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Groups vs. Individuals in Decision Making: Literature Review and Gift Exchange Experiment

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Introduction

Each individual takes daily decisions, such as how much to spend to buy a beer or how to invest their savings, if to rent or buy a home, or how to respect the constraints of their own budget, and so on. The result of these decisions may depend more or less by the decisions of other individuals. Decisions are made in conditions of risk and uncertainty in front of a deterministic set of preferences and can be taken individually or as a group. Group decisions are more important than most people realize. In fact many of the decisions that will be taken individually may be anticipated by prior consultation of relatives, family members or friends, almost all important decisions such as political, economic, legal and policy are taken by groups, as well as strategies of companies are decided by boards of directors.

Economic theory suggests that, for a set of information and data values, individuals under risk and uncertainty behave rationally taking the best decisions possible,[1] which corresponds to maximize expected utility. In fact, the game theoretical approach assumes that individuals have a perfect knowledge of their preferences and are able to calculate what decision is best suited to their interests. Another assumption is that individuals only care about their own pay-off, as claimed by Binmore's (2005) statement that humans are self-regarding creatures. Another condition assumed by game theory is common knowledge: each player knows the rules of the game and the agent of the other utility function (complete information) each player is aware that each player is aware and so on.[2]

The experimental evidence of a very broad and multidisciplinary field of study –behavioral economics, psychology, sociology, etc.– shows that in many cases the results of the decisions of individuals are systematically different from those postulated by economic theory.[3] Individuals when making decisions under conditions of risk and uncertainty behave irrationally by making decisions based on distortions of judgment. To explain these results, which are proposed as criticisms of expected utility theory (Hey 1998), it is necessary to take into account the heterogeneity of the level of rationality among individuals (cognitive limitations assumed as bounded rationality), a different amplitude of other-regarding preferences. Charness and Rabin (2002) show that subjects are more concerned with increasing social welfare than with reducing differences in payoffs, and a different attitude to risk and uncertainty depends not only on the individual but also on the source of uncertainty. For example, a source of uncertainty is

[1] In this case, I talk about normative decisions.
[2] Aumann and Brandenburger (1995) show that the role of the common knowledge is marginal because it plays a minor role in characterizing Nash equilibrium. For rationality and for the payoff functions, not even mutual knowledge is needed; only that the players are in fact rational, and that each knows his own payoff function.
[3] In this case, I talk about descriptive decisions.

the color of a ball drawn at random from an urn containing different color balls in unknown proportion, but also a stock market index.[4]

An important line of study on which, at first, I intend to focus concerns the research on decisions that groups and individuals take in non-interactive settings. These works, which start with the seminal studies of Kanehman and Tversky (1979), analyze decisions of individuals against nature, in order to verify whether they maximize expected utility. Results show that individuals make choices that diverge from normative patterns. Many works deriving from this line of study compare individual with group decisions, showing conflicting results. For example in the case of "hindsight", where some events are considered more likely in the presence of information on the result, Stahlberg et al. (1995) found that hindsight bias the groups have a slightly less distortion of individuals. In Stahlberg et al.'s results, one experiment suggests that group is subject to hindsight bias as individuals when its components made hypothetical forecasts. However, a second experiment indicates that the group has better access to their previous judgments than individual does. On the one hand, the group recalls better the earlier responses, on the other side bias are shown in the case that the group does not recall the decisions. In the latter case, "they still use the alleged information as an anchor of their guesses."[5]

In other works that investigate whether the groups' choices are more or less risky than individual ones under conditions of uncertainty (and risk), the results observed is risky shift.[6] These findings are conflicting with the common belief that group are more cautious than individuals when taking risky decisions, see Stoner (1961). In this area, several studies focused attention on the mechanisms that lead individuals in groups to increase the extremism of their positions because of a discussion on a topic. This phenomenon, that is a more general case of the risky shift, is defined group polarization.[7] Myers and Lamm (1975) reviewed a large amount of literature in order to find an adequate theoretical explanation of group polarization. The study of polarization has not secondary implications because it frequently occurs in everyday life from the parliamentary debates to decisions of a jury in a trial up to political debate.

Finally, in the non-interactive games, it is important to distinguish between intellective tasks and judgmental tasks. The intellective tasks can be used for subsequent evaluation because it

[4] Risk attitude is defined as the attitude towards given probabilities, which is taken as one source. See Abdellaoui et al. (2011) p. 699.
[5] Stahlberg et al. (1995), p. 56.
[6] Subjects in groups have the inclination to make decisions that are more fearless, than when they are alone.
[7] We have group polarization when in a group the average post discussion response will tend to be extreme in same direction of the pre-group inclinations of the group members. The polarization of the groups takes place when there is a strengthening of the dominant trend and we are seeing an exaggeration of the average trend. The polarization of the group does not imply the polarization of individual members.

exists a solution while judgmental tasks are evaluative, behavioral, or aesthetic judgments for which no generally accepted answer exists. The intellective task in turn may be differentiated by the degree of demonstrability. When the degree of demonstrability is high, there is the phenomenon of "truth wins" which means that the solution is recognized by a group as soon as it was expressed by someone. In intellective tasks, groups typically perform better than individuals do.[8] Another important field of study assumes asymmetric information in the case in which one of the subjects has more information than others have. In this case, there are many negative effects related to the distribution of information within groups, as discussion bias and evaluation bias that have a negative effects on the quality of the group' decisions.[9]

In this review, I intend to focus on methodological aspect. This is relevant as it allows to study under what conditions group decision-making outcomes are superior or inferior to the individual's ones. An important element that can determine the differences in behavior between groups and individuals is the relationship between the number of members of the group and the results of decisions. Kerr et al. (1993) show that the relative bias between groups and individuals can increase as the numerosity of the group.[10] The relative bias is the difference of the deviation of the group's distribution decisions and the ideal distribution, and the deviation of the individual decisions of the distribution and the ideal distribution. However, the authors argue that no conclusion on the relative bias can be done without operating specifications of the decision-making process of the group (namely depends on the nature of the decision task).

More recent studies showed that similar decisions, taken in a group or a team,[11] perform better than those taken individually, that are closest to the results predicted by theory. There are several hypotheses to which the bounded rationality hypothesis can be applied to a lesser extent to groups. Those who belong to a group behave looking more to their own interests. Also from a social point of view, making group decisions means to protect themselves from the consequences of irrational decisions, or by their own limitations. A better group performance can result in those cases where it is relevant problem solving, or even when there is the need for coordination. However sometimes the group decides not differently by individuals such as, for example, in the trust game studied by Kugler et al. (2007). The expected result of their experiment was that individuals in the role of responders gave back a higher amount than the one returned in groups in the same role. The results however show no difference between the amount returned by the groups and the one that individuals returned. Although in the role of senders is confirmed that individuals send a sums greater than the groups do.

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[8] Hastie (1986).
[9] Brodbeck et al. (2007), p. 461.
[10] Although it does not increase the intensity. Id, p. 699.
[11] The team is an organizational model that is often found in the workplace. The components of the team have a goal commune decided, for example, by a manager. Kerr and Tindale (2004) p. 624 argue, "The distinction between performance teams and performance groups is a fuzzy one."

A very important field of research analyzing group dynamics are the studies concerning the role of identity. There are two lines of research grounded on social psychology and economics. Both approaches study the influence of identity on social preferences. The theory of social identity was developed starting from seminal study of Tajfel et al. (1971), which sought to identify the psychological basis of discrimination within groups. According to this theory, social identity is formed by three main components: categorization, identification and comparison. An important point of social identity theory is that for people belonging to a group, membership has a meaning in the sense that it increases their self-esteem. Consequently, behavior conforms to perceived rules of group identity. Since group identity influences behavior, psychology experiments investigate whether people interact differently among members of the group and those outside the group. Yamagishi and Kiyonari (2000) reports that the results of an experiment with 91 Japanese participants confirmed the hypothesis that players of a Prisoner's Dilemma (henceforth PD) game would cooperate more with an in-group member than with an out-group member in the simultaneous game but not in the sequential game. The purpose of this work was to verify if favoritism that exists between the members of the same group depends on the expectations of reciprocity in-group or by identification in a social category per se. In this regard, they made two experiments: the first is a simultaneous PD, in the standard configuration,[12] where each person makes its decision without knowing the choice of the other subject. The two subjects cannot influence each other's decisions; in this case, the expected results are that cooperation is higher among members of the same group, and lowest among members of different groups. The second is a variant of the PD, in which the second subject takes a decision after the move of the first; in this case, the result is that the first subject can influence the decision of the second one, as the latter decides according to the choices of the first. In this game, the first player may lead the second player to practice cooperation. In the two treatments categorization of the subjects does not vary, whereby, difference in behavior is not dependent on the saliency of the identity of the group. The result, in simultaneous PD, is that people give more money to the member's in-group than to out-group, while in the sequential PD happens otherwise. This means that favoritism among members of the same group takes place when there are expectations of in-group reciprocity and not when there are direct reciprocity expectations.

In several papers, social psychology and experimental economics intersect their field of study borrowing, in its own sphere, the other's results. In particular, many papers, inspired by the model of Akerlof and Kranton (2000) on the influence of identity in economic performance, turned their attention to the role of identity in the influence of the group on individual decisions. Some experiments on the identity of the group analyzed individual's behavior belonging to natural groups (usually groups of natives) and the behavior of non-spontaneous

[12] For a more detailed discussion, see the following chapters.

groups like teams. In the first case, Fischbacher and Falk (2006) used the dictator game in two separate groups of natives in Papua New Guinea finding that there is a strong altruism towards victims of internal to the group and that the dictators upholding social norms when they transfer money. Eckel and Grossman (2005) "provided evidence that no overt means of identifying subjects with a team generated greater cooperation on the part of subjects than do random, anonymous team assignments".[13] Their results suggested that being identified with a team does not allow overcoming self-interest. Nevertheless, actions to improve the group identity enhance the level of cooperation. Charness et al. (2007b) in a PD and in the battle of the sexes do not find significant differences in the collaboration between group members and people outside the group although they find that group membership affect individual behavior when groups are soaring.[14]

From these studies, it appears, although not univocally, that there are significant differences between individuals and group decisions-making results, and that the determining factors can be manifold. This "discontinuity effect"[15] among individual and group behavior relates to various aspects such as competitiveness, rational choices, altruism, cooperation, risk and so on. However, literature has given attention to the relationship between the structures of the (unitary) group, which is involved in decision making process and learning process. For example, Kocher and Sutter (2007) despite the differentiation of the learning process between groups, have contrasting results. In addition, not all group members when making decisions have the power to propose. Finally, decisions are not taken at the same time but at different times and at different levels. In fact, some organizations, for example, make decisions collectively, others are organized top-down, and others have decision-making process more fractionated. I am interested in decision-making decision rules that affect also the learning process when the group takes decisions unanimously without face-to-face communication and without any possibility to communicate between other group members. In this regard, I analyze three decisions methods: (i) each member of the group makes its proposal and the group decides (baseline treatment the same of the referenced work). (ii) there is only one proposer and the other members of the group accept or reject the proposal (Leader scheme) or (iii) each member of the group makes its proposal and the group decides, but each group is divided into two subgroups (Subgroups scheme). The unanimity rule protects the individual choice because it gives the possibility to block any decision in which he does not agree. In this work, groups have a more rational behavior than individual does only in treatment with a learning effect

[13] Eckel and Grossman (2005), p. 384.
[14] Group salience is a key variable both in influencing quality of intergroup contact and in moderating the effects of intergroup contact on prejudicial attitudes.
[15] The discontinuity effect is known as the markedly greater competitiveness displayed between different, interacting groups relative to the competitiveness displayed when individuals interact with other individuals, see Insko and Schopler (1992), Wildschut et al. (2003). For a discussion, see the next chapter.

without communication, but when the members of the groups communicate with each other, groups have an opposite result similar to Cason Mui (1997). In the baseline treatment, all subjects are on the same level. In the Leader treatment, results are determined by proposals by one subject, randomly extracted as a leader, which are rejected or accepted by the other component. In this treatment, as I will discuss later, there is a limited learning effect. In the subgroup treatment, groups was divided into two subgroups where for each subgroup there is a first decision to be taken. If both subgroups reach an agreement, the final decision is made with a decision of the whole group. In the latter treatment, learning effect is amplified because the subjects decide twice with the same mechanism. So, if decision-making methods of the group varies how is affected the result? In addition, varying the learning mechanism I can control whether this affects the decision-making results. Finally, to complete the investigation, I execute some treatments to test the behavior of individuals in this game.

In first part of my thesis, I intend to review the most relevant results in the field of experimental economics in order to highlight the differences in decision making among individuals and groups. Given the extent of the literature, I intend to proceed as follows. I summarize the literature dealing with decisions in groups highlighting in particular why group decision making is important, how group combine individual preference and which are the more relevant results in-group decision making.

In first chapter, I review the most important works in the field of social psychology in investigating the differences between Natural groups and Induced identities in which I refer to how individual preferences change when the individual is part of a group. Then I summarize the study of the decision-making process in other disciplines (i.e. business and management), highlight group' failures in decision-making process, and finally focus on Diffusion of Responsibility which is a particular form of group aggregation by attribution.[16]

In second and third chapter, I illustrate a selection of the most recent literature of interactive games (games against strategically motivated opponents human or computer) in order to highlight differences in the results in-group decisions. I treat separately in simultaneous games (chapter two), such as the Prisoner's Dilemma, public goods game and the Takeover game, which analyzes the known problem of "winner course",[17] and sequential games (chapter three), including those that, in particular, were designed to measure social preferences, such as the ultimatum game, the dictator game, the trust game, and the gift exchange game.[18] I compare results of group decisions with individual ones, and examine cases where results differ,

[16] Explanation of an event that has occurred see Kelley (1967).
[17] In short, the winner's curse in a common value auctions with incomplete information means that the winner will tend to pay too highly.
[18] Levitt and List (2007).

highlighting, in particular, what are conditions in which groups have better results, and which ones they did worse than as postulated by economic theory.

In the fourth chapter, I discuss the laboratory experiment based on Kocher and Sutter's (2007) conducted in order to analyze the decisions taken in groups through the study of the differences in decisions-making process.

In last chapter, I summarize experimental results and offer some suggestions for future research.

1. Group decisions making

1.1. The importance of studying group decision making

In the twentieth century, economists' attention focused on the individual's rational choices. As discussed above, numerous criticisms argue that these assumptions fail systematically empirical verification. As noted in the introduction, the debate seems to be divided between psychologists that first falsified the assumptions of economic theory and economists that defended their position. Consolidation of experimental economics produced a large number of studies that confirmed some assumptions of economic theory while others do not. However, Cox and Hayne (2006) noted that focusing on the behavior of individual rational agent may be "barking up the wrong tree" because, especially in enterprises and organizations, the most important decisions are made by groups. Previous studies on the "winner course" focused attention on bids where individuals took decisions. However, there are different behavioral hypotheses when groups of individuals participate in the bids: according to a first hypothesis, different components have different information (and hence more information than individual has), or according to a second hypothesis in the case of common information to the whole group, each one has an individual viewpoint that it contributes to a better decision. Another hypothesis is that groups are more rational than individuals are into strategic value of the common auction.[19]

Below I list the most relevant results of the literature in this field of study:

(i) Groups are more competitive than individuals are, as shown by various studies on "discontinuity effect", Schopler and Insko (1992), Wildshut et al. (2003). In particular, it was observed that this effect is larger, when the group that is opposed has an attitude, induced by the experimenters, for cooperation, than when group decisions are taken when there is a bound communication.

[19] However, the results of this work differ from previous findings in the literature that support that groups make better decisions in the presence of different degrees of information and avoid "winner course". The small groups, when taking strategic decisions, are subject to an "information course", to a greater extent than individuals.

(ii) Group-representatives are less trusting than individuals are, see Kugler et al. (2007). As I will discuss in the third chapter, in a gift exchange, groups in the role of senders are less trusting than individuals are.

(iii) Groups are more polarized after discussion, see Myers and Lamm (1975). The risky-shift is considered a polarization phenomenon rather than a phenomenon linked to risk-taking.

(iv) Groups are not smarter decision makers per se but as they learn faster than individuals do, because group components understand faster the strategic nature of the game and converge faster to the equilibrium than individuals, see Kocher and Sutter (2005). Indeed, in the second round of the beauty contest games, the groups have chosen a lower value than those of the first round at a higher percentage than individuals did.

(v) Individuals and groups may differ in their preferences although the results are mixed in Charness and Sutter (2012) group has stronger self-interest preferences.

(vi) Group decisions are of better quality as in the case of intellective task solution, see Hastie (1986). Hastie reviewed the literature of social psychology that compares the behavior of individuals and groups with respect to the task with varying degrees of demonstrability in the solution. The groups do better than the individual does where solutions are easily demonstrable. When the solutions are more difficult to demonstrate the individuals perform slightly better groups of individuals but below the average of the best one.

(vii) Groups are less subject to biases (i.e. Hindsight bias), see Stahlberg and Frey (1995).

Up to this point, I do not make distinction between studies that identify social factors and those that analyze economic factors as determinants of the differences in collective and individual choices. However, differences that exist between the two areas of study may be relevant because assumptions are different: in the results of social psychology, decisions taken collectively are systematically different from those taken individually. Individual behavior changes under pressure from the social dynamics of the group by way of prestige, identity social, ethnocentrism, personal risk minimization, benevolence groups and hostility between groups and so on. These dynamics should theoretically be irrelevant when individual or groups take their decisions under a rigid discipline of the market. However, although the results are not univocal, even in the economic sphere, individual decisions differ from those of groups as groups make decisions consistent with market discipline while individuals behave less self-oriented (e.g. motivated by altruism).[20] The conditions for this to occur are numerous and I will show in detail below.

[20] There are also relevant methodological differences between the two approaches.

1.2. Group decision and individual behavior

The behavior of an individual can be very different when he makes decisions individually, or when taking decisions as part, or feeling of being part of a group. This section will examine under what conditions the individual preferences take second place when an individual acting in a group. In the field of experimental studies of the branch of social psychology, the phenomenon is analyzed mainly in two aspects, namely that individuals may belong to natural groups (such as gender or ethnic groups) or to groups that are constructed artificially (e.g., teams). The key lies in recognition of the group's values: how much more an individual identifies with a group, the more he will have a consistent behavior to that of the group. Moreover, the greater is the identification in a group, the greater the allocation to belonging to other groups of negative characteristics (for example is what that occurs in ethnocentrism). The identification in a group, or better, the value expressed by the group, are derived from the assumption that this is done for the need that the individual has to increase the self-esteem. Such assumptions are made as part of the "Social Identity Theory" dating back to the pioneering studies of Tajfel and Turner (1979), using the so-called experimental method the minimal-group paradigm in minimal group experiment (MGE) where groups are formed from trivial and entirely irrelevant tasks.[21]

An individual consolidates the membership of a group through two main processes: self-categorization and social comparison. The first one relates to how individuals assign themselves and others to categories based on beliefs, behavior, attitudes and other characteristics; the second one refers to the process of comparing others to oneself and labelling their traits as being like (in-group) or unlike (out-group) your own, often associating positive or negative attributes with the group.[22]

In this context, I cannot consider as a group if I refer to that set of people who only have some features in common, unless it is considered that they can have an influence on potential components. What distinguishes a group by random combination is the presence of real or imaginary interactions. According to some pioneering studies belonging to the research field of social psychology, see Mullen et al. (1992), a group can also be considered in terms of perceived similarities, for which, under certain conditions, individuals do not behave as they

[21] It is a method to investigate the minimum conditions so that it can emerge discrimination between groups. Besides the allocation of task irrelevant, minimal group paradigm occurs if there are also the following criteria: 1) membership in the group is anonymous; 2) no interaction between the actors; 3) no relationship between interest of the subjects and the task assigned.

[22] Some studies, that goes beyond the scope if my work, see De Dreu et al. (2011), that link endocrinology and intergroup bias.

would have done by individuals, but as members the group in which they completely identify (in-group bias).[23]

A perception of the relationship between individuals and the group that has been studied extensively in the literature is Intergroup bias that refers to the common occurrence to assess the members of their own group more favorably than a non-member of the group or any component, see Hewstone et al. (2002) for a comprehensive review of the literature. Intergroup bias is a broad concept that includes discrimination, prejudice and stereotypes. However, the measurements of these traditional explicit components that include cognitive, affective, and behavioral aspects are empirically disconnected because there are weak relationships between them. The development of implicit techniques, such as response-latency procedures or psycho-physiological measures, can reveal unintentional bias of which individuals are very unaware.[24]

In case interaction between groups showing a conflict, the greater the degree of conflict, the greater the likelihood that the components behave as a function of membership in the group instead of according to the individual characteristics. Some pioneering studies see Sherif (1966), assume that the conflicts between groups are rational because the groups have incompatible goals and compete for scarce resources. Competition causes intergroup conflicts.[25] Although it is an important element, conflict of interests is just a sufficient but not necessary condition to explain these behaviors. This is because the experimental evidences show that intergroup discrimination occurs for the mere presence of another out-group, in absence of pre-existing conflicts, anonymous membership in a group, and the absence of conflicts of interest.

Subsequent studies , as for example Abrams and Hogg (1988) have identified two corollaries of identity theory: successful intergroup bias enhances self-esteem, and depressed or threatened self-esteem motivates intergroup bias. Most experimental evidence confirms the first corollary while for the second corollary there is only weak evidence. Intergroup bias are the leading cause of intergroup and human conflict, and in this regard, I will mention briefly some recent theories of intergroup bias, regarding other laboratory experiment and narratives that are less relevant to the purpose of my study. This studies deal with issues exclusively related to individual psychological behavior of individuals in groups, rather than the social dynamics between groups. Intergroup bias can be seen as a compromise between the need for assimilation and need for differentiation; for discussion see Brewer (1991). Alternatively, according to the Subjective Uncertainty Reduction Theory, individuals are motivated to

[23] Baron and Byrne (1987) offer a typical social psychology definition of a social group as "two or more persons engaged in social interaction who (1) have some stable, structured relationship to one another, (2) are interdependent, (3) share common goals, and (4) perceive that they are, in fact, part of a group".
[24] Hewstone (2002) p. 577.
[25] Hewstone and Greenland (2000).

participate in the group to reduce subjective uncertainty, see Hogg (2000), while according to the theory of terror management (TMT) individuals are motivated by a need for self-preservation see Solomon et al. (1991). Finally, the theory of social dominance (SDT), proposes that ideology can either promote or attenuate intergroup hierarchies as proposed by Sidanius and Pratto (1999).

Social identity is the sense that a person has of himself that derives from the perception of belonging to a social group. Belonging to a (social) group or a team may be a necessary condition but not sufficient for which the interest of the group prevails on the individual one. This could happen when the degree of identification in the group (or teams), is high such as in the group problem solving. Economic analysis usually focuses on individual incentives for decision-making. In numerous experiments that verify the social identity theories in economics, starting from Akerlof and Kranton (2000), emerging mixed results, especially in those cases where it is used the technique of primed natural identities.[26] For example, in Solow and Kirkwood (2002), there is no difference in behavior between randomly formed groups and those formed through the completion of a questionnaire. On the contrary, the use of induced identity can give a greater control on the formation of group identity in the process since actions designated to improve the identification, contribute to a higher level of cooperation. Finally, some attributes such as the salience of the group effectively influence the behavior of the individual, conforming to that of the group. Hargreaves et al. (2009) analyzed the potential effect on the welfare of the individual, given by membership in a group. They implemented a trust game between insiders and outsiders. This welfare derives from the social capital and the psychological effect of belonging to a group. Results confirm that the membership influence individuals, however in terms of welfare, membership effect is neutral or negative since the existence of groups reduces confidence between groups and consequently decreases the welfare. Goette et al. (2006), implementing a PD, found that the creation of groups from organizations, influence the behavior of individuals through the set of codified rules, roles and internal values. This result states that is important, for organizations, to form groups because they promote efficient behavior in spite of individual selfish incentives.

At the end of this discussion, what emerges is that the greater the degree of individual identification with the group, the more the individual decisions are consistent with the interests of the group. Hence, differences in the qualification of the group influence individual decisions. Furthermore, in the same way, simultaneous or sequential interaction between groups can determine uniformity or not of individual behavior with those in the group. These differences are important, both for different ways in which the groups relate with other groups, both for behavior that individuals have in the groups. These results are important for the purposes of

[26] It is a technique by which the groups are formed spontaneously by individuals who have done all pre-trial activities and to which a generic task or questionnaire was assigned.

this study because, in case of randomly formed groups, where components are anonymous and do not communicate with other components, must be identified which of the three decision-making mechanisms used in the experimental design can have a role to ensure that the group make decisions more consonant with the economic theory.[27]

1.3. Decision-Making Procedures (and its failures)

The analysis of the decision-making procedures was also developed in the science management disciplines where there is a strong need to structuring the decision-making process in terms to support the activities of problem solving and to correction of the critical issues that gradually arise. Among several techniques that other disciplines such as science management and business administration have independently developed or borrowed from social psychology, I highlight some of those I have identified to have a role in influence on group behavior, idea generation, and problem solving that have the most interesting implications.

Brainstorming is a method in which group members gather ideas generated spontaneously by a discussion. It is considered the best-known tool to solve problems in creative way, and to increase the productivity of groups. Osborn (1953) argues that with brainstorming, groups propose ideas by 44% more useful than does a single individual does without the benefit of group discussion. In experimental terms, it is expected that group using such method outperform the equal-sized sets of non-interacting individuals (nominal group). However, several studies see Mullen et al. (1991) found that brainstorming groups usually underperformed[28] results that are obtained with the Nominal Groups Technique (NGT) in terms of both quantity and quality. This happens for fear of individual to receive critical appraisals, and desire of the participants to move forward with the dominant model or established idea generation.

To avoid this typical Brainstorming drawback, Delbecq et al. (1975) have developed Nominal Group Thinking Technique (NGT), which is a form of superior Brainstorming that involves the formation of a group that makes decisions with a minimum interaction with other component thanks to a protocol that regulates the interaction between the components of the group. This technique has the advantage of involving all members of the group to the idea generation process. In a first step, all the components are called upon to generate ideas individually and in silence. In a second step, all the ideas are put together and decisions are made as a group by voting the best idea. This technique requires the presence of a facilitator who establishes respect of times and procedures.

[27] It is assumed that the group take more rational decisions of individuals even though in my work I did not developed a treatment that controls this assumption.
[28] This is due to "production blocking" i.e. the inability to talk for more than one component at a time.

Similar to the NGT is Ideawriting that is a technique designed developed by Moore (1987), in order to minimize conflicts between components of a group, and that facilitate group decision-making process. Likewise to this technique, all components are called upon to provide some solutions to a problem in writing and in silence. Once finished the task, all solutions are inspected from time to time by all components that add written comments highlighting their strengths and weaknesses. Finally, components synthesize all the ideas and highlight those that can be developed in the future.

When a team is called to solve a problem or achieve a set goal, quality of the results is difficult to measure especially if you want to measure in terms of groups' potential. In fact, groups' decision-making process sometimes do not give effective results. One of the most remarkable issues in decision-making process is that groups usually exhibit the phenomenon of process loss. Process loss is any aspect of group interaction that inhibits good problem solving. The most common way for process loss to occur is when a competent member finds it difficult to disagree with the other members of the group. In this setting the most important challenge is to identify what is the benchmark against which to measure this loss (in numerous studies, the performance of the most competent member).

Groups may also experience the phenomenon of group motivation losses, in which occurs the phenomenon of social loafing, that I will discuss in the next paragraph, when a person exerting less effort to achieve a goal when they work in a group than when they work alone. For what concerns gender differences, males seem to be more affected while among ethnic groups those of Western cultures. By contrast, we have the group motivation gain that occurs where group members exert greater task effort than comparable individual performer. If decisions are made under stress, the group's performance deteriorates, as it increases the amount but the quality decreases. Finally, studies using the collective induction approach[29] derive the mode with which the groups solve the preferences of disagreements between the components: random selection among alternatives namely equiprobability decision scheme; voting namely majority/plurality decision scheme; demonstration namely truth-wins decision schemes, for further discussion see Kerr and Tindale (2004).

1.4. Diffusion of responsibility

In this section, I illustrate diffusion of responsibility phenomenon that affects modifications in individual behavior at the presence of other individuals. Change in behavior would be for concrete presence, and occasionally for the alleged presence of other individuals. Then changing behavior takes place for effect to belonging to a group or team[30] and for the

[29] The method entails "the cooperative search for descriptive, predictive, and explanatory generalizations, rules, and principles" among members in a group working on the same task. See Laughlin (2011), p. 58.
[30] For example, failure to report corruption in the workplace.

occasional presence of other individuals. This has implications both in the field of experimental economics (cost-benefit assessment of individual action), both in the field of social psychology (morality of individuals behavior). Diffusion of responsibility occurs when people are less likely to make a decision if they are, or perceive to be in the company of other (bystander effect). Hence, in case of a negative event in which people are involved, the greater the number of people that can help, the lower the probability that an individual will help.

The seminal study by Darley and Latanée (1968) was inspired by a murder case located in NYC occurred in 1964 in which a woman was stabbed near his house without the neighbors intervened to save her. To provide an explanation of what happened, it was conducted an experiment that simulates an emergency. The hypotheses to be tested was whether a set of unknown people assists to an unexpected event, the greater the number of individuals who attends the scene, the lower the responsibility to act and greater are the response time and if so for what reason. Trial participants were psychology students that during the course were called to take part in a discussion of personal problems encountered during their stay in college. Once the participants arrived in the laboratory, they were conducted in individual rooms to preserve their privacy, where communication was ensured through a speaker system. During discussion, one of the subjects simulated an illness similar to an epileptic seizure. During the fit, the person could not communicate with other participants, nor know what they were doing about the emergency. The main independent variable was the number of people that the person imagined that participated in discussion and dependent variable was the speed with which subject reports of illness to the experimenters. Subject was led to believe that there are more people participating in the discussion. Groups was of three types: group of two people, formed by the subject, and by the individual that would have had the illness. Group of three persons, formed by the subject, by the individual that would have had the fit, and by an accomplice voice. Group of six people formed by the subject, by individual that would have had the fit, and by four accomplice voices. By varying the number of participants perceived, it varied the sense of responsibility that should weigh on the subject. It also varied the composition of the group by gender (in turn, voices of male accomplices and voices of female accomplices), and by medical skills degrees.[31] Dependent variable is calculated from the time when victim has the illness up to the moment in which subject communicates the emergency to the experimenter. In the event that subject perceived to be alone, 85% of the participants announced the illness before the interruption of the experiment with an average of 52 seconds. If instead subject to be perceived with four other people, the percentage drops to 31% with an average of 166 seconds. In case in which also varies group composition of both gender was in medical skills, is not found any significant difference.

[31] One of the male voices claims to work occasionally in a hospital.

Similarly, when groups decision making, they can occur phenomena of diffusion of responsibility even if decisions are made under uncertainty. It is assumed that individual is concerned about the decision to be taken, as in the case of a bad result, he or she will feel directly responsible for the decision because it is easily detectable by others who can punish them. If decisions are taken as a group, individuals who are part of will feel less responsible for a bad result. Because it was a joint decision, which was taken along with others and, in case, that the group did not reached an agreement, the decision would not be taken. In addition, this mechanism helps to explain phenomenon of "social loafing". Contrary to the findings of social psychology, which tells us that team's feeling leads to increase the effort, and common sense, which supports the unity is strength, it has been observed by the classic study of Ringelmann (1913) that effort that is lavished in a group is less intense than they have done individually.[32] This is explained by the fact that, when individual effort occurs essentially in a unitary task, i.e. a task that cannot be divided into multiple sub-tasks, all individuals do the same work and is not possible a division of labor so that the contribution of each can be identified by those who commissioned it. For this reason, team effort is lost in the group result. Ringelmann considered tug rope as social pressure and the greater the number of individuals, which are subjected to this pressure, the lower the pressure felt by a person. Latané et al. (1979), commenting on the results of two experiments in which they tested the Ringelmann effect by measuring the intensity not the tug of war, but the cheering and clapping of groups of individuals, confirm the results of social loafing and identify three reasons. The first is "Attribution and equity" i.e. the group tries to maintain an equitable division of labor. The second is "Submaximal goal setting" i.e., after reading instructions, individuals do not maximize result but are stick to more or less defined standards. Finally, "lessened contingency between inputs and outcomes" because individuals in a group may feel diminished the contingency between inputs and results as they hide in the crowd.

In a recent paper, Thomas et al. (2016) question the traditional explanation of bystander effects in terms of diffusion of responsibility. This effect has a strategic component that does not depend on irrational anomaly morals of individuals but from awareness of existence of others bystander, regardless of being sensitive to their presence or absence. Experiment consists of taking a table in a market, in groups of two or five people, in which gain is one dollar per day. Occasionally, market manager needs a hand for supplies and aid whoever loses ½ dollar. However if no one helps, manager fines all participants of a dollar. There are different treatments in which varied ways in which participants are informed of request for help from the manager. In first treatment, request for help is announced via loudspeaker, in a second treatment the request is sent via private message. In this second case, also varies content of the

[32] Ringelmann (1913). The addition of a co-worker in the shooting game of war leads to a linear decrease of the average performance of the group.

message that states whether, and if so what, other participants are aware of request for help. In treatment with speaker where all groups are aware of the request for help and everyone knew that others knew, the bystander effect typical of diffusion of responsibility is observed. By varying number of participants varies result as in groups of five people are less likely to help you in groups of two people. In other treatments, results are more complex and depend on evaluations of each participant on the probability that another intervening on basis of the information in their possession. For example, when participants receive request for help but they know that others are unaware, the probability increases to intervene. While, if participants receive the request for help but they are not aware that others are unaware, the probability of aid decreases.

2. Simultaneous games

Simultaneous games are those in which each player moves only once, and moves are made simultaneously without knowing the strategic choices of the other player. It is assumed that all players know all choices available to each player. Then all players must evaluate not only their own best strategies, but also the best strategic choices of other players. Because we are in an uncertain environment, rational player will consider all the strategies that the other party may take by assigning them a certain probability. Player maximizes payoffs by choosing the strategy it believes to be the best response to the moves of the other party, weighted for the probability. A player can pursue pure or mixed strategies. In first case is a decision that player will always follow in every possible situation of the game, in the second case the player will the actions randomly in a probability distribution in order to be less predictable as possible. Here are some case studies that investigated different behavior of groups and individuals, particularly those jobs that analyze what is mechanism that is established in groups that makes people behave differently from what they would have done if they had been callers to decide for themselves. Reviewed papers belong to the field of experimental economics, while seeking to respond to the questions put by social psychology, borrowing the techniques of investigation.

2.1. Prisoner's Dilemma

The Prisoner's Dilemma (henceforth PD) involves the interaction between two players who can choose to cooperate or not cooperate with each other. Result of each player depends on the combination of choices of both players. In a generalized version, shown in the following matrix (normal form representation), players are asked to maximize their payoff and can choose between two strategies the X, Y the first one cooperative, the second one competitive. Each player maximizes his payoff by choosing a competitive strategy, but in case that both choose

the latter, they get a payoff (5,5) lower than they would get if they collaborate mutually (10,10). If there is no unique solution in dominant/dominated strategies then we use 'mutual best response analysis' to find a Nash equilibrium. In this game, the Nash equilibrium does not correspond to the social optimum.

	X	**Y**
X	10 10	15 0
Y	0 15	5 5

Figure 1 – The Prisoner's Dilemma matrix

Equilibrium can vary from single-shot game if game is repeated. Game can be repeated finite or infinite number of times. In the first case, result is identical to single-shot for backward-induction mechanism. In second case, players cooperate, because they provide endless rounds though they may enact punitive strategies (Tit for tat or Tit for two tat).

PD has been widely used to compare individual rationality, and group. Schopler and Insko (1992) noted that much of many studies that have investigated this issue showed that groups choose competitive strategies more frequently than individuals do.[33] They called this difference in behavior "discontinuity effect" broadening a concept already expressed in literature by Brown (1954) in order to distinguish the difference between behavior in groups and private characteristics of the members.[34] In this section I analyze the main results of two separate works have studied the PD by two different points of view. This question is relevant because, as noted by Charness and Sutter (2012), in PD games' group behavior is likely to lead to a lower level of social welfare because it decreases cooperation.

Charness et al. (2007b), in a 2X2 pattern PD, extend to strategic environments the results of social psychology, which noted that the membership of a group influences the individual's perception of the social environment and changes its behavior. In fact, they show that group membership, affects preferences because players, who belong to a group, identify themselves in it, and in a strategic environment, he behaves differently from those who do not belong to any group. Furthermore, an important role is played by saliency of the group that affects perception of the social and strategic environment. They used two sets of experiments: Face to Face and Anonymous. They also used two ways to vary the group' salience.[35] Feedback treatment,

[33] In the original version, the group defects more often than individuals do.
[34] Brown (1954).
[35] Individual awareness of belonging to a group and their differences in comparison with other groups.

whether the choices of group component are followed by a comment from the other, and the Audience one when a group' member making the choices in presence of other components. In Audience version, feedback is communicated immediately after decision-making; otherwise, feedback is communicated with a group' statement. In addition to that, group members take on two states: alternately hosted and host. This means that in the experiment with audience, only one of the participants makes the choices in front of his group. The two main results are that groups have a large and significant influence on individual choices, and that this influence is greater the greater the saliency and the group members act in a competitive way. This is an important result because it is partly in contrast to Tajfel and Turner (1979)[36] minimal-group paradigm. In Anonymous treatment, saliency of the group increases, due to common payoff, and there is more cooperation between components of the group compared to outgroup components. This effect disappears when payoff in common (payoff commonality) is removed. Table 1 shows key results of Face-to-Face experiments.

	Overall		**Feedback**		**No Feedback**	
	Host cooperates	**Guest cooperates**	**Host cooperates**	**Guest cooperates**	**Host cooperates**	**Guest cooperates**
Audience	**.360** **(0.048)**	**.460** **(0.050)**	**.240** **(0.064)**	**.380** **(0.064)**	**.440** **(0.070)**	**.580** **(0.070)**
No Audience	**.566** **(0.048)**	**.481** **(0.050)**	**.621** **(0.064)**	**.448** **(0.065)**	**.500** **(0.072)**	**.521** **(0.072)**

Table 1 - % of players who cooperate (standard errors are in parentheses).

In overall results, with no audience 57% of Host cooperates, while with audience, only 36%. The higher the saliency (also measured from being Guest and Host), the lower the cooperation. Similar results are obtained when players are anonymous in case they share an economic interest in the outcome. Table 2 below shows main results of Anonymous experiments with two treatments, with and without joint payoffs. In first case, player shares 1/3 of the payoff with the group' members, in second case, payoff only depends on their choices.

[36] The minimum conditions necessary for the establishment of a sense of group membership that would subsequently act to provide a basis for in-group / out-group discriminatory behaviors.

	Cooperation with in-group	Cooperation with out-group
Without common payoff	.296 (0.025)	.273 (0.023)
With common payoff	.544 (0.027)	.229 (0.021)

Table 2 – Play across conditions in the anonymous PD

With joint payoff (commonality), cooperation rate is higher with group' elements, while there is no significant difference between rates of co-operation in common case without payoff. In conclusion, the main result is that group influence individual choices in social situations.[37] The effect "institutional" Host, can be a positive or negative factor for the group, as for example, in PD, the attitude of host leads to a choice towards a single Nash equilibrium, in which both defects players, which leads to a decrease in the average payoff.

In previous work, minimal group identification is not enough to affect group's behavior, while saliency strengthens group identity with result of a higher social good. In following work, emphasis is on the effect that learning in a PD with super-games can increase cooperation in groups. Kagel and McGee (2016) tested "discontinuity effect" from the point of view of social psychology, both from experimental economics point of view, with teams that play in finitely repeated PD games with several repeated game against different opponents. Team members can communicate with each other via chat. This is useful to get information about players' beliefs. Authors aim at investigating if the discontinuity effect is persistent over time after the subjects have gained more experience in the game. Authors used Kreps et al. (1982) reputation model,[38] in which rational agents believe that there are in the population a certain number of "collaborative" people with which they cooperate in the early stages and defect at last stage. Therefore, they place great attention on the last repetition. Figure 2 shows results of the seven repetitions, which highlights, in particular, the average rate of cooperation for each period. In line with the results of the "discontinuity effects", in first super-game teams are less cooperative of individuals, but on subsequent repetitions, they are cooperative as or even more of the individuals so that, in general, teams are more cooperative than individuals are. Another result is that in the last game, groups collaborate less than individuals do. Last result means that in collaborative path there is no difference between groups and individuals.

[37] The social environment is the set of relationships and cultural environment in which certain groups operate and interact.
[38] Kreps et al. (1982), p. 245.

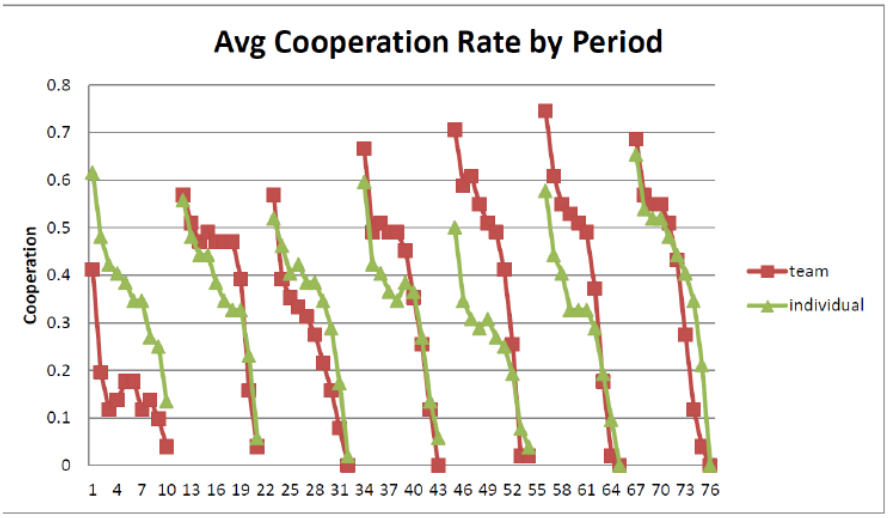


Figure 2 – Average cooperation rate by period

This is a result which shows that over time the discontinuity effect did not occur and that, contrary to the allegation made by Charness and Sutter (2012), groups' decisions probably not diminish social welfare.

2.2. Takeover game

Auctions are Bayesian games with incomplete information. Commonly there are two scenarios, private value action and common value auctions. In the last scenario, actual value of the item for sale is the same (ex post) for everyone, but bidders have different private information (ex ante) about what that value is. When auction's winner offered more of the property value, he incur to winners' curse. "The winner's curse in auction theory traditionally refers to the selection bias that arises because a bidder tends to win more often when his value estimate is too high than when it is too low" see Milgrom (2004) p. 256. Winner's curse is hard to avoid because, although there are strategies such as bid shaving, which involves offering less to avoid the risk of paying too much, it is difficult to properly calculate the asset expected value and the payout' auction conditional expected value.

One of the main works that compared groups' and individual's behavior in common-value auctions is Cox and Hayne (2006). To assess these differences, authors separate the composition effect of bidding unit by the amount effect of estimates (signals) of the auctioned item value. The first step was to compare the (G) groups decisions of 5 individuals with individual ones where each individual has signal sample size of 1 in a different market size (respectively 3 and 7 bidders). Second step is to compare these results with those we get if each individual signal sample size S > 1. *S* is the estimate of auctioned item value, with *S* distribute uniformly. Individuals and groups can have a 30 round learning effect with informative

feedback. Table 3 shows estimates of winning bids deviations from minimally rational bidding.[39]

(G,S,N) TREATMENTS								
	(1,1,3)	**(5,5,3)**	**(1,1,7)**	**(5,5,7)**	**(1,5,3)**	**(5,1,3)**	**(1,5,7)**	**(5,1,7)**
Intercept Deviation	+31 (203.9)	**+544*** (230.7)	+284 (225.4)	**+1411*** (266.4)	-270 (351.2)	+98 (157.4)	**+713*** (187.7)	-49 (195.9)
Midrange Deviation	-0.009 (0.009)	-0.004 (0.007)	-0.004 (0.012)	+0.014 (0.008)	-0.004 (0.008)	**-0.020#** (0.007)	-0.007 (0.006)	+0.010 (0.01)
Range Deviation	…	**+0.113#** (0.061)	…	**-0.116#** (0.091)	+0.352 (0.104)	…	**+0.211#** (0.06)	…
Number of Observation	52	74	48	55	49	81	101	52
$R^2 = 0.99$								

Table 3 – Bidding behavior by twice-experienced winners

*Significantly greater than the minimum rational discount by a one-tailed 5% t-test.
Significantly different from the theoretical value by a two-tailed 5% t-test. Standard errors are in parentheses.

An analysis of variances of the winning bids can be drawn the following conclusions: when each member of the group has distinct information with signal sample size of 5 (in bold in the table statistically significant values) groups are less rational than individuals. When instead the groups consist of individuals who have shared information, result is that group can be more or less rational than individuals. Cox and Hayne call this result "information curse" that is, as more information is available on the item at auction, the greater the distance from rational bids. Moreover, this distance is greater for groups.

The following work belongs to same field as Cox and Hayne (2006) but with two simplifications: learning task is less difficult –on the amount of information available to each individual– and there is no competition between groups. Casari et al. (2016) developed an experiment that analyzes individuals and group' decision-making in acquiring firm. To control when groups outperform the individual's choices, they vary the task difficulty. There are two versions of task, a simple version in which solution can be found from most of the subjects and hard version in which solution is prerogative of the few. This experimental design means that the experiment is inserted in the vein of intellective tasks (decision task with incomplete information). In order to identify how the group choices and individual ones are formed, decision process was divided into three steps: individual proposal step, a group chat step, and a decision making step. In this way, they not only examine how decisions are made but also how individual decisions are aggregated in the decision of the group.

Experiment is divided in two parts, Control Part, of 6 period, where all individuals decide in isolation and in a Main Part, of 20 period, where individuals decide on their own or in groups of three people, depending on the treatment. Players have to solve a decision problem with

[39] Measured by linear regressions relating winning bids to the signal sample midranges and ranges of the winning bidders.

imperfect information, and to foster learning at the end of each period players can observe the company's value even if it is not purchased. Individuals and groups make a proposal of amount b, lose or quit (an integer between 0 and 360) to a seller whose company worth "s". In easy task, "s" can assume the following values 38, 60, 90, 130, or 240, while in difficult task "s" assumes 100 possible values from 21 to 120. Each of the achievements of "s" has equal chances. If offer is rejected, payoff will be 0 but if it is accepted the payoff is equal to *(1.5s – b),* i.e. the uncertainty in choice is compensated by multiplying factor 1. Each decision is divided into three steps that I have described above. Table 4 shows percentage of bids by type. The main results are as follows. For the results evaluation are used two performance measures: percentage of Optimal Bids and percentage of the Winner Course Bids. In individual treatments, there are no significant improvements in performance (Optimal Bids increase or reduction in the winners' curse) both in the difficult, and in the easy task. The groups in the easy task, compared to the control treatment had significant improvements in performance (Optimal Bids increase or reduction in the winners' curse). This happens not due to greatest experience in game, but for taking a group decision. In difficult task, groups had no significant performance improvements compared to control treatment. Groups underperformed with respect to a "truth wins" benchmark since experiment is an intellectual task. To formulate bid in the group, decisions were taken unanimously. It was found that views were taken according to a median aggregation rules and for this reason, groups do not reach the target of truth wins benchmark. When there is no agreement, the best proposal is less likely to be chosen. In this way Cox and Hayne's results are confirmed.

	5-value (easy task)				**100-value (difficult task)**			
	Individual treatment		**Group treatment**		**Individual treatment**		**Group treatment**	
	Control part	**Main part**	**Control part**	**Main part**	**Control part**	**Main part**	**Control part**	**Main part**
Percentage of Bids by type								
(Near) Optimal: ***bids that yield highest expected profit***	35.6	37.5	30.6	50.5	15.6	22.7	22.2	13.0
Suboptimal: ***bids that yield positive expected profits***	44.4	44.2	51.1	39.8	14.4	11.7	13.3	26.5
Winner's curse: ***bids that yield negative expected profits***	20.2	18.3	18.3	9.8	70.0	65.7	64.4	60.5
Realized profits (per period)	−1.65	0.40	1.21	2.13	−2.83	−0.75	−0.50	−2.40

Table 4 – Descriptive statistics

2.3. Public good game

Public good game consists, in its simplest version, that subjects simultaneously and anonymously pay a sum of money in a container for a common cause. Experimenters who collect money, double it, and distribute it equally to the participants. In this case, private benefit of public good is equal to half of the contributions paid. The expected result from economic

theory is that no player contributes as performance of a unitary fee is less than unity, but if everyone were paying, performance would be greater to unity.[40] In this game, private interest is separated from the public one. Players who do not contribute are free riders. However, the experimental results actually see behavior of free riding less frequently than assumed and the payment of contributions is greater than 0.

Solow and Kirkwood (2002) studied group' identity effect in a public good experiment, starting from the feminist critique to economic theory according to that is necessary to adopt a vision in which gender is constructed from a sociological point of view. According to this criticism, membership in a community, or a group' identity can help to reduce free riding and that this effect may be different for men and women.

Experimental design is the standard public good games in which groups are formed for about half by men and women so as to explicitly avoid single gender group's formation that could distort the results. Groups' identity remains anonymous during the experiment and interaction between groups is done through terminals that provide anonymity. At each round, each member receives an allocation of tokens that can be invested in two investment opportunities the first called "individual account" the second is called "group account." Each token invested in individual has a performance of a cent while each token invested in the group, has a half cent return, irrespective of the other investment components. In this configuration, Nash equilibrium is to invest all of the contents in the individual account. The important part of the experiment is related to groups' formation as subjects were chosen from two different populations, the first by a large group of university students, half of which formed group called "Strangers" who remain anonymous to each other. Remaining subjects has been involved in some experimental pre-activities that seek to create a sense of community among participants by filling in a questionnaire through which members know about each other (study materials, personal taste). These individuals go to form the "Questionnaire" group. The second group was chosen among band members of the same university. This choice was motivated by the fact that the selected band was a stable centenary organization and that it has the characteristics of a social group. This group attends to the sporting performance of university teams. In addition, band members have a strong group identity, share living spaces and demonstrate cohesion that is expected of a social group. These individuals compose the "Community" group. Results of treatment are reported in the following table, from which I omitted results of each round. In all groups, men altogether contribute more than women do.

[40] As provided by social psychology individuals will pay the agreed amount for altruism, social norms or group identity.

	Total
All groups	
Males (N = 61)	395.80
Females (N = 64)	362.45
Both genders	
Strangers (N = 45)	376.02
Questionnaire (N = 40)	355.30
Community (N = 40)	405.20
Males	
Strangers (N = 23)	389.04
Questionnaire (N = 19)	360.84
Community (N = 19)	438.95
Females	
Strangers (N = 22)	362.41
Questionnaire (N = 21)	350.29
Community (N = 21)	374.67

Table 5 – Average contribution by gender, group, and group within gender

Considering all groups divided by gender, assumption that the average of men contributions is equal to the average of women's contributions is rejected.[41] Considering both genders, the average contribution of Community group is higher than that of the other groups contribution, while the average of Strangers contribution is higher than Questionnaire group one. However, null hypothesis that averages contribution of the Community group and those of the Strangers group are equal is rejected at the 5% while the hypothesis that the averages of Community group and Strangers are equal cannot be rejected at 10%. Results by gender shows that there is no significant difference in the averages of the results among women's groups. Considering group of men, there is a significant 1% difference between the Community group and the Strangers, while there is no difference between Strangers and Community at 10%.

At the end of experiment, there is an additional treatment in which were confronted 8 men belonging to the same fraternity and 8 women in the same sorority. These university associations are characterized by emphasizing group identity and philanthropic activities. Theoretically, this group would have to contribute more to the group of "Strangers", but the experimental result has been the opposite. This means, that there are more complex causes in the choices than mere categorization into groups and gender. In this case, several factors had to be considered such as those, for example, self-selection bias because membership of a social group is endogenous, based on the individual characteristics. So probably, the most competitive students participate in fraternity and sorority, while students that are more cooperative

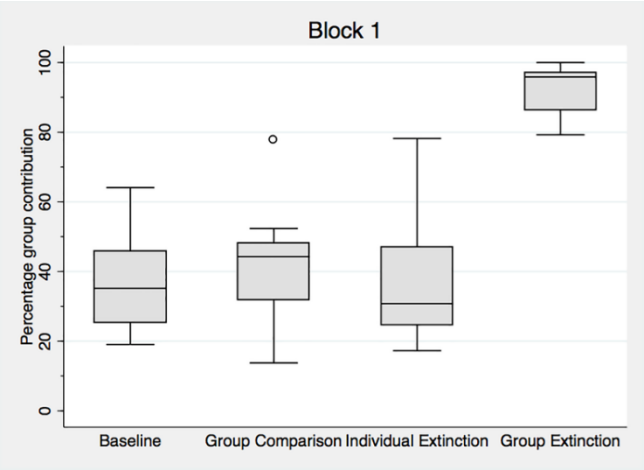
[41] Student test at 1% level of significance.

participate in the band. Finally, gender criticism that women are more attentive to the welfare of the people they are related to than men is not supported by the results.

Previous experiment has focused on the role that gender, associations, and communities in general, have to influence social identity, entering the debate of feminist criticism, while in following experiment the analysis is directed towards natural selection dynamics in evolutionary key, which assumes that groups have a predominant role in the appropriation of resources. In fact, the question being debated is whether competition between groups increases the value of altruistic behavior within a group.

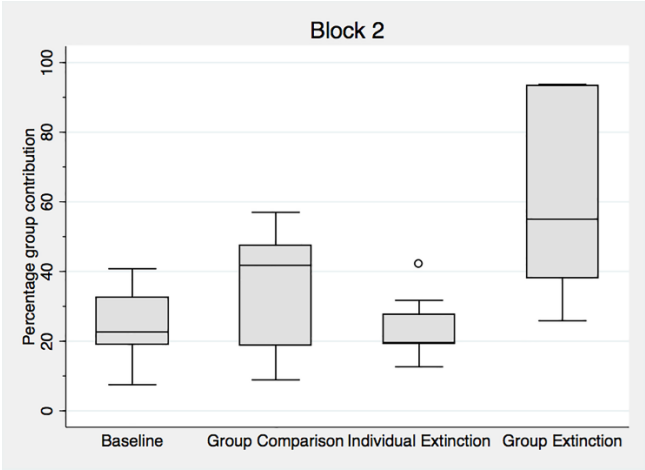
Eckel et al. (2016) identify what mechanisms by which a group has more or less successful when competing with another group to get hold of an amount of resources. The paper explores Darwin's observation that selection between groups fosters altruism, bringing group more altruistic to override other groups despite the presence within it of free riders. Experiment is based on a public good game, which best summarizes tension within group between individual interests and total welfare and investigates the role of the free rider. To isolate the role of altruism and cooperation, a rule of extinction of the groups has been introduced, in order to make extinguish the weaker group. Experiment design states that if the group earned less in the first block of experiments does not pass to the next block. Experiment is organized as follows: there are two blocks of 20 rounds each and 4 treatments. The first is Baseline treatment where the subjects participating in the public good game standards in two sub-variants; the second is Group extinction where the groups play a public good game for 10 periods in Block 1; at the end of the 10 times the groups are ranked in order of total earnings. Groups that have the lowest score are considered extinct and do not participate in Block 2. Group comparison where it is checked whether it is the information on the ranking that takes effect on groups. Here there is no extinction effect, because all groups after the disclosure of the ranking, are admitted to the Block 2. Finally, Individual extinction treatment had the purpose to check also whether that results in the treatment Group extinction is due to extinction mechanism exclusively. Treatment is identical to the latter with difference that an individual plays against a group. The following figure shows the results of the two experimental blocks:

Figure 3 – Aggregate data for Block 1 by treatment.



http://dx.doi.org/10.1371/journal.pone.0157840.g001

Figure 4 – Aggregate data for Block 2 by treatment.



http://dx.doi.org/10.1371/journal.pone.0157840.g002

In Block 1, members of Group extinction treatment contributes more to the public good (92% on average of the budget) than groups in other treatments. While in Block 2 the Group extinction is still the treatment that contributes more to the public good than groups in other treatments, even if in a smaller percentage (62%). To check if ranking has a role in the result, the contributions of Group of extinction was compared to those of the Comparison group and, difference is significant with p-value < .001, then ranking has no effect. To test whether results depend only on the threat of extinction, they compare results of the Individual extinction to those of the Group extinction, and differences in contribution are significant with p-value < .001. In control treatments between the first block and the second block, contributions to welfare do not change, while contribution of treatment Group extinction decreases significantly. Accordingly, when threat of extinction is removed, the contribution is initially high, and then converge toward Nash equilibrium with contribution equal to zero. In conclusion, this study investigate whether the extinction effect strengthens the group identity, or is a response to a threat. The conjecture of Darwin is confirmed and the only threat of extinction is sufficient to enhance cooperation between groups.

3. Sequential games

A game is sequential, when players make their moves one after another. Result of each player moves influence every future results. In this configuration, perfect information is not a necessary condition. You have imperfect information when a player may know that other player in a previous move did not perform a certain action, although you cannot know which of those possible have made because the moves can be simultaneous or hidden. An important

subset of sequential games are the ones with perfect information. In this case, both players have complete and perfect information about the decisions of the players in the previous moves and know the consequences of their actions. Simultaneous games can be presented in extended form by means of a decision tree. Figure 5 below shows an example of ultimatum game, which is a diagram in which are described, in correspondence with each node, the choices and the respective payoffs. Simultaneous games have a wide application because they allow to model reality dynamically.[42] In this chapter, I will provide a review of some works that analyze groups' actions and individuals, and in particular, ultimatum game / dictator game, trust game, and principal-agent game (also known as gift-exchange game).

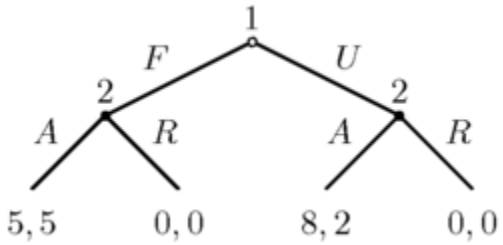


Figure 5 – Extensive form

3.1. Ultimatum game/Dictator game

In this game, first player receives an endowment of money. He may transfer part of his allocation making a take-it-or-leave-it-offer to the second player who can refuse or accept the proposed sum of money. In case of proposal rejection, both players will perceive no amount, in case of approval, allocation shall be shared according to the proposal of first player. Figure 5 shows the typical result shown by experimental economics studies according to which if the sum offered is equal to or greater than half of first player initial endowment, second player accepts otherwise rejects. In contrast, standard prediction for this game is that any amount that is transferred, even the smallest, of amount greater than zero should be accepted, as it is consistent with Nash equilibrium. Dictator game is a game version derived from ultimatum game and was introduced by Kanheman et al.[43] In this game (proper game) second player has a passive role because it cannot refuse the proposal (and therefore he is powerless). Standard prediction of this game is that who formulates the proposal does not transfer anything to second player. In contrast in results of experiments conducted on individuals the sum that the dictator transfers is on average greater than 0. Through this game, it is possible to keep separate distributional concern from strategic interaction ones. In a dictator game Cason and Mui (1997) show that proposals of a two individuals team tend to be more generous than proposals made

[42] Although in sequential games, the second player has an advantage because he or she knows the other's move, while simultaneous games are more equitable because the two players are on the same level.
[43] Kahneman et al. (1986).

by individuals. This behavior is explained by the "Social Comparison Theory" according to which individuals behave in the way they consider to be socially desirable. On the contrary, Luhan et al. (2009) found that with a three-member groups in the role of dictator, groups move smaller amounts than those of individuals because the most selfish member of the group manages to have greater influence on others. In another work, Elbittar et al. (2011) study how rules affect the groups' decisions in an ultimatum game. The results show that the individual behavior of the responder does not vary between the different treatments. In first place, where there are different decision rules, group decisions may be viewed as a sum of individual decisions. Second, the proposer behavior depends significantly on the internal decision rules in groups and is also significantly different from behavior of the proposer in one-by-one game. Unlike previous experiments, where was highlighted the importance of the interaction between social groups, the two following experiments have investigated how the institutional aspect affects decision-making results. In the following experiment, after the increase in the number of members of a team from even to odd in order to make the results more general, there is a shift from an environment in which decisions are taken with a possible compromise to one in which they are taken by majority vote.

Luhan et al. (2009) propose a studio replica of Cason and Mui (1997)[44] which findings are in contrast to results of an extensive literature. In particular, individuals transfer 26.09% of its endowment against 27.61% transferred from teams. On the contrary, Luhan et al. find that in dictator game teams formulate decisions that are more in line with the standard decision-making models of economic theory. The experiment consists of two treatments (Team-Treatment and Control-Treatment) with three consecutive stages each. Decisions made at each stage are independent and do not have any effect on the subsequent stages. In the first stages every subject in the role of the dictator decides individually on the transfer T € {0.0, 0.1, ..., 4.9, 5} to an individual receiver. In the second stage, each subject is a member of a dictator team of three individuals each, which must take a single decision on the T to be transferred to receiver group, always composed of three individuals. So each member of dictator' team earns 5-T, while each component of receiver' team earns T €. In third stages, each subject, with role of dictator, took a second decision, with the same rules of the first internship. In control treatment, stages are identical with the only difference in the second stage where the game is between individuals. Compared to Cason and Mui (1997), authors increased by an individual the number of team members that pass, from two to three.[45] Increase in the number of individuals may have an effect on the results of the game because with two members is likely to reach a compromise results while three members can apply an implicit rule of the majority.

[44] One of the main contribute of this paper is to have incorporation of some insights from social psychology regarding group behavior to study economic decision-making.

[45] Cason and Mui (1997) wished an extension of studies to analyze whether their results are generalized or depend on the numerosity of the team members.

Team members are categorized into tertiles according to results of Stage 1, so that those in the lowest tertile are the most selfish subjects, those in the central tertile are the moderates and those in the highest tertile are the "other- Regarding" ones. Teams are composed of homogeneous subjects "within-team heterogeneity" in order to measure influence in decisions in this regard too. The communication within the groups is via chat. Subjects were asked to reach unanimity in 10 minutes, while in case they do not reach unanimity they do not receive any payment. At the end of the experiments, personal information on the gender' subject was collected in order to measure the gender effect composition in the decisions.

TEAM-treatment	**Stage S1** **1st individual transfer**	**Stage S2** **Team transfer**	**Stage S3** **2nd individual transfer**
Average transfer T	0.94	0.54	0.66
Standard deviation	1.07	0.56	0.85
CONTROL-treatment	1st individual transfer	2nd individual transfer	3rd individual transfer
Average transfer T	1.27	1.17	1.25
Standard deviation	1.25	1.17	1.11

Table 6 – Transfers in the dictator game

Table 6 shows, for TEAM-treatment, that in S2 team transfers on average (€ 0.54) that is significantly lower than the average transfer of individuals, in S1 (€ 0.94) ($p < 0.01$). Even in S3, individuals average transfer of 0.66 €, is significantly lower ($p < 0.01$) than that in S1 but not different from the average of S2 transfer. In CONTROL-treatment, these three contributions remain stable in three stages. In S1 there is no significant difference between two treatments, in S2, there is a significant difference between two treatments ($p = 0.069$). In S3 there is a significant difference ($p < 0.05$), confirming hypothesis that, on team outcome was affected by the experience within team and not rather due to learning effect. As a further step, they examine the process of team decisions through a linear regression S2 transfer as the transfer function in S1. The most selfish component has the greatest effect on the group's transfer. The lower the transfer to S1 of the component most selfish, the lower the team move to S2. This result is in contrast with Cason and Mui (1997) which underline that on the contrary that subjects most "other-Regarding" decide transfers.

Experiment below can be considered complementary to the previous one because it shows that different decision rules affect the groups' choices, as they have a direct influence on the behavior of the same participants that act differently depending on the context. Elbittar et al. (2011**)** analyze, in an ultimatum game between groups, if, to varying group decision-making rules, also vary results. In particular, they point out that there are variations in the behavior of group' proponents, when it varies the decision-making structure of the respondents group. In this treatment, individuals do not communicate directly with each other and identity is unknown**.** Game has asymmetric information, because proponents do not directly observe the

minimum value of x € (0, π) under which respondents decide to reject the proposals; this value is obtained from a distribution function F (x), that is the probability that x offer is accepted, while *P (x) = 1 - F (x)* is the probability of rejection.[46] Experimental design includes four treatments, one treatment of One-on-one control, three "group-on-group" treatments, with three subjects groups differentiated according to the voting rules of the group of respondents. Into individual bargaining (I), subjects propose to transfer part of an endowment to another person who can accept or reject, if the second person rejects no one will receive nothing, whereas if he or she accepts, subjects will share the endowment as it was decided by the proponent. In the treatments with the groups, the group of respondents is structured according to the following three rules: unanimity with Rejection Default (URD), according to which to accept the proposed sum, all group members must vote, otherwise the proposal is rejected. Unanimity with Acceptance Default (URD) according to which to reject the proposed sum all group members must vote, otherwise the proposal is accepted. Majority Rule (MR), where the sum is accepted when at least two members of the group accepted. It is assumed that the individual behavior of responders P(x) is constant between treatments and that the chances of rejection will vary for each treatment according to the table below.

Treatment	Probability of rejection
I	P(x)
MR	$P^3(x)+ 3P^2(x) (1-P(x))$
UAD	$P^3(x)$
URD	$(1-P(x))^3$

Table 7 – Probability of rejection

Groups are composed of 3 subjects each, the proposers are named A and accepters which are called B. Groups are randomly paired, and none of the group members knows the identity of the other components. The experiment consists of 10 periods, which are preceded by 2 periods of practice. For each group-on-group treatment, the group members have changed randomly so that at the beginning of each period there are new groups of 3 subjects. Similarly, for every one-on-one treatment, the couples of the proponents and responders are designated at random at the beginning of each period. Initial allocation is 100 points. Both offers of proposer, which are in a range between 0 and 100, as well as the votes of accepters, occur without communication within groups. In the analysis of the results, they analyze separately result of respondents, and that of the proponents. On responder's side, the first step was to compare the refusal rates, conditioned to the amount of the offer, separating individual decisions from those of group.[47] Theoretically, individual refusal rates should not be different between treatments. Similarly, refusal of the unanimity with Rejection Default rates should be greater than the individual do, and these two, should have a higher rejection rate than Unanimity with

[46] With $P(\pi/2) = 0$ and $P(0) = 1$.
[47] Here they consider the individual decisions of the components, regardless of the decision of the group.

Acceptance Default treatment. Finally, Majority rule rejection rate should be higher for individual treatment and lower than other cases. By analyzing the proposer behavior, offers decrease over time, offers are higher for the Unanimity with Rejection Default than for other treatments; offers are not significantly different for other two voting rules compared to the control treatment. Finally, offers decrease over time in the Unanimity with Acceptance Default. In comparing results One-on-One, and those of the Group-on-Group Majority Rule, since the same individuals were proposers, both in individual treatments, and in those with the rule of the majority, there is the assumption that the same participants make different individual offers in two different situations.

3.2. Trust game

In this game, first subject decides what to send, if just a part or all of an initial endowment, to a second anonymous subject. Both players are aware that the amount transferred will be tripled. Second subject that receives the sum tripled decide, in turn, which amount to return to first subject. Nash equilibrium of this game, is a non-cooperative prediction of "no confidence", i.e. that first subject does not transfer any amount to second one, because there is expectation that, as a game between strangers, will not be returned nothing to him. Experimental evidence, see for example Berg et al. (1995), in a model where repetitions of interactions are absent, reputational penalties, contracts and punishment, show that first subject sends, contrary to what is expected, on average about half the endowment[48] and that a third of recipients return an amount greater than the one received. Bornstein et al. (2007) showed that groups in the role sender send a lower amount compared to individuals, and expect lower returns. Groups and individuals in responder role have yielded on average the same amount, so it can be concluded that groups trust more than individuals do but they are equally trustworthy. Degli Antoni and Grimalda (2016) analyze how groups' type influences trust formation and what differences there are between trust and trustworthiness within the respective group' components. Through a trust game, they test two hypotheses: a first Putnam Hypotesys that some associations influencing members to cooperation, solidarity and the common good, a second Olson Hypotesys, opposite a more disenchanted, that groups tend to private interests, and the activity of lobbying for special interests. Results show that associations members (such as scouts, or youth) trust more than trade union member do, while on the contrary associations members are less reliable than trade union member do.

Compared to previous experiment, I consider a trust game adjusted with expectations in which groups of 3 each with members possibility to interface within group. Kugler et al. (2007) analyze the behavior of individuals and groups, consisting of three subjects, in a trust game based on the Cox (2002) model, which concluded that groups and individuals do not differ in

[48] In this study, in correspondence with a budget of $ 10, it was observed, on average, a $ 5.16 transfer

amount transferred, but for amount returned, which is significantly lower for groups. Unlike the latter work, Kugler et al. (2007) have provided an asymmetric setting since there are interactions between groups and individuals. In addition it has been avoided, the possibility that an individual can play, both individually and as a group component, this in order to eliminate a carry-over effect between the treatments. To infer whether differences between groups and individuals depend on the expectations that decision has on the proposer behavior, they collect data on subjects' expectations. Participants in experiment were divided into four experimental treatments that are labeled by the initials[49] I-I, I-G, G-I, and G-G for 32 individual treatments, asymmetric 25, and 27 between groups. Sender receives an endowment X of 100 units of money while the receiver does not receive any endowment. At the end of the game, payoff is calculated X - x + y for sender, 3x - y for receiver. After decision, senders are asked to state their expectations on return (y / 3x), indicating that the most accurate forecast will be awarded. If sender is a group, expectation is applied to each component. Therefore, choice of x is taken as a measure of trust, whereas return y / 3x Indicates responder's trustworthiness.

Sender	**Responder**	
	I(ndividual)	G(roup)
I(ndividual)	65.5 (36.4) N=32	76.3 (31.2) N=25
G(roup)	54.0 (41.6) N=25	43.7 (42.4) N=27

Table 8 – Mean amount x sent by senders (standard deviation in parentheses)

Table 8 and 9 show sessions results: individuals move on average an amount higher than 65.5 and 76.3, respectively, for treatments I-I and I-G, compared to groups that transfer 54.0 and 43.7, respectively, for G-I and G-G treatment. By analysis of transfers, it is possible to measure degree of trust of the senders. When $x = 0$ we have that senders have no trust in responder, if $x = 100$, trust towards responder is complete. The intermediate sheet are reported in first two classes if $0 < x < 50$ and the second when $50 < x < 100$. Groups do not transfer anything with greater frequency than individuals do.[50]

[49] I stands for individual and G stands for group, see tables.
[50] $t(105) = 1.67$, $p < 0.049$, one-tailed test.

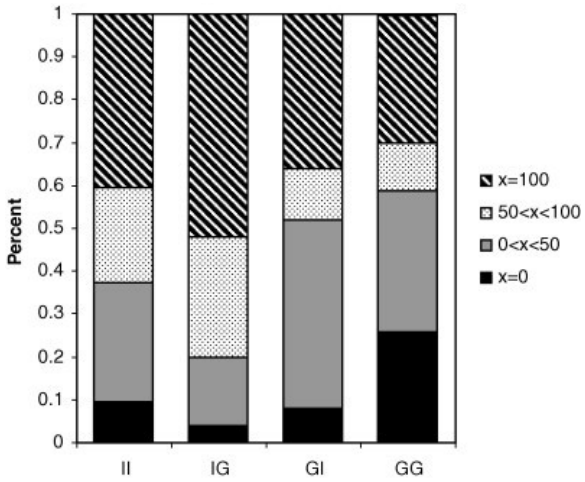


Figure 6 – Distribution of x

In addition, as Figure 6 can show it, for each treatment, groups do not transfer anything largely compared to individuals. Individuals and groups move in equal measure the entire endowment x, while individuals transferring part of the endowment in a range of 50 < x < 100 more frequently than groups.[51]

Sender	**Responder**	
	I(ndividual)	G(roup)
I(ndividual)	25.1 (19.5)	25.1 (17.5)
G(roup)	23.3 (22.1)	16.7 (18.7)

Table 9 – Mean return in % y/3x (standard deviations in parentheses)

From relative return table (y / 3x), it is possible to note that there are no significant differences between treatments, regardless of decision makers. If we look at decisions for treatment, and transferred amount, it is found that, if sender transfers all endowment, responder returns an average of 33.51%. This figure is significantly higher compared to 17.6% rate of return that is observed in range between 50 < x < 1 00, as the latter is in turn higher than the rate of return of from 0 < x < 50, which is the 9.12%. Individuals who have transferred full amount of their initial endowment (x=100) received back an amount sufficient to not have an overall loss of money. On average, however, the given back amount was not enough to make a profit. Those who have transferred intermediate sums (0 < x < 50 and 50 < x < 100), suffer a greater loss, because they received back a lower amount that they have transferred. From the analysis of expectations, it should be noted that individuals generally have higher expectations than groups (although there are no differences according to the responder). Finally, it should be noted that responders have earned more in all treatments, especially when sender is an individual responders that have greater gains than if sender is a group. To summarize, they found that

[51] t (105) = 2.9, p < 0.002, one-tailed test.

groups in the role of sender are generally less trusting than individuals do, but there is no difference in relative returns (trustworthiness) between group and individual responders.

Previous experiment aimed to replicate a past experiment in which are related trust and trustworthiness of groups and individuals, while the next, studying their determinants with a comparison between Communitarianism thesis and Institutional Economics ones. In this regard Degli Antoni and Grimalda (2016), have investigated the role that group has in shaping the preferences and behavior of its members. Here, are compared two hypotheses, the first one formulated by Putnam et al. (1993) and the second one by Olson (1982). There are two different visions of association's role that are not exclusive as they can live together as there are different associations with different purposes. Professional associations, trade union or political groups, are considered Olson-type because these associations aim to allocate the resources of the community to its members, while parochial, cultural and artistic associations are considered Putnam-type as with social interactions, it is possible to build trust and habits cooperatives among its members**.** Following assumptions, which include hypothesis A and hypothesis B on behavior within groups, occurred. Putnam "A" version, according to which members of the Putnam-type associations have a higher level of trust in public sphere than to those who are not member. Putnam version "B", according to which the trust of association members is higher than the trust that one has towards public sphere. Olson's version of "A", according to which the associations, members of "Olson-type" do not show a higher level of confidence of non-members and Olson "B" version in which the greater confidence is towards its members. Using trust game it is possible to study the Olson-type and Putnam-type group behaviors by measuring both trust and trustworthy of its members. In this trust game, both sender and receiver have an endowment of € 25. Transfers can be made in multiples of 5 (0-5-10-15-20-25). Transferred amount is doubled. Receiver decides how much to give back the sum provided, plus transfers received. Receiver is asked to indicate how much would return for each of the sender options. All subjects are called upon to make two decisions: the first as a sender and the second as a receiver. However, when subjects take the first decision as senders they do not know that they will have to take a second as a receiver. Subjects present in a room are matched anonymously with subjects present in another room. Couples are modified anonymously and without feedback, so they can be considered as two independent choices. Subjects are only paid for one of the two decisions. Of the 374 subjects taking part in experiment, 263 subjects are associated formally in six voluntary associations. Four are cultural associations, while two trade unions. 111 participants on time of the experiment were not members of any association, and in particular, 77 had never been associated in a partnership, but thirty seven they had been in the past. There are differences in results in these two sub-categories for which they were considered without distinctions. Measure of trust and trustworthy with respect to membership in an association is measured, especially in out-group

sample, not only with respect to single or multiple affiliate membership, but also in relation to the intensity of participation. Out-group sample is structured in eight categories,[52] so much thinner than in-group sample because the purpose is to measure generalized trust, while in in-group sample we have just three categories,[53] with the purpose of measuring particularized trust.

	Out-group		In-group	
	Median	**Mean (Std.dev)**	**Median**	**Mean (Std.dev)**
Non-members	10	10.496 (6.973)		
Members of Putnam-type only	15	15.172 (5.587)	15	14.342 (5.947)
Members of Olson-type only	15	14.5 (6.345)	15	15.833 (6.833)
Members of Residual only	15	15.441 (6.783)	15	15.610 (5.612)
Members of Putnam-type and Olson-type	12.5	12.917 (7.821)		
Members of Putnam-type and Residual	15	14.8 (6.994)		
Members of Olson-type and Residual	10	11.25 (6.440)		
Members of Putnam-type, Olson-type and Residual (All types)	15	14.091 (5.394)		
Members of at least one Putnam-type association	15	14.545 (6.344)		
Members of at least one Olson-type association	15	13.538 (6.479)		
Members of at least one Residual association	15	14.451 (6.667)		

Table 10 – Amount sent across treatment and association membership

Table 10 shows average amounts transferred. In Out-group treatment, we have the following results: in all combinations, except two,[54] associations contribute to a significantly greater degree of non-members subjects.[55] In addition, in the "in-group" treatment there are no significant differences between Members of Putnam-type only, Members of Olson-type only and the Members of Residual only.[56] To see if there is an in-group / out-group effect, considering the sums sent by elements that belong exclusively to one type of association.

[52] Non-members, Putnam-type Only, Olson-type Only, Residual-Only, Putnam & Olson-type, Putnam & Residual-type, Olson & Residual-type and All Types.
[53] Putnam-type, Olson-type and Residual.
[54] Members of Putnam-type and Olson-type and Members of Putnam-type and Residual.
[55] Putnam-type and Olson-type associations (Mann-Whitney p=0.3266) and members of both Olson-type and Residual associations (Mann-Whitney p=0.8546).
[56] Putnam-type (Mann-Whitney p=0.5741), Olson-type (Mann-Whitney p=0.5147) and Residual (Mann-Whitney p=0.9125).

Taking the average of the sums returned by receiver, on 6 possible transfers of Trust Game, it appears that members of all the types of association return a larger sum on average than non-belonging to any groups. This difference is more significant for members Olson-type only and the Residual-type only members, while it is lower for members of Putnam-type only. When considering multiple statistically significant differences associations, they have Putnam-type and Residual, at least one Putnam-type association, at least one Olson-type association and at least one Residual association. Finally, there is no significant difference between treatments "Out-groups" and "In-groups", for members of Putnam-type only, Olson-type associations and Residual.

As I have seen, trust and reciprocity are important elements in human relations and play a fundamental role in commercial transaction. In this regard, previous experiment analyzed the differences in behavior in trust and reciprocity connected to a different worldview. The studies that I review below, which are theoretical basis of our experimental design, analyze the role of fairness in economic relations (job market) namely, in this case, relationship between employers that determines wages, and the workers who decide an effort that influences, in part, the results of the company. Fehr et al. (1993) first test the hypothesis of wage fairness effort in an experimental competitive market. General result is that effort is positively correlated to the level of wages. In particular, an individual chooses to sacrifice money to help another individual in exchange for a gift that consists of a higher salary. With gift exchange, both individuals have a higher payoff than expected Nash equilibria. This behavior is also consistent with Akerlof (1982) which uses a special case of the principal-agent model. Principal-agent model is a class of games with imperfect information, in which one player (principal) sends an incentive to a second player (agent) to encourage him to act in best interests of the principal. Payoff depends on the action both of the principal both of the agent. Principal cannot bargain on the agent's behavior but can also choose one incentive scheme based on the context signals. Agent decides an optimal action to take, given the incentive, then decide whether to accept the proposal by the principal decision, which depends on the expected payment, and subjectively cost to perform the action**.**

Akerlof (1982) developed a Gift Exchange game, in which it is argued that employers, in certain circumstances, pay more than they should, and workers frequently reciprocate by working harder and with more care than they would do otherwise. A simple model of the Gift Exchange in the labor market is when a company takes on L workers who have a function effort equals $e(w - z)$. Where w is the wage paid by the company, z is the reference wage. Therefore, if $w > z$, the employer is generous, otherwise it is not. Revenue function is an increasing function effort of the workers and the net profit is given by the following equation:

$$\pi(w, L) = f(e(w - z)L) - wL$$

In case that employer chooses the wage level *w* for each L, maximization of profit will be ensured by the first order condition (Solow condition) *de/dw = e/w*. In equilibrium, the elasticity of the worker's efficiency wage is = 1, to the level of optimal wage. In gift exchange, the principal determines the wage level, while in return the employee decides the level of effort. As I have seen, the model is structured so that the levels of effort cannot be induced. So, theoretical prediction is that the principal has no incentive to pay a wage level beyond the minimum, because the workers would choose the lowest level ever effort. Ferh et al. (1993) show that principal reward the agents of 42% of the surplus and workers reciprocate with a higher level of effort than the minimum one.

In standard gift exchange models, there is not a contractual agreement linking employer and employees. Charness et al. (2012) that are inserted into the mainstream of literature of economic and psychological incentives, filled this gap analyzing alternative mechanisms to the traditional economic theory to achieve higher profits and greater social results. The starting point is a successful experience of a Brazilian company that allowed its employees to choose their own wages and working hours. In this model, similar to what happened in the Brazilian company; the employer can decide the level of pay or delegate it to the employee. It is a change from typical gift exchange game design as in first period, the employer decide whether to choose or to delegate the choice of wages, together with the desired level of effort, in the second step the employee, once observed a choice of employer, decides the level of effort and possibly wages.[57] The paper tested the hypothesis that this delegation will significantly increase effort level of employee. The salary is fixed, from period to period, assuming that in this way the performance of the employee is still higher than that which would be maintaining the fixed salary, for all periods. In repeated game, employee provides a high-level effort to induce the employer to delegate the choice of salary in the following period. In this contractual arrangement, it is possible to watch an increase of effort, for the principle of "The responsibility-alleviation effect"[58] in which an agent that carries the weight of the result increases the external impulses of loyalty, honesty and generosity. If the employer set the salary, this could mean a shift in the weight of the result on the side of the employer. The experimental design consists of 5 treatments, Partner treatment, Strangers treatment and Dictator treatment. There are two control treatments, one for partners and one for strangers. Partner treatment consists of two stages. In the first, the company can decide whether to assign to the corresponding employee, w wages or allow it to settle a wage level. Contextually the employer fixing a level *ĕ* of effort, which is not binding. The second step depends on what has happened in the first one. If the employer has fixed the wage, the worker will decide only effort

[57] It is a novelty, as economic theory predicts that the main never delegated the setting of wages to the worker, because it anticipates that the employee will choose the highest wage level at the lowest effort, with the result of having the worst results for the employer.
[58] Charness (2000), p.375.

level otherwise employee chooses both the salary and the effort level. Payoff functions are the following:

$$\Pi_F = (240 - w)e$$

$$\Pi_W = w - c(e) - 20$$

Where *F* is the enterprise, *W* the worker, *e* the effort, w the wage and *c(e)* the cost of effort that is an increasing function in *e*. Wage w is an integer between 20 and 120 while effort and cost are shown in Table 11. Company and employee know they are matched anonymously throughout the treatment. Delegation to wages fixing is limited in order not to jeopardize company life. Therefore, the maximum wage is 120, against the redemption value of the firm, which is 240.

e	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
c(e)	0	1	2	4	6	8	10	12	15	18

Table 11 – Effort levels and costs of effort

In Stranger treatment, the combination company-worker changes randomly each period. In Dictator treatment, in the first step, employer only sets an effort level that is not mandatory. In the second step worker fixed salary and the effort level. In these last two treatments was used the strangers matching protocol.[59] In the two control treatments, there is not the possibility of delegation. For which the company fixed the salary, and a level of effort not binding, while the employee chooses the level of effort.

Experiments have seen the involvement of 236 participants who played for 15 times in all treatments. No participants have taken part in more than one treatment. The results are summarized in Table 12 that shows the average values of salaries and effort.

	Partners PND	**Partners PD**	**Partners Control**	**Strangers SND**	**Strangers SD**	**Strangers Control**	**Dictator**
Wage	76.79	114.70	75.95	45.60	117.85	51.24	113.05
Desired effort	0.78	0.81	0.72	0.61	0.67	0.59	0.68
Actual effort	0.43	0.71	0.46	0.15	0.34	0.17	0.36
Firm Earnings	64.29	84.62	68.36	27.53	41.91	30.24	45.93
Worker earnings	51.09	84.15	50.01	24.93	93.81	30.35	88.96
Total Earnings	**115.38**	**168.77**	**118.37**	**52.46**	**135.72**	**60.59**	**134.88**

Table 12 – Summary of results

From results of the Partners treatments, in which a distinction is made between the results of decisions taken under condition of Partner delegation (PD) and decisions taken under not-delegation Partner (PND), workers have wage and effort at the highest level with the employer delegation. Difference is statistically significant both to partner treatment where the company

[59] That is a pairwise meeting process.

does not delegate both the treatment control partners.[60] Between PND treatment and Control groups there are no significant differences in both the minimum average level of wages (76.79, 75.95, respectively) both in effort which is very similar (0.43, 0.46, respectively). So in Partners treatment it can be argued that choosing to not delegate is not harmful in itself. By comparing the results of decisions taken under Strangers delegation (SD), and decisions taken under Strangers not-delegation (SND) with those taken under PD and PND, the effort level is widely lower (0.71 and 0.43 respectively) compared to the 0.34 and 0.15, and these differences are statistically significant.[61] However, in SD both the average wage level (117.85) and the effort (0.34) is higher than that of SND, (45.60) and (0.15), respectively.[62] Comparison with control treatment reveals that decision not to delegate does not imply a negative reaction.[63] Different level of effort among the treatment is influenced not only by higher wages but also by the decision to delegate or not to delegate. Isolating, with a GLS regression,[64] for each delegation and non-delegation treatment, in which is placed as the dependent variable the effort, in order to measure the effect of wages and that of the delegation, we have the following conclusions. Delegating decisions on wages, increased the worker's performance and improves both the firm's earnings and those of the worker, compared to the case where companies do not delegate. Isolating with a GLS regression, for each non-delegation and control treatment, they have the following conclusions: increase of the effort with responsibility is not due to a negative reaction of non-delegation but is due to a positive effect of the delegation. Finally, comparing Stranger treatment with Dictator treatment, they analyze the delegation effect on the effort. The higher level of effort, if the employee has had the opportunity to choose the wage, is due to an increase in the worker's responsibility towards the result.

As I noted from the literature review, experimental results are ambiguous. The results vary with some feature of decision-making process such as the voting mechanism or the variation of some structural characteristics such as process of formation of the groups, or the learning one. According to Kocher and Sutter (2007) there are some explanations about these findings. First, number of studies on the time was still small in numbers, secondly, as I pointed out in the review above, there is limited empirical knowledge about decision making in groups, and literature psychological cannot find any difference between the general decision-making of the groups and the individuals.[65] The authors suggest, for the first time in the literature, analyzing the group decision-making process through a one-shot gift-exchange game. This method allows

[60] Z = 3.980, p = 0.000; Z = 3.234, p = 0.001;Z= 3.702, p = 0.000, two-tailed test.
[61] Z = - 3.231, p = 0.001; Z = - 4.746, p = 0.000, for the delegation and non-delegation cases, respectively.
[62] Z = 4.197, p = 0.000; Z = 3.031, p = 0.002, for wages and effort, respect.
[63] The differences between the levels of effort are not statistically significant while those between the salary levels are significant.
[64] GLS is a linear regression model that is used when there is correlation between residuals.
[65] Although the distinction between intellective task and judgmental tasks can help to identify specific differences in decision making between groups and individuals. See Kocher and Sutter (2005).

a first step in the shed light of the black box of the decision making of the unitary groups.[66] In addition, the basis of inconsistency of the results there are the motivations of the group members and the group interaction processes. Main result is that groups follow two behavioral regularity; the first is that their behavior is more competitive than individuals do with results close to theoretical predictions of the theory of the standard games; the second that small groups tend to maximize better profits.

Kocher and Sutter (2007) studied differences in decision-making among groups and individuals through three different treatments based on gift exchange game introduced by Fehr et al. (1998) which is a bilateral bargain. In this model, firms are wage setters, whereas individuals are effort setters. In this scheme, the contracts are incomplete because the effort level that the worker has to choose, after the fixing of wages, is not included in the contract. According to this scheme, there are two types of entities: the subject of type A has an initial endowment $E > 0$ and sets a wage level $w < E$; once the wage w is set, the subject of type B , chooses an effort $f > 0$ that has a cost $c(f)$ increasing in f with $c'(f) > 0$. The structure of the payoff is as follows:

$$\Pi_A = (E - w)f \qquad (1)$$

$$\Pi_B = w - c(f) \qquad (2)$$

They believe that approach of rationality or selfishness of the group as a whole is misleading. They believe that group decisions are more rational as there is a learning effect in which the individual has to agree or disagree with decisions that are different from those that would take alone. Treatments are of three types. Firstly, (I) where type A and type B subjects are individuals. Secondly, (CG) where type A and type B subjects belong to groups of 3 individuals each. In this treatment, a PC mediates the communication between group members. Likewise, in (FG), the subjects of type A and type B belong to groups of 3 subjects each but the communication between the subjects of the same group takes place face-to-face without any limitation. Each type A subject has an initial endowment E equal to 120 experimental tokens. The wage w can be fixed in a range between [10; 100]. Those of type B have no initial endowment but once they are informed of the wage w, they choose an effort f that has the following cost structure that I show in Table 13.

e	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
c(e)	0	1	2	4	6	8	10	12	15	18

Table 13 – Effort levels and costs of effort

Bargaining is one-shot and there are no repetitions. Length of the treatments, that are 10 rounds, guarantees the learning effect. The anonymity is guaranteed both for components of type A, both for components of type B.

[66] Members have to agree on a single joint decision.

Treatment	Transfer *w*		Effort *f*		Earnings[a]		N
	Mean	std.dev.	Mean	std.dev	Role A	Role B	
I	45.71*	20.80	0.27+	0.27	18.4*	43.0+	28
CG	32.92*,+	16.01	0.20*	0.12	16.3+	30.0+,*	24
FG	48.13+	23.16	0.43+,*	0.30	24.9+,*	42.8*	16

a Reported earnings are in experimental points and exclude the show-up fee

*,+: Figures with the same superscript in a given column are significantly different ($p < 0.05$; two-sided U-test)

Table 14 – Descriptive results for *w, f* and payoffs

In Table 14 are reported results of the three treatments. On the one hand, it is confirmed what assumed, namely that individual of the treatment (I) on average transfer more than of the groups in the treatment (CG). However, on the other hand, the same does not happen in the effort choice since the differences between these two treatments were not significant. The other result is abnormal because, although according Kocher and Sutter treatments (FG) and (CG) are theoretically equivalent, the two groups have different outcomes and in part significant. In fact, treatment groups (FG) on average transfer more than individuals (I) do and more than of the groups of treatment (GC) with a significant difference between the groups. Similarly, it happens in effort *f* choice but the difference was significant only with individuals (I) and not with groups (CG). Because of inconsistency of some of the results, the differences found in the literature in behavior between individuals and groups can be explained only partially here. In this regard, further investigation into the role of the learning effect in the groups is needed by introducing some learning mechanisms other than face-to-face. My experiment is an extension of Kocher and Sutter (2007), limited to experiments that are computer mediated,[67] in order to solve some issues and to generalize the results.

In order to study the effects of formal requirements in which decisions are reached within groups, I introduce two treatments with two different decision-making processes: In the first, the decision-making process of the group is divided into two steps. In a first step, the decision process happens separately in two subgroups and, in case of agreement in both subgroups, it is possible to have a second step where there is another group decision with all components. In this case, the splitting into two subgroups also involves a learning effect divided into two parts. In the second treatment, only one component can makes decision, and the others can only accept or refuse. In this case, I have also a very limited learning effect because members only know the proposer preferences and the proposer does not know the preferences of other components. In this treatment, proposer can change behavior only by the refuse of his\her proposal and does not know who has accepted. The second treatment takes place in absence of learning effect, in which a single subject indicates proposals and other members can only accept or rejected the proposal. In this case, I have a decision-making mechanism similar to that of individual treatment, which it is moderated by the consent / refusal of the other

[67] This is relevant because the authors did not find differences in performance between groups and individuals if decisions are taken by individuals and groups who discuss face-to-face.

components of the group that do not reveal their preferences. In Baseline and Subgroup treatments, each subject knows the proposals of others components.[68] I have also increased the number of group's members, by 3 to 4.[69] Charness et al. (2007a) observe that the rationality violations decrease with increasing the number of individuals who make decisions together. Moreover, a large number of rounds does not seem to affect the result and Kocher and Sutter (2007) observed in their experiment that only three groups of 48, coming to last vote. Other scholars, see Kagel and McGee (2016), observed a significant effect of the repetitions on the results-to the game. Through these changes, group motivation and group interaction processes can be analyzed in a more general way.

4. Experimental procedure

Subjects and design 168 undergraduate students of the University of Siena, Italy and 56 undergraduate students of the University of Western Piedmont, Alessandria, Italy, for a total of 224, participated in the experiment. Experiment was organized and recruited with the software hroot (Bock, Nicklisch, Baetge 2012). Through this software, I sent to all students, herein already registered, an email that invite them to take part in some experimental sessions concerning economic decisions and that, as a result of these decisions, there would be gains in money to a variable extent dependent on decisions taken. For each subject, software registers and preserves the history of his participation in previous experiments. This useful feature prevents participation in those subjects with a potential learning effect because it is possible to exclude from invitation email those subjects who participated in similar fields experimental sessions. Another important feature is the random allocation of subjects in each session who were invited. This also limiting the arbitrariness of experimenters in this task. As we have seen, students were randomly assigned by hroot to four experimental treatments: 48 participated in six Baseline treatment sessions (B) where participants, divided into two opposing groups of 4 subjects each, made their proposals simultaneously and took their decisions by unanimity. 72 participated in Leader treatment (L) where participants, divided into groups of 4 subjects each, received proposals from a subject, randomly selected within groups' components, and other subjects accept or refuse them, and took their decisions by unanimity. 72 participated in 9 Subgroups treatment sessions (S) in which participants was divided randomly into two groups of 4 subjects each, divided in turn into two subgroups, consisting of 2 subjects each, where they took some preliminary decisions: if both groups reached an agreement, the results was voted again by all the members of the group, unanimously. Finally, 32 subjects participated in 4

[68] See Roth and Erev (1995), p. 171.

[69] As unanimity was required the transition to an even number to an odd number. As we saw in Luhan et al. (2009) this change in design can lead, in the absence of voting explicit rules, to a situation of potential compromise solution in groups.

Individual treatment sessions (I) in which a subject contracted with another individual, and decision was taken individually one-shot.

Treatments	N.	Participants
Baseline	6	48
Leader	9	72
Subgroups	9	72
Individuals	4	32
Total	28	224

Table 15 – Treatments and Participants

Procedure: All participants who were present at scheduled time, were invited to enter the experimental laboratory where they were randomly assigned to a personal computer (hence PC) via the extraction of a numbered ball from a bag. Panels that hinder communication between subjects and obscure the view of the other PC screens separated the PCs. Upon entering the classroom, subjects were asked to no longer communicate with other participants, and that their participation will be given a show-up fee of € 5.

Before the experiment, I read the full version of instructions and then a summarized version.[70] While reading, I have not shown nor profit maximization strategies or specific operating instructions. At the end of instructions reading, I asked the participants if there are questions for clarification.

Participants were assured that their decisions, and their payments, were and will remain anonymous and that the information collected about them will be treated confidentially and subject to Italian privacy laws. Experiment had neither a testing part nor more repetitions. It was also announced that the game will not be repeated and that the payoff calculation method was always verifiable.

In treatments (B), (L) and (D), components of the group A (Sender) received an initial endowment (X) of 480 experimental tokens.[71] Components of the group B (Responder) received no initial endowment. Final payoff for each Sender was $(X- w) * f / 4$, while for each Responder was $(w - c(f)) / 4$ where w is the amount transferred by type A subjects, f is the effort chosen by type B subjects, and $c(f)$ is the cost of effort. Similarly, for Individuals treatments (I), subjects A (Sender), received an initial endowment (Xi) of 120 experimental tokens, while subjects B (Responder) received no initial endowment. Final payoff for each Sender is $(Xi- w) * f$ while for each Responder was given by $w – c (f)$.

Experiment begun after the assigned location, after reading the instructions and expliciting any clarifications. Treatments were distributed via a PC through the z-Tree software. z-Tree is a

[70] See the instructions in the appendix.

[71] 1 experimental token is equivalent to 0.10 Euro for which consequently experimental tokens 480 have a value of 48 Euros.

software package for developing and deploy economic experiments that, thanks to a simple programming language, it allows to develop graphical user interfaces (GUI) conformable to the experimental design.[72] z-Tree software has an architecture that is both peer-to-peer, through which the interaction takes place between the experimental subjects, and both client-server through which experiment administration, collection and storage of data takes place. (Fischbacher 2007).

In treatment (B) each component of group A as a Sender, filled out a form in which there was 10 proposals *w* of preset amounts to be transferred to the Responder. Once formulated proposal, group' members had to find a unanimous agreement on *w*. If favorable, amount will be transferred to Responder. In case of disagreement, group had 5 attempts to find an agreement, but without agreement, game ended for both groups and they receive only show-up fee. Similarly, B group once received *w*, decided the effort *f* based on a form in which there are a range of preset proposal. Effort *f* had a cost *c(f)* which is increasing with *f*. Once formulated proposals, members of the group will have to find a unanimous agreement on *f*, which, if favorable, will be transferred to Sender. In case of disagreement, the group had 5 attempts to find an agreement and propose the offer, but without the agreement the game ends for both groups will be paid only show-up fee. If there was agreement in both groups, the software will calculate the individual payoff and the game ended.

In treatment (L) decision-making procedure is slightly different to (B) because proposal of Sender and Receiver was made by a sole person chosen at random by software while other components accept or reject the proposal, always within the limits of 5 votes.

Finally, in treatment (S) difference lied in voting mechanism. Senders and Receivers groups was divided into two subgroups, each subgroup ranks, for a maximum of 5 times, proposals of its components. In case of unanimity, proposals of two subgroups was ranked for a maximum of two times by the group in a whole.

Payments were made in private so that other participants did not know the amount received. Treatments involving groups had an average duration of 30 minutes while individual ones have lasted on average 20 minutes

[72] I build a simple graphical user interface (GUI) several forms with gray background (distraction free) while buttons are in red. For instructions texts, I used rich text format with sans-serif font 30pt bold while for other messages I used sans-serif font 28pt normal.

4.1. Results

I begin analysis starting from the comparison of results in the different treatments.[73] Tables 16-19 show average median, range, and standard deviation for each treatment respectively for *w* transfer, coefficient *f* and earnings of both groups. Data are expressed in experimental tokens.

			Transfer w			
Treatments	**Mean**	**Standard deviation**	**Median**	**Min**	**Max**	**Standard error**
Baseline	20.0	14.0	18.8	7.5	45.0	5.7
Individuals	29.1	18.3	26.3	7.5	60.0	4.6
Leader	34.2	19.9	30.0	7.5	60.0	6.6
Subgroups	23.3	21.0	15.0	0.0	60.0	7.0
Total	27.6	18.7	22.5	0.00	60.0	2.96

Table 16 – Descriptive statistics of w

			Effort f			
Treatments	**Mean**	**Standard deviation**	**Median**	**Min**	**Max**	**Standard error**
Baseline	0.17	0.12	0.10	0.10	0.40	0.05
Individuals	0.31	0.23	0.25	0.10	0.80	0.06
Leader	0.20	0.20	0.10	0.10	0.70	0.07
Subgroups	0.12	0.12	0.10	0.00	0.40	0.04
Total	0.22	0.20	0.10	0.00	0.80	0.03

Table 17 – Descriptive statistics of f

			Earnings A			
Treatments	**Mean**	**Standard deviation**	**Median**	**Min**	**Max**	**Standard error**
Baseline	15.6	8.6	10.9	9.8	30.0	3.5
Individuals	26.4	17.2	24.8	6.8	60.0	4.3
Leader	17.4	18.2	10.5	6.0	63.0	6.1
Subgroups	10.4	9.6	10.5	0.0	33.0	3.2
Total	19.18	15.88	11.25	0.00	63.00	2.51

Table 18 – Descriptive statistics of earnings A

			Earnings B			
Treatments	**Mean**	**Standard deviation**	**Median**	**Min**	**Max**	**Standard error**
Baseline	19.4	13.0	18.8	6.8	42.0	5.3
Individuals	25.7	14.5	23.4	10.9	48.0	3.6
Leader	33.1	20.2	29.3	7.5	60.0	6.7
Subgroups	22.9	20.6	15.0	0.0	59.3	6.9
Total	25.80	17.14	22.50	0.00	60.00	2.71

Table 19 – Descriptive statistics of earnings B

[73] This information is per capita for a direct comparison with treatment (I).

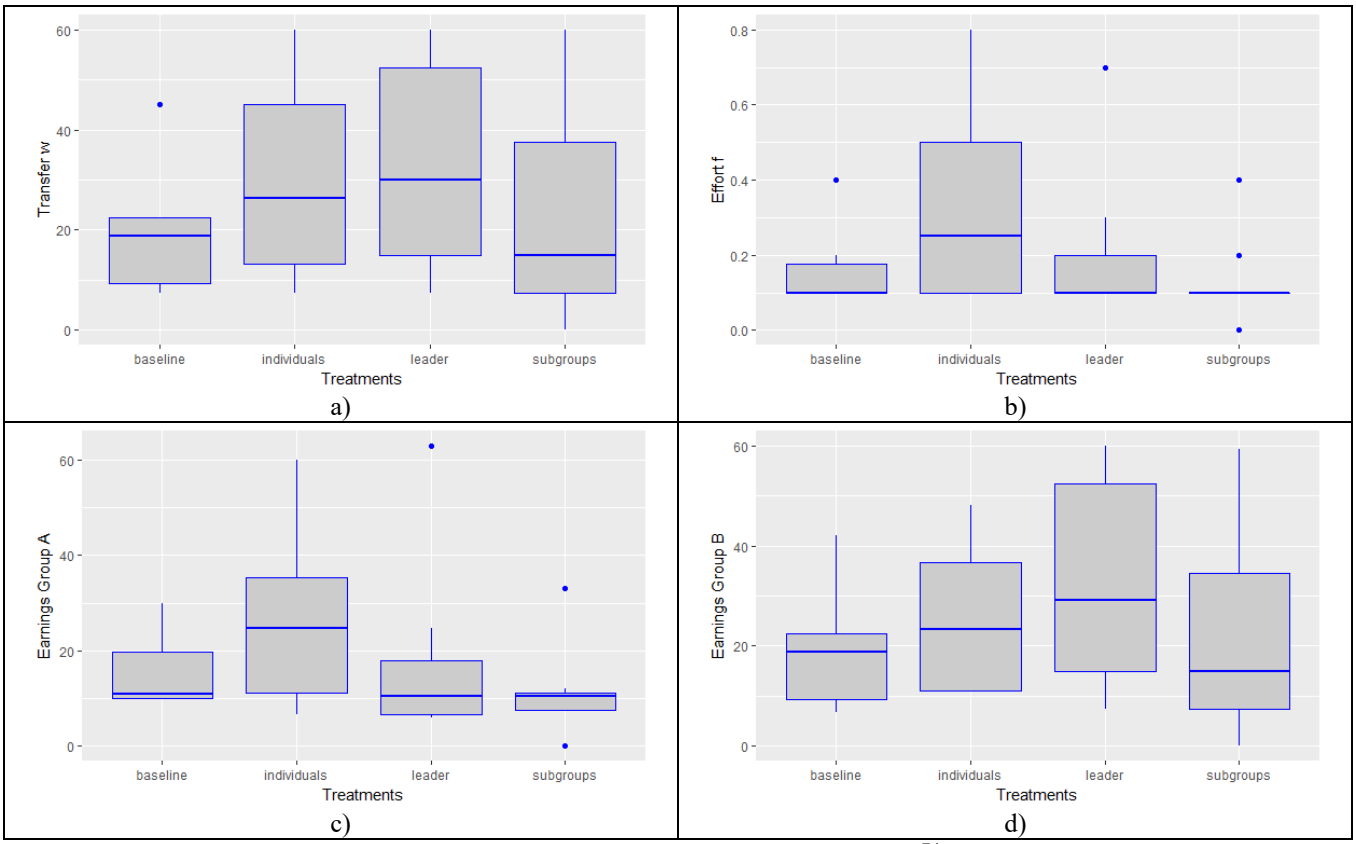


Figure 7 – Aggregate data by treatment[74]

In Figure 7a), I compare pairwise results of *w* transfers of treatment (B) and the ones of other treatments. At first, I compared treatment (B) with (L) to test if such differences in group decision-making results may arise from presence of a leader whose decisions are not influenced by explicit preferences but from those implied of other components. On average, groups (L) transfer a sum greater than 71% with respect to that sent by the groups of treatment (B) (p-value = 0.1532, Wilcoxon rank sum test)[75]. On average groups (L) transfer a higher amount than the other groups in treatments (S) and (I) respectively + 46% compared to treatment (S) (p-value = 0.2644) and + 18% with respect to treatment (I) (p-value = 0.4929). In group with Leaders, I observe results that are far more distant from that predicted by theory, although not significant. From the analysis of rounds, as I will see below, in this treatment only in three rounds there is a final value of *w* lower with respect to the starting one.

In comparison (B) with (S), I analyze the effect of decision-making process split in two separate steps. Compared to treatment (B), groups in (S) perform a higher transfers *w* of 16.7%,

[74] The box corresponds to the he 25th and 75th percentiles and the line indicates the median value. Lower whisker is the smallest observation greater than or equal to lower hinge - 1.5 * Interquartile Range (IQR) and upper whisker is the largest observation less than or equal to upper hinge + 1.5 * IQR. see: http://ggplot2.tidyverse.org/reference/geom_boxplot.html

[75] The Wilcoxon rank-sum test is a nonparametric alternative to the two sample t-test. It does not assume our data have a known distribution. It is usually used when is asked to compare the means of two groups that do not follow a normal distribution.

(p-value = 0.9525). Groups in treatment (S), transfer -31.7% compared to treatment (L), and -14.9% compared to treatment (B). As I will see from the comparison result of the sessions, in treatment (S) only in one session, subjects decide to transfer the minimum amount.

Finally, I compare results of treatment (B) with (I) to test if my experiment conforms to previous results. On average, individuals move greater sums of 45.3% compared to the treatment groups (B) (p-value = 0.1532). In comparison with remaining treatments, (L) and (S) subjects respectively choose a lower average *w* transfer of -14.9%, (p-value = 0.4929) and greater than 24.6%, (p-value = 0.4242).

In Figure 7b), I compare pairwise result of effort *f* of treatment (B) with the ones of other treatments. Among the average of the selected effort in (L) with the one selected in (B), there is a + 20% difference (p-value = 0.944), while components of treatment (S) choose a lower effort *f* of 26.7%, (p-value = 0.3504). Individuals of treatment (I) choose an effort on average 87.5% higher than that chosen in the treatment (B), (p-value = 0.1511). In comparison with remaining types of groups, (S) and (L) respectively, individuals choose a 155.6% higher average coefficient, (p-value = 0.01919) and 56.3% (p-value = 0.1666).

If I exclude treatment (I), I have that groups of treatment (L) choose a higher values with respect to (B), both in the choice of *w* transfer and of effort *f*, while treatment (S) choose higher transfers *w* and lower *f* effort than those chosen by members of groups (B).

As I discussed above, Charness and Sutter (2012) argue that group behavior can lead to a lower level of social welfare,[76] the latter expressed as the sum of the payoffs of both players. By analyzing payoff from this point of view, this hypothesis is confirmed. Compared to treatment (I), which has the greater payoff sum with respect of the other treatments, the treatment (B) has a lower average payoff of 32.8% (p = 0.3759). Treatment (L) has a lower payoff of 3.1%, (p = 0.9841) and treatment (S) -33.6% (p = 0.1925). In the following section, I discuss the relationship of reciprocity between group A and group B.

4.2. Analysis of the dynamics in the treatments

AGREEMENT REACHED IN ROUND	1	2	3	4	5
W (ABSOLUTE FREQUENCY)	6	4	4	6	3
F (ABSOLUTE FREQUENCY)	12	2	5	4	0

Table 20a) – Number of round to reach an agreement in all treatments

[76] The term Social refers to the increase or reduction in the payoff is determined by social factors such as trust and cooperation.

From Table 20a) and following, I can draw some conclusions about the number of rounds and their effects on learning. Roth and Erev (1995) argue that the dynamics of learning models[77] may be more important than asymptotic properties in intermediate term.[78] Also the speed of convergence towards the perfect Nash equilibrium –in this game for the B-type subject to choose the effort f lower and for this reason the subject type-A transfers the lowest level of wage w–[79] depends on the initial conditions –in this study the amount that subjects type B, received–. In addition, Kocher and Sutter (2007) noticed that most of the subjects who participate in experimental sessions had no awareness to backward induction solutions. In my treatments, I also considered this aspect. On the one hand, I have reduced the number of rounds from 10 to 5 and on the other, I have introduced two different learning mechanisms. From the results, I observe that no treatment except Subgroups (which provided for a maximum of 7 rounds) reached 5 rounds. In the Subgroups treatment sessions where it has reached the maximum number of rounds has been unable to reach agreement.

Round	**1**	**2**	**3**	**4**	**5**
Baseline	108.5	67.5			
Leader	150	172.5	140.0	110.0	
Subgroups	-	-	172.5	82.5	105.0

Table 20b) – Mean of proposals w by round in which agreement was reached

From Table 20b) as well as 20c), where I reported the average of proposals in the round where the subjects have reached an agreement, both *w* transfer, both the effort *f*, does not show a dynamic of unique learning path especially in the choice of effort *f*. No differences between the means are significant.

Round	**1**	**2**	**3**	**4**	**5**
Baseline	0.24		0.43		
Leader	0.23		0.36	0.17	
Subgroups	-	-	0.25	0.26	

Table 20c) – Mean of proposals f by round in which agreement was reached

Here I analyze the results of the rounds to check dynamic of convergence towards the final decision, using the classification of the Kocher and Sutter (2007) scenarios. I have the "game-theoretic truth wins" where the group reaches an agreement similar to that of theory (in my case $w = 30$ for group A and $f = 0.1$ for group B)[80] or "to compromise wins" as a compromise

[77] Learning meant both to learn the mechanics of the game, and to learn the behavior of other players. Roth and Erev (1995), p. 165.
[78] There is not a strict quantification of intermediate term as this occurs when in the simulations the learning curve becomes flat. Id, p. 166.
[79] This is the backward induction solution of which is mentioned later.
[80] In this section, the data are expressed terms of the group because there is no need to a confrontation with the Individuals treatment (I).

agreement on a median value of the proposals of the group members. The small number of sessions is unable to make meaningful statistical analysis (such as prediction from initial conditions) and confine myself to the graphic description. Overall, as I can see from Table 20a), the agreement was always reached before last round except in two sessions of treatment (S) in which it has not reached an agreement at the end of the last round.

a) Treatment baseline

On this treatment 4 to 6 sessions of Senders, reached an agreement in the first round. In the remaining sessions, the agreement was reached at the second round. In Figure 11a), from the results of the (B) 6 treatment sessions, in only 2 sessions components reached an agreement on the minimum value, while 3 out 6 of the groups reach the compromise agreement and only in one session has reached an agreement higher than median value.

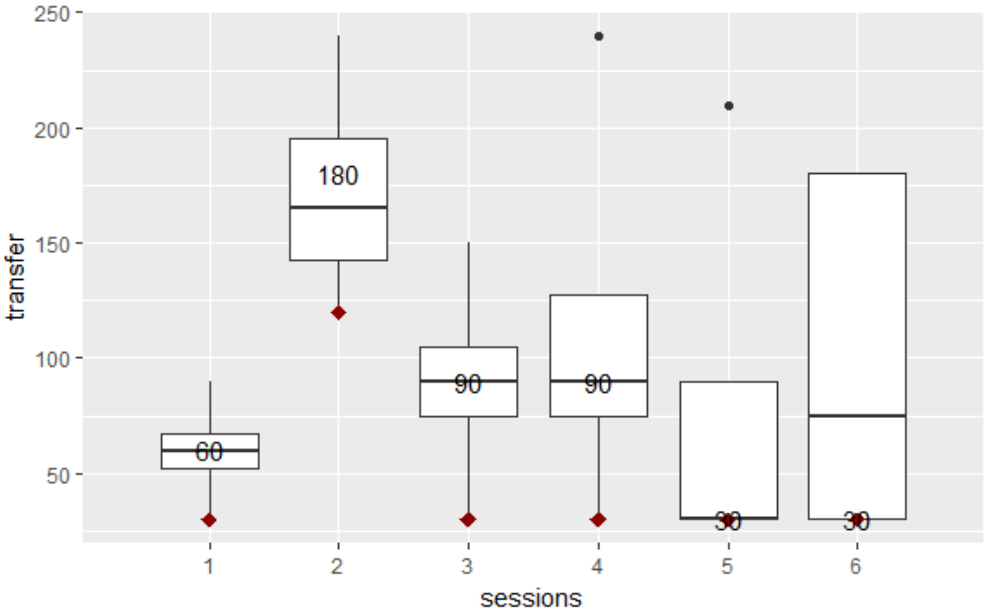


Figure 11a) – Rounds in Baseline sessions Group A

From results of the (B) 6 treatment sessions, in Figure 11b), in 4 sessions members of Receivers have reached an agreement on the minimum value while only in one session was reached both an agreement higher than the median value both a compromise agreement.

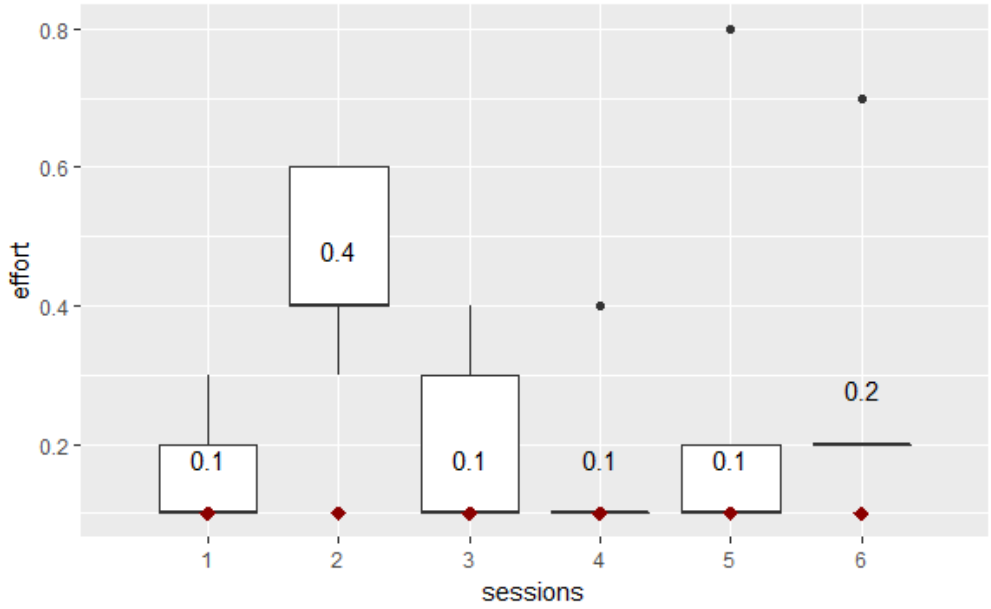


Figure 11b) – Rounds in Baseline sessions Group B

b) Treatment leader

As can be seen from Figure 12a) in treatment (L), leader does not fully exploit the learning effect because the agreement always takes place before last round.

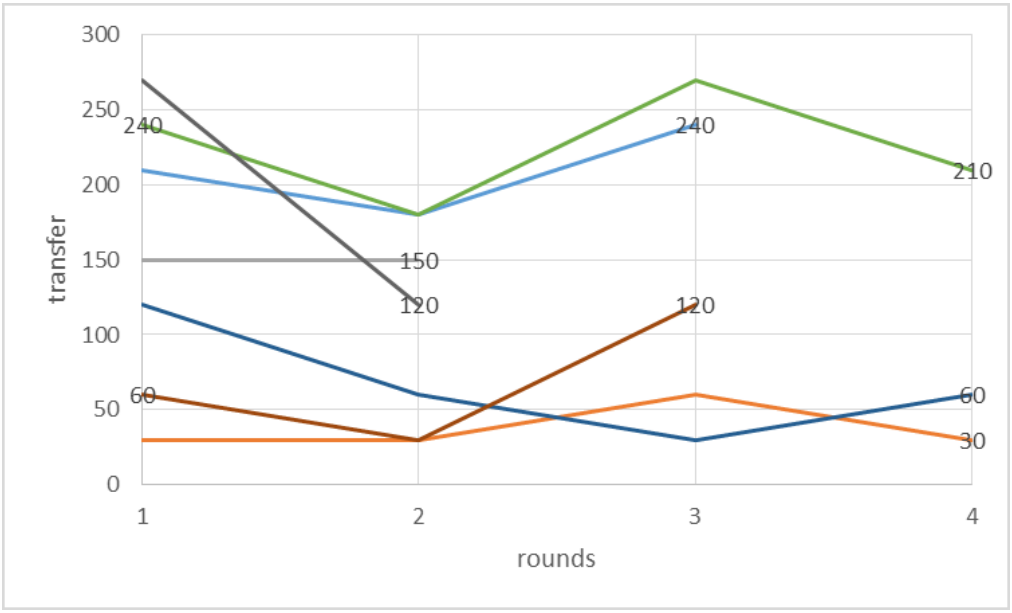


Figure 12a) – Rounds in Leader sessions Group A

From the observation of rounds, I can assume that leader, not knowing the preferences of others, behaves as if it were an individual who, in case of rejection of his decision, offers the same amount as proposed in the first round, or its minor variations, until it is able to impose his

decision. In this treatment, it can be expected that the initial conditions prevail without the equilibrium is reached. Leaders that start with a proposal greater than 150 experimental tokens continue to propose, except in one case, values higher than or equal to this figure. Only in 3 cases out of 9, the final amount is less than the initial proposal, while in 2 of 6 cases the final amount is greater than that initially proposed. From Figure 12a) there is no evidence of a "game-theoretic trend truth wins" nor a "compromise wins" trend. The agreement was reached probably only out of fear that the group has to lose everything if before the last round has not reached an agreement as determined by the experimental design. In all 9 sessions, agreement was reached before the fifth round.

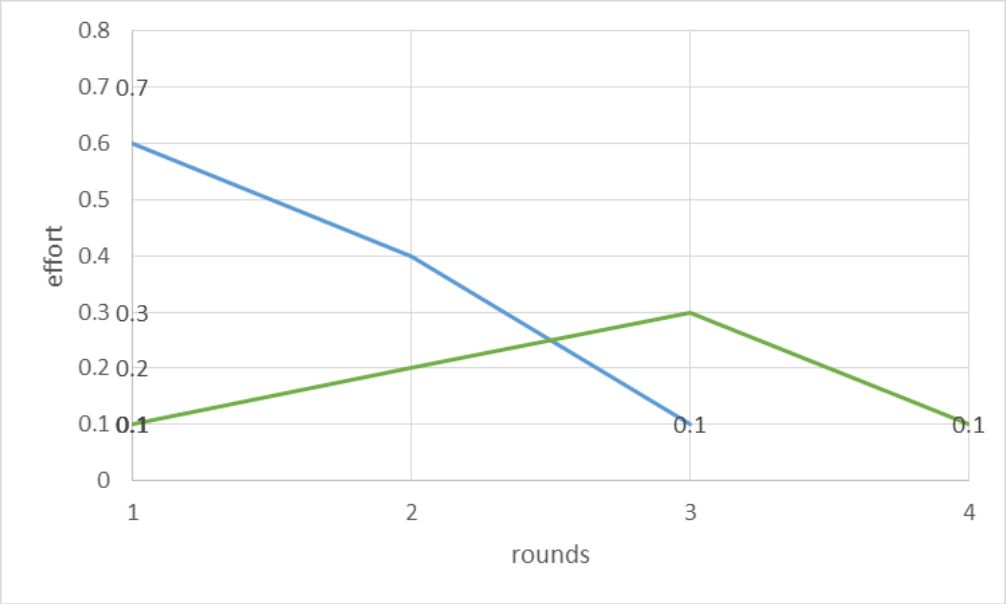


Figure 12b) – Rounds in Leader sessions Group B

In choosing the effort *f*, I observed less dynamic than that of Group A as of 9 only 2 treatments have voted the proposals of the leader beyond the first round and in one case there was a convergence effect has been achieved in 3 rounds. In 6 sessions out 9 agreement has been reached in the first round while in remaining sessions, agreement has been reached in the third and one in the fourth round. Preliminary analysis of the dynamics of the treatment I observe that the absence of learning effect has an influence on the decisions of the group which transfers higher average *w* levels and chooses higher *f* levels in respect of other group treatments.

c) Treatment Subgroups

Voting in treatments (S) takes place first in each of the two subgroups and then in group as a whole. The design was finalized also to increase learning opportunities of the group. Therefore,

I consider that this treatment has three rounds of default, one for each subgroup and one for the entire group.

In choosing *w* transfer, only one group proposes a sum consistent with the scenario "game-theoretic truth wins" and one group occurs scenario "to compromise wins". Two sessions do not reach an agreement, while in the other 4 sessions the results are heterogeneous with two transfers *w* above the median and two below the median but greater than the minimum proposal.

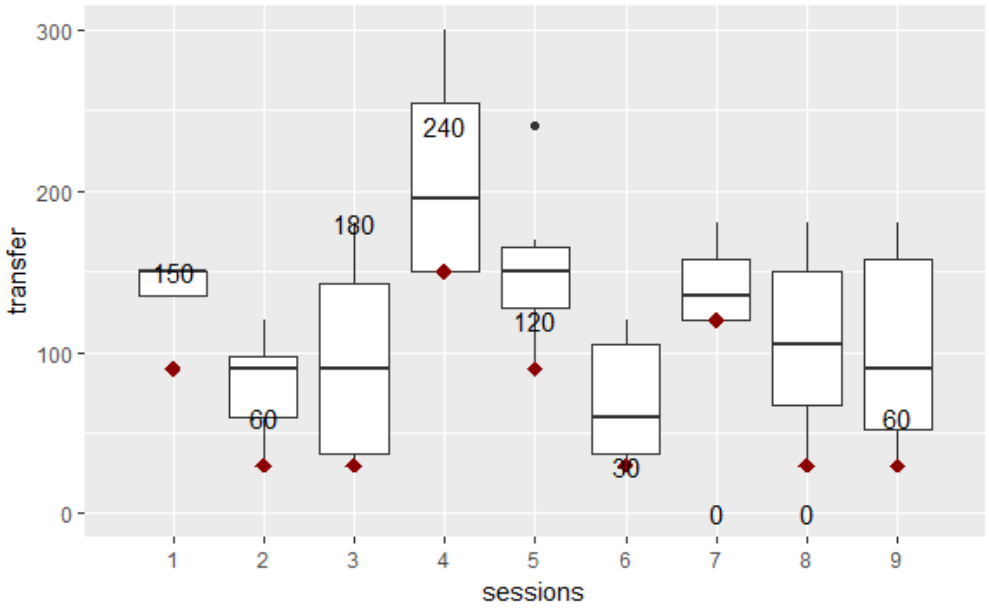


Figure 13a) – Rounds in Subgroups sessions Group A

In choosing effort *f*, in 2 sessions subjects do not reach an agreement, while in 5 sessions an agreement is reached for the minimum effort and in 2 sessions the agreement is on the median value effort.

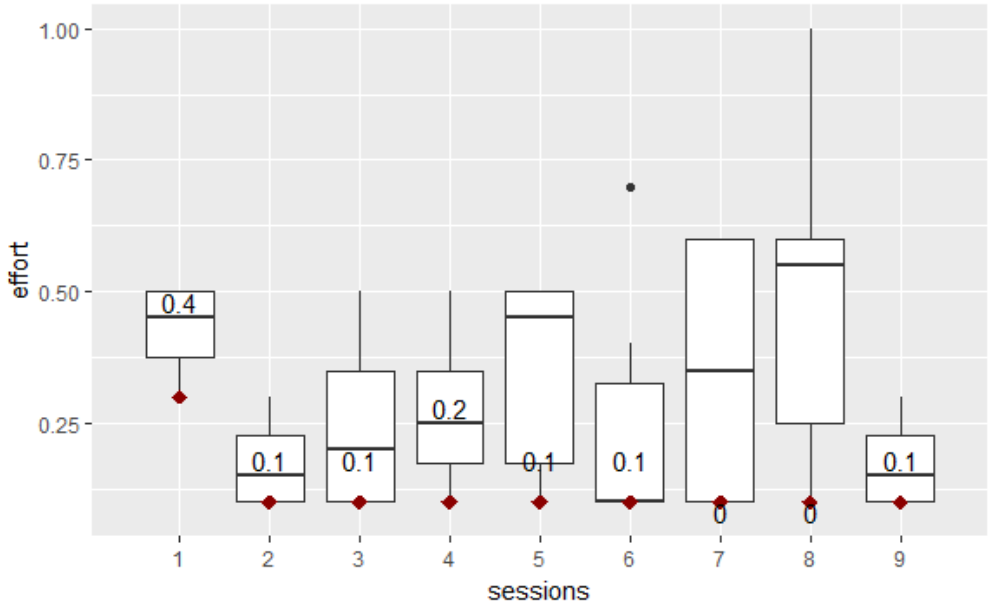


Figure 13b) – Rounds in Subgroups sessions Group B

4.3. Reciprocity

I also analyze reciprocity, since the role of the cost of being "other regarding" is not irrelevant to the final outcome. In fact, in our experimental design, the cost of effort is lower than 25% compared to the reference paper. In addition, this topic will be discussed below in the analysis of the effect of gender on group decisions. In Figure 9 likewise Kocher and Sutter (2007), I reported the marginal cost of being "other regarding" as responders, with respect to a given transfer level w. This cost is less than what you have in a trust game standard. Based on this cost structure, as expected result, the average rate of effort of the groups would have been higher than instead occurred.

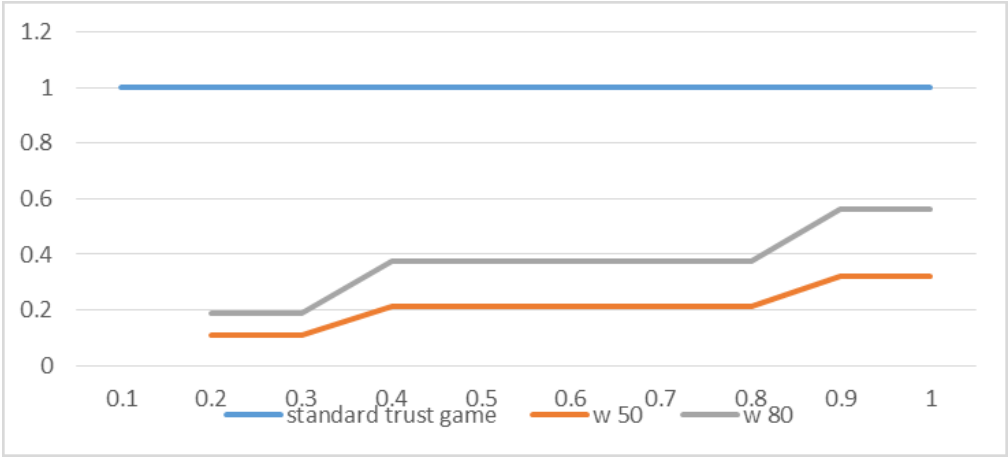


Figure 9 – Marginal costs of being other-regarding as responder

The following figures show the relationship between transfer *w*, and effort average *f*. In case of reciprocity during the decision-making process, to a higher level of transfer *w* corresponds a higher average level of effort *f*. Scatterplots of Figure 10 does not show any evidence of a trend of this type because the behavior of the groups are heterogeneous and varies considerably from treatment to treatment.

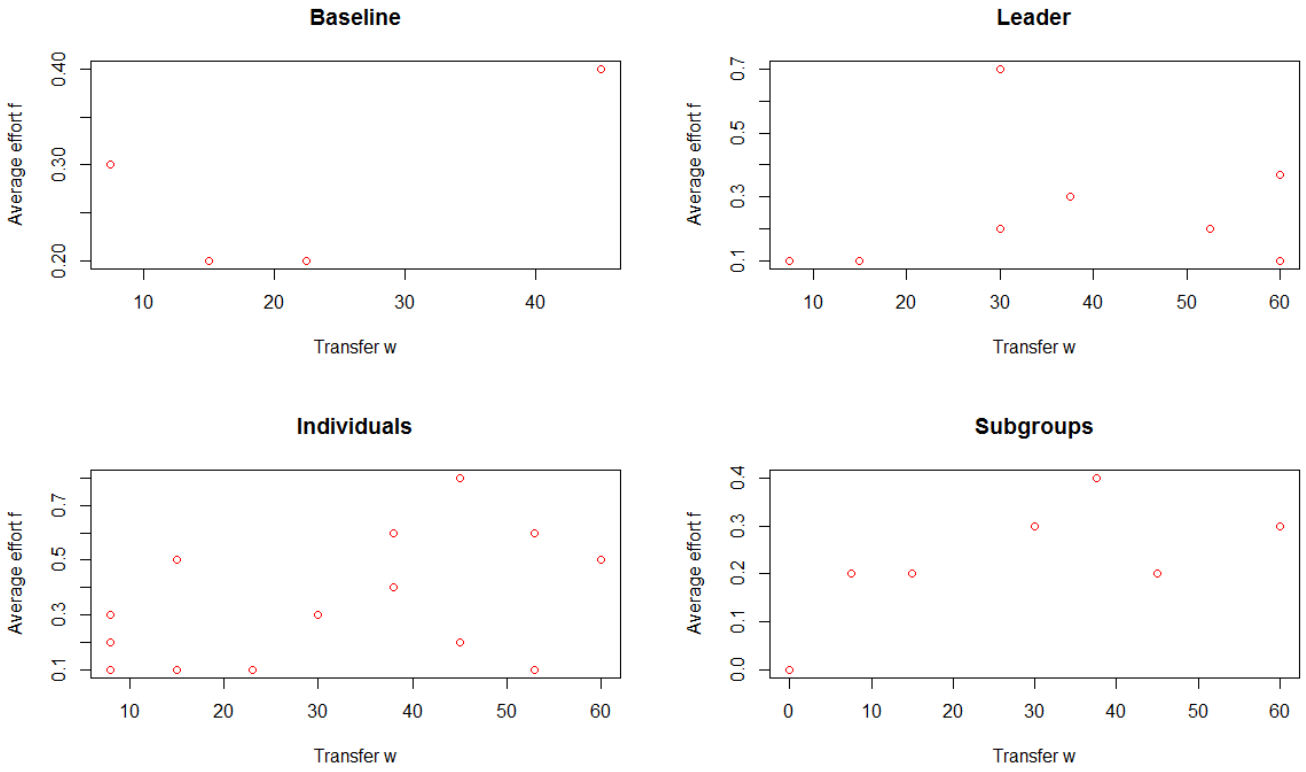


Figure 10 – Reciprocity in the four treatments

Alternatively, and in a more rigorous way, the relationship between the level of effort *f* and the transfer *w* can be estimated through a regression Tobit[81], which also takes account of the dummies of different treatments. The variable w^2 measures the rate, increasing or decreasing, with which *f* varies at variation of *w*.

[81] In the following sections, I discuss the descriptive statistics of the variables censored.

f ~ w_ind + w_ind^2 + Subgroup + Individuals + Leader, family = tobit(Lower = 0)

Pearson residuals:

	Min	1Q	Median	3Q	Max
mu	-1.7546	-0.6640	-0.2321	0.69437	2.693
loge(sd)	-0.9765	-0.7113	-0.3951	0.06223	4.597

	Estimate	Std. Error	z value	Pr(>|z|)	pvals	
(Intercept):1	0.04	0.09	0.38	0.70	0.70	
(Intercept):2	-1.845	0.120	-15.360	0.000	0.000	***
w	0.017	0.006	2.953	0.003	0.004	**
w^2	-1.94E+00	0.000	-2.161	0.031	0.034	*
Subgroup	-0.087	0.086	-1.009	0.313	0.316	
Individuals	0.006	0.077	0.077	0.939	0.939	
Leader	-0.083	0.087	-0.960	0.337	0.340	

R^2 = 0.306

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 21 – Regressions results

Overall, see Table 21, there is a positive relationship between the level of effort and transfer *w*, although with coefficient much lower of 1. The negative coefficient w^2 tells us that *f* increases when *w* increases but at decreasing rates.

4.4. Gender effect

The analysis of different decisions by gender is not the main subject of analysis, however, given the availability of data and the extensive literature on this subject, this study also provide a completion of that analysis. I reviewed for example Solow and Kirkwood (2002) that analyzed the relationship between group identity and gender and concluded that the only gender is not sufficient to explain the behavior of individuals. Chaudhuri and Gangadharan (2003) observed that men have a higher level of trust while women have a slightly higher reliability. Although not intentionally, the sample that I recruited is quite balanced between men and women as I can see in Table 22b). If I also consider the gender associated with the proposals of the various rounds, I get a sample of 51% women and 49% men as I can see in Table 20c. In my treatment, the identity of the members of the groups is anonymous so I can exclude the effect "Trust with known gender"[82] as members of the group do not know both the gender of the other members of their group, both gender of members of other groups.

[82] For example Eckel et al. (2002).

Treatments	N. Sessions	Male	Female	Male + Female
Baseline	6	20	28	48
Individuals	4	16	16	32
Leader	9	32	40	72
Subgroups	9	36	30	72
Total	28	104	120	224

Table 22a) – Gender by sessions (absolute values)

Gender	Baseline	Individuals	Leader	Subgroups	Total
Male	41.7%	50.0%	44.4%	50.0%	46.4%
Female	58.3%	50.0%	55.6%	50.0%	53.6%

Table 22b) – Gender by sessions (percentage values)

Gender	Type A	%	Type B	%	Total	%
Male	42	49%	40	49%	82	49%
Female	43	51%	42	51%	85	51%
Total	85	100%	82	100%	167	100%

Table 22c) – Gender by sessions (percentage values) proposals considered

On average, men in group A transfer 46.6% more than women in group B while they choose a higher effort of 30.8% to the one who choose women. These results on the one hand confirm the findings from the literature that men have greater trust than women do, on the other hand instead do not confirm what some authors claimed that women have a higher reciprocity than men do.[83] Since the level of *f* is not sufficient to measure the level of reciprocity, I also analyze the relationship between the cost of effort and the received level of *w* that is *c(f)/w*.

w	Mean	Standard dev	f	Mean	Standard dev
Men	33.99	18.00	**Men**	0.34	**0.21**
Women	23.18	15.71	**Women**	0.26	**0.22**

Table 23 – Mean e standard deviation

Similarly the previous regression, I make an analysis with Tobit regression because the variables are censored. In Figure 13a) and 13b) I explore the distributions for the values of w and transfers the effort *f*. The censored variables are respectively 7.5 and 0.1. In regression, I inserted dummies variables for treatments and for rounds. In consequence of the result of the effort coefficient, variable *c (f)/w* is censored to the value 0.

[83] Chaudhuri and Gangadharan (2003).

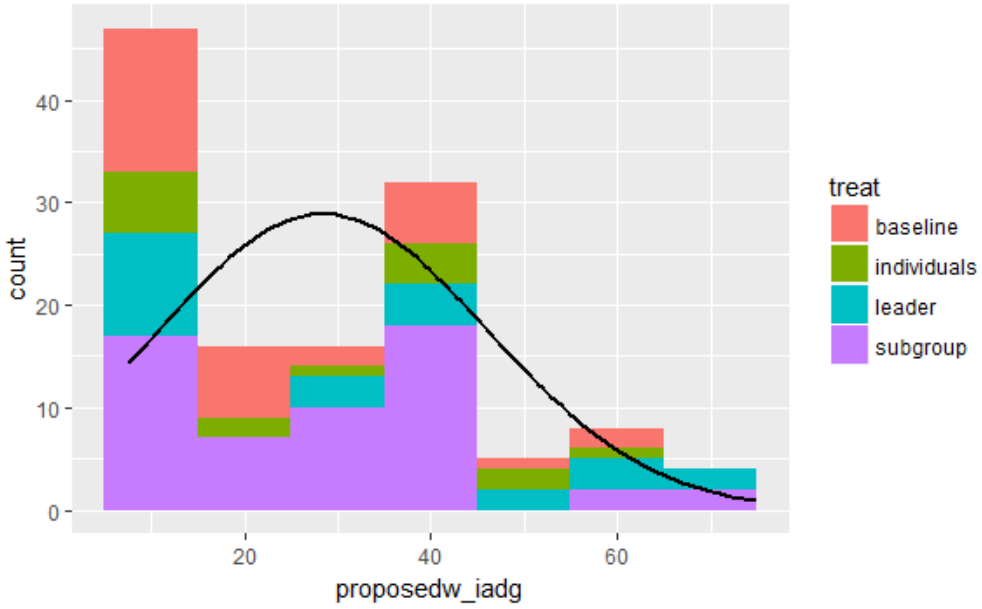


Figure 14a) – Censoring in the values of w

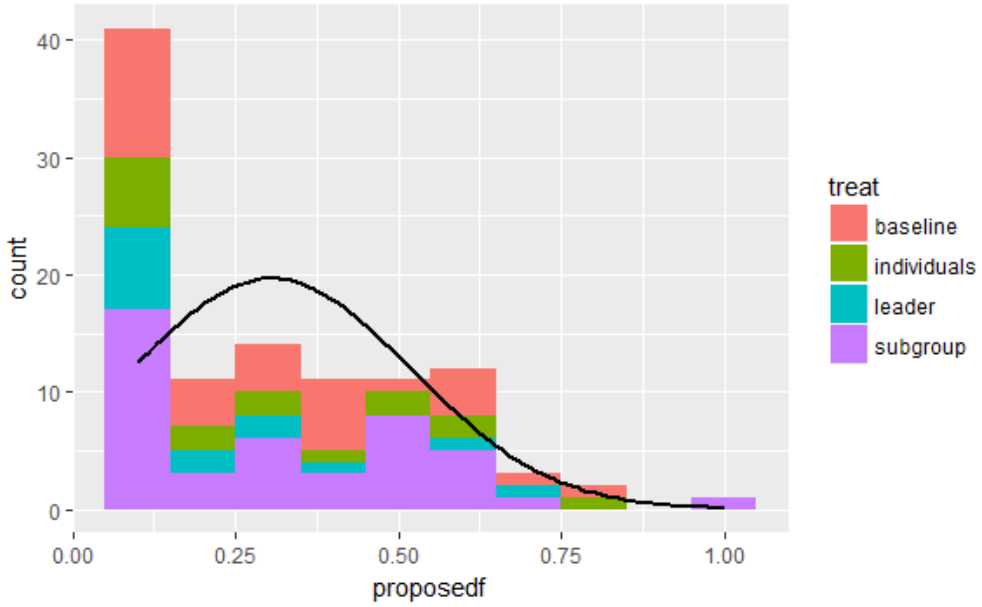


Figure 14b) – Censoring in the values of f

proposedw_i ~ gender + subgroups + leader + individuals + round2 + round3 + round4, family = tobit(Lower = 7.5)

Pearson residuals:

	Min	1Q	Median	3Q	Max
mu	-1.8644	-0.8873	0.07488	0.6901	2.617
loge(sd)	-0.9193	-0.7421	-0.42241	0.5607	4.596

	Estimate	Std. Error	z value	Pr(>|z|)	pvals	
(Intercept):1	28.624	4.512	6.344	0.000	0.000	***
(Intercept):2[84]	3.010	0.072	41.552	0.000	0.000	***
Gender	-12.630	3.722	-3.393	0.001	0.001	***
Subgroups	7.244	4.747	1.526	0.127	0.128	
Leader	10.837	6.119	1.771	0.077	0.078	.
Individuals	3.326	6.531	0.509	0.611	0.611	
round2	-8.311	4.705	-1.766	0.077	0.079	.
round3	-0.888	7.697	-0.115	0.908	0.908	
round4	-5.879	9.992	-0.588	0.556	0.557	

R^2 = 0.136
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 24 – Regression results

The results of Table 24 shows that the female gender components, in all treatments, transferring an average of 12.6 experimental tokens less than men, and the result is significant to 0.1%. The male gender components of the treatment leader transfer on average 10.8 experimental tokens more, the result is significant at 10% as well as in the second round the transfer is lower than 8.3 tokens with a significance of 10%.

proposedf ~ gender + subgroups + leader + individuals + round2 + round3 + round4, family = tobit(Lower = 0.1)

Pearson residuals:

	Min	1Q	Median	3Q	Max
mu	-1.4530	-0.8418	-0.1769	0.7708	3.453
loge(sd)	-0.9874	-0.6535	-0.2371	0.1522	8.509

	Estimate	Std. Error	z value	Pr(>|z|)	pvals	
(Intercept):1	0.324	0.046	7.054	0.000	0.000	***
(Intercept):2	-1.576	0.073	-21.601	0.000	0.000	***
Gender	-0.058	0.042	-1.385	0.166	0.168	
Subgroups	0.007	0.050	0.139	0.889	0.889	
Leader	-0.061	0.068	-0.894	0.372	0.373	
Individuals	0.017	0.065	0.267	0.789	0.790	
round2	0.069	0.060	1.139	0.255	0.256	
round3	0.060	0.084	0.712	0.477	0.477	
round4	-0.139	0.159	-0.879	0.379	0.380	

R^2 = 0.064
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 25 – Regressions results

From Tobit regression in Table 25, in which I put the effort in relation to gender, along with the dummy variables of treatments and rounds, showing that women on average choose an effort

[84] The intercept 2 is an auxiliary statistic whose square is analogous to the square root of the residual variance in OLS regression. See Yee (2015).

0.06 less than men do. The result is not significant, as no significant differences between treatments and rounds. However, the only effort *f* is not a sufficient measure of reciprocity because it does not take account of the cost incurred with respect to the amount received. For this reason, I repeated the Tobit regression correlating the percentage of the cost of the effort on the transfer w, calculated as *c(f)/w*, with the gender, together with dummies of the treatments and to those of the rounds. The coefficient values are expressed in percentages.

c_perc ~ gender + subgroups + leader + individuals + round2 + round3 + round4

Pearson residuals:

	Min	1Q	Median	3Q	Max
mu	-0.7841	-0.4082	-0.2313	0.0423	6.114
loge(sd)	-0.9974	-0.8600	-0.8026	-0.7324	28.915

	Estimate	Std. Error	z value	Pr(>|z|)	pvals	
(Intercept):1	13.85	4.13	3.35	0.00	0.00	**
(Intercept):2	2.89	0.09	33.54	0.00	0.00	**
gender	-1.44	3.79	-0.38	0.70	0.70	
subgroups	-6.17	4.47	-1.38	0.17	0.17	
leader	-8.49	6.22	-1.37	0.17	0.17	
individuals	-5.38	5.90	-0.91	0.36	0.36	
round2	-1.77	5.53	-0.32	0.75	0.75	
round3	-4.21	7.76	-0.54	0.59	0.59	
round4	-5.08	14.52	-0.35	0.73	0.73	

R^2 = 0.25475

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 26 – Regressions results

Table 26 shows that women choose an effort on average 1.44% less than men do. The result is not significant, as no significant differences between treatments and rounds. Some authors see Solow and Kirkwood (2002) concluded, in the face of conflicting results, that gender is not enough to explain different behaviors within groups since other factors can influence the outcome, such as the social nature of the belonging group. Also Chaudhuri et al. (2013) note that the gender differences are valid in one-shot experiments but, in the case of repetition, these differences, over time, tend to disappear. Cox (2002) in a study that differentiates behaviors of trust from those of the reciprocal, notes that men as first movers choose sums of money greater than those of women, and as a second movers observed that men have a positive reciprocity and women do not. Based on my results I can conclude that women, compared to men, have both a lower level of trust both a lower-level reciprocity. The first aspect is consistent with the literature cited and the second not. However, with respect to reciprocity, both of the measures used are not significant. In light of what my results are sufficient only partly to formulate general hypotheses both on gender behavior in the group and between groups.

5. Conclusions

5.1. Summary

In the first three chapters of my work, I reviewed a selection of articles from classic literature and the more recent one, according to the standard categorization (simultaneous game, sequential games), about the differences in results of individual and group decision-making in the field of experimental economics and in the social psychology. Then I highlighted, in detail, studies that I considered to be pointed for the methodology, for the originality of the experimental design and the relevance of the results. In this field, experiments are conducted in small groups. In this section, I dwell on methodological aspects related to this experimental work. One of the methodological issues that the literature has discussed not sufficiently is the theoretical relationship between the number of members of a group, and its similar forms, and the results of the internal decisions-making process inside. The number of members of the group may have an influence in the outcome of the vote, as in even numbers are possible compromise agreements while odd numbers is potentially the formation of majorities, although the mechanism of unanimity, used in most of the experiments, tends to protect minority positions. With regard to the theoretical relationship between the amplitude of the groups and results of the decision-making process, it should also be considered the relation with the aspect relating to the voting rules in the group. Referring to the results of the literature, Kerr et al. (1993) conclude that there may be a relationship between amplitude of the group and the difference between the amplitude of the errors between the group and individuals. However, they conclude that the decision error amplitude (the authors call judgmental) depends on other factors such as the nature of the decision-making process.

Other works such as Wildshut et al. (2003), which tests the procedural interdependence[85] on "discontinuity effect" in PD, there are significant differences in the results between groups of two and groups of three subjects. Still on this aspect Luhan et al. (2009), which have varied the number of group members in order to generalize the results of the reference paper, (Cason & Mui 1997), found no significant differences between the results of groups of two or three people.[86] Finally, the architecture of the vote may have consequences on the results. Elbittar et al. (2011), in an ultimatum game, have as a result that subjects move higher amounts in the case that the voting rule is the default rejection if not unanimity is reached compared to both the majority rule is the rule of acceptance default if there is no unanimity. From this review, it

[85] An example of procedural interdependence is the majority rule introduced in group decisions.

[86] Interestingly, it is that in the instructions was not clearly indicated the voting mechanism. So some groups of three individuals have decided unanimously, while others in the majority. Neither in this case significant differences in results have occurred.

appears that the number of members of a group cannot significantly influence the outcome though, given the still small number of study on the subject, further investigations are necessary. In my work I increased the number of members of the group compared to the reference study (Kocher and Sutter 2007) for procedural reasons increasing from three to four members. I left intact the system of voting by unanimity that has neutralized the possibility of compromise typical of the agreements that are in even number groups.

The second aspect, concerns the group identity and the consequent relationship that is established between the individual and the group and what are the mechanisms that induce subjects to behave in a group differently from how he would behave individually. This is relevant because one of the most challenging task of the experimental design is the construction of groups that have theoretically a sufficient identity to influence individual behavior. Instead, in other studies the groups are formed randomly without a predefined design. The literature on this subject is extensive. I considered some works such as Solow & Kirkwood (2002) that measure the gender effect on the results of a public good game. In this work, several types of individuals are identified that may contribute to the formation of group identity: gender, groups formed with a questionnaire through standard techniques, individuals belonging to bands or living in a college. A second study of Degli Antoni and Grimalda (2016) in a trust game comparing trust results and trustworthiness between groups formed following two different criteria: a more market-oriented (Olson type) such as professional associations and another more social-activity oriented such as voluntary associations (Putnam type). In addition, mixed conditions are studied in which the group members have participated in the past to different kinds of organizations. Charness et al. (2007b) finally measure the effect of group identity in a PD through two experiments: face to face and anonymous differentiating between different treatments for the degree of saliency. The result of anonymous treatment, in which the cohesion of the group increases in the presence of payments sharing, contrasts with the Tajfel (1971) Minimal Group Paradigm that satisfies the conditions in the absence of saliency. The heterogeneity of results suggests that further research in this field are also needed on different paradigms such as, for example, the study of the spontaneous behavior of groups that are formed in social networks with the techniques used for detecting Homophily between individuals. Compared to other identification and construction techniques of a group the Homophily is a very powerful principle that creates deep divisions between groups and delimits in a clear way the spheres of life of individuals.[87]

For richness of theoretical implications I also reviewed the literature on a pattern, specific of social psychology, connected to the minimum group identification from which are activated behavior in favor of their own group subjects, which is the Intergroup bias. This bias occurs

[87] McPherson et al. (2001).

when a member of a group has a favorable attitude toward the members of their group (In-Group members) compared with individuals who are not members of the group (Out-Group members). The model examines the way in which groups interact with each other, and what changes deriving therefrom individual behavior. The measurement criteria of the real extent of the bias of the individuals in the literature are not unique, as they can be implicit or explicit. Those explicit measure conscious characteristics of the subjects of cognitive type affective and behavioral, such as racial discrimination, whereas the implicit measurements are performed on features which individuals are unaware such as the abstract / concrete style of written language in response to a particular event. For a comprehensive overview on the state of this line of investigation to see, as I stated, Hewstone et al. (2002). Other mechanisms help to understand how an individual behaves differently because it belongs to a group. For example according to social identity theory Tajfel and Turner (1979), membership of a successful group gives its members a positive social identity that meets the individual needs of self-esteem, although other authors consider that the social identity is the compromise of conflicting requirements, such as the assimilation and differentiation in the group by outsiders to groups Brewer (1991). Overall, these articles have a useful basis for investigations on group behavior from psychological observations.

Finally, I focused on the effect that learning has on group decision-making process. It is a feature of the design that can have consequences on the achievement of dynamic equilibrium or not. I have already mentioned in the review, which in a context of non-interactive games, intellective tasks can be differentiated with respect to their demonstrability (Kugler et al. 2012). Casari et al. (2015) in an intellective task with "truth wins" with incomplete information, implement two tasks: one easy where the solution is accessible to all, one difficult where the solution is for the few. The result is that groups have better results than individuals in the simple task, but in the difficult task the group has worse results than those of individuals as if they disagree choosing the median solution. In interactive games, Roth and Erev (1995) address the issue from a methodological point of view showing that the adaptive dynamic models[88] are useful to recognize what games are sensitive to initial conditions and to predict how important are the initial conditions in the result. Kocher and Sutter (2007) implement a gift exchange game in 10 rounds with learning effect with the intent to ensure the predictability of the Nash equilibrium, starting from the initial conditions. Finally, Kagel and McGee (2016), in a PD where learning effect was further reinforced by the addition of super-games, they note that the first super-game is confirmed discontinuity effect, while in the following 6 games super-teams cooperate on average in the same way or more individuals. The extensive literature on this subject shows how important is learning effect in games. I put my work in this field of study

[88] Games that experimental psychology has shown robust learning properties.

because I tested both the extent to which learning has relevance effect on the decision-making process, both as the result varies with the variation of decision-making mechanism.

5.2. Concluding remarks

As I have seen, the differences between groups and individuals in decision-making process and are largely confirmed by the literature. In my review, I highlighted some works in interactive and non-interactive games that are a reference point in this field of study and, at the same time, I have analyzed other works that are the most recent developments. I also reviewed papers that analyze the differences in behavior between groups: the latter have the advantage of insight into the functioning mechanisms of the decisions of groups in order to identify the determinants of the differences between groups and individuals. The behavior of groups and individuals in decision making process shows a classic break recalled multiple times, namely the ”discontinuity effect” (Schopler and Insko, 1992). Charness et al. (2007b) verified the “discontinuity effect” in a PD. The effect is slightly confirmed since increasing the saliency of the group, it increases the competitiveness of groups.[89] Luhan et al. (2009) replicated the work of Cason Mui (1997). Their results confirm that teams are more selfish than individuals are, and that the most selfish team member has the strongest impact on team decisions. Kugler et al. (2007) found that, in the role of sender, groups are less trusting than individuals do, but there is no difference in the trustworthiness between group and individual responders. Degli Antoni and Grimalda (2016) analyze the determinants of the trust and trustworthiness in groups. They found that the groups of voluntary associations are more trust than those formed by individuals that do not belong to any association. In contrast, groups of associations are more trust than those formed by individuals that do not belong to any association. In addition, a mention should be given to the work of Cason & Mui (1997), in which they showed that the teams are more altruistic than individuals, as it is considered as an exception in the studies about the differences in individual and group decisions. For this reason, it has been replicated in many other studies –in our survey see Luhan et al. (2009). Finally, Kocher and Sutter (2007) in their work deepen methodological aspects in relation to which the results of decisions between groups and individuals approach the hypotheses from economic theory. They analyze the dynamics of the game in order to verify the ability of the model to predict the convergence towards the theoretical equilibrium starting from the initial conditions of the game. The results are that when groups are involved in the simplest games they transfer less amounts than individuals do, confirming the hypothesis. If instead the game is more complex, there are no significant differences between groups and individuals. In the results of the most complex games it is partially confirmed the result of Cason & Mui (1997).

[89] As we have commented above also occur the MGP conditions Tajfel and Turner (1979).

In my work, I have taken as reference the study of Kocher and Sutter (2007) because there are significant methodological issues on the predictability of the results and the effect of learning.

One of the most important results is, when group members are free to communicate in (FG) treatment, there is no difference with the decisions of individuals in the w transfer although choosing a higher level of effort *f*. Theoretically (FG) and (CG) groups should have similar results. From this result, I preferred to investigate the aspect of the paper relates to the impact of learning in groups.

What my work adds to the existing economic literature is the ability to explain with two treatments (L) and (S) what is happening in decision making in a group that takes unitary decisions with learning effect. These aspects are different from the formal aspects of decision-making processes that we discussed in Chapter 1, because it concerns the substantial aspect. Treatment (L) testes the role of learning effect in decisions as the proposed mechanism limits the learning of the only proposing subject. Theoretically, a group with limited learning effect decides in a less rational manner than a group with a wider learning effect such as (B). Treatment (S) increases learning effect as the components arrive, in case of agreements, to the final decision with a decision already taken in the previous rounds. Theoretically, this corresponds to a repeat of the game, albeit with a limited choice, and the result of this group shows a more rational outcome. I introduced two decision-making processes in which I modified the Kocher and Sutter's' (CG) treatment in order to take account of certain common circumstances in which decisions are taken in groups. In this way is possible to verify how varies group behavior when varies the decision-making learning process. The first is Treatment Leader (L) that reflects a centralized decision-making process. In this treatment, I have limited learning effect in order to control learning role in decision-making process. In fact, the sole proposer does not know the preferences of others in the group. The second is Treatment Subgroups (S) that reflects a fragmented and decentralized decision-making process. Treatment (S), on the contrary, expands the possibilities of learning. I left in the experimental design, as a treatment of reference, also treatment (I) which was also the subject of my review of the literature. I decided to do that in order to verify, if the results of these two new treatments are consistent with those of the literature that compare groups of and individuals. Unlike Kocher e Sutter (2007) in which the treatments are of 10 rounds, I have considered, consistent with literature, a reduced number of 5 rounds but still adequate to ensure a possible learning effect. I have also increased the number of members of the group from 3 to 4 both for structural reasons of the treatment (S), both for contextually verify the effect of this change on the results. I reduced both the initial allocation per capita, and the cost of the effort.

I used the field of experimental economics analysis as it gives the opportunity, through laboratory experiments to test theories, to analyze the possible failures of the theory, and to

detect empirical regularities for new theory see Smith (2009). In reference paper, different learning mechanisms applied to groups have led to mixed results. In my work with the treatment (L) I check the results in the absence of learning effect. With treatment (S) I introduce a complex decision mechanism, mediated computer, without the possibility of communication between group members. Through laboratory experiments, I can keep under control, via software, the interactions between groups, recording strategies, set the parameters, and collect the results.

In results of my experiment, groups of type A in treatment (L) transfer on average higher amounts than treatment (B) and (S), while in treatment (S) transfer less than (L) but more than (B). Groups of type B in treatment (L) choose an average effort higher than groups of treatments (B) and (S) while groups in treatment (S) choose an effort less than (L) and (B). In observed outcome from the analysis of treatment results of (L) and (B) and (S) there are differences although not statistically significant. Results of treatment (I) with respect to the treatments (B) and (S) has exhibited higher average values both in sums transferred both in effort choice. Group dynamic analysis did not reveal a significant effect of convergence towards a game theoretic value in any of the other two treatments. Groups A and B in (L) transfer on average more than groups A and B in treatments (B) and (S), and more than also groups A in treatment (I). The limited learning effect set results far beyond those of economic theory. With regard to treatment (S), I have observed, compared to treatment (B), a higher average value in group A and a lower average value in group B. Despite the complex decision-making mechanism that theoretically should have increased the opportunities for learning, I have mixed results. Therefore, by results of treatment (L) I can conclude that learning effect is a mechanism that may explain these differences and that knowledge of member's preferences can have a role in the decision-making process, because when there is no learning effect the results are far away to those hypothesized by economic theory. However, the ambiguous results of treatment (S) require a refinement of learning mechanism that it can refers, both in the number of components of the subgroup, which in my experiment turned out to be irrelevant, both in the number of rounds in the group vote, which in my experiment turned out to be insufficient. Moreover, the results with respect to the comparison between treatment (I) with treatments (B) and (S) improve the results of Kocher and Sutter (2007) as groups behave more rationally than individuals do. The improvement is due to the result of the treatment (S) that avoided a replica of Cason and Mui (1997). Finally, it is also replicated the result highlighted by Charness and Sutter (2012) in which individuals, compared to group decisions, get a greater level of social optimum.

6. References

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Annex

1. Instructions treatment (B) (Italian version)

Benvenuti in laboratorio e grazie per la vostra partecipazione

Vi preghiamo cortesemente di non comunicare con gli altri partecipanti alla sessione in corso a partire da questo momento

Stai collaborando a una ricerca sulla teoria dei processi cognitivi nelle decisioni economiche. Alla fine della sessione riceverai un gettone di partecipazione pari a 5 Euro. Seguendo le semplici istruzioni, che leggerò tra poco, potrai guadagnare una somma di denaro aggiuntiva il cui ammontare dipenderà dalle scelte che avrai effettuato nel corso dell'esperimento e che ti sarà pagato in contanti alla fine della sessione.

Tipologia di partecipante

All'inizio della sessione, il computer raggrupperà casualmente tutti i partecipanti in gruppi. Ci saranno due tipi di gruppi, Gruppo A e Gruppo B, e ciascun gruppo sarà composto da quattro componenti. La tua identità, così come l'identità degli altri partecipanti, resterà anonima. Nessuno dei partecipanti sarà a conoscenza del gruppo cui è stato assegnato. Le decisioni di gruppo saranno quindi completamente anonime.

Dotazione iniziale

Ogni componente del Gruppo A avrà a disposizione 480 gettoni sperimentali. Il Gruppo B non riceverà nessuna dotazione iniziale.

Fasi dell'esperimento

L'esperimento consiste in due fasi. Nella prima fase, il Gruppo A prende una decisione di gruppo, mentre nella seconda fase il Gruppo B prenderà, a sua volta, una decisione di gruppo. Ogni gruppo dovrà quindi prendere una sola decisione. Una volta trovato l'accordo unanime, non ci saranno altre decisioni, né ulteriori ripetizioni.

Fase 1: il Gruppo A sceglie un trasferimento

Ogni componente del Gruppo A propone un trasferimento w. Tale trasferimento determina quanti gettoni sperimentali della dotazione iniziale del Gruppo A sarà trasferito al Gruppo B. Il trasferimento scelto dal Gruppo A deve essere compreso tra 30 e 300 e può essere solo in tagli di 30, per cui sono trasferibili solo i valori 30, 60, 90, 120, 150, 180, 210, 240, 270 e 300.

Le proposte di ogni componente del Gruppo A sono comunicate a tutti i componenti del Gruppo A. A questo punto sarà possibile effettuare una votazione individuale delle quattro proposte riguardanti l'importo w. L'ordine di votazione è determinato dal caso. Se una delle proposte è adottata all'unanimità (4 voti), il Gruppo B riceverà w e la prima fase è conclusa.

Nel caso in cui nessuna delle quattro proposte raggiunga un accordo unanime, sarà effettuato un secondo turno di proposte in cui ogni componente dovrà indicare una nuova proposta w (può essere anche la stessa del primo turno). Le quattro proposte saranno di nuovo valutate separatamente e in ordine casuale. Se si raggiunge un accordo unanime, la prima fase termina; altrimenti, avremo un terzo turno di proposte.

La sequenza dei voti individuali sulle proposte durerà fino a quando non si raggiungerà una decisione unanime. Tuttavia, se dopo il 5° turno di proposte non si sarà raggiunto alcun accordo unanime, il computer selezionerà un importo casuale e i partecipanti otterranno come pagamento solo la quota di partecipazione di 5 Euro.

Fase 2: il Gruppo B sceglie un fattore

Ogni Gruppo B verrà accoppiato casualmente con un solo Gruppo A e verrà informato del trasferimento scelto nella prima fase. Dopo avere ricevuto questa informazione, il Gruppo B deciderà un fattore f, compreso tra 0,1 e 1,0 che può essere solo in tagli di 0,1, per cui sono disponibili solo i valori 0,1 0,2 0,3 0,4 0,5 0,6 0,7 0,8 0,9 1,0. Il fattore f determinerà il guadagno finale del Gruppo A ed ha un costo c(f) per il Gruppo B. Più è alto il fattore f e più alto è il costo per il Gruppo B, come indicato nella seguente tabella:

f	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
c(f)	0	3	6	12	18	24	30	36	45	54

Ogni componente del Gruppo B propone un fattore f. Le proposte di ciascun componente del Gruppo B sono comunicate a tutti i componenti del Gruppo B. A questo punto, sarà possibile effettuare una votazione individuale delle quattro proposte riguardanti il fattore f. L'ordine di votazione è determinato dal caso. Se una delle proposte è adottata all'unanimità (4 voti), la proposta sarà il fattore f scelto dal Gruppo B.

Nel caso in cui nessuna delle quattro proposte raggiunga un accordo unanime, sarà effettuato un secondo turno proposte in cui ogni componente dovrà esprimere una nuova proposta di f (può essere anche la stessa del primo turno). Le quattro proposte saranno di nuovo valutate separatamente e in ordine casuale. Se si raggiunge un accordo unanime su una delle quattro proposte, la prima fase termina; altrimenti, avremo un terzo turno di proposte.

Anche in questo caso, come per il Gruppo A, la sequenza dei voti individuali sulle proposte durerà fino a quando non si raggiungerà una decisione unanime. Tuttavia, se dopo il 5° turno di proposte non si sarà raggiunto alcun accordo unanime, il computer selezionerà un importo casuale e i partecipanti otterranno come pagamento solo la quota di partecipazione di 5 Euro.

Risultati e guadagni

Il risultato finale delle due fasi verrà calcolato nel seguente modo.

Per determinare il risultato del Gruppo A sarà considerata la sua dotazione iniziale (480 gettoni sperimentali), il trasferimento w e il fattore f scelto dal Gruppo B. In particolare, per arrivare al risultato finale, la differenza tra la dotazione iniziale e il trasferimento deve essere moltiplicato per il fattore f. I gettoni sperimentali saranno divisi equamente tra i quattro componenti del gruppo. In termini matematici:

$$\text{risultato per ogni componente del Gruppo A in gettoni sperimentali} = \frac{(480 - w) * f}{4}$$

Per determinare il risultato del Gruppo B sarà considerato il trasferimento w dal Gruppo A e il costo del fattore f. Per arrivare al risultato finale, sarà calcolata la differenza tra il trasferimento w e il costo c(f). I gettoni sperimentali saranno divisi equamente tra i quattro componenti del gruppo. In termini matematici:

$$\text{risultato per ogni componente del Gruppo B in gettoni sperimentali} = \frac{w - c(f)}{4}$$

Il risultato in gettoni sarà convertito in Euro secondo il seguente tasso di conversione:

1 gettone = 0.10 centesimi di Euro

Il guadagno totale di ciascun partecipante consisterà nella somma in euro guadagnata (supponendo che si sia raggiunta una decisione unanime in uno dei 5 turni di proposta) più i 5 Euro di partecipazione. Nel caso in cui il risultato sia negativo, ai partecipanti sarà comunque assicurata la quota di partecipazione di 5 Euro.

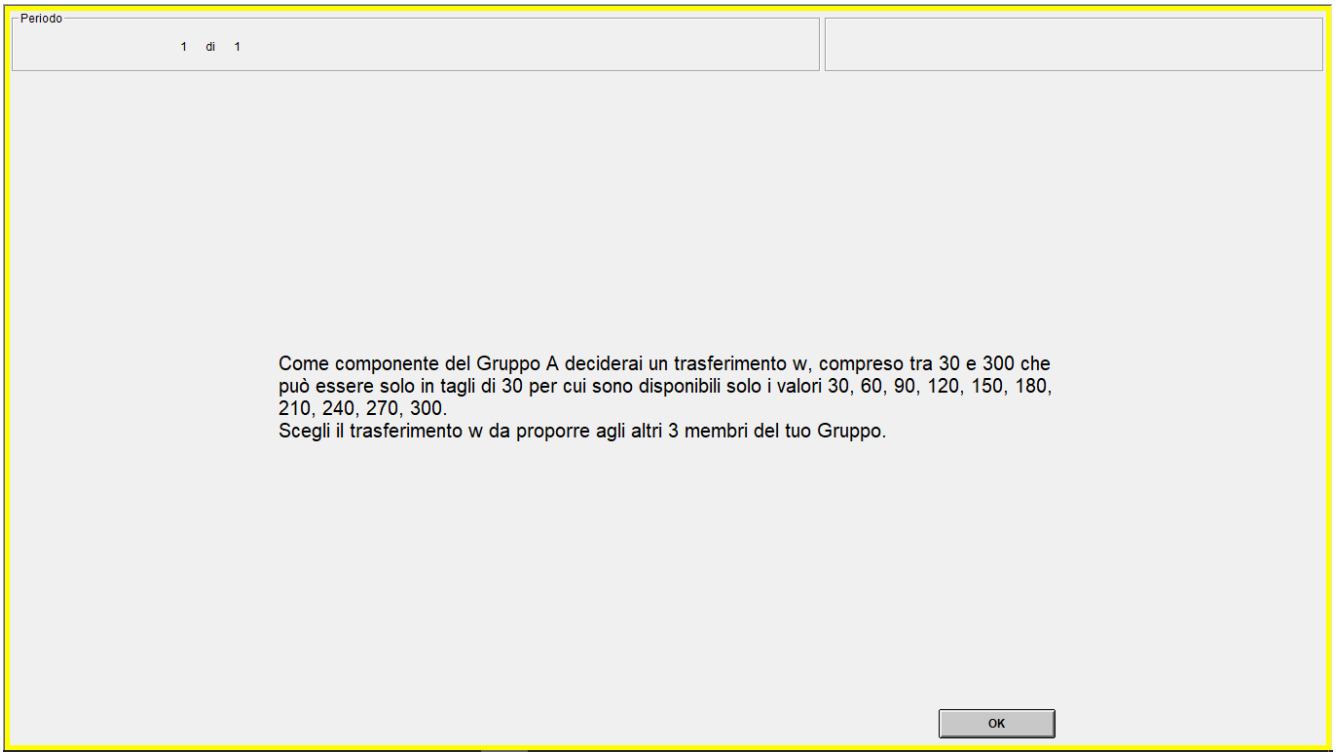
Riassumendo

Ogni componente del Gruppo A sceglie nella prima fase di trasferire un importo tra 30 e 300. Ogni proposta è valutata singolarmente e in ordine casuale. Se non vi è alcuna decisione unanime, ogni componente del Gruppo A presenta un'altra proposta (secondo turno). Sono possibili al massimo 5 turni. Una volta raggiunta l'unanimità, la prima fase è completata e il Gruppo B riceve il trasferimento w.

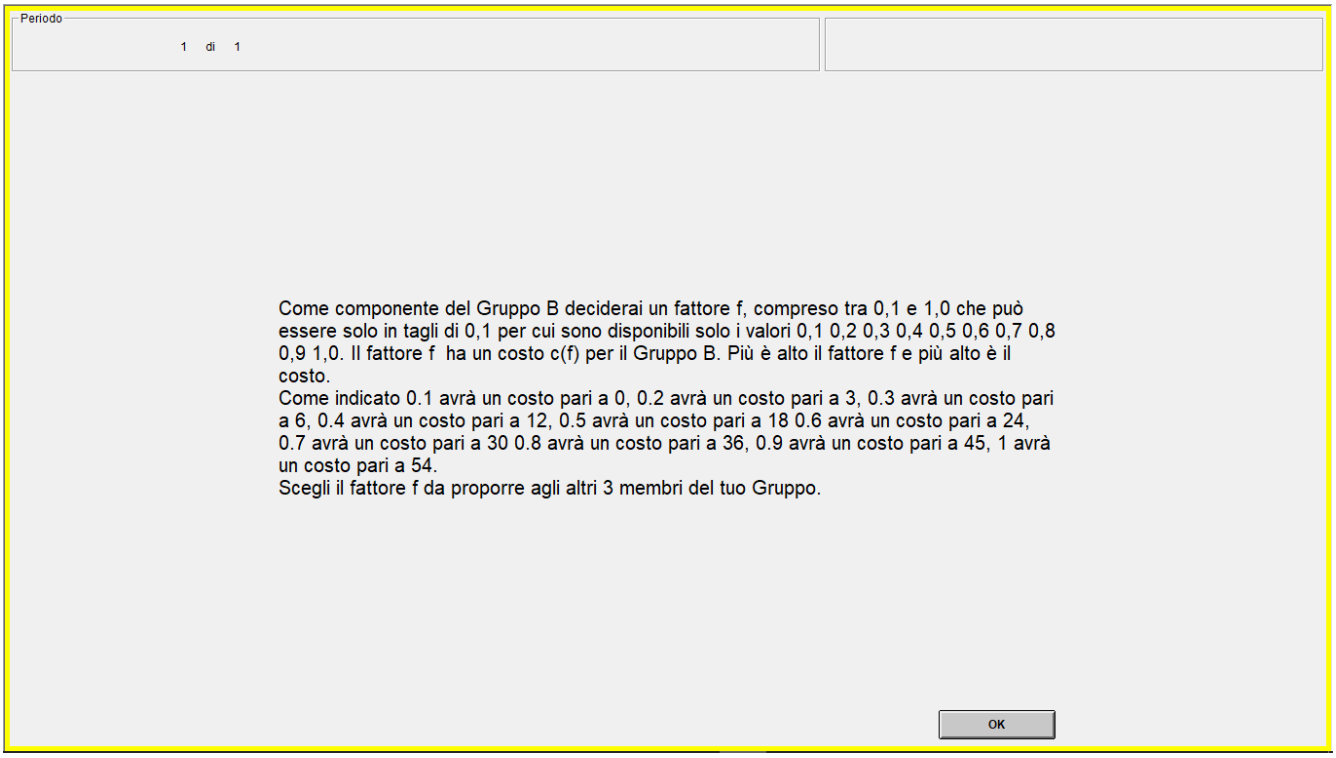
Nella seconda fase ogni componente del Gruppo B sceglie un trasferimento f tra 0,1 e 1,0. Il fattore è associato al costo c(f) indicato nella tabella di cui sopra. Anche per il Gruppo B, ogni proposta è valutata singolarmente e in ordine casuale. Se non vi è alcuna decisione unanime sulle proposte, ogni componente del Gruppo B presenta un'altra proposta (secondo turno). Sono possibili al massimo 5 turni.

Il risultato del Gruppo A dipende dal trasferimento w e dal fattore f scelto dal Gruppo B. Il risultato del Gruppo B dipende dal trasferimento w del Gruppo A e dal costo del fattore f. Il risultato di gruppo indicato in gettoni sperimentali sarò successivamente convertito in Euro e sarà diviso equamente tra i quattro componenti del gruppo.

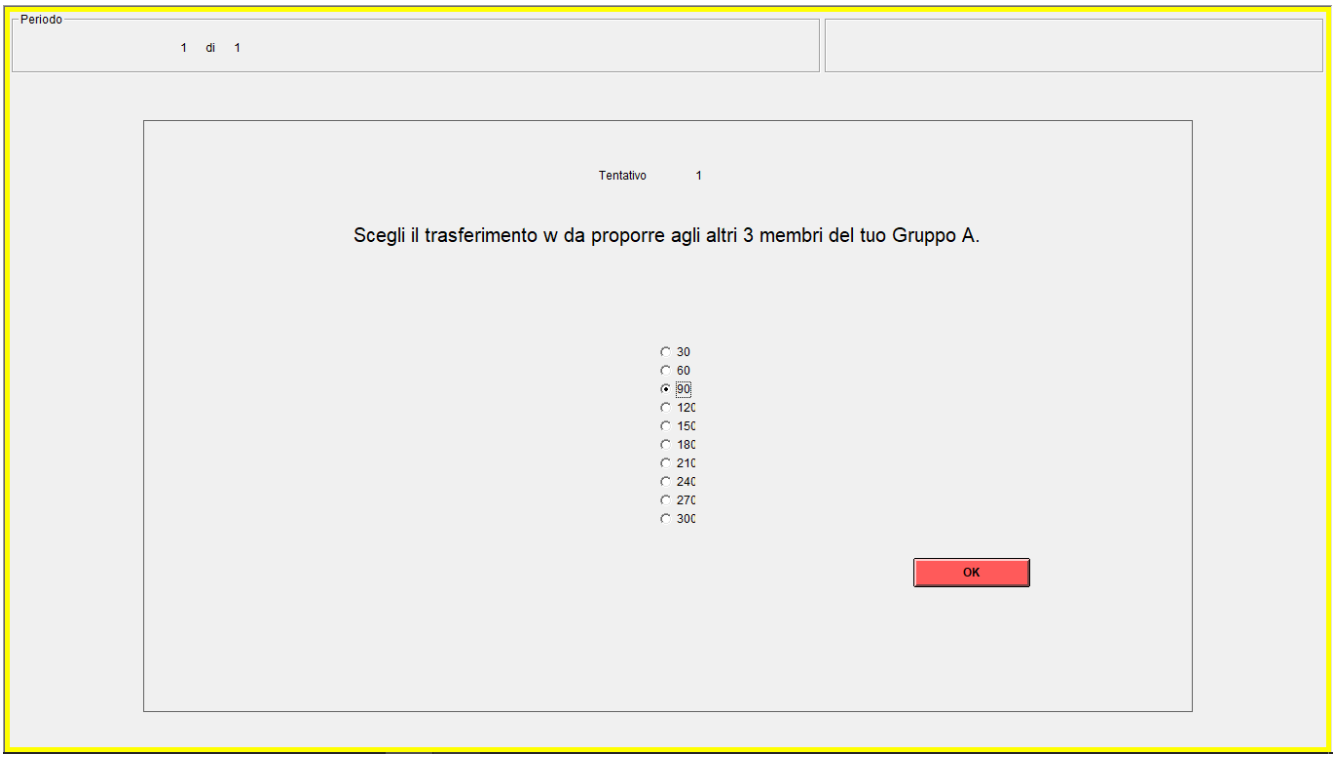
2. Screenshot



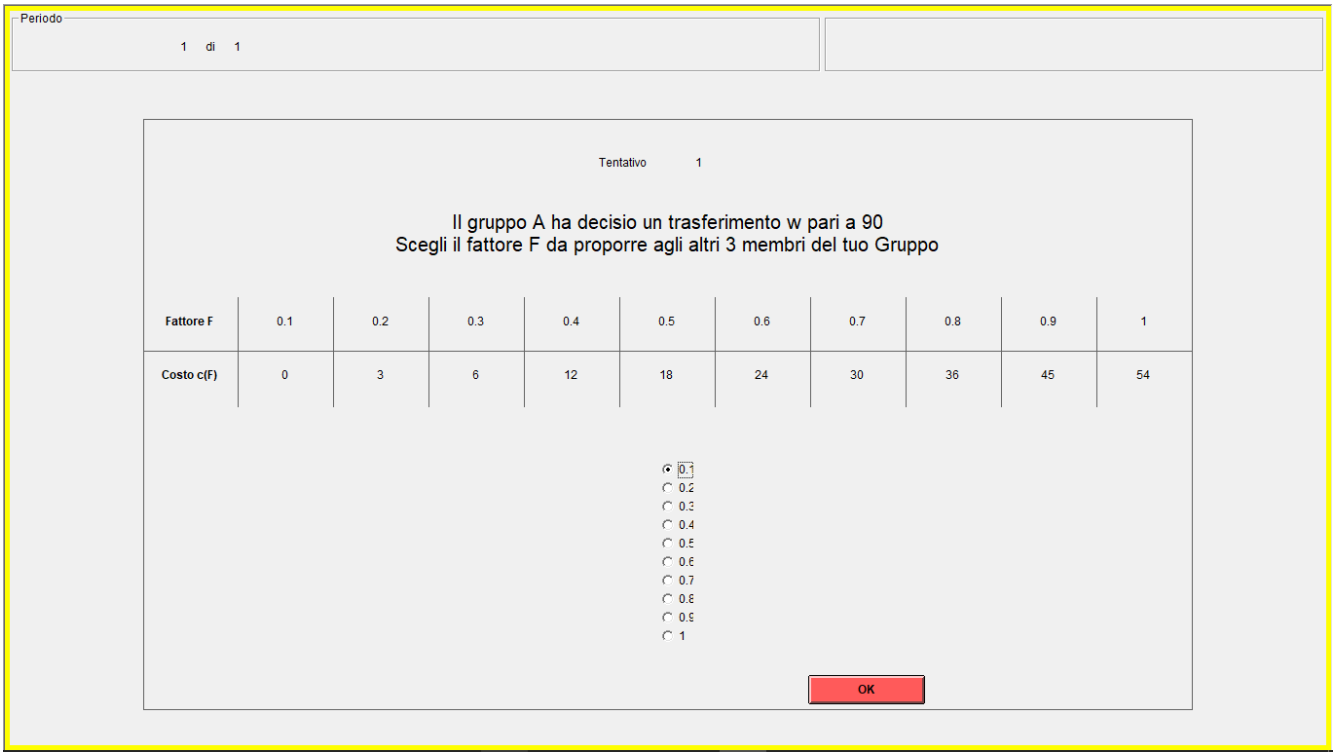
Screenshot 1 – Group A Instruction



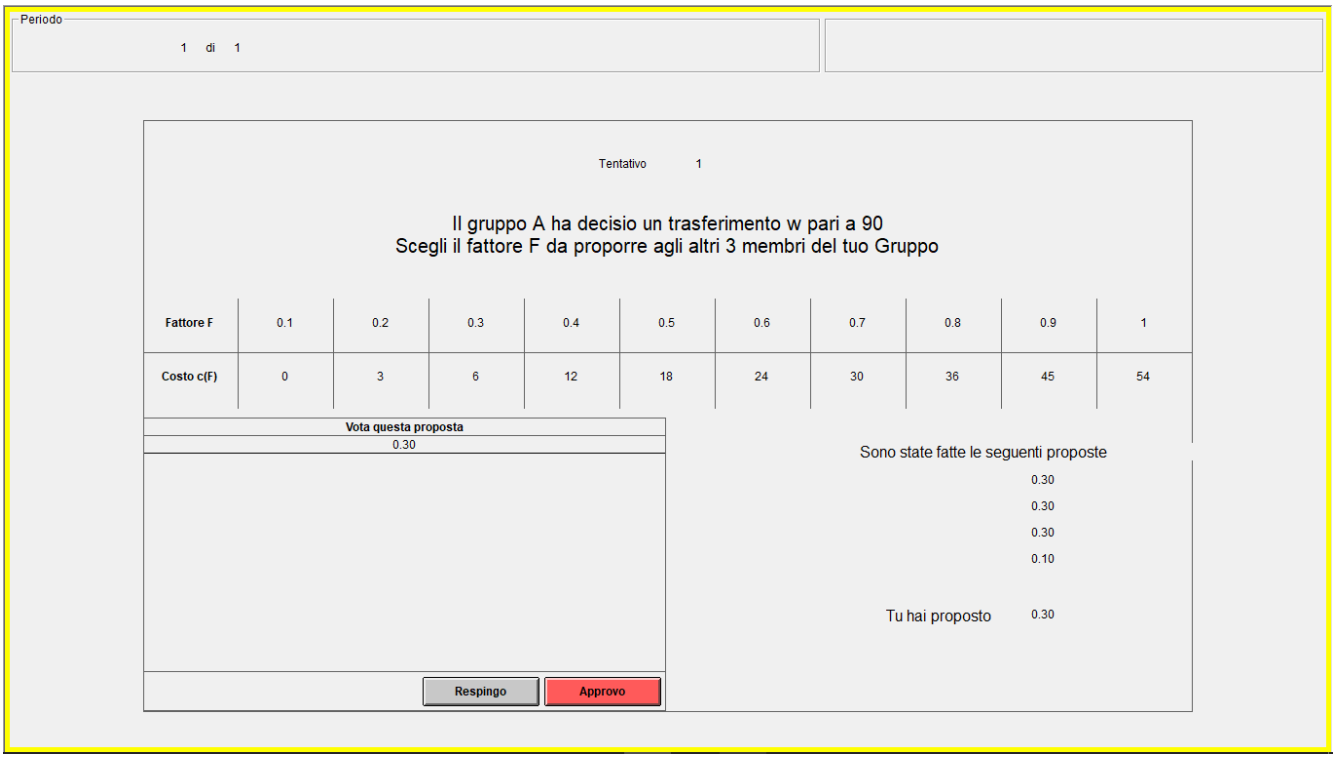
Screenshot 2 – Group B Instruction



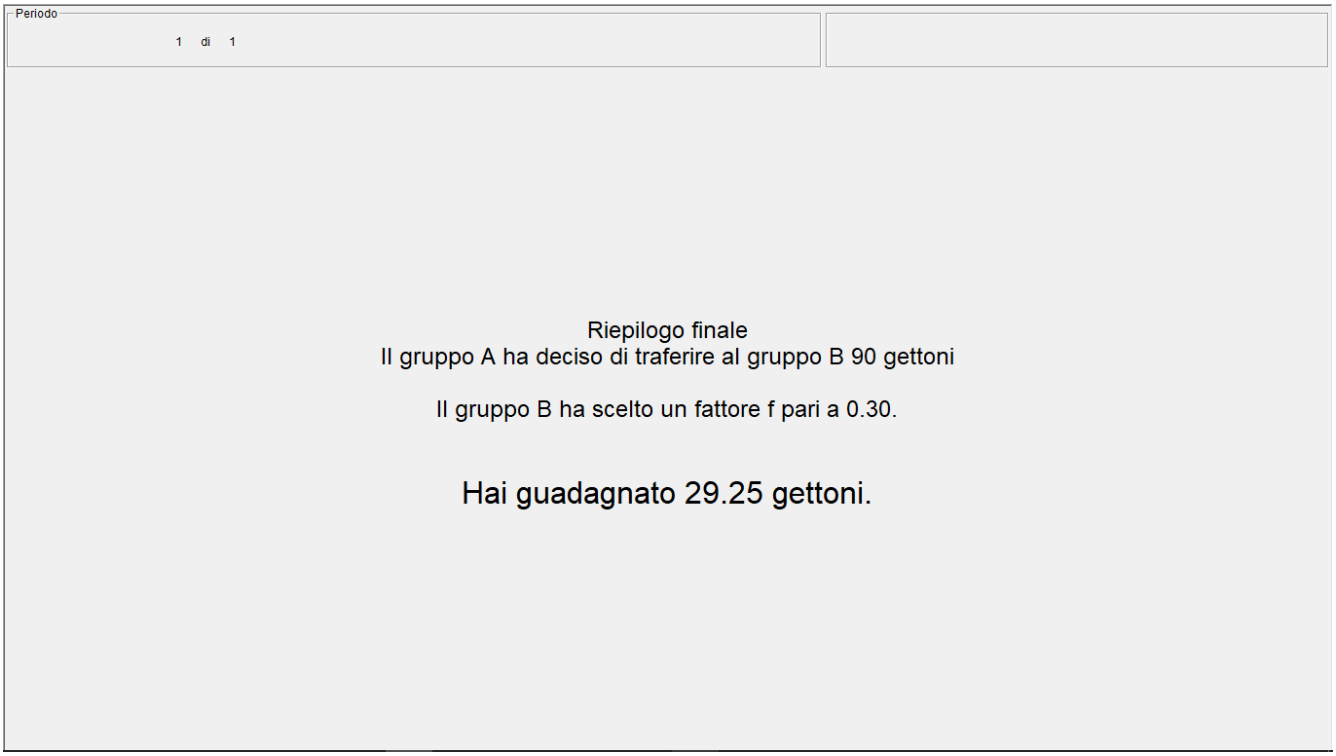
Screenshot 3 – Group A Transfer w choice



Screenshot 4b – Group B Effort f choice



Screenshot 4b – Group B Effort *f* choice (decision making process)



Screenshot 5 – Group A Payoff

Screenshot 6 – Group B Payoff

3. Statistical annex

Pearson's Chi-squared test
data: Earnings A Earnings B
squared = 776.67, df = 546, p-value = 2.734e-10

Table 25 – Pearson's Chi-squared test

Earnings A: baseline and individuals	**Earnings A: baseline and leader**	**Earnings A: baseline and subgroup**
W= 29.5, W = 66.5, p-value = 0.1706	W = 23.5, W= 30.5, p-value = 0.678	W = 18.5, W = 35.5, p-value = 0.3134
Earnings B: baseline and individuals	**Earnings B: baseline and leader**	**Earnings B: baseline and subgroup**
W = 34, W=61, p-value = 0.3016	W = 15.5, W = 38.5, p-value = 0.1715	W = 25.5, W = 28.5, p-value = 0.8588
Transfer w: baseline and individuals	**Transfer w: baseline and leader**	**Transfer w: baseline and subgroups**
W = 35, W = 61, p-value = 0.3303	W = 15, W = 39, p-value = 0.1532	W = 26.5, W = 27.5, p-value = 0.9525
Effort f: baseline and individuals	**Effort f: baseline and leader**	**Effort f: baseline and subgroups**
W = 29.5, W = 66.5, p-value = 0.1511	W = 26.5, W = 27.5, p-value = 0.944	W = 20, W = 34, p-value = 0.3504
Earnings A: baseline and subgroup	**Earnings A: subgroup and individuals**	**Earnings A: leader and individuals**
W = 18.5, W = 35.5, p-value = 0.3134	W = 30.5, W = 113.5, p-value = 0.01855 ***	W = 43.5, W = 100.5, p-value = 0.1059
Earnings B: baseline and subgroup	**Earnings B: subgroup and individuals**	**Earnings B leader and individuals**
W = 25.5, W = 28.5, p-value = 0.8588	W = 62.5, W = 81.5, p-value = 0.5903	W = 54, W = 90, p-value = 0.3078
Transfer w: baseline and subgroups	**Transfer w: subgroups and individuals**	**Transfer w: leader and individuals**
W = 26.5, W = 27.5, p-value = 0.9525	W = 58, W = 86, p-value = 0.4242	W = 60, W = 80, p-value = 0.4929
Effort f: baseline and subgroups	**Effort f: subgroups and individuals**	**Effort f: leader and individuals**
W = 20, W = 34, p-value = 0.3504	W = 32.5 , W = 111.5, p-value = 0.01919 ***	W = 49, W = 95, p-value = 0.1666
Earnings A: leader and subgroup	**Earnings B: leader and subgroup**	**Transfer w: leader and subgroups**
W = 33.5, W = 47.5, p-value = 0.5337	W = 27.5, W = 53.5, p-value = 0.2478	W = 28, W = 53, p-value = 0.2644
Effort f: leader and subgroups		
W = 29.5, W = 51.5, p-value = 0.2686		

Table 26 – Wilcoxon Rank sum test