the subject was actually going to be, possibly creating a bias in the direction of the outcome which maximised the payoffs of *both* players.

It should be noted that the method used to elicit subjects' responses is the strategy method. Each subject is asked what he would have done as player A in the first move; what he would have done as player B in the second move, in case player A had played Along; what he would have done as player A in the third move, in case player B had played Along. In this way, a strategy has been elicited for each subject.

A possible alternative would have been to let the subjects play the games out (see section 6), observing the subjects' choices only at those decision nodes actually reached in the course of the game. This method would have provided the result of the subjects' interaction for each game, but not the entire set of all possible choices for each subject.

A method that directly elicits strategies seemed to be the proper method for testing adoption of the different plans, as the purpose of the experiment is to test which plan or model of choice - sophisticated or resolute - the subjects adopt in the interpersonal decision context under consideration[9].

4.3 The results

Choices were distributed among the different strategies in the following way (percentages of subjects).

Table 2 – Results of Round 1

	Game 1	Game 2	Game 3
UUU	58%	46%	21%
AAA	17%	21%	33%
AUA	4%	21%	33%
AUU	21%	12%	13%

Table 3 – Results of Round 2

	Game 1	Game 2	Game 3
UUU	71%	63%	29%
AAA	—	4%	17%
AUA	4%	13%	25%
AUU	25%	17%	29%
Others (UAU)	—	4%	—

It is shown below how in <u>ROUND 1</u> the main results compare with the outcomes expected.

[9] There is a debate in the experimental literature on the different advantages and disadvantages of using this method for eliciting subjects' responses (Roth 1995; Brandts and Charness 2000; Cason and Mui 1998). Some major disadvantages are: the method removes from observation the possible effects of the timing of decisions; the method might force the subjects to think about each decision node in a different way than if they could concentrate directly on the decision nodes, therefore altering the outcomes of play; the method could give rise to ill-considered choice, as it reduces the incentive for subjects to think carefully about every possible element of the strategy; and the method might induce a different behaviour relative to a situation where a subject responds to the actual move of an opponent, as it requires the subject to answer hypothetical questions, instead of reacting to decisions taken by other subjects. Among the advantages: the method allows to acquire more information, by allowing to collect data on all decision nodes in the game; the method allows to gain insight in the motivations of subjects; the method gives information on "off action" paths, which are otherwise never reached.

GAME 1 (G1)

1. The number of choices for the sophisticated strategy is very high in G1. 58% of the players choose UUU, while only 17% choose the strategy for the Pareto dominant outcome, while the opposite is expected.

2. Only one choice is for AUA, as expected, as AUA is not a Pareto dominant outcome in this case.

3. AUU, which is not expected to have any relevance, but shows some similarity with UUU, was chosen by 21% of players.

GAME 2 (G2)

4. The number of choices for the sophisticated strategy decreases in game 2 (46%), while the number of subjects who chose one of the two Pareto dominant outcomes (AAA or AUA) is higher than in game 1 (42%).

5. Both the Pareto dominant outcomes attract the same number of choices (21%), so that it is not clear whether NBS-equal increments was relevant for choice.

6. The choices for the Nash bargaining strategy (AUA) are more in G2 than in G1 as expected, given that AUA in G2 is Pareto dominant and NBS-equal increments.

7. However, the strategy leading to the simple resolute outcome (AAA) attracts more choices here than in G1, despite the fact that in G1 it leads to the only Pareto dominant outcome, which also yields the highest sum of tickets. Choices for AUU decrease to 12%.

GAME 3 (G3)

The pattern of choice in G3 in general is different from the one in the other two games, and the difference is very marked with respect to G1.

8. The number of choices for the sophisticated strategy reduces drastically (only 21% of the subjects chose it in G3), while the subjects who chose one of the two Pareto dominant outcomes (through the strategies AAA or AUA) are 67%.

9. The two Pareto dominant outcomes attract again the same number of choices (33%), while strategy AUA is expected to attract more choices as it leads to the NBS outcome.

10. The Nash bargaining strategy (AUA) attracts more choices in G3 than in G2 as expected, since AUA is here Pareto dominant and NBS-equal increments.

11. Though, also the simple resolute choice strategy (AAA) attracts more choices in G3 with respect to G2, which is not expected, as AAA in G2 is the NBS-equal increments, while in G3 it is not.

The choices in ROUND 2 show the same pattern as in Round 1, but are different in value. The big difference lies in the increase in the number of subjects who choose the sophisticated strategy with respect to the strategies leading to the two Pareto dominant outcomes. Only in game 3 the Pareto dominant outcomes attracts more choices (42%) than SC (29%). The number of AUU choices is different. It nearly doubles from G2 to G3.

- In G1 no subject chooses the resolute strategy. 71% of the subjects choose the sophisticated strategy and 25% AUU.
- In G2 63% of the subjects behave according to sophisticated choice, only 4% follows the Nash strategy and 13% of subjects chose the simple resolute one.
- In G3 less than half of the subjects (29%) chose the sophisticated strategy, 25% choose the Nash bargaining strategy and 17% the simple resolute one: the Nash-equal increments attracts more choices, probably due to the fact that AUA yields the maximum payoff for player A.

The change in the results from Round 1 to Round 2 is due to interaction (most of the times subjects who chose a resolute strategy happened to be paired with sophisticated subjects) between the subjects. Few subjects adopt the sophisticated strategy in round 2 because they believe *a priori* that it is the rational strategy to follow according to a backward induction reasoning.

5. The players' motivations for choice

In the course of the experiment subjects were asked to discuss each of their decision with the other components of the group.

The motivations of the subjects as they emerge from the tape transcripts have been grouped according to the patterns of choice adopted by each subject in these games.

The strategies adopted by the subjects have been divided in four groups according to the outcome they lead to:

1. Strategies which lead to a non Pareto dominant outcome in all the three games: 29% of subjects adopt this pattern of choice. Three kinds of strategies fall in this group: (i) UUU in all games; (ii) (UUU,UUU,AUU) that is, UUU in G1, UUU in G2, AUU in G3; (iii) AUU in all games.
2. Strategies which lead to a non Pareto dominant outcome in G1 and G2, and to a Pareto dominant outcome in G3: 29% of the subjects adopt this pattern of choice. Three kinds of strategies fall in this group: (i) UUU in G1 and G2, AAA in G3; (ii) UUU in G1 and G2, AUA in G3; (iii) AUU in G1 and G2, AUA in G3.
3. Strategies which lead to a non Pareto dominant outcome in G1, and to a Pareto dominant outcome in G2 and G3: 21% of the subjects adopt this pattern of choice. Five different strategies have been played which lead to a non Pareto dominant outcome in G1 and to a Pareto dominant outcome in G2 and G3: (i) UUU,AAA,AUA; (ii) UUU,AAA,AAA; (iii) AUU,AUA,AUA; (iv) AUU,AUA,AAA; (v) AUA in all games.
4. Strategies which lead to a Pareto dominant outcome in all the three games: 17% of the subjects adopt this pattern of choice. Two patterns of choice fall in this group: (i) AAA,AUA,AUA; (ii) AAA in all games.

A full description of the subjects' motivations in this order is given in the Appendix.

This way of grouping decisions considers the pattern of choice of each subject in all the three games. It respects the logic of the structure of the experiment, and also allows to verify whether the suppositions about the subjects' choices have been confirmed. Besides, it shows that all subjects apart from one have adopted a choice pattern which falls in one of the four groups. In the following section the subjects' motivations for choice of different outcomes are described.

5.1. Motivations for the Sophisticated Choice outcome

In group (1) all subjects who choose always UUU motivate their choice with a backward induction reasoning. They think that the (50,50) outcome is unfeasible, even though optimal from an efficiency point of view; and the AUA strategy is incoherent, even though it implies Up for player A in box 3. Still these subjects recognise that in game 2, and more so in game 3, there is a stronger incentive for player B to go along, thus showing the relevance of the payoff structure of the games. These considerations offer a reason to point (1) in the results.

The AUU strategy differs from UUU (see point (3) in the results), as it implies an attempt to send player B a signal that player A wants to cooperate, but with the declared intention to "fool" him. This is justified by the consideration that moving along cannot have any cooperative meaning.

For the subjects whose choices fall in group (2), the backward induction reasoning holds for game 1, but stronger is the recognition of the different incentive to move along due to the payoff structure in game 2 and also in game 3, as it is reflected in their choices.

For the subjects of group (3), the 50,50 outcome is clearly the optimum, but it cannot be chosen because it is difficult to trust one's opponents in this game, and also because there is no possibility to communicate each other's intentions. Recourse to a backward induction reasoning is much less strong here.

5.2 Motivations for Pareto dominant and Pareto dominant-Nash bargaining solution outcomes

Let us consider now the motivations for Pareto dominant and Pareto dominant-NBS as they emerge from the subjects' discussion in relation to each game. This allows to see whether and how choices are influenced by the payoff structure. Besides, choices may be considered also in relation to the strategy that they imply, in order to see whether and how they are influenced by the strategy adopted: for example, a subject who chooses to move along always may have the same motivations in every game for any outcome.

(i) Pareto dominant outcome in game 1.

It implies playing along always. 4 subjects choose in this way, all belong to group (4) mentioned above.

The reason more often stated for choosing the Pareto dominant outcome is the maximisation of the sum of the players' payoffs: the 50,50 outcome guarantees that no tickets get wasted, that is, at least one of the two players will win the lottery. A further support to this choice is given by that subject (subject 1 in session III, group 2) who wants to share the prize with his opponent in case he wins the lottery.

Besides, playing along as player A is seen as a sign of 'fair play'; and a reward to player B for trusting A and moving along in box 2 ("feel fair to give B more"). Another reason for playing along is to build a reputation (of a "cooperative" player).

Sometimes to play along is seen as a provisional strategy, to be changed in the following round, in case the opponent does not coordinate on the same strategy. The subjects think the risk is worth taking, so that they do not end up always with a low outcome.

(ii) Pareto dominant outcome in game 2.

It implies playing AUA, along in box 1 as A, along in box 2 as B, up in box 3 as A. 5 subjects choose in this way, 3 belong to group (3); 1 to group (4); 1 to no group.

One reason to move along is the fact that B is more likely to move along here than in game 1, as he is losing less in case A goes up instead of along in box 3 [(40-45) in place of (25-45)]. According to another subject, player B may well try and gain 5 tickets (50-45); furthermore, B has only 5 to lose. One subject (group (4)) confirms the convenience of this option by offering to compensate B for A's winnings: the sumof 100 tickets is still the reason for going to box 3.

(iii) Pareto dominant outcome in game 3.

It implies playing along always. 8 subjects choose in this way. 3 belong to group (2); 2 to group (3); 3 to group (4).

The highest sum motivation is shared by all subjects. It is noted by two subjects (group (2)) that following a backward induction reasoning gives only 40 tickets in total, so that at least in box 1 player A should choose Along. Differently, it is also an advantage to player A, as it is better to lose 10 (by playing along instead of up in box 3) than to get only 30 (by playing up in box 1). This subject adds that "being irrational is better".

Playing along is also seen as a favour to player B (similarly as before). Furthermore (subject in group(3)), playing along as A in box 3 is considered as a sign of "perfect coordination": player B "pulls up" player A from 20, and player A exchanges the favour by leaving player B with 50.

For all subjects, in game 3 a relevant element for choice is the fact that the payoff structure is different: B has a less strong incentive to go up. Besides, (group (3)), up as A in box 3 is seen as taking advantage of B. By going along, A allows B to "use his pass" in box 2.

(iv) Pareto dominant-Nash bargaining solution outcome in game 2.

It implies playing along always. 5 subjects choose in this way. 2 in group (3); 3 in group (4).

Again it is mentioned that difference in payoffs matters: B has more incentive to go along, as he loses less than before (5 instead of 20 tickets), and gains 5 tickets by trusting A to go along (50-45). Only one subject (group 2) does not consider the difference as important. An element in persuading A to move along, is that A only loses 10 by going along in box 3 (50-60).

(v) Pareto dominant-Nash bargaining solution outcome in game 3.

It implies playing AUA. 8 subjects choose in this way. 4 belong to group (2); 3 to group (3); 1 to group (4).

As for game 1, the highest sum is a common motivation (the 50,50 outcome guarantees that no ticket gets wasted; the UUU strategy is to the advantage of those who run the lottery). As far as player B's choice is concerned, it is observed that going along in box 2 for B is still better, even if A goes up in box 3 (B gets 40 instead of 10). This underlines the importance of the Pareto dominance of the last two outcomes with respect to the Sophisticated Choice outcome. As for player A, it is a problem to choose along in box 3 (it is considered as "giving money as a gift"); but at the same time also choosing up in box 3 may be a problem, as it would take reasoning back to backward induction (still the subject who supports this view chooses to go up in box 3 as A).

Three subjects justify moving up as A in box 3 by arguing that at that point A has already given B the chance of getting 45 instead of 10. Besides one subject (subject 3 Session II GII, group 3) says that in this way A is giving both players the same additional 30 tickets with respect to the (30,10) SC outcome, thus explicitly advocating an equal increments argument.

From the subjects' discussion it results that the most common motivations for playing Pareto dominant or Pareto dominant-NBS are: the highest sum of tickets, that is, the absence of waste associated with a Pareto dominant outcome; A's idea of rewarding B for his trust; a general concept of Pareto dominance. As mentioned earlier in this section, another minor motivation for playing a Pareto dominant/Pareto dominant-NBS is to build a reputation for a "cooperative player".

When reaching a Pareto dominant/Pareto dominant-NBS outcome is associated with playing along in box 3 as A, this move is justified as a reward to player B for having trusted A (fairness towards B). On the contrary playing up in box 3 as A is considered as taking advantage of B.

When reaching a Pareto dominant/Pareto dominant-NBS outcome is associated with playing up in box 3, many subjects refer to the fact that A has already given enough to B, so that playing up is not unfair to B. One subject refers directly to an equal increments argument. In the other cases it depends on the fact that moving up in box 3 allows A to maximise his payoff.

However these are not the only reasons to play a Pareto dominant/Pareto dominant-NBS outcome. Other motivations are present in games 2 and 3, which are connected with the payoff structure of these games.

In game 2, B is more likely to play along than in game 1, given that in game 2 B risks to lose less tickets if A goes up in box 3 (only 5) with respect to going up in box 2 if A goes along in box 1; besides B might gain 5 tickets by trusting A to go along in box 3. The fact that B is more likely to move along in box 2 is an incentive for A to move along in box 1.

Playing along as A in box 3 (as playing Pareto dominant/Pareto dominant-NBS in game 2 implies) is better to A as well, because for A it is better to lose 10 tickets by not playing up in box 3 than to end up with 30 (the SC outcome).

The same reasoning is given for Pareto dominant in game 3, which implies playing along as A in box 3.

This element is even stronger in game 3, where B gets only 10 tickets in correspondence to the SC outcome, which explains point (10) of the results.

As suggested before, this shows that the structure of the payoffs is crucial (mainly the difference for B between the outcome he gets if A plays up in box 3 and the outcome he gets if he plays up in box 2). This is indicated by the fact that in games 3 and 2 the number of Pareto dominant/Pareto dominant-NBS outcomes chosen is much higher than in game 1, as it emerges in points (4), (6), (7) and (8) of the results.

The choice of a given strategy does not lead to choice of a Pareto dominant/Pareto dominant-NBS, in fact the opposite is true. It can only be said that playing along as A in box 3, following a motivation of Pareto dominance or fairness to B, will make the player going to the end of the game, without considering which of the two Pareto dominant outcomes is chosen. This is in line with points (5) and (9) of the results.

Therefore, it may be useful to consider more closely how subjects choose between the two Pareto dominant outcomes in games 2 and 3.

5.3 Subjects' choice between Pareto dominant and Pareto dominant-Nash bargaining solution outcomes

The motivations to be considered here are a subgroup of those considered when the choices for PD and PD-Nash bargaining solution outcomes in each game were introduced. A recapitulation of these motivations will be given in the Appendix.

I intend to see here which of the two Pareto dominant outcomes has been chosen, in order to see whether the NBS is a possible prediction of Resolute Choice in this case, and if so why.

It is in fact interesting to know whether the subjects differentiate their strategies to choose one specific outcome between the two: if they do not, why the same strategy (for example along always) is chosen? If they do, who plays always NBS and why? Who plays always Pareto dominant and why? Is the number of players who choose always the Pareto dominant outcome higher than those who always choose the Pareto dominant-NBS?

From the subjects' motivations it results that only one subject explicitly differentiated his strategy choice in order to select in both games the NBS-equal increments outcome.

In fact, this is the only case when a Pareto dominant-NBS outcome is chosen explicitly with an equal increments argument, and the choice between the two Pareto dominant outcomes is reasoned, justified by properties of NBS. In all other cases, most of the subjects choose Pareto dominant in one game and Pareto dominant-NBS in the other.

The choice of an outcome seems more driven by the strategy it implies. When playing Pareto dominant-NBS means playing AUA, going along is driven by considerations relative to the payoff structure of the games, while going up at box 3 is justified by the high enough reward obtained by player B with respect to the SC outcome.

When Pareto dominant-NBS means playing AAA always, considerations are diverse and imply the concept of Pareto dominance, but lead the subject to choose the 50,50 outcome independently of whether it is NBS or not.

This offers an explanation of points (5), (9) and (11) of the results.

6. An alternative way to look at the subjects' choices

As mentioned above when discussing about the experiment design, the method used in the experiment to elicit the subjects' responses is the strategy method. A direct consequence of this is that the results are all in terms of strategies chosen by subjects. An alternative to this design would have been to have the subjects play out the games and register the outcomes resulting from interaction.

In view of this, an alternative way to look at the experiment results could be tried, which consists in a simulation of the outcomes of the game that would have resulted had the subjects played the games directly.

Tables 2 and 3 give the percentages of subjects who played the different strategies in the different games and rounds. They also represent for each game and play the probability that a subject would play a certain strategy.

If one considers matching any two subjects who actually played the experiment, one can calculate the probability of occurrence of any of the four outcomes (for each of the three games and two rounds) in case the subjects in the experiment had played the games interacting directly.

Let us consider the following table. The strategies in the rows are played by the A players and the ones in the columns are played by the B players. By crossing the strategies played by an A and a B player it is possible to obtain the outcome that would have occurred from the matching.

	UUU	**UAU**	**AUU**	**AUA**	**AAA**
UUU	*d*	*d*	*d*	*d*	*d*
UAU	*d*	*d*	*d*	*d*	*d*
AUU	*c*	*c*	*c*	*b*	*b*
AUA	*c*	*c*	*c*	*b*	*b*
AAA	*c*	*c*	*c*	*a*	*a*

The five strategies were actually played by subjects in the experiment with a certain probability *p*, given in Tables 2 and 3. If one knows the probability with which each strategy has been played, one can obtain the probability of occurrence of each outcome from the direct interaction of an A and a B player.

Consider p_1 to be the probability that the strategy UUU is played, p_2 the probability of UAU, p_3 the probability of AUU, p_4 the probability of AUA and p_5 the probability of AAA.

Then, for example, the probability that outcome *c* occurs is equal to the probability that player B plays Up at the second node ($p_1 + p_2 + p_3$) - that is, the sum of the probabilities that the strategies

UUU, UAU and AUU are played - times the probability that player A plays Along at the first node ($p_3 + p_4 + p_5$) - that is, the sum of the probabilities that the strategies AUU, AUA and AAA are played.

The probabilities of occurrence of the different outcomes are shown below in a simplified game diagram:

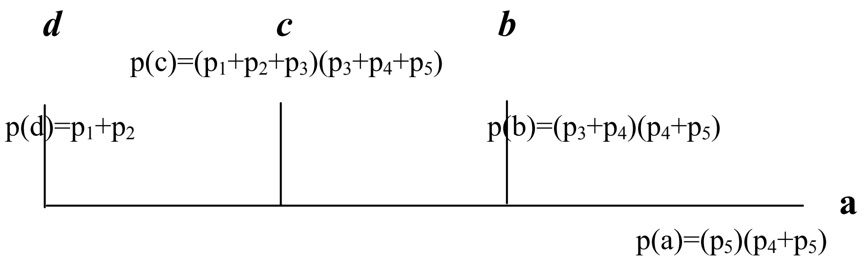
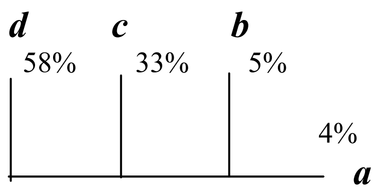


Figure 2 – Probabilities of occurrence of the different outcomes from the interaction of an A and a B player in the experiment

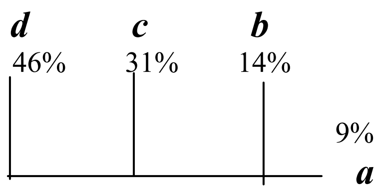
Therefore, by knowing the probability with which each strategy has been played by the subjects in the experiment (Tables 2 and 3), it is possible to calculate (for each game in each round) the probability with which the different outcomes would have occurred in case the subjects had interacted directly.

These are given below in 6 diagrams which show - for each of the three games in the two rounds - how often the outcomes would have occurred from the random interaction of the A and B subjects, on the basis of their strategy choices in the experiment.

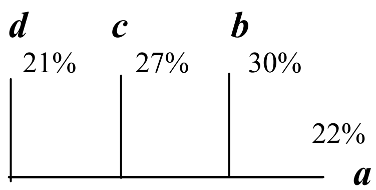
ROUND 1



GAME 1

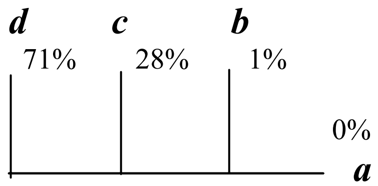


GAME 2

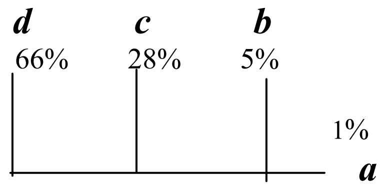


GAME 3

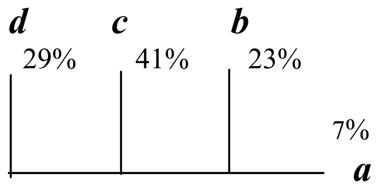
ROUND 2



GAME 1



GAME 2



GAME 3

As far as the Sophisticated Choice outcome *d* is concerned, two things can be noted. In both rounds, its probability of occurrence reaches very high levels in Game 1, but also decreases considerably through games.

In Round 1, it occurs 58% of the times in Game 1, 46% in Game 2 and 21% in Game 3, where its probability of occurrence is less than half than that of Game 1.

The probability of occurrence of the Sophisticated Choice outcome is always higher in Round 2 with respect to Round 1. It reaches the highest value in Game 1 (71%) and decreases in Game 2 (66%); the lowest probability is always in Game 3 (29%), again less than half the level it has in Game 1.

It should be noted also that in both rounds the probability that the SC outcome occurs from interaction is higher than the probability of reaching a resolute outcome in Game 1 (when there is one such outcome) and also in Game 2 (where there are two such outcomes). Only in Game 3 this does not occur.

The Resolute Choice outcome is *a* in Game 1; and in Games 2 and 3 there are two Resolute Choice outcomes, *a* and *b*. The chance of getting to a Resolute outcome is extremely low in Game 1 (4%) in Round 1, and goes to 0% in Round 2.

The chance that players get to a Resolute Choice outcome is higher in those games where there are two such outcomes. In Round 1 it sums up to 23% in Game 2 and increases to 52% in Game 3. In Round 2, the same probability is still very low in Game 2 (only 6%), while it increases considerably in Game 3 (30%).

Only in Game 3 the probability of reaching at least one of the resolute outcomes is higher than the chance of getting to the sophisticated one. This is true for both rounds, even if the difference between the two probabilities is of 31% in Round 1 while it nearly disappears (1%) in Round 2. Besides, only in Game 3 in Round 1 the probability of getting to a resolute outcome is higher than the probability of getting to any other outcome.

In Games 2 and 3 one of the two Pareto dominant Resolute choice outcomes is also the Nash solution to the game seen as a bargaining game, which is also the Pareto dominant outcome that gives equal increments of tickets to both players with respect to the sophisticated outcome. This outcome is *a* in Game 2 and *b* in Game 3.

In Round 1, the probability of this outcome occurring is highest in Game 3 (30%); it is only 9% in Game 2. This occurs also in Round 2, even if the probabilities are lower (23% and 7%).

With respect to the other Resolute Choice outcome, the Nash solution is more likely to occur only in Game 3 in both rounds. The difference between the two outcomes is of only 8% in round 1, but is higher in round 2 (16%). In Game 2 the probability that subjects go to the Nash bargaining outcome is lower than the chance of playing the other resolute outcome in both rounds.

From these results not much can be inferred on the relevance of the resolute outcome being the Nash solution to determine its occurrence. The probabilities of both Pareto dominant outcomes increase from Game 2 to Game 3, but outcome *b* is always more likely to occur than outcome *a*, whether it is or it is not the Nash bargaining solution.

One result that emerges is the frequency of occurrence of the *c* outcome. This outcome is not consistent with any of the choice models considered: it does not correspond to sophisticated behaviour, nor can it be reached by behaving resolutely, as it is never Pareto dominant with respect to the sophisticated outcome.

In Round 1 *c* occurs always more than one fourth of the times, 33% of the times in Game 1, 31% of the times in Game 2, 27% in Games 3. In Round 2 it occurs with a slightly lower probability than in Round 1, with the exception of Game 3, when the chance of outcome *c* occurring is 41%. It occurs more frequently than the sophisticated outcome only in Game 3, in both rounds.

There are many strategy combinations that can generate outcome *c*. It will result from interaction whenever the A player adopts a strategy where the first move is Along and player B adopts a strategy where the second move is Up. As noted above, there is no straightforward explanation for the occurrence of outcome *c*, at least not on the basis of the models of choice considered here. Again it is interesting to note that the simulation of the subjects' interaction, on the basis of their strategy choices in the experiment, has given a result that did not emerge from the analysis of the subjects' choices for strategies.

7. Conclusion

The results show a very different behaviour of subjects in the different games. The Sophisticated choice strategy is chosen by around half of the subjects in Games 1 and 2, while this number drastically diminishes in Game 3. The pattern of choices is similar in the second round, after interaction has taken place.

Choices for the resolute outcomes follow a similar but inverse pattern: they are much higher in Game 3 than in Games 1 and 2. No clear cut difference is found between the resolute strategy as straight Pareto dominance and the resolute strategy as Nash bargaining.

The motivations expressed by the subjects in the group discussion, which are the main feature of the qualitative experiment, turned out to be very useful in understanding and interpreting the results. They revealed that choice for a Pareto dominant outcome is mainly driven by the idea of Pareto optimality itself. Motivations differ slightly when the strategy leading to a Pareto dominant outcome differs. If AAA is chosen, an idea of fairness towards the other player is present; when AUA is chosen, the tendency to maximise one's own payoff is stronger. A clear motivation to choose the NBS outcome does not seem to emerge. The choice of one particular Pareto dominant outcome seems to be driven more by the considerations which determine the choice of up or along in box 3 as A.

A result to be noted is the relevance of the payoff structure of the games in motivating choice. Games that are identical in their structure and equilibria, but different in their payoffs, induce different choice behaviour.

Due to the experiment design, the subjects' responses are all in terms of strategy choices. An alternative design would have been to let the subjects play the games and register the resulting outcomes. Therefore, an alternative way to look at the experiment results has been considered, by simulating the outcomes of the games that would have resulted had the subjects interacted directly.

In general, these results do not seem to lead to conclusions which are much different from the ones obtained in terms of strategy choices. One exception is the high frequency of occurrence of the *c* outcome. Difficult to explain in terms of the strategy models considered, it represents an improvement of simulating the subjects' interaction with respect to only considering the subjects' choices in terms of strategies.

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9. Appendix

Table 1 – Preference combinations which allow to compare MC, SC and RC

	(i) No outcome Pareto dominant over SC	(ii) 1 outcome Pareto dominant over SC (different from MC)	(iii) 1 outcome Pareto dominant over SC (equivalent to MC)	(iv) 2 outcomes Pareto dominant over SC (1 is equivalent to MC)
(1) SC : c MC : a	A: a≻c≻b≻d B: b≻c≻a≻d	A: a≻b≻c≻d B: b≻c≻a≻d		
	A: a≻c≻b≻d B: b≻c≻d≻a	A: a≻b≻c≻d B: b≻c≻d≻a		
	A: a≻c≻b≻d B: b≻d≻c≻a	A: a≻b≻c≻d B: b≻d≻c≻a		
	A: a≻c≻d≻b B: b≻c≻a≻d			
	A: a≻c≻d≻b B: b≻c≻d≻a			
	A: a≻c≻d≻b B: b≻d≻c≻a			
(2) SC : c MC : b	A: b≻c≻a≻d B: a≻c≻b≻d	A: b≻a≻c≻d B: a≻c≻b≻d		
	A: b≻c≻a≻d B: a≻c≻d≻b	A: b≻a≻c≻d B: a≻c≻d≻b		
	A: b≻c≻a≻d B: a≻d≻c≻b	A: b≻a≻c≻d B: a≻d≻c≻b		
	A: b≻c≻d≻a B: a≻c≻b≻d			
	A: b≻c≻d≻a B: a≻c≻d≻b			
	A: b≻c≻d≻a B: a≻d≻c≻b			
(3) SC : d MC : a	A: a≻d≻c≻b B: b≻c≻d≻a	A: a≻b≻d≻c B: b≻c≻d≻a	A: a≻d≻c≻b B: b≻c≻a≻d	A: a≻b≻d≻c B: b≻c≻a≻d
	A: a≻d≻c≻b B: b≻d≻c≻a	A: a≻b≻d≻c B: b≻d≻c≻a	A: a≻d≻b≻c B: b≻c≻a≻d	
	A: a≻d≻b≻c B: b≻c≻d≻a			
	A: a≻d≻b≻c B: b≻d≻c≻a			
(4) SC : d MC : b	A: b≻d≻c≻a B: a≻c≻d≻b	A: b≻a≻d≻c B: a≻c≻d≻b	A: b≻d≻c≻a B: a≻c≻b≻d	A: b≻a≻d≻c B: a≻c≻b≻d
	A: b≻d≻c≻a B: a≻d≻c≻b	A: b≻a≻d≻c B: a≻d≻c≻b	A: b≻d≻a≻c B: a≻c≻b≻d	
	A: b≻d≻a≻c B: a≻c≻d≻b			
	A: b≻d≻a≻c B: a≻d≻c≻b			

The strategies and motivations of subjects

The strategies adopted by the subjects are divided in 4 groups and their motivations, as they emerge from the tape transcripts, are described accordingly:

1. Strategies which lead to a non Pareto dominant outcome in all the three games;
2. Strategies which lead to a non Pareto dominant outcome in G1 and G2, and to a Pareto dominant outcome in G3;
3. Strategies which lead to a non Pareto dominant outcome in G1, and to a Pareto dominant outcome in G2 and G3;
4. Strategies which lead to a Pareto dominant outcome in all the three games.

1. Three kinds of strategies have been played which fall in this group: (i) UUU in all games; (ii) (UUU,UUU,AUU) that is, UUU in G1, UUU in G2, AUU in G3; (iii) AUU in all games. 29% of the subjects have adopted this pattern of choice.

i) The four subjects who choose to go up in all games are the subjects of group I, session III.

Game 1. All subjects apart from one motivate their choice with a backward induction reasoning. They consider (50,50) as unfeasible, given the noncooperative structure of the game; an outcome which is "optimal because all the tickets get distributed, but non optimal from the point of view of the subject who takes the decision at the moment in time".

Subject 1 outlines the possibility of getting to a 'better' outcome in every game. Game 2. Subject 1 also decides to play along in G2, but retreats his decision in G3 in view of the determination of the other players in the group. Other subjects perceive G2 and G3 as different from G1: in G2 player B's payoff if A goes up in box 3 is higher than in G1, so that B loses less in this case, as the difference with respect to B going up in box 2 is smaller.

While subject 1 suggests that going along as B in G2 could be used to send the other group "a signal that there is an intention to reach the optimal 50,50 outcome", all the others consider UUU as the only strategy. On the one hand, going along in box 3 is "irrational" for player A, unless there is the possibility of a binding agreement; on the other hand, even if going AUA is justifiable in terms of "efficiency" (both 50,50 and 60,40 use up all the tickets available), it is "incoherent".

Game 3. In G3 all the subjects notice that there is a stronger incentive for B to go along. For player 1 this should induce A to go along in box 1, while up in box 3 for A is justified by the presence of equal increments: "B has already earned a lot by A going along in box 1".

ii) UUU,UUU,AUU. Subject 4 in session I, group II follows a backward induction reasoning. Given that A cannot be trusted to go along in box 1 in the absence of any agreement, there is no reason for B to go along in box 2. Besides, he excludes the possibility that going along as A might be perceived by the other players as "a sign of good will". In G3, where he chooses AUU, he expresses a doubt that it might be sensible to try, but does not give any explanation.

iii) In the same group, subjects 2 and 3 played AUU in all games. For both subjects the strategy for A is along in box 1 and up in box 3. According to subject 3, going up is "rational according to subgame perfection", and going along in this case has to be interpreted as a signal for B that A wants to "share the probability". But the intention is "to fool them". Subject 2 thinks to "randomise" to get more chances, choosing along as A and up as B. However, it is important to look at the incentives for A and B not to behave cooperatively: by moving along A loses 10 (60-50), and B loses only 5 (50-45) (this is what A loses by moving along in box 3, and B loses by moving up, given that A moves along in box 3). As the incentive is higher for A, he is induced to play up. Besides, subject 2 distinguishes between two different approaches to play, the "rational criteria" and the "fairness idea", which inform choice a priori. Moving along has no cooperative meaning, it is chosen to get an outcome better than 30: therefore B cannot "interpret it as a cooperative behaviour".

2. Three kinds of strategies fall in this group: (i) UUU in G1 and G2, AAA in G3; (ii) UUU in G1 and G2, AUA in G3; (iii) AUU in G1 and G2, AUA in G3. 29% of the subjects adopted this pattern of choice.

i) UUU,UUU,AAA is chosen by subjects 1 and 4 in session I group I, and by subject 4 in session II group II.

Game 1. Backward induction reasoning is found convincing in G1, given that "nobody believes in the goodness of heart of the players downstairs", as player 1 says.

Game 2. In G2 subjects 1 and 4 note that B undertakes less risk in moving along in box 2, while he gains the chance of getting to the end, even if he is not to gain much anyway (only 5 tickets). According to subject 1 A might think of going along in box 3, as he has chosen along in box 1, still going up for A seems to both players the reasonable strategy to adopt. The MTP argument, introduced by subject 1, is not convincing for subject 4.

Game 3. According to subject 1, in G3 playing along is intended by player A as a "favour" to player B, who ends up with only 10 tickets if player A goes up in box 1. Besides, A should go along all the way, in order to try to reach a "solution of compromise" in this game. However, player A has himself an advantage in going along to the end of the game, even if by going along and not up in box 3 he loses 10 tickets: it is better to sacrifice 10 tickets, than to end up always with 30. Being "irrational" is better. Subject 4 accepts subject 1's argument, and is convinced that one should risk more, and go along.

Game 1. Subject 4 in session II does justify playing UUU in G1 by a backward induction reasoning: as player A has a strong incentive in going up in box 3, player B will choose to go up in box 2. Even if A does play along in box 1, he might well be doing that to induce B to go along, and then act "noncooperatively" in box 3. Games 2 and 3. The same reasoning probably holds for G2, but no motivation is given. Although the choice in G3 is different, it is not discussed by the subject. One might think that subject 4 follows the general reasoning, according to which it is worthwhile to go along as B in the second box (as the tickets attached to UUU are only 10 to B), and along as A at least in the first box (as the total amount of tickets attached to UUU is only 40).

ii) The pattern UUU,UUU,AUA is adopted by subjects 2 and 3 in session I group I, and by subject 1 in session II group II.

Game 1. Backward induction reasoning motivates choice in G1.

Game 2. As far as G2 is concerned subject 2 notes that "here it is convenient to collude", as also B might find it convenient to be at box 3, or better he loses less than in G1; on the other hand A risks 10 tickets by going along, but can gain up to 20 or 30 tickets if he reaches box 3. According to subject 3, if it is true that B gains more by going along with respect to game 1 (he gets 40 instead of 25), he also gains little, as noted by subject 1, only 5 tickets (50-45), and is therefore not likely to choose along. Besides B knows that A will go up in box 3 -"it does not make sense not to go out"- and will therefore go up at box 2. This argument persuades subject 2 also, who at the end decides to play UUU.

Game 3. The reaction is different in G3. According to subject 3, even if "at the end of the day it is always the same thing", that is, the backward induction reasoning applies, it is also true that the UUU strategy is at the advantage of those who run the lottery. Thus subject 3 suggests that the logical strategy to play is AAA, since if one decides to play up as A in box 3 backward induction reasoning applies; however at the end he decides to maximise the number of tickets in box 3. Subject 2 hesitates: he is willing to risk the 5 tickets as B, but fears that the others will go up as B and leave him with 20 as A. He agrees that 50,50 is the solution which allows not to waste any ticket, but is not convinced A should go along in box 3. Subject 1 in session II group II states his decision to go up in G1 and G2, but does not give any explanation. As all the subjects in his group have chosen UUU in G1, one might think that his reasons conform to the ones of the other subjects for this game, and to the one of subject 4 in G2, where he disagrees with subjects 2 and 3. In G3 he does not comment or state his choice, which is the same as player 2.

iii) AUU,AUU,AUA. Subject 2 in session III group II adopted this pattern of choice.

Game 1. As player A the decision is to play up in box 3 in order to get the 60 tickets. However, in box 1 A might well decide to go along, thinking that B will move along "for the final 50,50 share". As B in the second box the decision is to go up: in box 3 B can get only 5 tickets more than in box 2. The outcome of "maximisation" is 60.

Game 2. Decision is the same as in game 1. B in box 2 has the "second highest probability", so he will go up there.

Game 3. The decision is for along in box 2 but no comment is made.

3. Five different strategies have been played which lead to a non Pareto dominant outcome in G1 and to a Pareto dominant outcome in G2 and G3: (i) UUU,AAA,AUA; (ii) UUU,AAA,AAA; (iii) AUU,AUA,AUA; (iv) AUU,AUA,AAA; (v) AUA in all games. 21% of the players have adopted this pattern of choice.

i) Subject 2 in session II group II plays UUU,AAA,AUA.

Game 1. In game 1 the decision for players A and B is to go up. While 50,50 is the "best way to go", the possibility of getting there depends on whether both think that 50,50 is the best. Besides, the structure of the experiment is such that there is no way of "testing" one's opponent's behaviour, as decisions have to be made before interaction takes place. Player A can decide to go along in box 1 only if he thinks that B will do the same in box 2. However, B has much to lose by going along [25-45 if A goes up in box 3] and little to gain [50-45 if A goes along in box 3]. Besides, B cannot trust A to go along in box 3. For B it is impossible to understand whether A goes along in box 1 to go to the 50,50 outcome or to cheat B and get 60. UUU is motivated by the fact that there is no reason for the players to trust each other.

Game 2. In game 2 the decision for A and B is to go along. A will lose 10 by going along in box 3 [50-60 if A goes up in 3], but B is more likely to go across. By going along in box 2 B risks to lose 5 [40-45 if A goes up in box 3] instead of 20 in game 1 [25-45], and gains 5 [50-45 if A goes along in box 3].

Game 3. In game 3 subject 2 decides to go along as B, and to go along in box 1 and up in box 3 as A. Even if A goes up in box 3, for B it is better to go along than to get the UUU outcome of 10. On the other hand, A may well go up in box 3: "at least you are giving B the chance of winning more than 10". Besides, by going up in box 3, A increases the chances of both players by 30 tickets [60-30 for A; 40-10 for B], rather than increasing B's chances by 40 [50-10] and his own by 20 [50-30]. In addition, A risks 10 [30-20] to give B the chance of getting 40.

ii) UUU,AAA,AAA.

For subject 3 in session II group II only two choices are possible in game 1: up immediately and along all the way. The advantage of the 50,50 outcome is that both players have the same 50% chance of winning the lottery, and that no tickets get wasted. Indeed, the fact that the total probability of the UUU outcome is only 60% constitutes the incentive to go along. However, there are two reasons to go up immediately: "the question of trust" and the absence of "any kind of feedback". In fact, the absence of feedback is itself the reason for the lack of trust. A cannot trust B and B cannot disentangle the true reason why A went along in box 1.

Game 2. In game 2, as argued by subject 2 in (i), B has a "less strong incentive to go up": he loses only 5 and gains 5 tickets by "trusting a bit" A to go along.

Game 3. In game 3, for B the situation is the same as in game 2. A has to go along at least in box 1, because the total number of tickets won for UUU is only 40. Up in box 3 for A is "a bit taking advantage" of B. One has not to think too much of what B will do.

iii) AUU,AUA,AUA is adopted by subject 3 in session III group II.

Game 1. In game 1, the decision for A is to go up in box 3. Then, B has no incentive to go along. He has 20 tickets to lose from box 2 to box 3 [25-45 if A goes up in box 3], while A will only lose 10 [he probably refers to 50-60 if A goes along in box 3, but it could also be 20-30 if B goes up in box 2]. If B does not go along in box 2, A has no incentive to go along at box 1. Up all the way or along all the way are the only possibilities. However, it is difficult to go along in the second box, because B can get only an extra 5, but can equally get 20 less, while by going up he gains 45. As A one can take the risk of going along in box 1.

Game 2. Again B has a problem in moving along in box 2, as "I fight with myself that there won't be a person like me nor a person like you (subject 1) once we go across". The final decision however is to go along.

Game 3. By going along in box 1 A is "really asking B to go along", as A is doing B "really a large favour" by not leaving him with only 10 tickets, that is, no chance of winning. Besides, A will go up in box 3, as he has done B the favour of moving on from box 1: A will leave B with 40, he could have left him with 10.

iv) Subject 4 in session III group II played AUU,AUA,AAA.

Game 1. B may want to go up because he gets a chance of 45%. If B relies on A going along at box 3, he assumes that A is "altruistic", as A can get 60% and leave B with 25%, not only maximising his own probability, but also minimising B's one. Up as B is not worth if the intention is to win a lot. However, the decision as B is to go up. For A it is not always better to go up all the time. A needs to build a reputation, since he is worse off in box 2 with respect to box 1 if B decides to go up. However, the decision as A is not to "reward" B in box 3. One can "gamble" in the first box, and take the chance of losing 10 tickets in the second, but in the third box the probability of winning is too high to go up.

Game 2. The decision differs in this game for player B, who goes along instead of up in box 2, where B can try and gain 5%. The expected gain of such a choice is positive, even if the reasoning is not clear. It seems to imply that if a "chance to collaborate" occurs, he might also gain "100%".

Game 3. The decision is to go along always. He notes that B has now "more incentives to win 45% of probability" and then to move up at box 2, "B earns 100% more than in game 2 at the same stage". Therefore, for A moving along is riskier, even if he is keen on risking to lose 10 tickets. However, subject 4 advocates "perfect coordination" when answering to subject 3's argument for playing up in box 3 as A: "I left B with 40 as player A in box 3, but he pulled you up from 20 to 60".

v) AUA in all games is adopted by subject 4 in session II group I.

Game 1. In game 1, A will go up in box 3, because by going along he would increase B's chances and decrease his own. As B knows that, he will go up at box 2, otherwise he risks to lose 20 [25-45] to gain 5 [50-45]. One gets an higher probability by going there as A than there as B, 105 [60+45] as opposed to 100 [50+50]. "As player B you get an higher probability without getting to the end, 105 versus 100, so you have an higher probability and reduce your opponent's one from 105 to 45". [This may mean that AUA is better because as A one gets 60, and as B one gets 45]. In games 2 and 3 B is more likely to move along; he is not losing as much as before, only 5 tickets [45-40], and still he gets 40, so he is more likely to take the risk of going along.

4. Two patterns of choice fall in this group: (i) AAA in all games; (ii) AAA,AUA,AUA. 17% of the subjects choose a Pareto dominant outcome in all the three games.

i) AAA in all games is chosen by subjects 1, 2 and 3 in session II group I. Subject 3's choice cannot be considered reliable, as the subject showed to have serious difficulties in understanding the games and the structure of the experiment itself. In the discussion about game 1 he said that 50,50 is preferable to everybody, but that the problem is how to get there. Still A is the best outcome for player A, and B would rather go up in box 2. Apart from a few requests for explanations, he did not contribute to the discussion any further.

Game 1. According to subject 1, "the others cannot know whether we'll go to 50,50: it is a question of our belief, what they think we'll do, up or continue. For A the best will not be reached because B will go up in box 2 being afraid that A goes up in box 3, and B won't choose at all, because A will go up". The 60 outcome for A is not the optimum, because the lottery "does not have the chance to win the money", as only some of the players get the money. It is a pity that one cannot play more times the same game, because one could see how the others play, know whether they "play fair or not" and then decide how to move. The chosen outcome is less than the final one, it is a big temptation to go up in boxes 2 and 3. But if one thinks this way, the outcome will always be low, nobody will be prepared to take the risk. Indeed, the basic problem is one of reciprocal trust. After the first box, A has to trust B, after the second box, B has to trust A. The question to answer is, if the others go along as A in box 1, will we go up as B in box 2, or interpret the move as a sign of "fair play", a sign that they want to go along? And would we take the risk to give A the chance? Subject 1 decides to go to 50 in the first game, and if the opponents do not play accordingly, to go for 30 in the second game (even if he talks about 'game' he has understood the structure of the experiment, and therefore refers to 'round').

Games 2 and 3. As for games 2 and 3, the incentive for A not to go up is less here than in game 1. The incentive for B to go along is higher, as B is not losing as much as in game 1. When subject 2 says that the difference is not important, subject 1 answers that it is connected with how much difference one wants and is ready to take. In game 3 the choice is obvious "according to our thoughts", because A is obviously going to win, but if he passes it is a sign that he wants to go to a higher point; A is able to win more than B. As player A one is giving B the chance to use one's pass, one shows not to be satisfied with 30, as B should not be satisfied with 45.

Game 1. According to subject 2, A in game 1 has no incentive to go along in box 3, as it would just be "to give money as a gift"; it could also be a sign that A wants to collaborate, but there is no reason why A should collaborate, as no communication is possible. One possibility is that the players in the other group have realised as well that the best option is 50,50 for everybody (when subject 1 says, the problem is not one of getting the highest probabilities, but of getting at all to the late stages of the game). Subject 2 is convinced that the fact of playing both as player A and as player B has to have an influence on the way of playing. The sum of tickets won is relevant because one plays both as A and B; by going to 50,50 the maximum amount of tickets is obtained. When subject 1 asks whether the choice would be for along or up in box 2 if A went along in box 1, subject 2 says that by being both A and B one is in fact interested in the sum of tickets, while were one only A or B the strategies chosen would be differently affected. A relevant aspect of this, when making inferences on the opponents' choices, is that "we are the other players, facing the same decision". Thus, given that as player B he would go along only if player A told him that he will go along in box 3, being he himself player A, he would go to 50,50. The choice in game 1 is for 50,50. It is not sensible to play so to react to the others' strategies, because there are only two rounds. However, after the first round one can have "a general feeling" and change one's play accordingly.

Games 2 and 3. As for games 2 and 3, in the group discussion it emerges that the incentive for B to go along is more here, as B is not losing as much as in game 1. However, subject 2 does not consider the difference so important, [given that the absolute value of the payoffs does not change]. The choice is for playing along in all the games.

ii) The pattern AAA,AUA,AUA has been chosen by subject 1 in session III group II.

Game 1. The problem of reputation is central. In game 1 subject A is "creating a reputation automatically" by moving across, still he might be "pretending" and go for 60. Without speaking a reputation is difficult to build. Still, a rational strategy is to go either up or along, as a reputation cannot be built otherwise. It seems better to go up for each player at every point: A will get 60, B will get 45. However, a possibility is that A recognises that B has more to lose from moving from 2 to 3 (20) than A (10), and therefore he would go along and feel "fair" to reward B with another 10 or another 25, as B risked in the hope A would be more "altruistic". In fact, in the game one estimates the probabilities of what the others are going to be. That is the reason why it does not make sense to move up as B in the second box and at the same time to go along as A in the first one: if one goes up, "one expects somebody else to do it". By giving up 60 and going along as A in box 3, he "just wants to make sure that one of us takes the money", which, he says, is a way of maximising. Besides, after maximising the sum, he wants to "split it up".

Game 2. The choice of the subject here is for up as A in box 3. For player B it is not "such bad a punishment" to go along at box 2, and "player A is not getting such a reward if he decides to go across". For player B there is a small difference in going across, he can gain or lose only 5 tickets. However, B knows that somebody is going to win if he goes across. Up as A is not a punishment for the other player. This is confirmed by the subject's intention "to compensate B and pay some money" after he wins.

Game 3, The subject confirms that there is no point in going up as players A and B in boxes 1 and 2. Moving up as player A in box 3 is "pretty fair", given that A still leaves B with 40 tickets instead of 10.

It is worth to mention the choice pattern of subject 1 in session I group II, which is the only one which does not fall in any of the four groups: UUU in game 1; AUA in game 2; UUU in game 3.

Consider game 1. 50,50 is the best outcome, in terms of "balancing out the chances for each side", and in terms of "mutual benefit", as one or the other player will surely win. The ideal for player A remains 60,25, which however relies on B. Up seems the most logical choice, even if tickets are half with respect to the end, because it is unlikely one will reach box 3, as backward induction reasoning predicts. In order to get to 50,50 one relies on "good will", whereas by being rational both sides are trying to get the least risk for the maximum outcome, that is, they quit in box 1. The possibility exists that in box 3 A might decide to sacrifice 10 tickets by going along instead of up to bring into play all the 100 tickets. B might interpret as a sign the fact that A went along from box 1 to box 2 and decide to go along in box 2 by "taking on trust" that, if A has thrown away 10 tickets from box 1 to box 2, he may well decide to throw away 10 tickets from box 2 to box 3. Besides B is always at a disadvantage apart from box 2 and the 50,50 outcome, while A cannot be happy of 30, and his ideal is 60 or 50,50. Then, both parties have an incentive to move on from box 1. From the view of maximum possibilities, boxes 1 and 2 are unattractive, while box 3 and 50,50 yield a high possibility. Again, there is a big incentive if both sides are "conspiring" by reading each other's intentions in boxes 1 and 2 to try and get to 50,50. In one sense A has a little incentive to go across. In box 2 he has a smaller probability of winning than in box 1 if he goes up; this is the only possibility he has to be cheated, as with 60 he gets 30 more, with 50 he gets 20 more. Player A's hope is that B assumes that A is trying to be cooperative and that B himself is cooperative. B has a big incentive to go along in box 2. In the hope that A will "keep his side of the bargain" and go along in box 3, B doubles his possibility of winning the lottery (50 instead of 25) and gets 5 more tickets than B would get did he decide to go up instead of along in box 2. However, all this is quite hypothetical, because the lowest risk outcome is up for A in box 1 and for B in box 2. Only there is a possibility that once I decide to go across and the other side reckons as a "game strategy and is prepared to cooperate". To sum up, waste of tickets is not important, difference in winning probabilities is not important, the highest chance is what matters, that is, the choice is up for A in box 3. For A there is a big incentive to "switch logic from cooperative to rational".

Subjects' motivations for choice between Pareto dominant and Pareto dominant-Nash bargaining solution outcomes

The motivations to be considered here are a subgroup of those which were dealt with when the choices for Pareto dominant and Pareto dominant-Nash bargaining solution outcomes in each game were introduced. In the following a recapitulation of these motivations will be given.

9 subjects out of 24 play one of the two Pareto dominant outcomes in both games 2 and 3.

(a) 4 out of 9 subjects choose Pareto dominant-NBS in game 2 and Pareto dominant in game 3, which implies playing along in both games. (3 of these subjects choose AAA also in game 1, one chooses SC in game 1) Motivations for Pareto dominant-NBS in game 2 concern the payoff structure of the game: B risks to lose less tickets (only 5) than in game 1 if A goes up in box 3, with respect to going up in box 2 if A goes along in box 1; and gains 5 tickets by trusting A to go along in box 3. Besides A only loses 10 tickets by going along and not up in box 3. In game 3, the payoff structure is still important. Besides the MTP motivation is present, so that along as A at least in box 1 should be played. A also has an advantage, as it is better for him to lose 10 tickets by playing along in box 3 than to get the SC outcome of 30. Playing up is seen by one of the subjects (the one who plays UUU in game 1) as taking advantage of B's trust, while by playing along A gives B the chance to use A's pass in box 1. By going along both players A and B show not to be satisfied with 30 and 45 respectively.

(b) 1 subject chooses Pareto dominant-NBS in both games 2 and 3, which implies playing AAA in game 2 and AUA in game 3. (He chooses UUU in game 1). This subject differentiates his strategy according to the outcome he wants to reach. He justifies Pareto dominant-NBS in game 2 with considerations on the payoff structure of the game. And he explicitly uses an equal increments argument to justify the AUA strategy which leads to a Pareto dominant-NBS in game 3: both players get an equal increase of 30 tickets with respect to the SC outcome; A has already given enough to B, by risking 10 tickets, to give B 40.

(c) 3 subjects choose Pareto dominant in game 2 and Pareto dominant-NBS in game 3, which implies playing AUA in both games. (1 plays AUA also in game 1, the other 2 play AUU and AAA in game 1). The motivations of these subjects are related to the payoff structure of the games. In both games (with respect to game 1), by going along in box 2 B risks to lose only 10 if A goes up in box 3, so that A may well go up without feeling too unfair. This is more true for game 3, where the gain for player B if A goes up in box 3 with respect to what he gets if A goes up in box 1 is much more than in game 1. One subject in game 2 also expresses the intention to compensate B in case he wins the 60 tickets as A. Note that this subject chose the Pareto dominant outcome also in game 2, while the others played AUA and AUU in game 1.

(d) 1 subject chooses Pareto dominant in both games, which implies playing AUA in game 2 and AAA in game 3 (he plays AUU in game 1). In game 2 choice is driven by considerations on the payoff structure of the game. In game 3, the choice for moving along as player A intends to reward B for moving along in box 2.

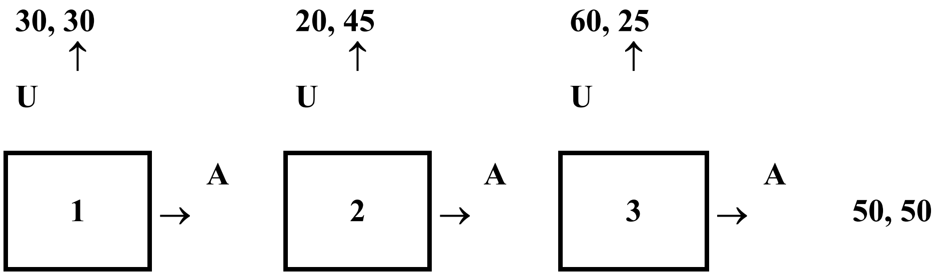
INSTRUCTIONS

In this experiment you will play three games, in which two players, player A and player B, alternatively have to decide whether to end or continue the game. A different pair of payoffs for the two players is associated with each decision.

What the players gain in each game are tickets for a lottery to be held twice over a £8 prize. There are 100 lottery tickets available, and every outcome of the game will give each of the two players a share of the 100 tickets (the sum of the tickets won by the two players may be less than 100). The number of tickets won determines the player's chance of winning the lottery prize, as it will be explained later.

The games you are going to play in this experiment are of the same kind. They have the same structure and differ only in the payoffs. Now consider, for example, Game 1.

GAME 1



BOX 1. The game starts. The total number of lottery tickets available to players A and B is now **60**, the other 40 tickets are kept by the experimenter and are not going to be distributed.
It is A's turn to decide how to move, and two options are given:
A can choose either to go Up (**U**) and quit the game or to move Along (**A**) to the next stage, **BOX 2**.
If A chooses Up, the game ends: A gets **30** tickets, B gets **30** tickets. No further decision needs to be taken.
If A chooses to go Along to **BOX 2** the total number of tickets available to players increases to **65**, and now it is B's turn to move.

BOX 2.B can choose either to go Up (**U**) and quit the game or to move Along (**A**) to the next stage, **BOX 3**.
If B chooses to go Up, the game ends:
A gets **20** tickets, B gets **45** tickets.
If B decides to go Along to **BOX 3**, the total number of tickets available to players increases to **85**, and it is A's turn to move.

BOX 3. Again A can choose either to go Up (**U**) and quit the game or to move Along (**A**).
If A chooses to go Up, the game ends: A gets **60** tickets, B gets **25** tickets. If A decides to go Along, the total number of tickets increases to **100**: A gets **50** tickets, B gets **50** tickets, and the game is over.

The number of tickets gained by the players determines **the chance of winning the lottery** in the following way.
Suppose, for example, that A decides to go Along at Box 1 and B decides to go Up at Box 2, so that the game ends with a total payoff of 65 tickets: 45 won by B and 20 won by A.
When the lottery is held, a number between 1 and 100 is randomly drawn: if a number between 1 and 20 comes out, A wins the prize; if a number between 21 and 55 comes out, nobody wins the prize; if a number between 56 and 100 comes out, B wins the prize. That is, 20 tickets give player A a chance of 20% to win the lottery prize, and 45 tickets give player B a chance of 45%.

The experiment is organized as follows.
8 players will take part in each experiment session. They will be divided in two groups of 4 players, and each group will play in a different room.

ROUND 1

You will be asked to discuss your decisions about each of the three games presented to you with the players in your group. After the discussion is over, you will have to decide what you would choose in BOX 1 and in BOX 3 if you were player A, and in BOX 2 if you were player B. Notice that you will actually play both as A and as B.
After all decisions have been taken, each player from your group will be matched at random with a player from the other group, and will be given the results of his play in two stages:

STAGE 1.Each player in one group will play as A, and be paired at random with a B player in the other group. Then, each player will be told the number of tickets he and his opponent have won.

STAGE 2.In the second stage, A players will play as B, and B players will play as A. As in Stage 1 they will be randomly paired and told the number of tickets they have won.
Thus, in one of the two stages you play as player A and in the other as player B.

ROUND 2

After having seen the results of Round 1, you will be asked to make decisions about the three games again.
When all decisions have been taken by all players, the same matching process will be done for Round 2, and the results from matching will be disclosed.

At the end of Round 2, one game out of the three that you have played will be picked out at random, and two different lotteries will be held for this game, one for STAGE 1, the other for STAGE 2.

Participation to the end of the experiment, which will take about one hour and a half, will entitle you to a participation fee of £2 plus the eventual winning of the lottery prize.

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