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Three Essays on Group Dynamics, Other-regarding Preferences and Cooperation

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Tesi di dottorato di Caterina Cruciani, matricola 955547

Coordinatore del dottorato

Prof. Michele Bernasconi

Tutore del Dottorando

Prof. Michele Bernasconi

The undersigned Caterina Cruciani, in her quality of doctoral candidate for a Ph.D. degree in Economics granted by the *Università Ca' Foscari Venezia* and the *Scuola Superiore di Economia* attests that the research exposed in this dissertation is original and that it has not been and it will not be used to pursue or attain any other academic degree of any level at any other academic institution, be it foreign or Italian.

A Raffaele e Valerio

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Contents

Summary

This thesis addresses dynamics of other-regarding preferences emerging in informal contexts, where clear commitments among individuals are not possible. The impossibility to establish clear reputations, or to sanction behavior that does not conform to formal or implicit rules of the game, makes classic motives for increased cooperation inapplicable. Yet, examples of spontaneous cooperation, altruism or trust are abundant both in real life and in controlled laboratory experiments.

The investigation on the reasons behind behavior that does not conform to neoclassical game theoretic predictions is not simply motivated by the amount of evidence emerging from the laboratory or real life, but has a significant economic potential. In fact, informal contexts are difficult to regulate and could profit from the existence of other-regarding preferences and the behavior that derives from them. Using experimental methods, this thesis addresses specific instances of economic behavior motivated by other-regarding preferences, elaborating on two different ideas.

The first one deals with preferences for the well being of future generations, coupled with a concern for the environment and tests experimentally if groups remain more self interested than individuals when consuming a renewable resource in an explicitly intergenerational context, building on the empirical evidence on the bystander effect. This effect posits that the amount of help one shows to strangers is decreasing in the number of other individuals that potentially could provide help.

In the context of this experiment, we wonder whether consumption choices that have a direct effect of future generation are influenced by the presence of other individuals, compar-

ing an individual and a group treatment consuming a renewable resource in chains of non-overlapping generations. The participants in this experiment have been recruited through the Amazon Mechanical Turk online platform, which guarantees extreme anonymity both among participants and with the experimenter and represents an increasingly used option in experimental investigations.

The experimental evidence shows that a concern for the well being of future generations, even coupled with a concern for the environment, is not sufficient to completely overcome the inability of groups to achieve the consumption pattern individuals alone achieve. Nevertheless, the knowledge of the implications of sustainable development is able to explain lower consumption levels in groups, even in an experimental context in which the renewable resource is not explicitly defined. This suggests that environmental literacy is a dimension that deserves attention when dealing with the regulation of natural resources that have a non-excludable nature.

The other two papers build on two different ideas of similarity to address whether perceived similarity can be a driver of trust or cooperation.

The first paper builds on the vast literature on trust games. An experimental analysis introduces "real" partner selection in a trust game to investigate whether other-regarding preferences in informal environments benefit from this feature, while at the same time controlling for similarity as a driver of increased trust, following on the literature on minimal group paradigm and in-group out-group bias. According to this literature, there is a tendency to show favoritism towards individuals perceived as belonging to one's group and discriminate out-group individuals, even when such group membership is minimally induced with irrelevant contextual cues.

This experiment involved undergraduate students of Ca' Foscari University in a trust game in which a subgroup of the investors could choose a characteristic of one's trustee. Partner selection is real in the sense that a trustee with the given characteristic is assigned to the investor to play the game, and no hypothetical or strategy-method choices are involved.

We find some support for the hypothesis under tests, in particular we find that trustees are

more responsive to the introduction of partner selection, and are able to highlight different patterns in the more generous participants in both roles of the game, exploiting the potential of quantile regression.

In another paper, similarity is shown to be a successful driver of increased cooperation in a simulation environment, when individuals may freely join and leave informal groups and utility depends from individual features summarized in a vector of binary salient values and in an adaptive parameter representing general values.

The simulations are able to reproduce stylized facts, such as the tendency of poorer agents to join together and offers support to the idea that similarity can indeed support the emergence and stability of cooperation.

This thesis contributes to the literature on other-regarding preferences testing their implications in novel experimental contexts, in order to suggests alternatives to formal regulation and solutions for contexts in which the traditional tools to support cooperation and trust, such as punishment or reputation, cannot be applied. Besides presenting new results, the two experimental papers offer insights into directions for future research, building on the evidence collected.

Chapter 1

Better alone than in bad company? Intergenerational responsibility and sustainable consumption

Abstract

This paper investigates the existence of a bystander effect in an experiment where different chains of generations make consumption choices regarding a renewable resource. According to this effect, individuals when alone are more other-regarding than when in groups, even when these groups are purely informal and individuals may simply share the burden of helping others without any coordination. The experimental setting frames the problem as an intergenerational consumption task, in which a renewable resource, whose stock doubles in between generation, is involved. Participants are guaranteed anonimity in a setting of infinite horizon - they do not know for sure whether they belong to the last generation in the chain. Experimental results show statistically significant differences in consumption patterns between treatments, showing that the bystander effect survives also when dealing with renewable resources. Individual characteristics have also been used to explain behavior, in order to assess whether individual responsibility interacts with specific traits in determining different consumption levels across generations and setups. Beliefs regarding the consumption choices of others and the level of the resource stock available for consumption are the main determi-

nants of consumption choices, while demographic characteristics are not able to explain the data. The introduction of a question regarding the knowledge about sustainability allows to address whether different disposition towards this issue have an effect on consumption, with some support for this hypothesis from the regression analysis.
JEL Codes: C91, C92, D99.
Keywords: Individual, Groups, Intergenerational Consumption, Renewable resource.

1.1 Introduction

This paper investigates whether being the only individual responsible for the consumption possibilities of the future generation has an effect on inducing more sustainable consumption pattern than a situation in which this responsibility is shared with others. This effect is akin to the *bystander effect* Darley and Latan (1968), an important social psychology concept that implies that an individual is less likely to help another in need as the number of other potential helpers increase. The bystander effect has found significant support in social psychology experiments and has proven to be particularly strong in non-emergency situations and in situations in which opportunity rather than physical costs were involved, thus making it a relevant factor in shaping decisions in economic contexts.

The relevance of the bystander effect in economically relevant situations has already been investigated in K. et al. (2012) in which subjects were involved in an n-person dictator game, finding strong support for this effect even in the presence of experimental features that in general favor cooperation and altruism, such as improved information and direct communication between players.

This paper uses a renewable resource as the resource to be consumed. Such resources are in general natural resources that reproduce according to some biological factors over time. The total supply of renewable resources is determined by two factors: the rate of growth of the resource over time and the rate of consumption. Examples of renewable resources include fish in a lake, freshwater or wild forests. Managing the consumption of renewable resources is fraught with intergenerational considerations, as current consumption may lead

to the exhaustion of the resources, making consumption for all future generations impossible. On the other hand, in order to ensure (some) consumption by future generations, the current generation need not constrain consumption as much as it should in the case of private goods that occur as a finite stock, as even a little quantity of the renewable resource can grow into a more significant stock for the following generation. Lastly, the management of renewable resources is complicated by the fact that many occur as natural common pool resources - resources that are rival in consumption but not excludable- thus opening a debate regarding appropriability and regulation.

There exists a large body of literature dealing with common pool resource management that will be only marginally addressed in this paper, as the focus of the present work is not to shed light on optimal regulation mechanisms, but rather to test whether a concern for the environment is able to counterbalance the bystander effect, strengthening altruistic motivations in supporting lower appropriation rates of the current generations. We are aware of only one experimental paper framed in a CPR setting in which following generations composed by different people play a common pool resource game Fischer et al. (2003). In this paper the authors find a strong support for what they call "optimistic free riding", in the sense that the responsibility to preserve the resource for future generations is recognized compared to a non intergenerational setup, but people expect more restraint from others than they themselves actually show. In our view this results confirms the idea behind the bystander effect, although in Fischer et al there is no explicit analysis of the effect of group size on contributions.

This paper uses a dictator game in which the dictator and the receiver belong to two separate generations; the lack of overlap between generations ensures that there is no conflict between concerns for own future wellbeing and that of future generations', as each generation lives only for one period. In order to test for the bystander effect, a treatment employing a multiple-individuals dictator game is also introduced. Differently from K. et al. (2012), the three individuals making up the groups do not have any contact with each other (no communication). This setup induces a very weak group membership, as the word group is used also in the instruction, but participants never meet or talk to one another.

The bystander effect is in a way analogous to the concept of *moral wiggle room*, introduced

to explain observed giving behavior in dictator games by Dana et al. (2007), who show that reducing the transparency with which a dictator's action translate into the recipient's payoff increases the number of selfish choices. In particular Dana et al. (2007) also uses a *diffused responsibility* treatment in which two dictator determine the final allocation of the initial pie, where if only one dictator chooses the fair outcome over the unfair one (which is more favorable to the dictators in the same way) then the fair outcome is implemented.

This experiment is framed in an infinite-horizon setting in which chains of non-overlapping generations make a consumption decisions. Individuals are told that there is an unknown possibility that they may belong to the last generation in their chain, but never known with certainty if that were the case. In total three non-overlapping generations were formed. Participants are simply told the details about their current generation and whether the stock of resource to be consumed comes from the choices of other individuals or is randomly determined. The choice of the infinite horizon, although more complicated to implement in a laboratory setting, is aimed at increasing realism.

The main result of this experiment is that even informal membership to a group induces the bystander effect: amounts passed in group generations are significantly lower than those passed in individual generations. The fact that group members had to divide whatever was passed collectively by the members of the group in the previous generation may have diluted even more the responsibility that each individual in the group treatment felt for the following generation.

Besides addressing the role of an intergenerational link on the bystander effect, this paper also addresses whether different sources of experimental income affect differently the profile of consumption. Namely, the paper addresses whether the consumption choices of the members of the first generation are different than those of the second and third generation, when it is known that the resource stock received is determined by the choices of another generation of players and it is not randomly determined, as it is for the first generation.

Related questions regarding the strength of a concern for the environment and other individual-specific characteristics are also investigated in order to assess their relevance in the determination of consumption patterns.

1.2 Literature review

This paper addresses consumption choices of a renewable resource in chains of non-overlapping generations in order to address whether the bystander effect exists also under conditions of minimal group membership and if is affected by environmental considerations.The consumption choice of the individuals involved in this experiment is framed as a dictator decision using modified versions of the dictator game, first introduced by Kahneman et al. (1986) in psychology and popularized in economics by Forsythe (1994). In a standard dictator game, two individuals are matched and have to divide a given endowment. Only one of the individuals (the dictator) has the power to decide on the allocation of the endowment between himself and the other person (the receiver), who cannot but accept. Differently from the ultimatum game, in which the receiver has the power to turn down offers he does not like, in a dictator game any positive transfer from the dictator to the receiver is not dependent on strategic considerations, as the receiver is only a mute player in the game. Thus, any amount greater than the game theoretic prediction of zero transfer testifies of other-regarding concerns, be them due to fairness or altruism.

In a recent review of experimental evidence on the dictator game, Engel (2011) finds that across 616 different experiments dictators give on average about 30 percent of the pie, with some differences across the many different experimental conditions used (see also Camerer (2003) for a review). Whether the reason for this significant difference from standard game theoretic predictions comes from fairness or altruistic motives, we can nevertheless conclude that some form of concern for others is at play.

Given its simple structure, the dictator game has often been used to investigate other-regarding motives underlying economic interactions. Among the many applications of dictator games (DG), the ones that are more closely related to this work start from Cason and Mui (1997), where the idea of team dictator game was first introduced. As happens also in this work, they employ a modified version of the DG in which groups of dictators evenly split what has not been transfered to the same number of anonymous receivers, who in turn evenly split what they get from the dictators. There are two main differences between Cason and Mui (1997) and the experiment presented in this paper: the main difference is that their

focus is to address how group decision making takes place, and in order to do so they enable face-to-face communication between the two dictators to come up with an agreed transfer. This paper will use a much more informal form of group with each group including three members. Secondly, environmental concerns are not at play, as the amount to be divided is simply framed in experimental currency that has no growth rate before reaching the receivers.

Cason and Mui (1997) has been frequently cited in related investigations of the role of group decision making on individual other-regarding preferences, as their main result is that group discussion drives team choice towards the more other-regarding standpoint. In Luhan et al. (2006) Cason and Mui's main conclusion is challenged by new experimental data, which show that group polarization is in favor of the more selfish standpoint. This conclusion is more consistent with literature on the rationality of group decision making in games, which finds that in general groups tend towards the more rational (game-theoretic) solution Kugler et al. (2012).

This experiment involves a series of different non-overlapping generations in a dictator game. It features a group treatment, in which series of three dictators are considered, and a baseline treatment in which a standard single-person intergenerational dictator game is played. The baseline is in the spirit of Bahr (2008), who use a sequential dictator game to study average behavior along three generations, A, B and C. The authors find that the intergenerational framework induces more altruistic behavior in subjects on average, especially when social history (history of previous transfers to B from A) and social interactions (pre or post playing) are introduced, while anonymity tends to foster greediness. Differently from Bahr (2008) this work introduces uncertainty regarding the total number of generations and uses a dictator game in which a renewable resource is to be diveded, thus reducing the conflict between present and future utility, as the resource grows in between generations if not depleted.

The group treatment of this paper is similar to the group treatment implemented in Dana et al. (2007) as both use more than one dictator in order to determine the allocation of the following generation, but with important differences. In this paper, groups of three dictators make consumption choices that determine the consuption possibility of a following generation of three dictators. In a way Dana's *moral wiggle room* is limited in this paper, as individuals

in the first generation cannot implement a fair outcome alone even if they wanted to, but can only do their fair share.

A different setting investigating consumption behavior in an intergenerational setting is that of Common Pool Resources, which also features a renewable resource that grows in between generation. In this setting, the most related work to the present investigation is Fischer et al. (2003), in which chains of non-overlapping generations of four individuals play a CPR game in a finite-horizon setting. Subjects are not told at which point of the chain they live, nor the total number of generation, which nevertheless they know to be finite. The authors find strong evidence for what they label "optimistic free-riding" behavior: subjects expect others to refrain from consumption more than they turn out to do and more than they themselves are willing to do. Using two different growth rate for the renewable resources Fischer et al. (2003) are able to show that when preserving the resource is difficult (due to a low regeneration rate) subjects put less effort in trying to preserve it, consuming more than when the resource grows at a faster rate. The setup used in Fischer et al. (2003) is similar to the one used in this paper in two respects: the use of a renewable resource and the lack of communication between the members of the same generation. Nevertheless, this paper uses a dictator game, which is devoid of the strategic implications underlying consumption choices in a CPR setting.

This paper also sets out to test the persistence of a very well known effect in social psychology - the bystander effect Darley and Latan (1968). This effect depicts how group settings affect individual behavior and implies that a bystander is less likely to help a victim the larger the number of other potential helpers. Although this effect was mostly studied in context where some sort of help had to be provided, the variety of treatments implemented allows to conclude that the bystander effect is stronger in non-emergency situations and when bystander intervention entails opportunity rather than physical costs (Fischer et al. (2011)). The potential of the bystander effect in explaining economic situations has already been tested in K. et al. (2012), where groups of varying numbers of individuals could agree on the division of a windfall pie provided by the experimenters with an unknown individuals. This paper is able to establish that the bystander effect is still alive and well and that the larger the number of potential helpers is the worse off the recipient. Using also a strategy-method approach to rule

out the uncertainty regarding the choices of the other dictators and increasing direct communication among them is not able to weaken significantly the bystander effect that eventually seems to be framed by subjects as a Prisoner's Dilemma game.

Differently from this example and from Cason and Mui (1997) and the literature on team and group dictator games, this paper allows no form of communication among dictators and employs a medium that guarantees the maximum possible level of anonymity among subjects - the internet. Participants in this experiment are involved in computerized tasks that can be accessed only by registered members of an online crowdsourcing platform- Amazon Mechanical Turk. The role of anonymity in reducing evidence of other-regarding preferences has already been established in Hoffman et al. (1994, 1996), although positive transfers are still observed. More recent papers regarding the role of anonymity draw very different conclusions on real anonymity significantly reducing Franzen and Pointner (2012) or not affecting Koch and Normann (2005) the profile of transfers from dictator to recipient. Although a proper literature review on this topic is beyond the scope of this paper, we can conclude that the form of anonymity induced by the experimental conditions is sufficient to reduce at the minimum the perception that dictators and recipients could eventually meet and any experimenter effect.

1.3 The experiment

1.3.1 Research questions

Building on the existing literature, this paper sets out to test a series of related research hypotheses through a novel experimental setup.

- **Hypothesis 1 - "Bystander trumps renewable"**: the bystander effect survives even when no interaction whatsoever is possible in group treatments and when the resource to be divided is renewable - the reduced intragenerational tension coming from the renewability of the resource is not sufficient to make groups as efficient as individuals.
- **Hypothesis 2 - "Of the origin of the pie"**: participants that face a resource stock

(pie) that is determined by the choices of other individuals will behave differently than individuals that know the pie has been randomly determined: the endogenous pies will trigger a different behavior than an exogenous one.

- **Hypothesis 3 - "Beliefs shape choices"**: individuals in groups, even if there is not any possibility to meet, talk or interact for sure with the same persons again, act as groups - individuals respond to the behavior they expect from others.
- **Hypothesis 4- "Sustainability consciousness"**: individuals that are more environmentally conscious (have a good understanding of the implications of sustainable development) exhibit different consumption patterns than others.

The relevance of addressing hypothesis 1 and 4 stems from the consideration, already pointed out earlier in this work, that many real-life instances in which a resource with significant economic value has to be managed by unstructured groups of people deal with environmental goods, or more in general with common-pool resource goods. Addressing whether renewability is in itself a motive for restraint is a natural first step in understanding how environmental consciousness can be used to improve informal group choices, although the literature on common-pool resource games already leads us to expect that renewability alone may not be enough to overcome the bystander effect. Nevertheless, those individuals that have a more pronounced perception of what sustainable development is are expected to behave differently (Hyp.4).

Hypothesis 2 offers an interesting first look at reciprocation dynamics in informal groups: if the origin of the pie matters, even in informal groups, where pies are determined by the previous generation, this goes in the direction of supporting the idea that the willingness to reciprocate is an element that should be further enhanced in order to achieve a more sustainable consumption pattern.

Hypothesis 3 has been included as previous evidence on group tasks and from similar experiments, as mentioned in the previous sections, shows that ingroup beliefs are a powerful driving force in shaping individual decisions. It would be interesting to find that, no matter the fact that group members never even interact, beliefs regarding the perception of fellow group members have a significant impact.

1.3.2 Experimental setup

The experiment is composed by two treatments involving different numbers of subjects in an intergenerational setting in which chains of non-overlapping generations consume a renewable resource, whose stock doubles in between generations. Given the nature of the problem, the experiment is constructed in order to represent an infinite-horizon setting, better suited to address issues of intergenerational and sustainable consumption issues. This implies that subjects are are told in the instructions that there is an unknown probability that their generation may be the last one, but they are never told either how many generations make up their chain or which is their position in the chain (unless they belong to the first generation for reasons that will be clarified later).

The first treatment uses chains of generations with only one member (*individual treatment*), while the second uses three-member generations (*group treatment*). Groups are formed randomly, using the submission order with which the data had been recorded. There are three generations per treatment.

In all generations and treatments subjects have to make the same choice: decide how much to consume of a renewable resource, which grows by a factor two in between generations. The object of consumption is a renewable resource, in order to reduce the clash between individual and societal concerns that characterizes intergenerational consumption. In order to leave something for the next generation, the present generation need only to avoid exhaustion of the renewable resource, but does not need to reduce consumption drastically.

The maximum consumption level for the different generations is defined as follows:

- individuals in the first generation know they can consume up to 10 units of the unspecified renewable resource;
- individuals in the second and third generation know they can consume up to x units of the unspecified renewable resource, where x is the level of resources left after the consumption of the first generation and doubled due to the natural growth rate of the resource.

Individuals in the group treatment face the choices described above, but they are also told which is the total amount of resources that they group may consume and that they have to share it equally - they have access to a third of whatever is available for their generation. Subjects in both treatments are told that their chain is composed by generations exactly like their own (individual or group) facing the same rules.

The fact that each member of the group generation may consume at most one third of the available resources is included in the instruction as a rule of the game in order to rule out intra-generational issues, as the focus of the analysis is transfers across generations. Moreover, this setup implies, as mentioned above, that in both treatments individual make fully comparable choices, which will allow to look at the group treatment data also at individual level.

The experiment was run using Amazon Mechanical Turk (AMT), an online crowdsourcing platform that is being increasingly used for economic experiments. AMT was created explicitly to recruit human workers for tasks that could not be easily done by computers such as extracting information from images - human intelligent tasks or HITs as they are now called tasks on AMT. AMT brings together requesters, who post HITs, and workers, who choose which HITs to accept looking at their description, including general content, wage offered and average estimated completion time. Payments (in US dollars) are managed by Amazon, who acts as an intermediary between the requester and the workers. HITs have to be reviewed by the requesters and explicitly approved before the payment takes place.

AMT is an online labor market that offers unique advantages for behavioral research: subject pool access and diversity and low cost, besides allowing for reducing the lag between theory building and experimentation Mason and Suri (2012). In fact, the number of individuals working on AMT is rather stable over time, diversified in race, gender, background and origin (as there are no country restrictions on workers), and allows to run experiments at very low costs and in relatively short amounts of time.

In the behavioral disciplines, there have been numerous papers dealing with the reliability of workers on AMT compared to more classic laboratory participants. For instance Paolacci et al. (2010) finds that in classic judgment tasks such as the conjunction fallacy or the outcome bias, the behavior in AMT does not significantly different from a classic student population.

Amir et al. (2012) finds that subjects on AMT basically follow the same choice patterns as observed in laboratory experiments for tasks like the dictator game, which is very similar to the game used in this paper, even with very low stakes (1$).

Given the setup of this experiment, the above defined research questions imply that

- **Hypothesis 1 - "Bystander trumps renewable"**: the amount consumed by the group members will be greater than that consumed by the individuals for all generations
- **Hypothesis 2 - "Of the origin of the pie"**: consumption patters in the endogenous and in the exogenous subgroups of the participants will be different.
- **Hypothesis 3 - "Beliefs shape choices"**: a positive and significant correlation of in-group beliefs and consumption exists in the group treatment for all generations.
- **Hypothesis 4- "Sustainability consciousness"**: individuals that are more environmentally conscious will consume less than other individuals in all treatments and generations.

1.3.3 Overview of the participants pool

Overall 217 individuals participated in this experiment, 52 in the individual treatment and 165 in the group treatment. Table 1 reports the details of the different generations and the appendix includes a transcript of the advertisement of the different tasks and full instructions.

Generation	Subjects by treatment		Average pay	Average time	Effective hourly rate
	Individual	Group			
first	20	60	0.75 USD	4.5 minutes	9.95 USD
second	17	56	0.65 USD	5 minutes	7.73 USD
third	15	49	0.50 USD	5.5 minutes	5.45 USD

Table 1.1: Details of the experiment

The starting goal was to have 20 independent observation per treatment; although individuals in the group treatment never interact, we still decided to collect three times as many observation, in order to be able to look at the data both at group (20 observations) and at

individual level (60 observations). The reason behind the general decrease in the numerosity of the data collected as generations go by is due to either exhaustion of the resource by the previous generation (which happened only in the individual treatment) or to impossibility to form groups or double entries by participants. The experiment was structured in order to minimize the possibility for Turkers to participate in more than one generation[1]. The three generations used in this experiment were run as separate tasks, posted online one after the other. Nevertheless 4 individuals participated to two generations and the last of their entry was removed from the data. Out of the 217 observation collected, group data were checked for inconsistent ingroup beliefs and participants whose average belief regarding the group contribution exceeded the available pie were removed from the analysis.[2] This brings the total group numerosity down to (57 in generation 1, 53 in generation 2 and 41 in generation 3).

The consumption choices of the first generation were used to determine the maximum available consumption of the second generation and the same goes for the third generation. Thus, subjects in the second and third generations are confronted with the consequences of real choices by real players, not with fictitiously determined renewable resource stocks. Subjects in the second and third generation are not told to which generation they belong, they are simply reminded that the consumption possibilities that they are facing were determined following the choices of a generation of real individuals that preceded their own. Subjects in the first generation are told they are first in the chain, in order to avoid ambiguity regarding the origin of the renewable resource stock - which is not dependent on the choices of other real people.

Before concluding the experiment, but after the choice has been made subjects are asked to answer to one or two (depending on the treatment) **belief questions**:

- for the individual treatment: subjects are told that the experiment involves also group generations (three individuals) and are asked to guess whether the average consumption choice of group generations is higher, lower or the same compared to the average choice of individual generations;

[1]The instructions of generations 2 and 3 specifically stated that M-Turk IDs would have been checked before payment and double entries to more than one generation would be removed and payment refused.

[2]There were three such individuals in group 1, 3 in group 2 and 8 in group 3

- for the group treatment: subjects are asked to guess what has been the average consumption choice of the members of their generation (excluding their own choice) and to guess whether the average consumption choice of individual generations is higher, lower or the same compared to the average choice of group generations.

For each correct belief question a 0.05 USD bonus was awarded and an overview of the final results including this bonus was posted online and made available to subjects involved in the experiment. Table 2 gives an overview of the answers to the belief question regarding whether the average consumption of the other treatment was higher, lower or the same compared to the average consumption of one's treatment. Remember that subjects found out about the

Treatment	Generation	Belief wrt other treatment		
		higher	lower	the same
Individual	1	8	7	5
	2	13	3	1
	3	7	4	4
Group	1	27	19	11
	2	29	13	11
	3	19	11	11

Table 1.2: Beliefs regarding average consumption of other treatment

existence of the other treatment after the choice task. As the table shows, the belief that the consumption of the other treatment was higher was the modal choice of both treatments and all generations, which is striking given that the question was incentive-compatible. This is consistent with an idea of optimism because every subjects thinks he did better than the others (consumed less). Since in all instances of this experiment the average group consumption was higher than the average consumption in the individual treatment, the correct belief for the individual treatment was "higher", while the correct belief for the group treatment was "lower". The fact that beliefs are quite distributed across the possible options seems to rule out the idea that the bystander effect is indeed rationally known or perceived to subjects.

The experiment includes also a short **individual information questionnaire**, in order to collect other useful information for the data analysis, including

- gender

- age
- existence of siblings
- knowledge of the term sustainability
- (if yes to the previous question) provide a definition of sustainability

Table 3 presents an overview of the individual characteristics of the subjects involved in the different treatments and generations.

Generation	Treatment	Gender		Age			Siblings	
		M	F	min	ave	max	yes	no
First	individual	8	12	18	32.4	52	14	6
	group	26	31	19	34.25	65	52	5
Second	individual	10	7	20	28.8	43	17	0
	group	30	23	21	32.6	53	45	8
Third	individual	7	8	21	36.2	56	12	3
	group	18	23	18	30.9	54	36	5

Table 1.3: Individual information by generation and treatment

The use of the question regarding sustainability has been taken from Bahr (2008), who also investigate intergenerational consumption. The answers provided by subject to the question defyning sustainability have been coded by the author and used for data analysis in four different groups:

1. **Classic sustainability**: definitions including reference to the future, to restraint or close to the classic definition of sustainability [3];
2. **General sustainability**: definitions more similar to the dictionary definition of sustainability [4];

[3] According to Sustainable measures, `http://www.sustainablemeasures.com/node/35` all the (many) existing definitions of sustainability have to do with concepts akin to living within the limits, understanding the interconnections among economy, society, and environment and an equitable distribution of resources and opportunities. This view is consistent with the classic definition of sustainable development drawn from the Bruntland Commission report, where it is defined as *"a kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Bruntland Commission, *Our Common Future*, 1987).

[4] Definition of the term "to sustain" by The Free Dictionary, `http://www.thefreedictionary.com/sustain`, in general to keep in existence, maintain.

3. **Wrong definition**: the term sustainability is known but a wrong definition is provided;

4. **No definition**: the term sustainability is not known.

Table 4 provides an overview of the classification of the sustainability definitions provided by generation and treatment.

Generation	Treatment	Sustainability definition			
		classic	general	wrong	none
First	individual	8	5	5	2
	group	18	9	18	12
Second	individual	7	1	5	4
	group	22	8	10	13
Third	individual	5	2	4	4
	group	15	7	14	5

Table 1.4: Sustainability definition: classification by treatment and generation

1.4 Results

This section presents an overview of the analysis of the experimental data collected, starting out with some descriptive statistics focusing on consumption data across treatments, looking separately at each generation. A first testing of the hypotheses presented in the previous section is carried out using statistical tests, finding statistically significant support for the main hypotheses under test, in particular of hypothesis 1 and 3. A later subsection compares behavior across generations by treatment in order to test hypotheses 2 and 4, while the concluding part of this section introduces regression analysis and its main findings.

1.4.1 Descriptive statistics and hypothesis testing

Generation 1

Here are some descriptive statistics of the subject pool involved in the first part of the study (**generation1**), which includes 77 individuals overall (20 in the individual treatment and 57

in the group treatment. Since the subjects in the individual treatment do not communicate, their (individual) data can be treated as independent, thus the analysis of the group treatment includes 57 data.

Figure 1 shows the histogram of consumption choices in the **individual** treatment, which represents a benchmark in order to test the existence of the *bystander effect*. Recall that all individuals in this treatment could choose to consume at most 10 units of renewable resource, knowing that what was not consumed would double before the next generation, formed by one individual, arrived. It is worthy of mention that 3 out of 20 individual decided to consume

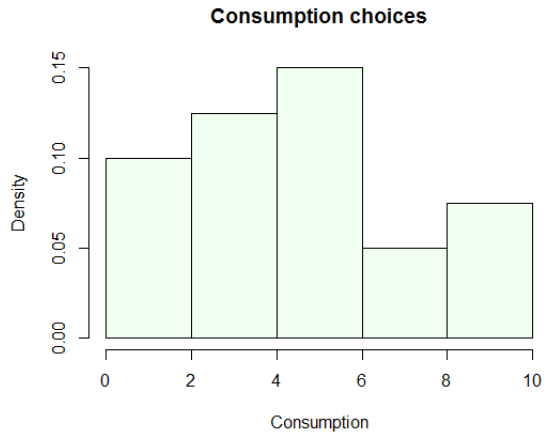

Figure 1.1: Individual treatment -Generation 1

the entire pie, thus stopping those generation chains.

Figure 2 focuses on the consumption choices of the individuals in the **group** treatment. All individuals could choose to consume at most 10 units of renewable resource, knowing that the other two members of the generation were facing the same choice and that what was not consumed by the three generation members would double before the next generation, formed by three individuals, arrived. Individuals in this treatment were also asked to guess the average consumption choice of the other members of their group, knowing that they would be awarded a further bonus if guessed correctly. The left-hand panel of Figure 2 shows the distribution of consumption choices, while the right-hand one plots consumption choices versus the beliefs regarding the average consumption of the other group members.

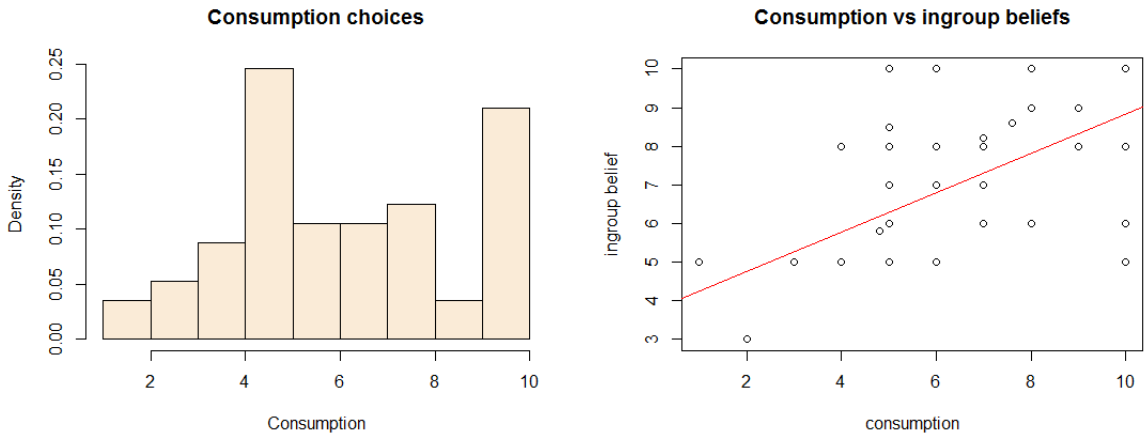

Figure 1.2: Group treatment -Generation 1

The correlation between consumption choices and beliefs is statistically significant, as confirmed by the correlation analysis, which finds a positive correlation of 0.62 (Pearson product moment correlation) with a p-value of $9.627e-08$ on the alternative hypothesis that consumption and ingroup belief are positively associated, as we posited in Hyp.3.

As mentioned at the beginning of this section, a statistical test of the difference between the consumption patterns emerging from the individual and the group treatment confirms the existence of the **bystander effect** in this experiment. In fact, a one-sided test checking whether the consumption choices of the individuals in the group treatment were significantly higher is supported with 97 percent confidence interval (Mann-Whitney test, p-value 0.027).

Another pattern emerging from experiment investigating intergenerational consumption in group settings (such as Fischer et al. (2003)) pointed also to the existence of **optimistic free-riding**, referring to the fact that, when elicited, belief regarding the contribution choices of fellow group members to a public good are always lower than one's consumption. We tested this effect in the group treatment thanks to the information on ingroup beliefs collected in an incentive-compatible way through the attribution of a bonus for correct answers. In the context of this experiment, we cannot really speak of "free-riding" as the choices of fellow ingroup members do not affect one's utility, but we can still check if the main message of optimism survives in this context. In particular, in this experiment such process translates into

expecting higher consumption levels from others than one's own consumption level. Comparing the consumption choices of the individuals in the group generations and the beliefs regarding average ingroup consumption choices shows that the former are indeed significantly lower than latter with a 90 percent confidence interval (one-sided Mann-Whitney test, p-value 0.099).

Generation 2

Generation 2 includes 70 individuals overall, 17 in the individual treatment (as 3 chains were interrupted due to the exhaustion of the resource by the previous generation) and 53 in the group treatment (due to double entries or missing or inconsistent data). Differently from generation 1, where all individuals in both treatments were facing the same consumption opportunity (the size of the available pie was always equal to 10 units), individuals in generation 2 faced different pie sizes according to the individuals in generation 1 that preceded them in the generation chains. In order to analyze the data, consumption and ingroup belief levels have been normalized using the pie size. Thus, consumption and belief levels are expressed as shares of the available consumption and not in absolute terms.

Recall that individuals in both treatments were told that a generation like their own (individual or group) made up by real individuals had preceded them, but were not told explicitly they were second in the chain. Figure 3 focuses on the consumption choices of the 17 individuals in the **individual** treatment.

Figure 4 show the consumption pattern emerging from the choice of the second generation of individuals in the **group** treatment. As previously explained, in the case of group treatment, since the data are independent at individual level, we are using the full set of data collected (53 individuals).

As Figure 4 shows, there is a positive (0.58) correlation between consumption choices and expectations about the consumption of the other ingroup members, which is statistically significant (p-value $2.657e-06$, Pearson product moment correlation), finding again support for Hyp.3 as we did for generation 1. Another similarity with the patterns emerging from

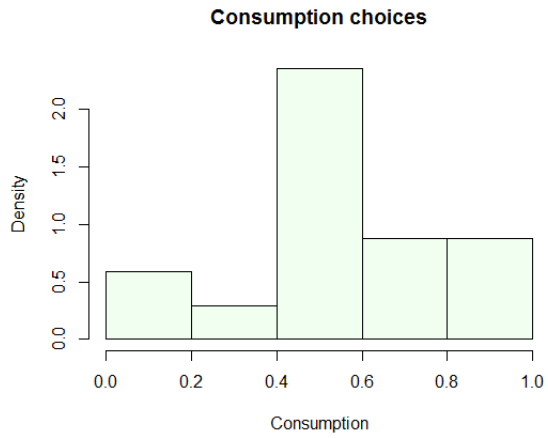

Figure 1.3: Individual treatment -Generation 2

generation 1 is the presence of a significant bystander effect: again, the consumption choices of the group generations are significantly higher (one-sided Mann-Whitney test, W statistic 349.5, p-value 0.083) with a 92 percent confidence interval.

The other effect observed in generation 1 - what we called "optimism" - is not confirmed looking at the group data of the second generation. In fact, again consumption choices are not anymore significantly lower than the beliefs regarding ingroup consumption, although the result of the test is around 10-percent (one-sided Mann-Whitney test, p-value 0.11).

Generation 3

Generation 3 is the last generation in this experiment and concludes all the chains that had not already stopped due to exhaustion or other reasons. This generation includes 56 individuals overall, 15 in the individual treatment and 41 in the group treatment. As for generation 2 and differently from generation 1, individuals in this generation faced different pie sizes according to the individuals in the previous generations, thus data have been normalized and are expressed as shares of the available consumption and not in absolute terms.

Again, recall that individuals in both treatments were told that a generation like their own (individual or group) made up by real individuals had preceded them, but were not told

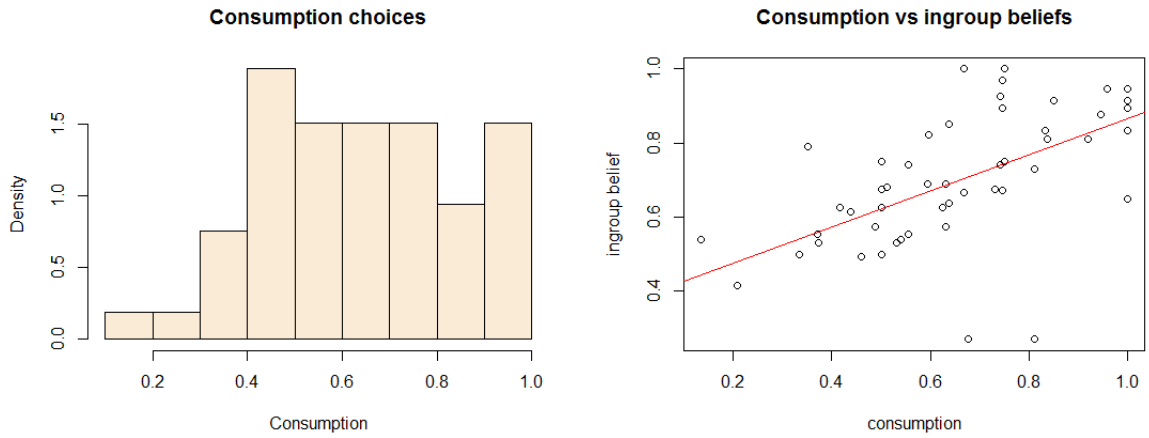

Figure 1.4: Group treatment -Generation 2

explicitly they were third in the chain. Figure 5 focuses on the consumption choices of the 15 individuals in the **individual** treatment.

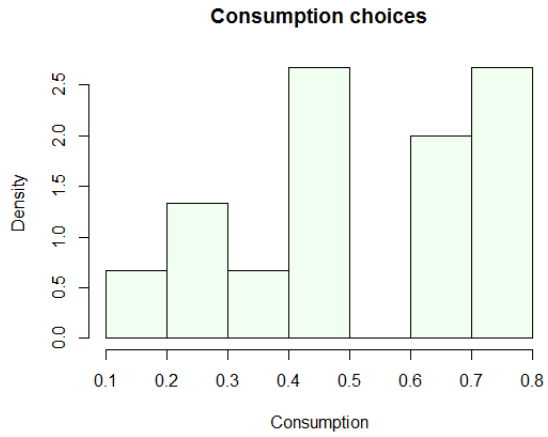

Figure 1.5: Individual treatment -Generation 3

Figure 6 show the consumption pattern emerging from the choice of the third generation of individuals in the **group** treatment. As previously explained, in the case of group treatment, since the data are independent at individual level, we are using the full set of data collected (41 individuals).

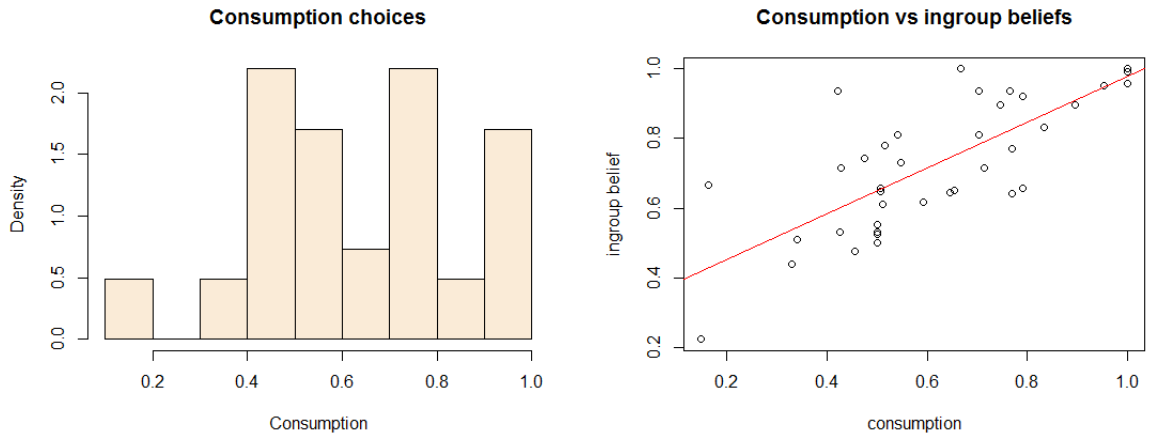

Figure 1.6: Group treatment -Generation 3

As Figure 4 shows, there is a positive (0.78) correlation between consumption choices and expectations about the consumption of the other ingroup members, which is statistically significant (p-value $8.858e-10$, Pearson product moment correlation), as happened for generations 1 and 2. We can then conclude this preliminary analysis with strong support for Hyp.3 - beliefs regarding group members, even when such members are not even met and no interaction takes place significantly and positively affects consumption. The existence of a bystander effect is again confirmed also for the third and last generation of the data: using a one-sided Mann-Whitney test, we can conclude that group consumption (using individual data) is significantly higher than consumption in the individual treatment (p-value 0.061). Lastly, the "optimism" effect is confirmed as well, with a confidence interval of 98 percent (one-sided Mann-Whitney test, p-value 0.020).

1.4.2 Behavior across generations

This section investigates whether consumption patterns emerging in the different generation of the same treatment are statistically different, explicitly addressing Hyp 2 "Of the origin of the pie". The relevance of this analysis lies in the fact that individuals in generation 1 are the only ones that do not face a consumption problem that is affected by the choices

of other (real) individuals, but receive a fixed pie decided by the experimenters[5]. On the other hand, individuals in generations 2 and 3 know that their consumption opportunities have been shaped by other real individuals. Figure 5 provides an overview of the normalized consumption choices of the group and individual generations.

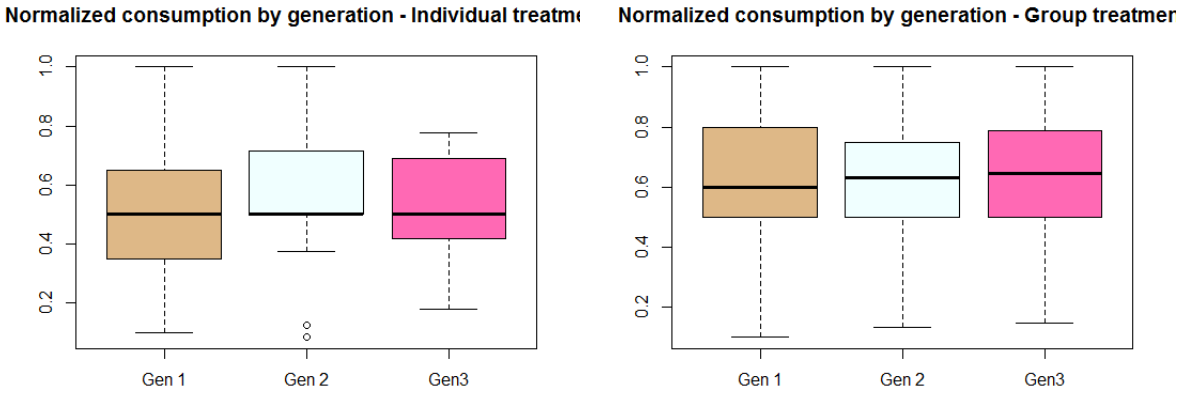

Figure 1.7: Comparison across generations - Individual (right) and Group treatment

Consumption choices across all generations have been normalized with respect to the maximum available renewable resource stock - 10 units for all individuals in generation 1 and depending on the choices of the previous generations for the others. Table 7 reports the results of Mann-Whitney test (W statistic, with corresponding p-values in parentheses) comparing the different generations within each treatment. As the data show, the different generations are not statistically different - there seems to be no effect of the origin of the resource stock (experimenter vs other real players).

Even comparing the choices under the exogenous (Generation 1) and the endogenous (Generations 2 and 3) pies does not allow to spot any significant difference, with Mann-Whitney test results yielding no support for Hypothesis 2. Thus, there seems to be no effect of facing the choices of other real individuals or the outcome of random decision. It is important to mention that the experimental instructions never mentioned the fact that all individuals in Generation 1 where facing the same stock equal to 10; they were simply told that the size of

[5]As shown in the appendix, experimental instruction for Generation 1 participants specifically refer to a random determination of the initial pie

Generation	Treatment	
	individual	group
1 vs 2	153 (0.6126)	1527 (0.9234)
1 vs 3	153 (0.6513)	1181 (0.9307)
2 vs 3	133.5 (0.8329)	1092 (0.9695)

Table 1.5: Testing the difference across generation by treatment

the resource stock had been randomly determined. Given that the individuals in Generations 2 and 3 knew that the resource stock had been determined by the choices of the previous generation, they may have realized that different chains involved different stocks, but this consideration was never explicitly made in the instructions.

Another hypothesis under test within treatments is whether sustainability awareness gives raise to statistically different consumption patterns (Hyp.4). The knowledge about sustainability has been tested including in the post experimental questionnaire a question in which a definition of the term had to be provided. Definitions have been classified in the four profiles described in the previous section. In particular, two definitions refer to correct specfications of the term, although only one (labeled "classic" sustainability) refers to definitions in line with the idea of sustainable development.

Comparing whether having stated a classic definition of sustainability entails a different consumption pattern - that is comparing consumption vectors of the individuals giving the four definitions of sustainability- shows that classic sustainability differs significantly only from general sustainability (two-sided Mann-Whitney test) with a confidence interval greater than 90 percent (p-value 0.08) for the group treatment. There is no statistical difference between individuals categorized in the classic sustainability paradigm and individuals providing wrong definitions or no definition in the group treatment. Looking at the individual treatment, we could find no significant different at statistical level in the pattern emerging from individuals fitting in the classic definition of sustainability and any other groups.

A related question deals with whether having an idea of sustainability that is coherent with sustainable development affects the beliefs participants have on fellow group members.

Two-sided Mann-Whitney test run on pairwise comparisons between beliefs by participants in the classic sustainability subgroup and the other subgroups show no statistically significant difference. Overall, preliminary data seem to provide only a mild support for Hypothesis 4 - individuals with a sustainability consciousness do behave differently from only some subgroups of the participant population.

1.4.3 Regression analysis

This section continues the investigation presented earlier using a regression analysis. The choice data collected during the experiment for each treatment will be analyzed also through the answers to the questionnaire collected at the end of the task, using all the elements included in Figure 8.

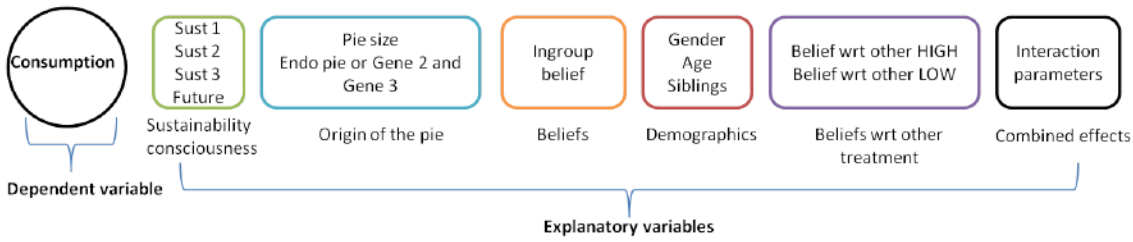

Figure 1.8: Regression elements

As the Figure shows, the regression analysis will address three of the four research questions presented in the previous sections: Sustainability consciousness, Origin of the pie and Beliefs (for the group treatment). The first of these hypothesis will be investigated including three dummy variables referring to definitions 1-3 of the sustainability classification (classic, general and wrong) with respect to the fourth element of the classification - no definition given. In addition we also included another dummy indicating whether the given definition included explicitly a mention of the word "future", which applies to some cases of sustainability 1. We expect that the regression analysis will confirm the support already found for the positive role of sustainability consciousness in reducing consumption.

The role of the origin of the pie will be assessed by introducing a variable indicating the pie size (how much each participant may consume at most) and a dummy variable (labeled

gene_endo) relative to origin of the pie, equal to 1 if the stock of the renewable resource is endogenously determined by the choices of other participants (as it is for generations 2 and 3) and equal to 0 otherwise. In some model specification the variable *gene_endo* has been replaced by two dummies referring to generation 2 and 3 separately, in order to capture also if the eventual role of the endogeneity of the pie applies differently for the two generations.

In the case of the group treatment data, a variable representing the ingroup belief will also be included, in order to confirm the significantly strong and positive effect of such beliefs in driving consumption choices in this treatment.

Moreover, the role of individual characteristics will also be assessed through simple demographics. The inclusion of demographics (*age, gender, siblings*) is standard in this kind of analysis, and allows to understand whether specific individual features systematically contribute to specific consumption patterns. There is mixed evidence on the role of age and gender, while to our knowledge the existence of siblings has not been investigated in similar experiments. We would expect that being raised with siblings increases the habit of sharing.

Two further groups of explanatory variables have been included in the regression analysis: Beliefs with respect to the other treatment and Combined effects. The former group includes the incentive-compatible answers given to the question regarding whether the other treatment did consume more, less or the same on average than one's treatment. Recall that the existence of the other treatment was revealed after the task was completed, in the post-experimental questionnaire. As pointed out earlier, the modal answer to this question was that the other treatment consumed more, which turned out to be correct only for the individual treatment. By including this variables we want to investigate whether having a correct belief testifies of some behavioral pattern - do all people that correctly identifies the individual treatment as the the one with the lowest average consumption share consumed less than the others? Moreover, by using the belief "the two treatments consumed the same on average" as benchmark, we can also check whether individuals who expect differences to emerge behave differently.

We expect also that such variables will be particularly significant in the interaction terms - the group labeled combined effects. Such effects include the interaction between the definitions of sustainability and having a correct belief regarding the average behavior of the

other treatment (lower consumption by individual treatment). Do individuals in the group treatment that are aware of the concept of sustainable development and have a correct belief regarding the performance of groups with respect to individuals consume even less?

All generations

This section applies the considerations outlined above to the data collected by treatment, with all generations pooled together. We estimate two basic versions of the models, one with normalized consumption levels and the other using level consumption.

$$\textbf{Normalized consumption} = \alpha + \beta_1 gender + \beta_2 age + \beta_3 siblings + \beta_4 sust1 + \beta_5 sust2 + \beta_6 sust3 + \beta_7 future + \beta_8 gene2 + \beta_9 gene3 + \beta_{10} normalizedbelief + \beta_{11} beliefl ow + \beta_1 2 beliefhigh + \beta_1 3 sust_1 * correctbelief + + \beta_1 4 sust_2 * correctbelief + \beta_{15} sust3 * correctbelief + \epsilon \tag{1.1}$$

where $\beta_{10} = 0$ for the individual treatment, and correct belief is belief high for the individual treatment and belief low for the group treatment.

$$\textbf{Consumption} = \alpha + \beta_1 gender + \beta_2 age + \beta_3 siblings + \beta_4 sust1 + \beta_5 sust2 + \beta_6 sust3 + \beta_7 future + \beta_8 pie + \beta_9 gene2 + \beta_{10} gene3 + \beta_{11} belief + \beta_{12} beliefl ow + \beta_{13} beliefhigh + \beta_{14} sust_1 * correctbelief + + \beta_{15} sust2 * correctbelief + \beta_{16} sust3 * correctbelief + \epsilon \tag{1.2}$$

where $\beta_{11} = 0$ for the individual treatment and correct belief is belief high for the individual treatment and belief low for the group treatment.

Since the individual treatment represents the benchmark behavior to which consumption in the group treatment has been compared, the overview of the regression analysis will start from this treatment. Table 6 presents the linear model explaining normalized consumption

(models 1 and 2) and level consumption (model 3 and 4) with the above-defined explanatory variables. The regression analysis for the individual treatment shows that the size of the pie inherited from the previous generation is positively and significantly explaining consumption choices in the individual treatment, alongside the two belief dummies regarding the average behavior of the other treatment. Both believing that the group treatment consume more and less than the individual treatment entails significantly higher consumption levels. Since this belief was elicited after the task was completed, it seems to suggest that, compared to those who expect no difference between treatment, those who consumed more tend to expect more inequality between the treatments. No demographics or interaction terms are significant in this regression, nor was substituting the dummies relative to generations 2 and 3 with one single dummy variable reflecting the endogenous nature of the pie (shown in the appendix). There seems to be no effect of the origin of the pie in the individual treatment.

Table 7 presents the results of the regression analysis with respect to the Group treatment, including all generations, with the two model specifications outlined before: normalized consumption (models 1 and 2) or consumption levels (models 3 and 4) as dependent variables. In the group treatment, ingroup beliefs and pie (or normalized beliefs) significantly and positively explain consumption. Moreover, individuals in generation 3 consume significantly less than individuals in generation 1. This effect is also captured when the dummies for generations 2 and 3 are pooled together using the dummy *gene endo* (in the appendix) but this specification shows that the effect is driven only by generation 3. Interestingly, those who stated the belief that the other treatment would consume more on average consume significantly less than those who stated the consumption would be the same. The interaction terms of sustainability definitions and beliefs that the other treatment had consumed less indicate that those who provided a definition consistent with an idea of sustainable development do consume less and realized that the individual treatment would indeed consume less, consume significantly less than those who stated that the two treatments would be on average the same. Again there is no effect of demographic variables.

	Model 1	Model 2	Model 3	Model 4
(Intercept)	0.40†	0.38***	−4.18	−2.18
	(0.23)	(0.07)	(3.15)	(1.64)
gender	−0.03		−0.25	
	(0.08)		(0.98)	
age	−0.00		−0.01	
	(0.00)		(0.06)	
siblings	−0.03		−0.27	
	(0.11)		(1.36)	
sust 1	−0.00		3.19	1.30
	(0.19)		(2.29)	(1.41)
sust 2	−0.00		2.84	
	(0.21)		(2.53)	
sust 3	0.05		3.89	1.83
	(0.20)		(2.41)	(1.47)
future	0.04		−0.17	
	(0.12)		(1.39)	
gene2	0.05		0.87	
	(0.10)		(1.25)	
gene3	0.01		0.48	
	(0.10)		(1.14)	
belief low	0.27*	0.25*	3.48*	3.12*
	(0.12)	(0.10)	(1.41)	(1.23)
belief high	0.27	0.16†	5.66*	3.80*
	(0.20)	(0.08)	(2.42)	(1.47)
sust 1*belief high	−0.17		−4.26	−2.45
	(0.23)		(2.74)	(1.87)
sust 2*belief high	−0.03		−2.97	
	(0.27)		(3.31)	
sust 3:*belief high	−0.17		−4.85	−2.81
	(0.24)		(2.87)	(2.01)
pie			0.49***	0.46***
			(0.11)	(0.09)
N	52	52	52	52
R^2	0.19	0.12	0.46	0.43
adj. R^2	−0.12	0.09	0.23	0.34
Resid. sd	0.26	0.23	3.04	2.81

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.6: Individual treatment - all generations

Comparison within generation

This section presents the regression analysis by generation for the individual and group behavior generation by generation. Since the number of observation per generation is quite limited, in order to keep regressions meaningful we had to slightly reduce the number of regressors. In particular, the regressor relative to the mention of the word future has been removed, as it

	Model 1	Model 2	Model 3	Model 4
(Intercept)	0.15	0.15*	0.88	0.79†
	(0.11)	(0.07)	(0.84)	(0.42)
gender	−0.01		−0.15	
	(0.03)		(0.25)	
age	0.00		0.01	
	(0.00)		(0.01)	
siblings	0.02		0.07	
	(0.04)		(0.38)	
sust 1	0.06	0.04	0.47	0.50
	(0.05)	(0.05)	(0.44)	(0.33)
sust 2	−0.03	−0.07	−0.09	
	(0.06)	(0.05)	(0.49)	
sust 3	0.05	0.02	0.59	0.70†
	(0.05)	(0.05)	(0.45)	(0.37)
future	−0.03		−0.12	
	(0.05)		(0.42)	
pie	−0.01		0.01	
	(0.01)		(0.08)	
gene 2	−0.02		−0.29	
	(0.04)		(0.33)	
gene 3	−0.07		−0.76†	−0.59*
	(0.05)		(0.45)	(0.30)
norm. ingroup belief	0.79***	0.78***		
	(0.08)	(0.07)		
belief low	0.05	0.02	0.60	0.28
	(0.07)	(0.06)	(0.59)	(0.47)
belief high	−0.09*	−0.08*	−0.57†	−0.59†
	(0.04)	(0.04)	(0.32)	(0.31)
sust 1*belief low	−0.23**	−0.19*	−1.74*	−1.37*
	(0.09)	(0.08)	(0.75)	(0.64)
sust 2*belief low	−0.13		−1.21	
	(0.11)		(0.93)	
sust 3*belief low	−0.16†	−0.11	−1.47†	−1.16†
	(0.09)	(0.08)	(0.75)	(0.64)
ingroup belief			0.77***	0.81***
			(0.08)	(0.05)
N	151	151	151	151
R^2	0.50	0.48	0.73	0.72
adj. R^2	0.44	0.45	0.70	0.70
Resid. sd	0.17	0.17	1.46	1.44

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.7: Group treatment- all generations

was never able to explain the consumption choices, and all interaction terms have also been removed. In all the tables included in this section models 1 and 2 use normalized consumption levels as dependent variable, while models 3 and 4 use consumption levels, except for

generation 1, where only the level model has been estimates since all participants face the same pie equal to 10 units.

Table 8 reports on the regression analysis for generation 1 of the individual treatment. As Table 8 shows, consumption in the Individual treatment in generation 1 is moderately

	Model 1	Model 2
(Intercept)	8.87*	7.88**
	(3.12)	(2.30)
age	−0.10	−0.09
	(0.07)	(0.06)
gender	−4.00*	−3.78**
	(1.31)	(1.12)
siblings	0.47	
	(1.31)	
sust 1	−4.33*	−3.72**
	(1.81)	(1.18)
sust 2	−2.64	−1.92
	(2.07)	(1.28)
sust 3	−0.93	
	(2.11)	
belief high	3.84*	4.12**
	(1.56)	(1.26)
belief low	5.63**	5.82**
	(1.54)	(1.39)
N	20	20
R^2	0.67	0.66
adj. R^2	0.44	0.51
Resid. sd	2.11	1.96

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.8: Determinants of consumption choices - Individual treatment- Generation 1

explained at a statistically significant level by gender, with males consuming less than females. Moreover, we observe a significant and negative effect of the dummy regarding sustainability definition 1 regarding classic sustainability. This evidence supports the interpretation that the perception of an idea of sustainability can help in reducing consumption of renewable goods, thus easing preservation. We do find also a positive effect of having stated that the other treatment had consumed both less (belief low) and more (belief high) on average. This confirm what was already found at the previous section, regarding the higher consumption

of individuals who tend to think that there will be some sort of inequality between the two treatments.

Table 9 presents instead the regression results of the first generation of the group treatment. Differently from the analysis of the individual treatment, only ingroup beliefs seem to partially explain consumption choices at a statistically significant level, there are no significant effects of an demographics variables. In both models presented, a higher belief regarding the consumption of fellow group members (although no interaction whatsoever exists among members) induces a higher consumption. We do not find any relevant patter concerning demographic variables, while we find only a minor effect of providing a wrong definition of sustainability, which induces increased consumption compared to not providing any definition.

Tables 10-13 detail the regression analysis for the other two generations of each treatment. These cases differ from the above mainly because the renewable resource stock was not exogenously determined by the experimenter, but was the result of the consumption choices of the previous generation. Thus,as mentioned before, models 1 and 2 use normalized consumption levels as dependent variable, while models 3 and 4 use consumption levels

Table 10 looks at the determinants of consumption in the second generation of the individual treatment. The dummy variable relative tot he presence of siblings has been omitted, as all individuals in this generation stated they do have brothers or sisters. Model 2 shows the statistically significant effect of gender, where males consume significantly more than females, differently from what happened in generation 1. As Table 10 shows, the inclusion of the dummies regarding the sustainability perception is again able to explain partially the consumption choices observed, although in this case it is the definition of general sustainability (dictionary definition of the verb "to sustain") that is significant, with a negative sign as we expected. Having a perception of what it means to sustain consumption over time, affects the choices of the individuals in this generation. Models 3 and 4, using consumption levels as dependent variable, point also to the positive and significant role of the pie size in shaping consumption decisions, which is also confirmed by the correlation found between consumption levels and pie size (0.58 Pearson's product-moment correlation, p-value 0.006972). The inclusion of the beliefs regarding the other treatment does not lead to very significant results, with some sup-

	Model 1	Model 2
(Intercept)	0.26	0.75
	(1.51)	(0.94)
age	0.02	
	(0.02)	
gender	−0.09	
	(0.55)	
siblings	0.41	
	(0.95)	
sust 1	0.09	
	(0.78)	
sust 2	−0.67	
	(0.89)	
sust 3	0.99	1.06*
	(0.74)	(0.53)
belief high	−0.39	
	(0.75)	
belief low	−0.45	
	(0.80)	
ingroup belief	0.78***	0.77***
	(0.14)	(0.13)
N	57	57
R^2	0.45	0.43
adj. R^2	0.35	0.41
Resid. sd	1.95	1.85

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.9: Group treatment - Generation 1

port for the pattern emerged also in the pooled regression and in the first generation, with a positive and significant effect of thinking that there will be some sort of inequality (in this case that the group generations would consume less on average).

Table 11 reports the regression analysis for the second generation of the group treatment, where again models 1 and 2 use normalized consumption as dependent variable, while models 3 and 4 use consumption levels. As the data show, consumption in the second generation of the group treatment seems to be primarily driven by ingroup beliefs and pie size, as it did also for generation 1. No demographic variable is significant in explaining consumption and there is a minor effect of having provided a wrong definition of sustainability in determining lower consumption levels. Since this effect has to be interpreted with respect to stating

	Model 1	Model 2	Model 3	Model 4
(Intercept)	$0.78^{\dagger}$	0.77^{**}	0.09	-2.11
	(0.39)	(0.22)	(6.87)	(2.38)
age	-0.01	-0.01	-0.12	
	(0.01)	(0.01)	(0.14)	
gender	0.21	0.21^{*}	2.62	2.34
	(0.11)	(0.09)	(1.81)	(1.41)
sust 1	0.01		0.34	
	(0.17)		(2.50)	
sust 2	$-0.55^{\dagger}$	-0.56^{*}	-6.48	-6.55^{*}
	(0.26)	(0.19)	(3.90)	(2.81)
sust 3	0.00		0.63	
	(0.16)		(2.30)	
belief high	-0.01		0.52	
	(0.23)		(3.61)	
belief low	0.23	$0.23^{\dagger}$	2.72	2.16
	(0.28)	(0.12)	(4.26)	(1.75)
pie			0.64^{*}	0.61^{**}
			(0.22)	(0.17)
N	17	17	17	17
R^2	0.58	0.58	0.65	0.61
adj. R^2	0.26	0.44	0.30	0.47
Resid. sd	0.21	0.18	3.07	2.65

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.10: Individual treatment - Generation 2

that sustainability is not known, one could conclude that at least thinking to know what sustainability is (although providing a wrong definition) induces less consumption than not giving any answer.

Tables 12 and 13 conclude the presentation of the regression analysis, starting with the third generation of the individual treatment.

Table 12 shows that, as found for generation 2, the pie size plays an important role. Differently from generation 2, the dummy regarding the general definition of sustainability is statistically significant, although with a positive value - which implies consumption is higher for the individual providing a general definition of sustainability than for those who do not what sustainability means, and the same applies also for the individuals providing definition 1, as shown by model 4. We also find a significant negative effect of providing a wrong definition

	Model 1	Model 2	Model 3	Model 4
(Intercept)	0.33*	0.30***	0.42	0.30
	(0.16)	(0.07)	(1.04)	(0.47)
age	−0.00		−0.00	
	(0.00)		(0.02)	
gender	0.04		0.09	
	(0.05)		(0.38)	
siblings	0.01		0.01	
	(0.07)		(0.52)	
sust 1	0.01		−0.07	
	(0.06)		(0.46)	
sust 2	−0.03		−0.37	
	(0.08)		(0.60)	
sust 3	−0.13	−0.13*	−0.94	−0.86†
	(0.08)	(0.06)	(0.59)	(0.44)
belief high	−0.06		−0.25	
	(0.06)		(0.48)	
belief low	−0.05		−0.32	
	(0.07)		(0.57)	
norm ingroup belief	0.52***	0.52***		
	(0.10)	(0.09)		
ingroup belief			0.50***	0.51***
			(0.12)	(0.11)
pie			0.30*	0.27*
			(0.12)	(0.10)
N	56	56	56	56
R^2	0.45	0.42	0.69	0.69
adj. R^2	0.34	0.40	0.62	0.67
Resid. sd	0.18	0.17	1.31	1.23

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 1.11: Group treatment - Generation 2

of sustainability, and the dummies relative to the belief questions on the other treatment are again significant and positive, confirming the trend emerged in all regressions of the individual treatment data.

Lastly, table 13 summarizes the regression analysis for the last generation of the group treatment. As we found for all group generations, beliefs regarding the choices of other ingroup members and pie size are the most significant variables explaining consumption behavior. Demographics variables are not significant in explaining consumption choice, but sustainability

	Model 1	Model 2	Model 3	Model 4
(Intercept)	−0.00	0.01	−5.34	−4.02†
	(0.24)	(0.20)	(4.53)	(1.89)
age	0.01	0.01	0.08	
	(0.01)	(0.01)	(0.11)	
gender	−0.09		−2.72	
	(0.21)		(3.70)	
siblings	0.05		3.23	2.01
	(0.11)		(2.48)	(1.70)
sust 1	0.00		2.77	2.95†
	(0.14)		(2.28)	(1.54)
sust 2	0.39	0.30*	7.56	4.84*
	(0.25)	(0.11)	(4.26)	(1.91)
sust 3	−0.30†	−0.28*	−3.01	
	(0.13)	(0.09)	(2.61)	
belief high	0.29*	0.31**	3.18	3.84*
	(0.11)	(0.08)	(2.14)	(1.47)
belief low	0.31	0.24*	6.06	4.57*
	(0.17)	(0.10)	(3.01)	(1.77)
pie			0.23	0.32*
			(0.15)	(0.10)
N	15	15	15	15
R^2	0.77	0.75	0.88	0.84
adj. R^2	0.46	0.62	0.66	0.71
Resid. sd	0.15	0.12	2.42	2.23

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.12: Individual treatment - Generation 3

definitions are. In fact, we find a significant an negative effect of providing a definition of sustainability in line with a dictionary definition (Sustainability 2) and a definition coherent with the idea of sustainable development (Sustainability 1).

	Model 1	Model 2	Model 3	Model 4
(Intercept)	0.86***	0.73***	1.42	0.48
	(0.21)	(0.08)	(1.20)	(0.32)
age	0.00		0.02	
	(0.00)		(0.02)	
gender	0.03		0.15	
	(0.06)		(0.37)	
siblings	−0.10		−0.63	
	(0.08)		(0.51)	
sust 1	−0.16†	−0.09	−0.47	
	(0.09)	(0.07)	(0.54)	
sust 2	−0.28**	−0.22*	−1.61*	−1.21*
	(0.10)	(0.08)	(0.62)	(0.47)
sust 3	−0.11		−0.53	
	(0.09)		(0.55)	
norm ingroup belief	0.08	0.07		
	(0.05)	(0.05)		
belief high	−0.14†	−0.12†	−0.54	
	(0.07)	(0.07)	(0.45)	
belief low	−0.10	−0.11	−0.53	
	(0.08)	(0.08)	(0.51)	
ingroup belief			0.18**	0.19**
			(0.06)	(0.06)
pie			0.41***	0.40***
			(0.08)	(0.07)
N	49	49	49	49
R^2	0.34	0.28	0.76	0.73
adj. R^2	0.18	0.20	0.70	0.71
Resid. sd	0.20	0.20	1.20	1.19

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.13: Group treatment - Generation 3

1.5 Conclusions and discussion of the results

Using a variation of the traditional dictator game to compare individual and group behavior, this experiment was aimed at addressing whether the significant evidence on the bystander effect survives in context of extreme group informality and where a renewable resource is used in an explicitly intergenerational framework. The other hypotheses under test addressed the role of ingroup behavior in shaping individual decisions and the possibility that a better knowledge of the implications of sustainability may help in choosing a more sustainable con-

sumption pattern. Thanks to the experimental protocol used, we could also address whether being affected by the outcome of real choices, as opposed to a fixed, randomly determined experimenter's decision, has an impact on how people make consumption decisions.

The experimental evidence collected provides support to most of the experimental hypotheses under test. First of all, it allows to conclude that the bystander effect survives even when an intergenerational responsibility is introduced and under very light constraints induced by the renewable nature of the resources to be consumed, which reduces the trade off between current and future consumption. The consumption patterns emerging from the group treatment are significantly higher than those emerging from the individual treatment.

The role of the resource stock and of ingroup beliefs are also supported by statistical tests. Moreover, the regression analysis has shown that consumption choices in both treatments across generations consistently respond to these two factors: level of the pie received when endogenously determined and beliefs regarding ingroup behavior. Both effects are supported by strong, significant and positive correlations with consumption choices. The fact that the resource stock matters for generations 2 and 3 and not for generation 1 depends simply on the fact that such explanatory variable does not enter the regressions of generation 1 as all individuals receive the same pie.

It is important to stress that the level of the renewable resource stock matters more than its origin matters in determining consumption. In fact, the relevance of the origin of the pie size could be interpreted in the sense of indirect reciprocity if we found significant differences between generations that are affected by other generations and the first generation. Nevertheless, statistical tests do not allow to conclude that generations are different within treatment, although the regression analysis showed a significant lower consumption of generation 3 for the group treatment.

This experiment frames the consumption problem not simply in intergenerational terms, but using a renewable resource. Introducing such resource as a consumption good affects the incentives of the experiment in two ways: on one side, it makes intergenerational consumption less costly for the current generation, as whatever is left after consumption of one generation doubles before another arrives. On the other side, it taps into issues of sustainable

consumption, as potential destruction of the resource becomes an issue that affect all future generations.

The introduction of a question addressing the knowledge about sustainability was aimed at understanding whether a concern about sustainable consumption could affect consumption patterns. The current coding of the answers given by subjects classified four different profiles and the regression analysis showed further support to the hypothesis that being able to provide a correct definition of sustainability contributes to lower consumption levels.

The renewable nature of the resource indirectly marks another difference between the two treatments that deserve mention: from a pure efficiency point of view, reducing consumption in the individual treatment is more efficient than doing so in the group treatment when the individual choices are considered. In other words, when a subject in the individual treatment gives up one unit of resource, he knows that the following generation will receive two units. When a subject in the group treatment gives up individually one unit of resource, the efficiency of this transfer depends on whether his fellow group members give up on the same amount each. In fact, if a subject in the group treatment is the only one giving up one unit of consumption, each individual of the following generation will receive two thirds of resource units. Such a concern for efficiency in the group treatment should have guided individuals to choose a consumption level that they believed was in line with the average of the other group members. This consideration may not have been relevant in the current experiment, judging from the comparison between consumption choices and beliefs regarding the consumption of one's group members, which as previously mentioned are significantly different.

The regression analysis was also able to highlight two very different patterns behind the consumption choices of the two treatments. If groups are driven by internal beliefs, the regression of the individual data shows an interesting effect of the beliefs regarding the choices of the other treatment. Since this belief was elicited after the experimental task and that individuals when making their consumption choices were not aware that another treatment existed, such beliefs could not literally drive behavior, bur rather seem to represent a tendency to expect inequality by individuals who consume more compared to those who expect no difference between the treatments.

This experiment exploited a variation of the traditional dictator game. Such game appears as a suitable choice for investigating whether a concern for future generations can be triggered simply by framing the problem as intergenerational, much in the spirit of Guala and Mittone (2010), who conclude that the game lends itself to testing the potential of different experimental conditions and contextual cues in activating different social norms, rather than being regarded as an instrument to draw conclusions on normative behavior *per se*. Following this interpretation, the current work could be extended in order to address whether different experimental conditions (for instance making the renewable resource less abstract, or providing a less general view of different generations) are able to induce a more sustainable consumption pattern of the renewable resource. Moreover, there is a significant effect of having the correct notion of sustainable development in reducing consumption, despite the fact that group generations continue to show less restraint. This suggests that an "environmental literacy" is another viable avenue to study sustainable consumption patterns.

1.6 Appendix 1 : Experimental instructions

This section reports a transcript of the instructions of the online tasks posted on Amazon Mechanical Turk. The sections regarding introduction and individual questionnaire apply to all generations and treatments.

1.6.1 Introduction and examples

Thank you for participating in this experiment! Your answers will be used to investigate behavior in interactive games in an academic research paper, thus we ask you to answer as truthfully as possible. You will be paid $0.10 as a base rate plus a bonus depending on the outcome of the game. Because the amount of money you can earn depends on your decisions in the game, it is important that you read these instructions with care.

This game involves several players like you that will make independent choices. This means that you decide for yourself and that no one except you will know what you decided. The data collected will be processed anonymously by the experimenters, thus your m-turk ID will be used only for payments and removed from the data before the analysis. In this task you will have to make just one decision regarding the consumption of a renewable resource. Consuming such resource has a value for you. The setting in which you will make your decision involves chains of different generations, for each chain only one generation is "alive" at a given time. The choices of one generation will affect the options of the next generation according to the following mechanism: what one generation does NOT consume remains for the following generation, who receives it doubled as the resource naturally grows by a factor two in between generations. There is also a probability that a generation is the last one, in which case the resources left by the generation will not benefit anyone. The probability that a generation is the last one is unknown. You will be told further details about your generation in the next pages. What you consume will be your result in the game, and will be translated into US$ with the following exchange rate: 1 unit= $ 0.10 Remember that what you do NOT consume remains for the following generations and gets doubled before it reaches it. Let us go through a very simple example to familiarize you with the task!

EXAMPLE 1 Imagine that the current generation may consume at most 10 units of the renewable resource. If the current generation decides to consume 8 out the 10 available units, 2 units remain and double before the future generation arrives. Thus, this generation has at most 4 units to consume.

EXAMPLE 2 If the current generation consumes 6 units out of the 10 available units, how much can the followinge generation consume at most?

- 4
- 8
- 6

Answer If 8 Is Selected CORRECT, the following generation may consume at most 8 units! In fact, consuming 6 units leaves 4 units for the following generation, which receives them doubled - 8 units!

Answer If 8 Is Not Selected NOT CORRECT, the following generation may consume at most 8 units! In fact, consuming 6 units leaves 4 units for the following generation, which receives them doubled - 8 units!

1.6.2 Generation 1

Individual treatment You belong to Generation 1. As previously mentioned, your generation belongs to a chain of generations. You are the only individual in your generation. In your chain all generations are composed by one individual only. The stock of initial renewable resource has been randomly generated. You may consume up to 10 units of the renewable resource, knowing that whatever you do NOT consume will be doubled before the next generation (one individual) arrives and decides how much to consume. Please write down how much you want to consume (digits only, one decimal place allowed)

Thank you for making your choice. Before concluding this experiment we would like to ask you a few further questions. You may earn additional money by answering carefully

to them, so please read these instructions carefully. We are interested in knowing how you believe others in this game might have played. If you provide a correct answer you will earn additional $0.05. This bonus will be calculated when all data have been collected, so please allow for 2 days. Detailed results will be posted at this link.

In this experiment there are also chains of generations in which three members are present. Now think about the individuals in first generations in those chains of three-member generations. Do you believe that the average consumption of a group generation 1 is higher or lower than the consumption of an individual generation 1 (like yours)?

- higher
- lower
- the same

Group treatment You have been assigned to Generation 1. As previously mentioned, your generation belongs to a chain of generations. There are three individuals in your generation. All generations in your chain are composed by three individuals. In a chain of group generation like yours, each member may consume at most one third of the available resource. The stock of initial renewable resource has been randomly generated. Your generation may consume up to 30 units of renewable resource in total. Each of you may consume up to a third of what is available. You may consume up to 10 units of the renewable resource, knowing that whatever you do NOT consume will be doubled before the next generation (three individual) arrives and decides how much to consume. Please write down how much you want to consume (digits only, one decimal place allowed)

This task is almost over. Before concluding this experiment we would like to ask you a few further questions. You may earn additional money by answering carefully to them, so please read these instructions carefully. We are interested in knowing how you believe others in this game might have played. If you provide correct answers you will earn additional $0.05 per question. This bonus will be calculated when all data have been collected, so please allow for 2 days. Detailed results will be posted at this link.

For this question you have to provide a number. Your guess will be considered correct if the real value lies between plus or minus 10% of your guess. How much do you believe the OTHER members of your group consumed on average? (excluding you from the average)

In this experiment there are also chains of generations in which only one member is present. Now think about the individuals in first generations in those chains of one-member generations. Do you believe that the average consumption of an individual generation 1 is higher or lower than the average consumption of a group generation 1 (like yours)?

- higher
- lower
- the same

1.6.3 Generation 2 and 3

The choice questions were phrased in the same way as in generation 1, except for mentioning that the size of the available pie was due to the choices of a previous generation and for the different pie sizes

Individual treatment -example As previously mentioned, your generation belongs to a chain of generations. All generations in your chain are composed by one member only. There has been a generation (one real player) before yours, whose choice determined the amount of total renewable resource available for your consumption choice. Now it is your turn to make your consumption decision.

Remember that you are the only individual in your generation, in a chain of generations in which all generations have only one member. Following the choice of the previous generation (one real individual), you may consume up to 16 units of the renewable resource, knowing that whatever you do NOT consume will be doubled before the next generation (one individual) arrives and decides how much to consume. Please write down how much you want to consume (digits only, one decimal place allowed)

Group treatment - example As previously mentioned, your generation belongs to a chain of generations. There are three individuals in your generation and in all generations of your chain. In a chain of group generation like yours, each member may consume at most one third of the available resource. There has been a generation (three real individuals) before yours, whose joint choices determined the amount of total renewable resource available for your consumption choice. Now it is your turn to make your consumption decision.

Remember that there are three individuals in your generation, in a chain of generations in which all generations have three members. Following the choices of the previous generation (three real individuals), your generation may consume up to 4.8 units of renewable resource in total. Remember that each of you may consume up to a third of what is available. You may consume up to 1.6 units of the renewable resource, knowing that whatever you do NOT consume will be doubled before the next generation (three individual) arrives and decides how much to consume. Please write down how much you want to consume (digits only, one decimal place allowed)

1.6.4 Individual questionnaire

Thank you for making your choice, the task is almost over. Before concluding we would like to collect some further information that will be needed for statistical purposes

What is your gender?

- Male
- Female

What is your age?

Do you have any siblings?

- No
- Yes

Have you ever heard the term sustainability?

- Yes
- No

If yes, can you give a brief definition?

Thank you for participating in this experiments! Your final results will be posted at this link by 48 hours after the batch is complete and payments will start shortly afterwards. Please remember to copy and paste the Qualtrics ID that will be shown in the next page onto the box on Mechanical Turk, as it necessary to receive your payment!

1.7 Appendix 2 : Alternative regression specifications

This section includes further model specifications that have been used to determine the best models outlined in the result section. Table 14 shows the alternative specification for the full data of the individual treatment using the dummy relative to the endogenous nature of the pie, instead of the two dummies relative to generations 2 and 3. Models 1 and 2 refer to the normalized specification, while 3 and 4 to the level specification. The results are consistent with what has already been shown in the result section.

Table 15 presents alternative model specification for the group treatment. using the dummy relative to the endogenous nature of the pie, instead of the two dummies relative to generations 2 and 3. Models 1 and 2 refer to the normalized specification, while 3 and 4 to the level specification. Also in this case, the results are consistent with what has already been shown in the result section.

	Model 1	Model 2	Model 3	Model 4
(Intercept)	0.41†	0.38***	−4.06	−2.18
	(0.22)	(0.07)	(3.09)	(1.64)
gender	−0.03		−0.23	
	(0.08)		(0.97)	
age	−0.00		−0.02	
	(0.00)		(0.05)	
siblings	−0.02		−0.19	
	(0.11)		(1.31)	
sust 1	−0.01		3.11	1.30
	(0.19)		(2.24)	(1.41)
sust 2	−0.01		2.75	
	(0.20)		(2.48)	
sust 3	0.05		3.88	1.83
	(0.19)		(2.38)	(1.47)
future	0.04		−0.20	
	(0.11)		(1.37)	
gene endo	0.03		0.64	
	(0.08)		(0.99)	
belief low	0.27*	0.25*	3.52*	3.12*
	(0.11)	(0.10)	(1.38)	(1.23)
belief high	0.26	0.16†	5.63*	3.80*
	(0.19)	(0.08)	(2.39)	(1.47)
sust 1*belief high	−0.15		−4.09	−2.45
	(0.22)		(2.65)	(1.87)
sust 2*belief high	−0.02		−2.89	
	(0.27)		(3.26)	
sust 3*belief high	−0.16		−4.75	−2.81
	(0.24)		(2.82)	(2.01)
pie			0.49***	0.46***
			(0.11)	(0.09)
N	52	52	52	52
R^2	0.18	0.12	0.46	0.43
adj. R^2	−0.10	0.09	0.25	0.34
Resid. sd	0.25	0.23	3.00	2.81

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 1.14: Individual treatment - all generations, alternative specification

	Model 1	Model 2	Model 3	Model 4
(Intercept)	0.14	0.15*	0.70	0.96†
	(0.11)	(0.07)	(0.83)	(0.50)
gender	−0.01		−0.12	
	(0.03)		(0.25)	
age	0.00		0.01	
	(0.00)		(0.01)	
siblings	0.01		−0.08	
	(0.04)		(0.36)	
sust 1	0.06	0.04	0.45	0.52
	(0.05)	(0.05)	(0.44)	(0.33)
sust 2	−0.04	−0.07	−0.17	
	(0.06)	(0.05)	(0.49)	
sust 3	0.03	0.02	0.49	0.60
	(0.05)	(0.05)	(0.45)	(0.37)
future	−0.03		−0.11	
	(0.05)		(0.42)	
pie	−0.00		0.04	
	(0.01)		(0.08)	
gene endo	−0.03		−0.37	−0.49†
	(0.04)		(0.33)	(0.29)
norm. ingroup belief	0.78***	0.78***		
	(0.07)	(0.07)		
belief low	0.05	0.02	0.63	0.32
	(0.07)	(0.06)	(0.59)	(0.47)
belief high	−0.09*	−0.08*	−0.54†	−0.56†
	(0.04)	(0.04)	(0.32)	(0.31)
sust 1*belief low	−0.24**	−0.19*	−1.80*	−1.50*
	(0.09)	(0.08)	(0.75)	(0.64)
sust 2*belief low	−0.13		−1.17	
	(0.11)		(0.94)	
sust 3*belief low	−0.15†	−0.11	−1.40†	−1.15†
	(0.09)	(0.08)	(0.75)	(0.64)
bel			0.76***	0.80***
			(0.08)	(0.05)
N	151	151	151	151
R^2	0.49	0.48	0.72	0.72
adj. R^2	0.43	0.45	0.69	0.70
Resid. sd	0.17	0.17	1.46	1.45

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 1.15: Group treatment- all generations, all model specifications

Chapter 2

Birds of a feather flock together? Partner selection and perceived similarity in a trust game experiment

Abstract

This paper presents the results of an experimental analysis in which couples of players play a one-shot trust game in either one of two treatments - one allowing for partner selection and the other with random matching. Partner selection is performed according to the choice of one specific characteristics out of five possible items, in order to allow for similarity perception to become a driver for increased trust and reciprocation, measured through the transfers between the two players. Quantile regression analysis is performed on the data collected in order to address the local heterogeneity in transfers and is able to highlight significant determinants in the two treatments.

JEL Codes: C1, C9.

Keywords: Trust game, similarity, selection.

2.1 Introduction

This paper aims at investigating how trust can affect interpersonal relationships in economically relevant interactions. The concept of trust has been at the center of a very large and diversified scholarly investigation and although many different definitions of trust exist, there is still no agreement on which is the most relevant and especially on what ultimately drives and shapes trust among individuals. From social psychology, to economics or computer science, addressing the determinants of trust remain an open issue worthy of investigation.

This paper will not deal with trust in general, but will focus on trust-building processes in situations characterized by lack of formal rules and excluding the possibility for reputation building. Such anonymous settings are very frequent in real life, especially as the diffusion of Internet-based interactions is becoming very common on a daily basis for many individuals. We tend to search the web not simply to look for information, but also for acquiring goods and services, exchange and form opinions on all sorts of topics. Trust has been found as useful medium to reduce transaction costs in many economically relevant situations, boosting information exchange and fostering the formation of social capital - important elements to construct both personal and professional relationships. Trust plays a role in all situations potentially characterized by moral hazard, in which the effort cannot be observed or does not directly translates into a positive outcome, where an individual may choose or not to trust that another will perform as promised even in absence of control or sanctions.

Trust heuristics guide us in interacting with new people, as we use the experience accumulated in previous situations to extrapolate rules of behavior that may help us again in achieving a successful result. Heuristics can be formed and used in stable contexts, with clear rules and are facilitated by the possibility to also observe others over time, but when the boundaries of the environment we are interacting in are continuously expanding or even uncertain, such heuristics may not be effective anymore. Interactions over the web are just one example of such situations, where personal information, ideas and plans are exchanged over social networks everyday and online platforms offer all sorts of user-provided services. Besides being an important environment in which trust can be studied, the web environment offers important suggestions as to which dimensions of interpersonal interactions correlate

more with trust building. In particular, computer science adopted the idea that similarity correlates with trust to build recommender and rating systems, finding significant empirical evidence looking at data collected from online rating communities.

One of the main messages of this literature is that there exist a significant correlation between trusted users and users sharing similar interests, supporting the idea that similarity is a relevant dimension of trust building. Social sciences have also addressed the issue of trust, but there is not much literature on the role of similarity in building trust, although the relation between similarity and attraction and similarity and discrimination have extensively been studied.

Another important example of trust in contexts of uncertain boundaries comes from the literature on social trust - trust in institutions or in elected individuals whose performance is above one's control. This literature offers an interesting point of view regarding similarity - the salient value similarity approach. According to Siegrist et al. (2000), "salient values consist of the individual's sense of what the important goals (ends) and(or processes (means) are that should be followed in a particular situation" and are "an aspect of the individuals understanding of the meaning of a specific situation" (page 355). Salient values can be generalized to more than one situations, potentially changeable in saliency and most often rapid, implicit, unarticulated and automatically elicited. The salient value similarity model is based on the idea that people use heuristics based on perceived similarities while making choices in complex environments and tend to base their judgments on the feeling that other persons or organization have the same understanding of a specific situation. Poortinga and Pidgeon (2006) finds that "value similarity explains most of the variance in general trust and skepticism" and "precedes other trust-relevant evaluations".

Bringing the idea of similarity in an economic laboratory is a rather new venture in the experimental literature. Previous experiments addressing trust that introduce individual information have been aimed at addressing potential sources of discrimination or understanding the general trustworthiness of specific types by allowing for partner selection in economic games. This paper will introduce partner selection as a mean to build trust and will address if and how perceived similarity interacts with this process.

The experiment presented in this paper investigates the determinants of trust and trustworthiness in a simplified setting in which anonymous players interact on a one-shot basis, in order to rule out any possible reputation effect. The main working hypothesis under test is whether partner selection can become a driver of trust building even if it is based on individual characteristics and not on past behavior in a similar setting. Players interpreting the role of Investors in a trust game will have the possibility to select their trustees on the basis of one out of five features with different nature. The role of partner selection has been investigated in a few other trust game experiments with mixed conclusions regarding its effect on trust building or even on increased discrimination. This experiment differs from previous one introducing partner selection in that it introduces real partner selection and does not use participants in both roles of Investors and Trustees, foregoing the use of strategy-method techniques that, on one side, allow to collect more data and address the causes and sources of trust and trustworthiness, but make the decisions taken less salient.

This experiment addresses also the possibility that perceived similarity along some individual characteristics may also play a role in strengthening trust and trustworthiness processes. This idea builds on the conclusions emerging from the economic literature on homophily and group dynamics and from social psychology and computer science reviewed in the following section. An important point of difference with the existing literature is that similarity is not measured on experimentally induced identities: individuals choose among characteristics that the subjects already possess. This was partly done already in experiments of partner selection in which gender or ethnicity could be chosen, but this experiments adds also taste and risk dimensions to the choice options.

The data collected show a localized effect of the covariates on the size of the transfer both to the Trustees and back to the Investors. More and less generous Investors and Trustees are significantly affected by different variables. We also find some support for the partner selection hypothesis in the Trustees in the partner treatment, where there is a significantly larger share of individuals returning at least what was sent to them than in the baseline treatment. Among the investors, partner selection has a significant detrimental effect, leading to lower transfers in the upper quantiles of the distribution, where also choosing a partner with a similar characteristic has a significant negative impact.

2.2 Literature review

Trust is a relevant driver in economic interactions as it can facilitate all sort of exchanges, especially those characterized by some degree of moral hazard - when the actions of the person trusted cannot be observed or punishment for lack of trustworthiness is not feasible. In a world where many exchanges are taking place increasingly through impersonal and anonymous mediums such as the Internet, often through incomplete contracts, investigating which are the determinants of trust under very informal environmental conditions becomes particularly relevant. Moreover, the definition of trust and the understanding of its underlying mechanisms still remains unfinished business in social sciences. In fact, although there is agreement on the importance of trust in economics, there exist many different definitions of trust across economics and other social sciences.

The investigations of the motivations of trust has been pioneered by psychology, where numerous different trust scales have been produced to create **attitudinal** measures of this phenomenon. The more important trust scales used in psychology and sociology are reviewed in Robinson et al. (1991), and refer mainly to the scales that have been used more often and have proven to have good properties in terms of internal consistency both in a specific experiment or across different ones. As Table 2.1 shows, the scales reviewed offer different insights into the determinants of trust among different individuals, with some being more focused on the concept of social trust than others. The review below does not include other scales used to address more directly social trust -trust in institutions- such as the World Value Survey, the European Social Survey and the Eurobarometer.

These scales are not based on a notion of similarity, but focus on individual attitudes towards others. The role of attitudinal similarity enters social psychology for its interaction with interpersonal attraction, but not explicitly with interpersonal trust, finding a significant positive effect of attitudinal similarity on liking, but no relation between personality similarity and attraction, as reviewed in Ziegler and Goldbeck (2005). Social psychology also established the role of similarity in general in fostering discrimination through the minimal group paradigm Tajfel (1970), according to which informal groups formed on the basis of an irrelevant shared characteristic (even one induced by the experimenters) exhibit discrimina-

trust scale	developer	main goal	structure
Machiavellianiasm	Christie and Geis, 1970	measures a person's general strategy to deal with other people, focusing in particular on the degree to which a person believes others are manipulable	71 items divided into three areas (nature of interpersonal tactics, views of human nature, abstract or generalized morality); standard-category Likert format (1-7, with 7 being "agree strongly")
Philosophies of human nature	Wrightsman 1964, 1974	focuses on evaluating the expectations about how other people generally behave	divided into 6 main components (trustworthiness, altruism, independence from pressure to conform, strength of will and rationality, complexity of human nature, variability in human nature), each characterised by 14 items, 7 scored positively and 7 negatively, presented in a -3, +3 standard form Likert scale. The first four dimensions are independent of the last two, an overall favourability towards huma nature score is calculated starting from the first four
Interpersonal trust scale	Rotter 1967, 1971	measures a person's expectation regarding the reliability of the behaviour, promises or (verbal or written) statements of other individuals	it contains 25 trust items and 15 filler items, can be administered in 10-15 minutes and takes the form of a Likert-type scale (1-to 5 with 5 being "strongly disagree")
Specific interpersonal trust scale	Johnson-George and Swap, 1982	measures different varieties of interpersonal trust held by one individual for a specific other, emphasis is on the trust manifestated in an intimate relationship	43 item, half of which keyed in the negative direction, responses generated on a ninie-point scale then standardized Likert scale
Trust scale	Rempel and Holmes, 1986	measure of trust in close relationships, trust defined as "the degree of confidence you feel when you think about a relationship"	18-item Likert scale, covering three aspects of trust: predictability, dependability and faith, subject pools were couples
Faith in people scale	Rosemberg, 1957	also called "misanthropy scale", assesses one's degree of confindence in the trustworthiness. Honesty, goodness, generosity and brotherliness of people in general	Guttman-type scale (two forced-choice and three agree-disagree statements. Scores range from 1 (high faith on all five items) to 6 (low faith on all 5 items)
Trust in people	Survey Research Center, 1969	slight rephrasing of the above "Faith in people" scale	three-item forced choice format, scores range from 0 (low trust) to 3 (high trust)
Acceptance of others	Fey, 1955	tests the relationship between feelings of self-acceptance, acceptance of others and feelings of acceptability to others	20 attitude statements, from "almost always" (scored as 1) to "very rarely" (scored as 5). Scale ranges from 20 (low acceptance of others) to 100 (high acceptance)

Figure 2.1: Review of trust scales

tion of the members of the out-group and favoritism with respect to members of the in-group. Recent developments in social psychology also looked at the role of salient value similarity Siegrist et al. (2000); Poortinga and Pidgeon (2006) in establish social trust between individuals and institutions, suggesting another dimension of similarity that may have a role in lowering the perceived risk of some political decisions (e.g. introduction of a regulation on genetically modified food), increasing trust in the institution taking them.

Given its potential role in economic exchanges, trust has also been investigated by the economic literature. From a more standard economic point of view, trust represents a violation of individual rationality, as pure utility maximization of monetary outcomes would go against investing resources in a person that has no binding commitment to reciprocate this generous behavior. In order to test this implication from standard theory, experimental economics introduced the **trust game** Berg et al. (1995). In a trust game a player (the Investor)

receives an endowment from the experimenters and has to decide how much (if any) he wants to send to a second player (the Trustee). Any amount sent to the trustee is tripled by the experimenters before it reaches the trustee, who has to decide how much (if any) to send back. Utility maximizing agents should anticipate that the trustee is likely to keep all that is transferred, thus should not send anything in the first place.

Yet, hundreds of experiments show that despite significant variations in the experimental protocol, individuals on average trust counterparts with a sizable share of the pie provided by the experimenters and that many return significant amounts Camerer (2003). Reconciling empirical data with theory requires accepting that non-standard preferences are at play in shaping investment decisions in a trust game. There are several lines of explanation regarding the nature of these "social" preferences that include social norms, altruism or generosity and individual characteristics.

The idea that trust is an example of non-selfish behavior and non-standard preferences can still be reconciled with an idea of rationality when addressing the normative nature of trust and trustworthiness. Bicchieri et al. (2011) finds that trusting behavior is not a social norm, but trustworthy behavior is. Thus, trusting becomes rational when the general social norm is that people should reciprocate to trusting behavior.

Cox (2004) tries to disentangle pure other regarding motives (altruism) from anticipated reciprocation, finding evidence supporting the existence of trust in the sense of anticipated reciprocation: individuals send significantly more when the recipient has the possibility to reciprocate. Moreover, this paper also finds evidence in support of reciprocation from recipients, who sent significantly more when the transfer was made by the same recipient they were giving money back to.

Glaeser et al. (2000) examines whether subjects characteristics are indeed able to predict choices made in trust games or envelope-drop games,using evidence from the classic attitudinal questions and trusting attitudes from the psychology literature. The main results of this paper are that trusting attitudes are only able to partially predict trustworthiness, while only past trusting behavior and not attitudinal questions are predictive of trust. The predictive value of attitudinal measures can be recovered starting from the idea that trust may be

target-dependent by McEvily et al. (2012),who claim that the previously mentioned lack of correlation between attitudinal and behavioral measures of trust found in Glaeser et al. (2000) depends mainly on the fact that the different measures are based on different targets. In a re-elaboration of Glaeser's data, they can show that, when the same targets (e.g. strangers) is used, the two types of measures correlate, reconciling in a way the two approaches.

If trust is rooted in an assessment of trustworthiness of the person trusted, allowing people to select whom they want to trust should induce higher transfers in a trust game. This paper allows for partner selection in order to test this claim in an experimental context. Moreover, partner selection will be performed by selecting specific characteristics in the partner, in order to investigate whether individuals look for partners that are similar to themselves and if the do how they behave towards them. The idea that similarity perception may affect trust patterns has roots in both economic and psychology literature, with important evidence coming also from experimental analyses.

The idea that similarity may strengthen other-regarding preferences towards particular groups is not new and has roots in the idea of minimal group paradigm Tajfel (1970). According to this idea, even when groups are formed on the basis of arbitrary and irrelevant characteristics, individuals tend to behave differently towards in-group and out-group members, discriminating the latter. Building on the idea of minimal group paradigm, another strand of literature confirming that the recognition of a common trait may lead to discrimination defines the in-group-out-group bias. In the experimental work by Chen and Li (2009), a group is defined by asking people to rate paintings and it is also shown that individuals tend to be less envious of a better result of in-group individual, even if normally group identity requires some time or complex task to be established (reference needed). Nevertheless, the existence and the power of the in-group-out-group bias has been proven even in very peculiar contexts: Ruffle, Sosis and Ruffle (2006) find even kibbutz members are prone to this bias. The idea that similarity may support other-regarding preferences has roots in the literature on homophily, where individuals show more cooperative behavior towards similar individuals.

From a computer science perspective, trust has been initially interpreted in the sense of security issues, such as authentication, protection of identity or authorization, but soon stretched to include a more complex dimension - social trust - necessary to deal with the

increasing amount of user-generated content (Goldbeck (2008)). One interesting insight from the computer science literature on trust on the web is the important role of users similarity in building and supporting trust online, which has become a widely adopted foundation for trust-based recommendation systems. Ziegler and Lausen (2004) finds empirical support for the claim that in a specific domain trusted peers are more similar to a given individual than the average user, looking at similarity in topics of books bought and reviewed in an online community. Although a review of this literature is beyond the scope of this paper, it is worthy of mention that the idea that similarity correlates with trust formation is very well accepted and supported at empirical level Goldbeck (2006).

Similarity relies on the identification of (partly) common characteristics across different individuals. The first work to explicitly address the role of identity in economic decision making is Akerlof and Kranton (2000), in which a utility function that values different forms of identity is introduced. Such formalization allows to explain even behavior that may seem detrimental to individuals (joining a gang for instance) and has been further extended in other works by the same authors. An empirical test of the role of (induced) identity on trust is presented in Gueth et al. (2008), who test both the role of labeling and of "shared interests" on trust and trustworthiness patterns in a trust game experiment. Even if the experimental protocol is able to induce greater sense of identity between in-groupers through labeling and reduced intergroup bias through a common fate treatment in which subjects play a public goods game, Investors do not behave differently in the identity treatments compared to the baseline and only Trusteees show moderate in-group favoritism for a subset of the experimental conditions. The authors conclude that trust may be a social disposition rather than being so much dependent on identity perception.

Identity perception may be experimentally induced as in Gueth et al. (2008) through labels or additional group tasks, or can be indirectly suggested by describing features of the different participants that may allow to identify different types.

Such identification can be achieved through different experimental protocols : for instance showing pictures of other players (Wilson and Eckel (2006); Eckel and Petrie (2011)) or providing different sort of information (Croson and Buchan (1999); Fershtman and Gneezy (2001); Slonim and Garbarino (2008); Castillo and Petrie (2010)). The possibility to identify some

features of one's counterpart in a trust game have not been studied with an explicit focus on the role of similarity perception, but rather on the possibility of discrimination, building on the in-group, out-group bias. In particular, Wilson and Eckel (2006) show how simply showing pictures of counterparts in a trust game induced increased trust in same-ethnicity pairs and led to a beauty premium with attractive trustees receiving more trust, while Caucasian discriminated against Blacks even in a setting in which pictures of counterparts had to be bought as in Eckel and Petrie (2011). Discrimination is also found in Fershtman and Gneezy (2001), where male players in a trust game discriminated against different ethnicities, in Slonim and Garbarino (2008) who find that men and women trust women and older players more than men and younger players and in Castillo and Petrie (2010) where the information about gender and ethnicity is used to male expectations about behavior. On the other hand, Croson and Buchan (1999) finds no significant gender discrimination. Lev-On (2009) suggests to distinguish between behavior towards a certain fraction of the population and behavior towards a specific individual, as often, although we have prejudices against some group, we may befriend some individuals of that group (and the opposite is also true). In order to avoid confusion between these two aspects, he provides only information about gender and ethnicity.

Introducing identification in the experimental protocol may allow to implement partner selection, giving participants in the experiment the possibility to choose their partner. Partner selection has also been implemented in a number of trust game experiments, although in a different way than this paper. For instance, the above-mentioned Slonim and Garbarino (2008) allows Investors to choose from three possible Trustees using gender and age, while Eckel and Wilson (2000); Slonim and Guillen (2010) introduce respectively the use of smiley faces and information on gender and an ability measure to describe partner types. In a meta-study of 162 trust games Johnson and Mislin (2011) finds that random matching reduces the amount sent to Trustees, with matching procedures being one of the experimental features that most affect trust in such games.

The possibility that partner selection and in general the diffusion of more information regarding other players may affect trust and trustworthiness has already been partially explored in the economic literature, although there is mixed evidence on the effect of partner

identification/selection across experimental results, as this brief review aimed at showing.

The goal of this paper is to push forward this debate, developing a task in which partner selection is real, although based on the choice of only one characteristic. The effect of similarity perception will be inferred looking at the choices of the individuals that will select a partner with whom they share a characteristic. Differently from all experiments reviewed, similarity perception will not be experimentally induced - participants will simply choose a characteristics their counterparts already possess before the experiment takes place.

2.3 Research hypothesis

This paper addresses the role of partner selection on the creation of trust using a trust game, in which the results of a partner treatment will be confronted with a baseline treatment. The setup fo the experiment allows also for focusing on the potential role of perceived similarity in strengthening the trust-building process. Thus, three different hypothesis will be tested:

- **HYP. A1: Effect of partner selection on trust**: the possibility of choosing one's trustee induces more trust in the investor, measured as increased transfer compared to the baseline treatment.
- **HYP. A2: Effect of partner selection on trustworthiness**: knowing to be chosen induces more trustworthiness in the trustee, measured as increased amounts returned compared with the baseline treatment.
- **HYP. B: Perceived similarity and trust**: investors looking for similar characteristics in their trustee tend to send more than both investors that do not choose their partner (baseline) and investors that choose a partner according to a characteristic they do not possess.

After a section describing the setup of the experiment and giving descriptive statistics on the data collected, the three above hypothesis will be investigated looking at aggregated and individual behavior both within and across treatments.

2.4 The experiment

The experiment involves a classic **trust game** with two phases: in the first one, a player (the Investor) receives an endowment from the experimenters and has to decide how much (if any) he wants to send to a second player (the Trustee). Any amount sent to the trustee is tripled by the experimenters before it reaches the trustee, who has to decide how much (if any) to send back, thus concluding the second phase. The rules of the game are common knowledge.

In order to investigate the role of perceived similarity and partner selection on trust, this experiment involves a trust game with two treatments: a baseline treatment, which resembles the classic structure described above, and a partner treatment, in which the participants in the role of Investors are allowed to select their partner choosing one specific feature. Compared with related literature on partner selection and trust, this paper allows for investigating also the Trustees' behavior, as it does not use participants in both roles, but distinguishes between individuals involved as Investors or as Trustees. Moreover, subjects are told that they will be effectively partnered with an individual with the characteristic they selected and thus make only one choice, as opposed to answering to several scenarios, one of which will be randomly chosen at the end of the experiment. This design feature was chosen to make more salient the decision of the participants.

This experiment involved undergraduate students of Ca' Foscari University registered in the subject pool of the Ca' Foscari Laboratory for Experimental Economics between the end of April and May 2012. Students participated through an online interface, thus, did not either meet the experimenters or the other participants while the experiment was in progress. Students were sent invitations to register through a link, where a short individual questionnaire (more on this later) had to be filled and were randomly divided between the roles of Investors and Trustees and in the two treatments. Investors played immediately, while Trustees were contacted once the decisions of their matched investor were received. Finally, all subjects received an email feedback with the result of the game and instructions for collecting the payment.

Since the matching in the partner treatment was for real and not hypothetical, not all the

data collected in the first phase (questionnaire) was used. If subjects could not participate because of lack of matching opportunities or because their matched trustee failed to respond to the transfer received, they received anyway a flat fee equal to 2 . If participants played the game their final earnings depended on the transfer and on one belief question. Each couple of participants started out with 10 tokens, to be exchanges at a 0.50 per token rate. The exchange rate was common knowledge to all participants. The belief question used a standard belief incentivation scheme [1] and was as follows:

- for the Investors: they had to state their belief regarding how many tokens would be returned
- for the Trustees (only in the partner treatment): they had to state for which characteristics they were chosen.

The average length of the experiment was about 5 minutes (including instructions, questionnaire and decisions) for an average pay of 4.5 (2.73) for investors in the partner (baseline) treatment and an average of 4.03 (2.73) for trustees in the partner (baseline) treatment. As previously stated, participants did not come to the lab, but could complete the experiment from anywhere, provided an Internet connection was available. The experiment was run in Italian, a translation of the instruction is available from the author upon request.

2.4.1 Individual questionnaire

The partner treatment of this experiment allows Investors to select a specific characteristic they want their Trustee to have. They are told in the instruction that one Trustee with that characteristic will be select from the available trustees.

The setup of this experiment allows for partner selection along only one of five possible items, with radically different information contents:

[1] The investors were rewarded on the basis of Nyarko and Schotter (2000), such that guessing the exact transfer back entailed winning 1, while stating a wrong belief was rewarded according to the following scheme: $1 - (0.0011 * ((\text{belief-transfer received})^2))$. The Trustees were rewarded with 1 if guessed correctly according to which characteristics they had been chosen, o otherwise

- gender;
- choice of preferred painting;
- eye color;
- choice of travel insurance;
- area of study.

Once chosen the information on which they wish to base their selection, Investors could choose the specific trait of their Trustee: for example, one Investor could ask for a Trustee with blue eyes.

Since the partner selection is in the hands of the Investors only, we can discuss their relevance with respect to potential trustworthiness of the individuals having a specific trait. The first one of these features - gender - allows to address the existence of possible social stereotypes regarding the trustworthiness of specific subsets of the population, although the evidence from the literature is mixed on which gender is generally considered more trustworthy. Both choice questions (choice of preferred painting and choice of a travel insurance) refer to individual preferences that are not easily transferable to the trustworthiness domain. For the painting question four different artworks with the same subject (a still life) have been chosen, with no further identification regarding the author or the period in which they were painted, as shown in Figure 2. Thus, choosing one painting or another entirely depend on taste.

The question regarding the choice of a travel insurance has been introduced as an indirect way of providing information regarding the attitude towards risk, without using a more classic risk question. Trusting naturally entails an element of risk, as in general it is not known for sure how the other person will behave. Thus, the relation between trust and risk has been subject to experimental investigation, in order to understand if standard risk aversion measures are able to predict trusting behavior. Houser et al. (2010) find that there is no such predictive relationship combing trust games and risk games with a classic measurement of risk aversion. The authors conclude that measures of risk based on price lists are not able to predict trust, although they do not exclude that other forms of risk to have such a

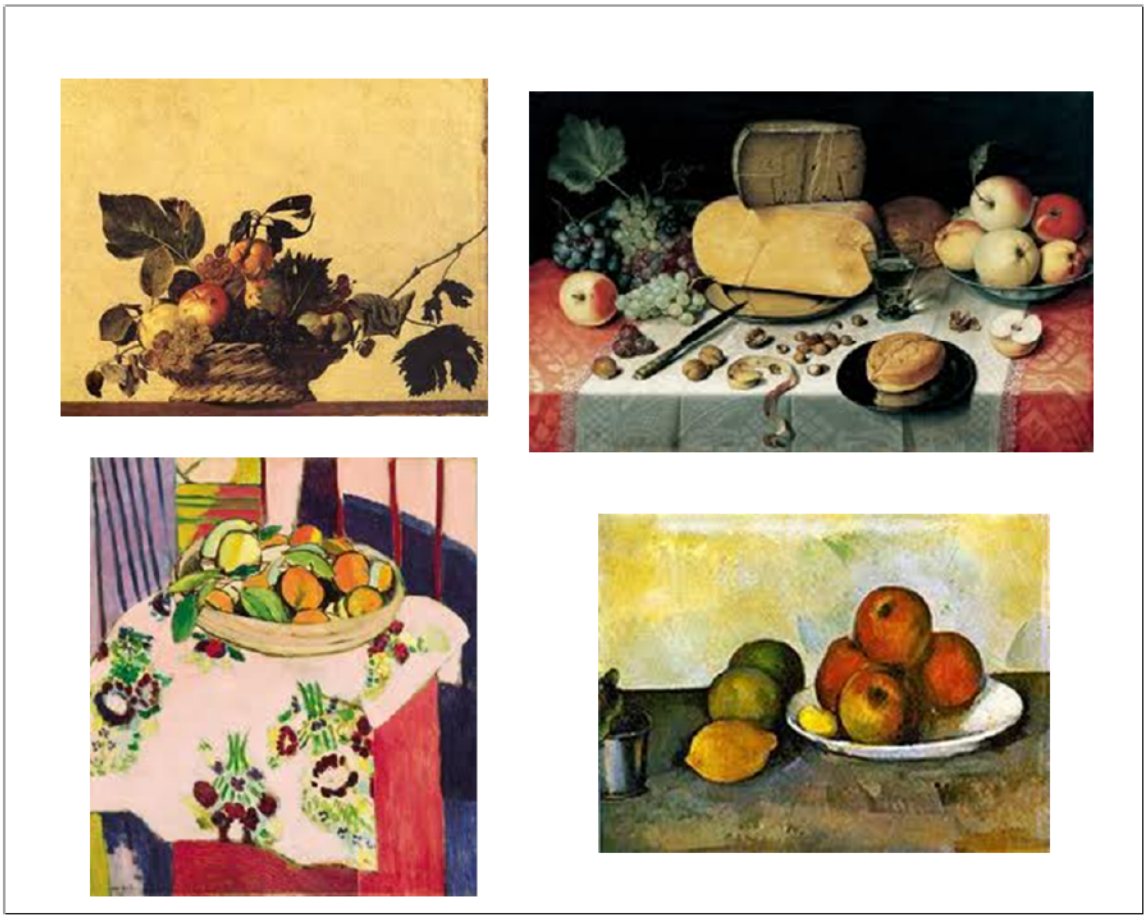

Figure 2.2: Preferred painting: still life by Caravaggio, Matisse, the Dutch school and Cezanne

predictive relationship, building also n the consideration that risk entails "state" uncertainty in a setting of perfect information (possible states are known), while risk involves "strategic" risk in context of imperfect information (about others).

The question used reads as follows: *"Picture the following situation. You are about to start a journey by plane and carry a suitcase, whose value for you is 1000. Statistically speaking, in journeys like the one you are about to do, one suitcase out of a thousand gets lost. You have to decide if you want to buy a travel insurance and, if so, which is the maximum price you are willing to pay to insure your suitcase, choosing one of the options below".* The available answers are *"I do not want to buy an insurance", "I want to to insure my suitcase for 1", "I want to to insure my suitcase for 5", "I want to to insure my suitcase for 10".* This question allows to address in general whether individuals are risk averse or not (by comparing those

		Gender		Area of study				Insurance			
		M	F	Econ	Science	Lit	Lang	none	1	5	10
All	I	66	69	93	7	14	21	15	42	26	52
	T	48	87	53	8	31	43	16	22	30	77
Baseline	I	16	25	33	1	3	4	5	17	6	13
	T	13	26	8	2	17	12	5	5	8	21
Partner	I	50	44	60	6	11	17	10	25	20	39
	T	35	59	45	6	13	30	10	17	21	46

Table 2.1: Overview of participants pool (1)

choosing to buy one of the proposed insurances with those not buying any insurance), but allows also to look at individual preferences over dealing with risk situations.

The question regarding the area of study is introduced as a way to proxi some measure of identity, especially since the number of possible faculties is quite limited due to the subject pool chosen. In fact, only four faculties existed when the experiment was run at Ca' Foscari University of Venice - Economics, Literature, Languages and Sciences. Eye color (brow, blue, green, black) is a radically arbitrary characteristics that should bear no specific evaluation regarding the trustworthiness of individuals, and was introduced in order to assess the mere power of partner selection.

2.5 Experimental results

2.5.1 Descriptive analysis of participants

Overall 41 couples for the baseline treatment and 94 couples for the partner treatment were formed. Table 1 summarizes the characteristics of the participant pool as concerns individual characteristics. In the table "I" stands for Investors, "T" for Trustees.

As Table 1 shows, the largest share of individuals involved in this experiment are Economics students, which mirrors the composition of the total Laboratory subject pool, where such students are also the majority. There are more females than males in all treatments and roles, except among the Investors of the Partner treament. Overall, the most expensive

		Eye color				Choice of painting			
		Brown	Green	Blue	Black	Caravaggio	Matisse	Dutch	Cezanne
All	I	79	25	29	2	63	35	21	18
	T	80	33	19	3	46	46	23	20
Baseline	I	23	8	9	1	3	33	1	4
	T	23	8	7	1	16	13	4	6
Partner	I	56	17	20	1	41	24	16	14
	T	57	23	12	2	28	33	19	14

Table 2.2: Overview of participants pool (2)

insurance is the most chosen option, both among he Investors and the Trustees.

The choice question regarding paintings shows different patterns across treatments, while, unsurprisingly, most participants have brown eyes, as shown in Table 2.

Figure 3 reports on overview of the information on which Investors selected their Trustee and shows that the majority of Investors in the partner treatment used the insurance question. Out of the 94 Investors, 48 chose partners (trustees) according to a characteristic they have as well (e.g. same gender). Such choices allow to create a further subset of Investors who made "homophilic" choices that will be used to investigate in more detail the effect of perceived similarity on trust. Homophilic investors show a trend that is broadly consistent with what

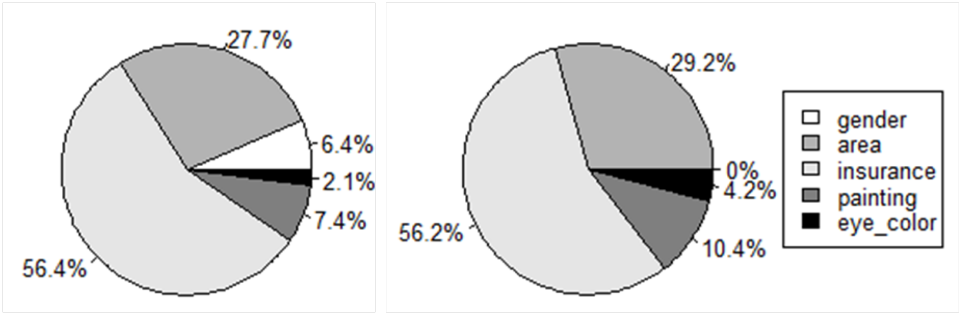

Figure 2.3: Investors' choice of partner- all partner investors (left) and homophilic investors

happens in general in the partner treatment, with "insurance" and "area" of study being the two most asked for characteristics.

On the other hand, trustees could not make any choice regarding their partner, but simply

stated their belief regarding which characteristic they had been chosen upon (e.g. because of I am female). Figure 4 reports further details on Trustees' beliefs.

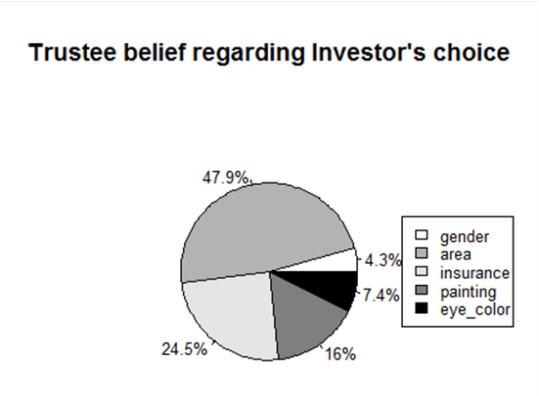

Figure 2.4: Overview of beliefs regarding reason for being chosen- Trustees, partner treatment

It is interesting to compare Figures 3 and 4, as they seem to point out to very different patterns. While investors in the partner treatment, especially among those making homophilic choices, seem to disregard gender as an important characteristic in choosing their partner, trustees overall choose it as the second most frequent reason for being chosen. The question regarding area of study is considered important by both Investors and Trustees, although there is a sizable difference between the number of times in which it is actually used for partner selection compared to the beliefs.

2.5.2 Descriptive analysis of the choice data

Running a Shapiro test for normality on the Investors data shows that the data are not normal looking at pooled ($p - value = 2.34e - 05$) and separate (partner $p - value = 2.491e - 05$, baseline $p - value = 0.0535$) treatments, although the data of the baseline treatment are very close to the 0.05 threshold for being considered normal. Figure 2.5 report qqplots for the three distributions (all, partner and baseline). Given the non-normality of the data, testing for homogeneity of variances requires using a test that is robust to such departures from non-normality, such as the Levene test, which shows that data in the partner and the baseline treatment do have homogeneous variances ($p - value = 0.3277$).

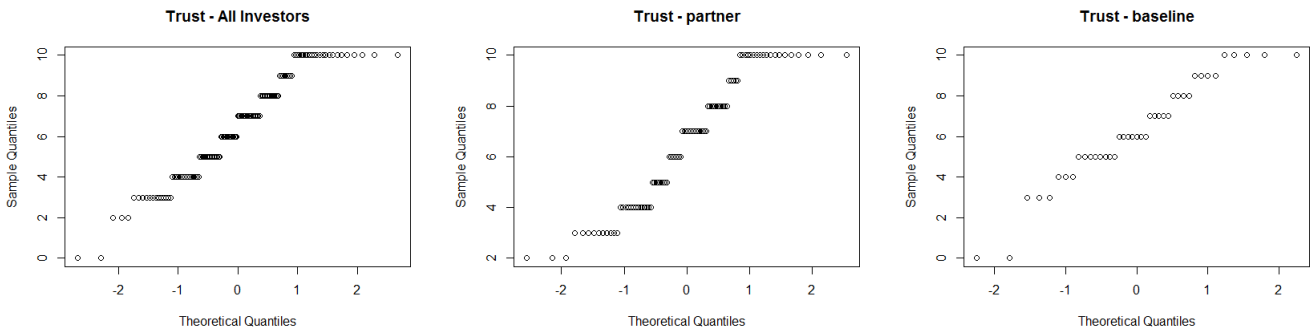

Figure 2.5: Qqplot of transfers from Investors- all, partner and baseline treatment

Looking at the trustees, Shapiro tests on the normality of the normalized transfers both at pooled and separate level show that the data are not normal (all data $p - value = 0.0006476$, partner $p - value = 0.0004917$, baseline $p - value = 0.007782$), and a Fligner-Killeen test, which shows that data in the partner and the baseline treatment do not have homogeneous variances ($p - value = 0.01237$). Figure 6 reports the qqplot for the three distributions.

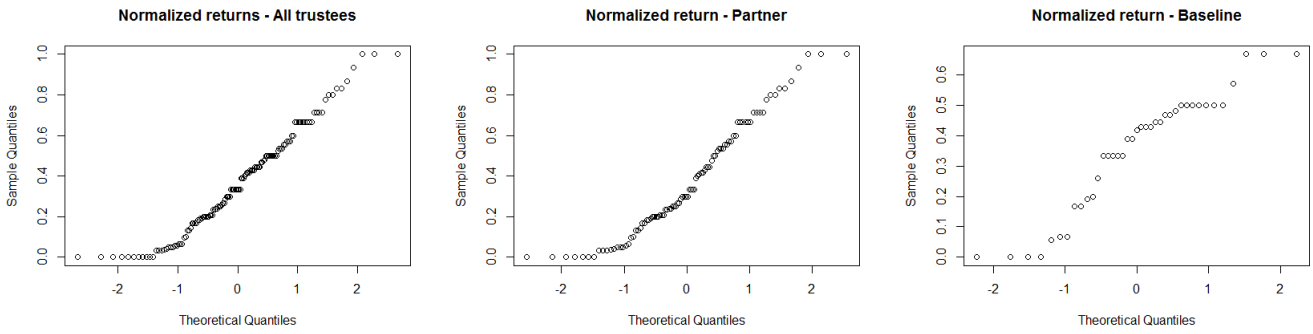

Figure 2.6: Qqplot of transfers from Trustees- all, partner and baseline treatment

This descriptive analysis of the data suggests using non-parametric tests that do not assume normality or homoskedasticity of the data.

2.5.3 Hypothesis testing

Effect of partner selection on trust

Hypothesis A1 of this experiment posits that being able to determine a characteristic of one's partner induces more trust in the Investors, who then make more generous transfers compared to the baseline case, in which no partner selection is possible. Figure 7 reports evidence from the 94 observations collected for the partner treatment and the 41 observations of the baseline treatment. Testing the whether the transfers in the two treatments are significantly different

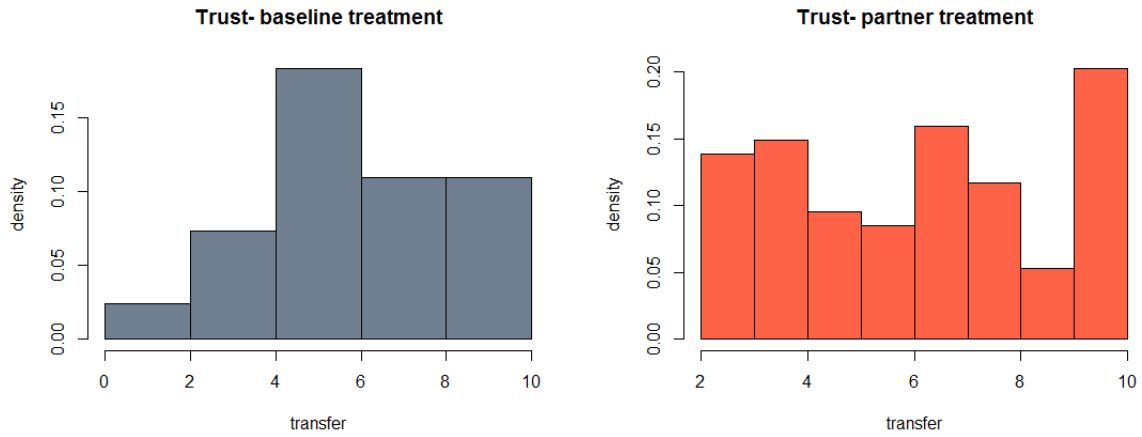

Figure 2.7: Distribution of transfers from Investors- baseline and partner treatment

shows no support for the hypothesis that the partner treatment entails higher transfer with a $p - value = 0.34$ (one-sided Mann Whitney test [2]).

Effect of partner selection on trust of homophilic investors

Inference on hypothesis B regarding the effect of perceived similarity on trust can be made from the comparison between the behavior of homophilic investors (investors selecting a partner with a characteristic that they also have) and both the baseline and the partner treatment. Comparing the distribution of transfers by homophilic investors with both the baseline and the distribution of the other investors in the partner treatment shows that the two distributions are not statistically different using a Mann-Whitney one-sided test (p-values respectively

[2]The Mann Whitney test has been chosen because it makes no distributional assumptions, not requiring data to be normal, but requires data to have homogeneous variances

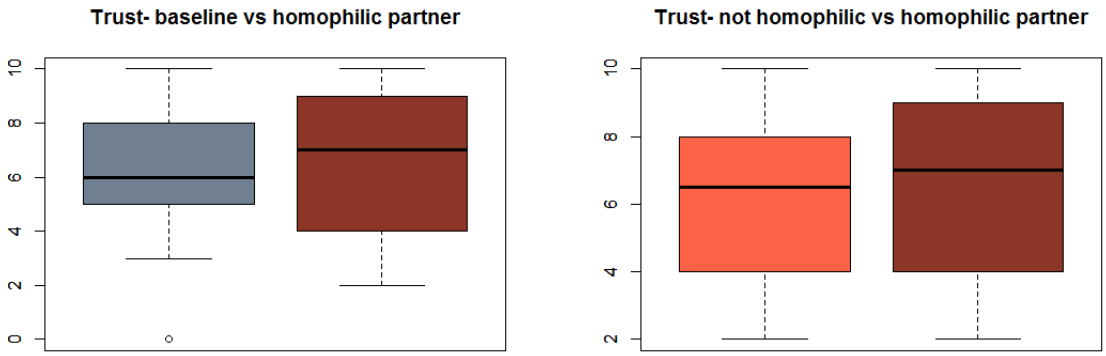

Figure 2.8: Distribution of transfers from homophilic investors: comparison with baseline distribution (left) and non homophilic partner distribution

Variables	Treatment	Correlation coefficient	p-value
Beliefs vs transfer	Baseline	0.406	0.005
	Partner	0.405	$2.52e-05$
	Homophilic Partners	0.328	0.011

Table 2.3: Investors - Correlation between beliefs and transfers

0.2891 and 0.3302 for the within-partner treatment comparison).

As previously mentioned, beliefs regarding the amount that would be returned were also elicited in an incentive-compatible way. Looking at the correlation coefficients (Table 3) between such beliefs and the amount transferred by investors shows that beliefs are significantly correlated with transfers in both treatments. Moreover, if we look only at investors making homophilic choices, the correlation is still significant but less pronounced.

Effect of partner selection on trustworthiness

Does the knowledge of being chosen affect trustworthiness in trustees? The evidence reported below refers to 94 observations from Trustees of the partner treatment and 41 from Trustees of the baseline treatment. Since different trustees received different transfers the data have been normalized by the transfer received.

Testing the whether the transfers in the two treatments are significantly different shows

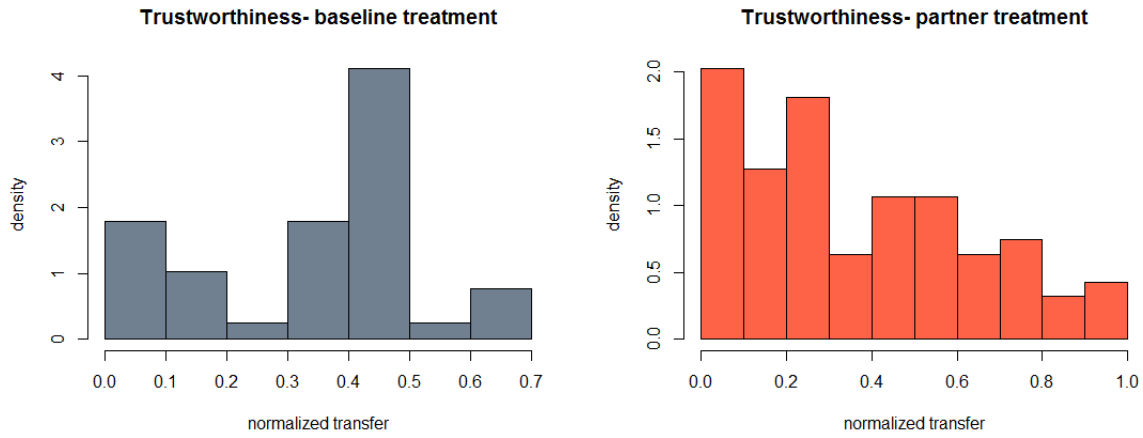

Figure 2.9: Distribution of transfers from Trustees - baseline (left) vs partner treatment

again no support for the hypothesis that the partner and baseline treatment are significantly different (using a Kruskal-Wallis test due to non-normality and heteroskedasticity of the data)

Although we could find no apparent difference between the two treatments, there is a natural partition of the dataset that helps shedding more light on the data. In fact, we could partition the choices made by Trustees in two subsets: the "reciprocal" choices (when the Trustees gives back at least what was transferred or more - before the amount is tripled) and the non-reciprocal choices. This partition yields the following table of count data. Performing

	reciprocal	non reciprocal
baseline	12	27
partner	48	46

Table 2.4: Trustees - reciprocal and non reciprocal transfers across treatments

a Fisher test on the count data of the reciprocal and non reciprocal choices in the two dataset yields a very significant result ($p - value = 0.025$) supporting the hypothesis that there are fewer reciprocal choices in the baseline treatment. The odds ratio is 0.427, which implies that a reciprocal choice in the partner treatment is $1/0.427 = 2.34$ times more likely than in the baseline treatment.

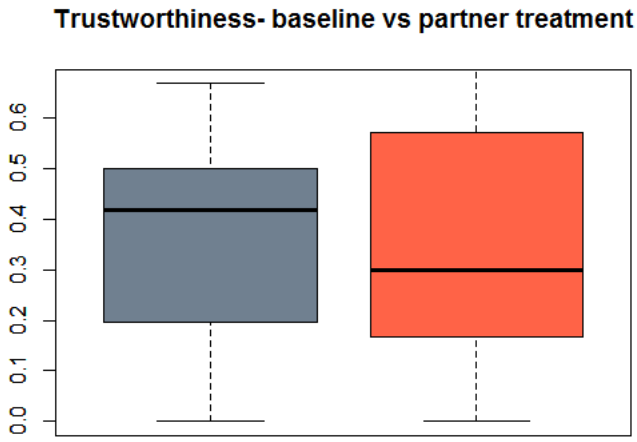

Figure 2.10: Distribution of transfers from Trustees - baseline (left) vs partner treatment

2.5.4 Quantile regression

The overall evidence presented so far regarding trust behavior does not support the hypotheses regarding the role of partner selection or of perceived similarity in inducing higher levels of trust. The same can be said for the hypothesis regarding increased trustworthiness of the individuals in the partner treatment. Nevertheless, it is important to remember that the tests used refer to the *entire* distribution of transfers and do not allow to look in mode detail at localized heterogeneity. Previous research involving trust games has highlighted the mixed impact of specific features even in context of partner selection, as pointed out in the literature review section. There is reason to believe that looking at the mean or median behavior forgoes looking at relevant patterns of behavior that may affect subgroups of the population considered. For instance, wealth effects inducing different behavioral patterns in richer or poorer individuals may be at play, whose effect may appear diluted in the analysis focusing on mean or median behavior.

This section will address this issue of local heterogeneity, shedding a different light on the relevance of the hypothesis presented so far.

The regression analysis investigating at a deeper level the relations between transfers and the other explanatory variables collected in the experiment will be run using quantile regression analysis (Koenker and Hallock (2001); Koenker). This choice depends on three considerations:

1. the transfer vectors are distributed between 0 and 10 only (for the investor case); thus, the normality assumption underlying linear regression methods cannot be innocently used;
2. using quantile regression allows to avoid assuming constant marginal value for an increase in transfer: in fact, can we say that sending 3 instead of 2 tokens is the same than sending 8 instead of 7?
3. quantile regression can be used to estimate the determinants of transfers looking at specific quantiles, in particular looking at the extreme quantiles that are very meaningful in this case.

In order to check whether different quantiles of the distributions of the Investors' and Trustees' choices exhibit different patterns, we will estimate the following models:

1. **INVESTORS BEHAVIOR**

$$transfer_{inv} = \alpha + \beta_1 partner + \beta_2 noins + \beta_3 ins1 + \beta_4 ins5 + \beta_5 lit + \beta_6 sci + \beta_7 lan + \beta_8 gender + \beta_9 belief + \beta_9 same \quad (2.1)$$

with $\beta_1 = 0$ and $\beta_9 = 0$ in the regression of the baseline treatment investors. The partner treatment has also $\beta_1 = 0$ and includes also dummy variables with the type of information chosen by the investors.

2. **TRUSTEES BEHAVIOR**

$$normalizedtransfer_{tru} = \alpha + \beta_1 partner + \beta_2 noins + \beta_3 ins1 + \beta_4 ins5 + \beta_5 lit + \beta_6 sci + \beta_7 lan + \beta_8 gender \quad (2.2)$$

with $\beta_1 = 0$ in the regression of the partner and baseline treatment investors.

In all models specifications *partner* is a dummy variable indicating the partner treatment, *no ins, ins1, ins5* refer to the choice of insurance in the risk question, *lit, lan, sci* refer to the faculty to which each individual belongs, *gender* is a dummy variable set to 1 if male and *same*indicates which investors in the partner treatment chose an individual with a characteristic they also have.

Tables 5-10 show the regression results, starting with the Investor case. All tables except tables 6 and 8 report estimation of the regression model for the for the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles. Standard errors are computed assuming local (in tau) linearity (in x) of the the conditional quantile functions and computes a Huber sandwich estimate using a local estimate of the sparsity.

As Table 5 shows, only a few of the individual characteristics are significant in explaining behavior. In particular, we can observe that the lower percentiles (from 0.10 to 0.50) tend to share similar dynamics with the significant effect of belonging to the Science faculty (significantly more generous than a student in Economics) and of beliefs regarding expected trustworthiness. These two effects are significant also at the 0.75 percentile,where we also have that gender becomes significant. The right tail of the distribution (the individuals making the more generous transfers are significantly affected by gender, belonging to the partner treatment and to the Faculty of Literature and are the only group in which beliefs on expected return of the transfer is not significantly affect the size of the transfer. Moreover, belonging to the partner treatment entails lower transfers for all quantile specification, with coefficients at the .50 and 0.90 quantile yielding a statistically significant effect. This runs against Hypothesis A1: individuals choosing their partner tend to transfer more than individuals in the baseline case. Table 2.6 reports regression analysis for the partner treatment that will allow to shed more light on this effect.

Table 6 reports regression coefficients for the baseline treatment of the Investors, highlighting basically the same dynamics. The two tails are missing in this table because the method used for computing the standard errors is not able to estimate the model in those two cases. We can use bootstrapped standard error, which show similar pattern for the more generous

	Model 1	Model 2	Model 3	Model 4	Model 5
(Intercept)	2.00*	3.00***	3.62***	4.14***	8.28***
	(1.08)	(0.49)	(0.46)	(1.07)	(1.40)
Partner treatm.	−0.36	−0.40	−0.62**	−0.43	−1.04*
	(0.82)	(0.35)	(0.30)	(0.64)	(0.59)
No Insurance	0.82	0.60	0.75	1.64	0.77
	(1.49)	(0.67)	(0.53)	(1.06)	(0.71)
Insurance 1	0.55	0.20	0.38	1.07***	−0.19
	(0.61)	(0.27)	(0.41)	(0.33)	(0.75)
Insurance 5	−0.64	−0.80	−0.13	0.00	−1.34
	(0.57)	(0.60)	(0.57)	(0.56)	(1.03)
Literature	0.55	0.20	−0.25	0.50	−0.19***
	(0.65)	(0.29)	(0.37)	(0.83)	(0.00)
Science	4.18**	3.00***	2.50***	2.64***	0.96
	(1.95)	(0.29)	(0.50)	(0.50)	(1.20)
Languages	0.55	0.40	0.00	1.36*	1.15
	(1.30)	(0.56)	(0.33)	(0.79)	(0.71)
Gender	0.27	0.20	0.37	1.71***	2.00**
	(0.52)	(0.28)	(0.36)	(0.38)	(0.90)
Belief	0.18***	0.20***	0.25***	0.21***	0.06
	(0.07)	(0.03)	(0.02)	(0.05)	(0.05)
Num. obs.	133	133	133	133	133
Percentile	0.10	0.25	0.50	0.75	0.90

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2.5: Quantile regression - All investors

	Model 1	Model 2	Model 3
(Intercept)	5.00***	3.85***	4.00***
	(0.47)	(0.49)	(0.77)
No insurance	2.00*	1.69	2.67***
	(1.10)	(1.19)	(0.74)
insurance 1	−1.00	0.23	0.22
	(0.80)	(0.55)	(0.53)
insurance 5	1.00	0.69*	0.67
	(0.88)	(0.38)	(0.43)
lit	1.00	−0.92	1.56
	(1.05)	(1.59)	(1.49)
sci	3.00***	2.69***	2.56***
	(0.66)	(0.52)	(0.35)
lan	4.00***	1.31	0.56
	(1.15)	(2.27)	(1.59)
gender	0.00	−0.77	0.44
	(0.87)	(0.56)	(1.19)
belief	0.00	0.23***	0.22***
	(0.09)	(0.08)	(0.06)
Num. obs.	39	39	39
Percentile	0.25	0.50	0.75

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2.6: Quantile regression - Investors - Baseline treatment

individuals (only gender and no info have a positive and significant effect), while beliefs are not significant neither for the 0.10 or the 0.90 percentile.

Table 7 reports the quantile regression estimation for the partner treatment of the Investors. Interestingly, the only percentile in which few regressors are significant is the 0.50 percentile, where only the beliefs regarding expected trustworthiness are significant. The rest of the distribution shows again differences across different percentiles: among the individual characteristics, again belonging to the Science faculty and being more risk averse (Insurance 5) are significant for almost all percentiles, as are beliefs. Looking at the information chosen about the trustees, it is remarkable that the feature that was a priori considered less informative (eye color) is significant in three out of the five percentiles analyzed. Choosing a partner according to faculty and choosing a partner of the same type are significantly explaining transfers, although the latter variable reduces it compared to choosing a partner that does not have the same characteristic, differently from what we expected.

Table 8 reports the results of the quantile regression all the participants involved as Trustees. A first important result to mention is that belonging to the partner treatment induces significantly higher transfers in the upper percentiles of the normalized transfer distribution (0.75 and 0.90), which is in line with the idea that trustworthiness is a social norm, while trust is not, as in Bicchieri et al. (2011). More generous trustees are more so in the partner treatment than in the baseline one. The regression analysis shows how different individual features (such as gender or belonging to a specific faculty) have a different effect on the different parts of the distribution, as we found also for the Investors.

Table 9 focuses on the baseline treatment only for the central quantiles (0.25, 0.5, 0.75), showing a significant effect of some individual features for specific quantiles only.

Table 10 concludes the review of the quantile regression results looking at the partner treatment. It is interesting that the Trustees that have a correct belief regarding the reason for which they were chosen transfer significantly more in two percentiles (0.50 and 0.90) and that the regression analysis is able to capture the significant effects of some of the explanatory variables only in the right-hand tail of the distribution.

	Model 1	Model 2	Model 3	Model 4	Model 5
(Intercept)	2.45***	2.00***	2.49*	5.83***	7.18***
	(0.38)	(0.41)	(1.25)	(1.17)	(0.50)
Eye choice	3.11***	2.75***	1.30	2.39***	2.06
	(0.73)	(0.64)	(3.26)	(0.84)	(3.91)
Faculty choice	−0.65	0.25	0.32	0.30	0.70***
	(0.53)	(0.56)	(0.66)	(0.63)	(0.19)
Gender choice	1.17***	0.75	−0.70	−0.39	−0.39
	(0.35)	(0.47)	(1.51)	(0.65)	(0.60)
Paint choice	−0.93***	−1.25*	−0.95	−2.04	2.03
	(0.18)	(0.70)	(0.65)	(2.91)	(3.76)
No Insurance	−0.07	0.75	0.57	0.70	−0.39
	(0.82)	(0.72)	(1.16)	(0.90)	(0.50)
Insurance 1	0.30*	0.50	1.00	0.30	−0.09
	(0.17)	(0.38)	(0.79)	(0.63)	(0.19)
Insurance 5	−1.53**	−1.50***	−0.70	−1.61*	−1.94***
	(0.71)	(0.47)	(0.74)	(0.88)	(0.51)
Literature	0.53*	0.50	0.00	0.13	−0.09
	(0.27)	(0.35)	(0.61)	(0.96)	(0.49)
Science	2.67***	2.75***	2.03	1.43**	1.12
	(0.31)	(0.30)	(1.80)	(0.66)	(0.86)
Languages	−0.47	−0.25	−0.14	1.91**	1.33***
	(0.31)	(0.50)	(1.06)	(0.84)	(0.47)
Gender	0.04	0.25	0.86	2.57***	2.52***
	(0.25)	(0.33)	(0.79)	(0.60)	(0.21)
Belief	0.21***	0.25***	0.27***	0.09	0.06**
	(0.02)	(0.03)	(0.08)	(0.06)	(0.03)
Same	−0.19	0.25	0.24	−0.30	−0.61***
	(0.33)	(0.38)	(0.61)	(0.62)	(0.17)
Num. obs.	94	94	94	94	94
Percentile	0.10	0.25	0.50	0.75	0.90

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2.7: Quantile regression- Investors - Partner treatment

	Model 1	Model 2	Model 3	Model 4	Model 5
(Intercept)	0.07**	0.22***	0.33***	0.37***	0.46***
	(0.03)	(0.08)	(0.06)	(0.05)	(0.13)
No ins	−0.02	−0.04	0.00	−0.02	0.06
	(0.06)	(0.09)	(0.09)	(0.13)	(0.11)
ins 1	−0.01	0.02	−0.02	−0.07	−0.11
	(0.03)	(0.07)	(0.06)	(0.05)	(0.09)
ins 5	−0.04	−0.10	−0.05	−0.05	−0.11
	(0.03)	(0.07)	(0.09)	(0.03)	(0.07)
lit	−0.01	−0.05	0.02	0.07	0.16*
	(0.03)	(0.08)	(0.06)	(0.07)	(0.09)
sci	0.00	0.02	0.10	0.22***	0.22***
	(0.01)	(0.21)	(0.24)	(0.07)	(0.08)
lan	0.10**	0.12**	0.10	0.09*	0.04
	(0.04)	(0.05)	(0.07)	(0.05)	(0.10)
gender	−0.03**	0.03	0.09	0.13***	0.10
	(0.01)	(0.07)	(0.08)	(0.05)	(0.07)
partner	−0.02*	−0.08	−0.03	0.11***	0.22***
	(0.01)	(0.07)	(0.05)	(0.04)	(0.06)
Num. obs.	133	133	133	133	133
Percentile	0.10	0.25	0.50	0.75	0.90

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2.8: Quantile regression - All Trustees

	Model 1	Model 2	Model 3
(Intercept)	0.03	0.31^{*}	0.50^{***}
	(0.16)	(0.16)	(0.13)
No ins	−0.07	0.02	−0.06
	(0.19)	(0.14)	(0.08)
ins 1	0.16	−0.03	−0.08
	(0.27)	(0.12)	(0.12)
ins 5	0.05	−0.03	0.00
	(0.07)	(0.06)	(0.07)
lit	0.03	0.06	0.00
	(0.16)	(0.16)	(0.15)
sci	0.40	0.12	0.25
	(0.35)	(0.16)	(0.19)
lan	0.30^{**}	0.11	0.00
	(0.12)	(0.15)	(0.12)
gender	0.08	0.08	0.00
	(0.10)	(0.07)	(0.06)
Num. obs.	39	39	39
Percentile	0.25	0.50	0.75

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2.9: Quantile regression- Trustees - Baseline treatment

	Model 1	Model 2	Model 3	Model 4	Model 5
(Intercept)	0.04	0.17***	0.21***	0.51***	0.56***
	(0.04)	(0.05)	(0.07)	(0.07)	(0.14)
ins no	0.05	0.07	−0.09	−0.06	0.09
	(0.05)	(0.07)	(0.12)	(0.08)	(0.14)
ins 1	0.00	0.06	−0.01	−0.12*	−0.11
	(0.04)	(0.10)	(0.09)	(0.07)	(0.10)
ins 5	0.00	−0.08	−0.12	−0.10	−0.11
	(0.04)	(0.05)	(0.12)	(0.08)	(0.08)
lit	0.00	0.00	0.03	−0.10	0.10
	(0.07)	(0.11)	(0.09)	(0.13)	(0.12)
sci	0.00	−0.03	0.29	0.07	0.22
	(0.03)	(0.06)	(0.29)	(0.14)	(0.30)
lan	0.00	0.05	0.11	0.10	0.22**
	(0.03)	(0.05)	(0.09)	(0.08)	(0.09)
gender	−0.05	−0.02	0.18	0.25***	0.22**
	(0.03)	(0.05)	(0.12)	(0.06)	(0.09)
bel	0.00	−0.03	0.21**	0.00	0.06***
	(0.02)	(0.07)	(0.09)	(0.05)	(0.01)
Num. obs.	94	94	94	94	94
Percentile	0.10	0.25	0.50	0.75	0.90

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2.10: Quantile regression- Trustees- Partner treatment

Comparing the evidence emerging from the quantile regression analysis confirms that there exist some local heterogeneity affecting the data, with different underlying patterns from the more to less generous subjects. Allowing for partner selection affects behavior significantly in some parts of the distributions, although it does so in a different way among the Investors and the Trustees. Partner selection has a negative effect among the Investors, but a significant and positive one among the more generous Trustees.

2.5.5 Understanding Trustees' behavior - Logistic regression

As previously mentioned, a natural partition of the Trustees data entails separating those who returned at least as much as what was sent (reciprocal choices), to those who did not. Using this partition in a logistic regression, we are able to investigate which characteristics are significant in increasing the odds ratio of making a reciprocal choice by Trustees.

The only significant coefficients regard belonging to the partner treatment and being a Languages student. In particular, when we go from the partner to the baseline treatment, the log odds of a fair transfer (versus an unfair one) decreases by 0.86, or in other words, the odds of making a reciprocal choice when in the partner treament increase by a factor 0.42 compared to the baseline treatment. In the same way, being a Languages student implies that the odds of making a reciprocal choice of studying languages increase by a factor 2.36 compared to the reference case (being a student in Economics). The same logistic regression for the baseline and partner treatments could not lead to any notable results and has been omitted.

	Model 1	Model 2
(Intercept)	−1.51	0.43
	(1.45)	(0.39)
cara	0.69	
	(0.58)	
mat	0.32	
	(0.60)	
dut	0.11	
	(0.66)	
e brown	1.54	
	(1.31)	
e green	1.49	
	(1.34)	
e blue	1.56	
	(1.38)	
ins no	0.07	
	(0.65)	
ins 1	−0.21	
	(0.55)	
ins 5	−0.20	
	(0.48)	
lit	0.08	
	(0.53)	
sci	0.78	
	(0.88)	
lan	0.86*	0.73*
	(0.47)	(0.41)
gender	0.64	0.56
	(0.43)	(0.39)
partner	−0.86*	−0.92**
	(0.46)	(0.41)
AIC	199.86	181.93
BIC	243.21	193.50
Log Likelihood	−84.93	−86.97
Deviance	169.86	173.93
Num. obs.	133	133

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2.11: Logistic regression -Trustees - all data

2.6 Discussion and conclusion

Trust can be a powerful lubricant of economic interactions. A significant strand of literature in experimental economics and psychology has shown that social history -being able to know past choices of one's counterpart- helps building trust, and evidence from related literature dealing with other-regarding behavior (cooperation, for instance) shows that reputation can help support other-regarding behavior that would not be predicted by neoclassical game theory. Nevertheless, in a world where physical distances and formal boundaries matter less everyday, where the information we may acquire is limited or uncertain and where reputations are difficult to build due to the swiftness of exchanges, on what terms can we trust? Meeting strangers online to chat, sell and buy goods or services, starting new professional partnerships with new suppliers or collaborators are just a few examples where individuals have to show some degree of trust.

Experimental evidence has highlighted the resilience of trusting behavior to experimental manipulations, which seems to suggest that individuals on average either possess some preference for trusting or are able to understand the economic potential of trusting behavior and behave accordingly. This paper aims to address determinants of trust in economic interactions, building on this evidence accumulated in economics, psychology and computer science and focusing in particular on the idea that when given the chance to exploit some informational advantage individuals would do so in order to show more trust. A related but very important related investigation deals with similarity perception an on whether choosing a partner with similar characteristics is able to further strengthen this process.

This paper follows in the strand of trust game literature dealing with partner selection, but represents a first attempt to bring "real" partner selection in the laboratory, in order to test whether the selection of similar individuals does induce higher levels of trust, avoiding strategy-method type of questions. We allow for partner selection along one of five characteristics, collected from the participants before the study. Thus, investors choose only once and only one characteristic and make only one investment decision.

The results of the experiment show how the informational advantage given to the investors

in this experimental framework is not exploited in order to look for more trust, but induces lower transfer compared to the baseline treatment. Moreover, similarity seems not to induce greater trust in investors. Thanks to the use of quantile regression, we were able to look at how the different explanatory variables affected the transfer choices in the different parts of the transfer distributions, showing for instance that the belief on how much would be returned by the Trustee guides transfers decisions for all but those investors making the more generous choices - beliefs either are not significantly explaining transfers or are doing so with very small coefficients- which suggests that higher levels of trust do not depend on economic considerations but on a preference for trusting.

Although being real, we must acknowledge that partner selection still featured some element of randomness, in the sense that investors were matched with a person having the characteristic they chose drawn from the pool of people with that characteristic. Moreover, characteristics were arbitrarily chosen and their relevance to subjects was not assessed. The importance of choosing arbitrary and somewhat superficial characteristics lies in the attempt to reconstruct informal interactions, where what we know about our counterparts is general and often unrelated to the task. Nevertheless, real partner selection could be improved in future studies by investigating which are the trust stereotypes in our subject pool or by providing more specific descriptions (more than one features).

Experimental evidence from economics and social psychology suggests that discriminating individuals that we perceived are different is a strong and significant behavioral pattern, even when arbitrary and unimportant features are used to create groups. In this experiment, choosing a partner with a similar characteristic seems not to produce more trust, but significantly explains lower transfers, at least in some quantiles of the distribution. In this experiment similarity is based on features participants already possess (faculty, eye color and gender) or on expressions of their underlying preferences (taste and risk) - thus, we aimed at assessing the role of existing similarity and not of experimentally induced similarity. In a follow up of this work, we aim also at assessing the degree of similarity perceived by participants with individuals sharing that same characteristics - for example if women feel or not more similar to other women than men- in order to further qualify the results obtained in terms of the role of similarity perception on trust.

The experimental set up used in the paper, introducing real partner selection and employing two different sets of participants as investors and trustees, allows for investigating also whether partner selection has an effect on trustworthiness.

The experimental results show that trustworthiness behavior was positively affected by the introduction of a partner treatment. In fact, belonging to the partner treatment entails significantly higher transfers than the baseline for the upper quantiles (0.75 and 0.90). Differently from the investors, we see no significant differences between male and female behavior among the trustees (insignificant coefficients or very small significant ones only for some quantiles). Moreover, having a correct belief on the reason why one was chosen significantly explains transfers for the upper quantiles only. Looking at the share of trustees who decided to reciprocate investor's behavior -send at least as much as what was sent or more- we observed that such choices are significantly more frequent in the partner treatment than in the baseline.

The discrepancy between the modal feature chosen in the desired trustee (by the investors) and the modal inference (by the trustees) on the reason why chosen poses an interesting question regarding which are the underlying motivations for such choices, and whether the different effect of the partner selection on investors' and trustees' transfers can be explained by them. Such question represents an interesting direction for future research, which could be pursued by addressing also trustworthiness stereotypes in the subject population from which our participants are drawn.

This experiment addressed the determinants of trust and trustworthiness in a simple, economically-relevant situation in order to investigated whether real partner selection can support trust and whether similarity perception ca further strengthen this process. The experimental results provide only partial support for the hypothesis presented, although with the caveats mentioned above and suggests that partner selection and similarity should be further investigated, both improving the experimental rendition of partner selection and paying particular attention to the possible determinants of trust and trustworthiness, as preliminary evidence seems to support what has already been found in other experimental investigations - trust and trustworthiness are significantly different processes.

Chapter 3

Does Sharing Values Lead to Cooperation? A Similarity-based Investigation

3.1 Abstract

Understanding what motivates and fosters collective actions has major implications in the governance and management of organizations, in the regulation and design of public policies, and has long attracted the interests of scholars and practitioners in business and economics. If trust and reciprocity certainly qualify as possible drivers of collective actions in some specific environments, as the uncertainty regarding the interaction structure increases, they are not likely to be able to explain the emergence of stable interacting groups in reality. This paper deals with how groups of agents emerge in a dynamic contest characterized by lack

of formal structure and uncertainty regarding the possible individual outcomes. Through the development of a stylized agent-based model we aim to show how similarity in values can be a successful driver for cooperation. A second-version of the model, where memory of past interactions has a role, introduces further dynamics and is able to create successful and relatively stable groups.

Keywords: Similarity, Social trust, Cooperation, Groups[1].

3.2 Introduction

The emergence of cooperation among utility-maximizing individuals is a long-standing puzzle for scholars. Economic and organizational research dedicated significant attention to the study of cooperative dynamics, addressing its drivers through a plurality of methods and tools.

Among others, agent-based literature and game theory contributed to this field, modeling possible explanations for the emergence and evolution of cooperation among utility-maximizing agents resorting to *reciprocation* -direct or indirect (Axelrod, 1984; Nowak and Sigmund, 1998)- or other forms of *shadow of the future*(Axelrod and Dion, 1988). The former type of reciprocation, *direct reciprocity*, is classically formalized through repeated encounters between the same two agents who can decide either to cooperate or defect: mutual cooperation can be sustained by the long-term strategy, even if the best short-term one would be defection (Axelrod, 1984). In the standard framework for *indirect reciprocity*, agents are randomly chosen pairwise -a donor and a recipient-, and the likelihood of meeting the same individual is very low: information acquisition allows to build one agent's reputation, which ultimately allows to sustain cooperation even among strangers (Nowak and Sigmund, 1998,

[1]This chapter is a joint work with Anna Moretti, Department of Management and Paolo Pellizzari, Department of Economics, University Ca' Foscari of Venice. The authors wish to thank the audiences at Ca' Foscari University of Venice and at the II Venice-Kagenfurt Workshop, and two anonymous referees for very useful comments and insights.

2005). Explanations of sustained cooperation based on the shadow of the future, refer to repeated games characterized by those mechanisms supporting cooperative actions in exchange for a future chance of reciprocation (Axelrod and Dion, 1988).

Research on cooperation and groups formation also dedicated significant attention to "other regarding preferences", suggesting the idea that individuals may feel more altruistically towards similar others. This idea has been studied in sociological and economic theory under the label of *homophily*, namely the tendency of social actors to form ties with other actors similar to themselves in terms of several dimensions - race, culture, religion, occupation, attitudes, etc. (McPherson et al., 2001). This concept has been variously used and developed in game theory, economic and organizational research: from tag-based cooperation models (Riolo et al., 2001), to spacial and other forms of clustering (Axelrod, 1984), to peer pressure in partners selection to form alliances (Kandel and Lazear, 1992).

In this paper we aim at contributing to this strand of literature analyzing the emergence of cooperation among unrelated individuals based on the preference for similarity, proposing a model with two peculiar features: the context informality and the presence of agents characterized by multi-dimensional types.

This model shows features resembling standard social dilemmas in which cooperation is classically studied. Individuals choose to join a group anticipating they will experience a participation premium that is available to members only. This participation premium has an immaterial component depending on similarity, which has features of non rivalry among group members, although naturally it is excludable to non-members. Moreover, in order to participate in a group, individuals have to overcome the fear of being worse off after joining, as they will end up sharing their endowments with others. Due to this uncertainty regarding others' individual endowments and to the structure of the utility functions, relative free riding takes place *within* the group: richer individuals bring relatively more material resources to the common pie but reap only an equal share of it, thus risking to be relatively free rided upon by less wealthy members.

In our model, similarity across individuals is measured along a vector of individual characteristics (salient and general values), pertaining to their individual preferences. Values enter

into the computation of individual utilities alongside the material endowment (building on the idea of homophily). As in Alesina and La Ferrara (2000), we assume that "if preferences are correlated with these characteristics, [this] is equivalent to saying that individuals prefer to join groups composed of individuals with preferences similar to their own".

The utility function developed in this model is inspired from a concept found initially within the risk management literature, that of *Salient Value Similarity*, which introduces salient values as the relevant dimension for the perception of similarity. In our view, these values represent core standpoints of agents that cannot be subject to any adaptive processes. The other dimension of similarity is that of *general values*, which may be seen as more volatile positions than salient values, representing the perception of agents regarding the environment they are interacting in. As an example, the reader can think to potential cooperators of different races and diverse cultures, where the similarity among agents depends on an immutable trait (race) and on another cultural attribute that potentially can be adjusted and blended through repeated interaction and "contamination" among group members.

Agents are heterogeneous in their "endowments" and at each time decide to join one of two groups or alternatively to stay on their own. Deciding to join, they automatically commit all their endowment as a contribution to the group, receiving as a payoff an equal share of the total contributions to the group plus the value coming from similarity (the immaterial component of the utility function). Agents are free to join and leave groups at any time, with no costs of entry or exit. If they decide to exit (that is to say, stay on their own), they will keep their initial endowment only.

Given the setup of our model, we expect to observe on one side, the emergence of groups that are strongly affected by preferences for similar others and, on the other side, the detrimental effect of heterogeneity in endowments on participation to groups, which translates in wealthier individuals preferring to stay on their own.

Interesting dynamics will be observed increasing the number of "races" and variety of "cultures", when more information is available, and with the introduction of a memory parameter for agents' previous choices.

The paper is organized as follows. After an introductory section aimed at contextualizing this work within existing literature, Section 3.4 introduces the main concepts and the features of the model. Results are presented in Section 3.5, where we discuss both representative examples and aggregate data obtained running a large number of simulations. Section 3.6 concludes discussing specific examples of potential application of the model and suggesting directions for further extensions.

3.3 Background Theory

Collective action is a very important driver in economics and has rightfully attracted a lot of interest from both economic theory and empirical analysis. The emergence of stable groups of like-minded agents is at the basis of the creation of institutions, of the provision of specific goods and services and in general of the progress of human society. If a strand of literature has focused more on understanding how to incentivize players to cooperate and form stable cooperative groups, there is still uncertainty regarding what fosters informal bonds that are common in everyday life in a setting of informal, unstructured interactions. When agents are not forced to join forces, which are the drivers that make them want to?

This paper is naturally framed in the context of cooperation and group formation research and represents an attempt to move forward in the investigation regarding the motivations for cooperative actions in *informal contexts*. In such environments interactions are sufficiently random and the probability of meeting the same person again is very low (or there is no possibility to precisely store information about previous encounters), thus there is very low possibility to resort to reciprocation. Moreover, informal contexts are characterized by the absence of biased interactions (Riolo et al., 2001), such as embedding agents in two-dimensional spaces (Axelrod, 1984; Lomborg, 1996) or other context-preserving networks (Cohen et al., 2001). Informality of the cooperation context can be also drawn from the presence of negligible direct or indirect costs (or their complete absence) for cooperating or participating in a group. These settings have been somehow less explored by agent-based literature, thus making them a challenging territory for both a theoretical and an empirical investigation.

The present work is characterized by an informal setting, and by a specific choice concerning the formalization of the *utility function* (further details are available in next section 3.4): it features both a material and a non-material component, where the former is constituted by an equal share of total individual contributions to the group, and the latter is based on similarity, and summarizes the idea of homophily as a driver of utility for the agents.

A lot of empirical evidence on the role of homophily has been provided by sociological and economic literature, showing how people prefer to connect, work, build relationships and play with similar individuals. Homophily has been explored in the literature across several dimensions like race, ethnicity, sex, age, religion, education, occupation -which refer to *status homophily*- and attitudes, abilities, beliefs and aspirations -which instead describe the *value homophily* (McPherson et al., 2001).

Empirical evidence supports the existence and role of homophily considerations. For instance, the study of Shrum et al. (1988), looking at race and gender differences shows how students of US high schools build friendships mostly among similar individuals.

In Lincoln and Miller (1979), it is shown also how work relations are affected by a selection bias due to homophily, resulting in highly homogeneous teams in terms of gender and ethnicity. The explanation given by the authors to the homophily bias in organizational processes is that: "Social homogeneity increases ease of communication and improves predictability of behavior, values which are central to organizational culture. Thus, [homophily] is nonetheless an expression of a rationalizing process - the need to eliminate uncertainty from organizational arrangements". In this sense, homophily considerations enter as an immaterial component in the utility function of organizations.

Studies focusing on value homophily have also shown that attitudes, deep beliefs, and values similarity lead to attraction and interaction (Huston and Levinger, 1978), as for example, in the tendency of adults to associate with those with similar political orientations (Verbrugge, 1977).

The idea that similarity may in some ways foster cooperation is not new, either in experimental economics or in agent-based literature. In the former, it stems from an evolution

of the experimentally founded fact that group identity or other forms of shared identity do support cooperative behavior among members (see Akerlof and Kranton (2000) for a seminal introduction to the role of identity in decision making) and increase uncooperative behavior among non-members (referred to as the in-group-out-group bias in Chen and Li (2009) and Sosis and Ruffle (2006)).

In this work we refer to a specific formalization of similarity, that of *salient value similarity*. This concept has been developed in the risk management literature, where it is used in a slightly different way, but its main message is carried over to the present work: salient value similarity has been consistently found as a precursor of *social trust* - trust regarding the institutions we live in.

Poortinga and Pidgeon (2006) describe salient value similarity as based on the idea that people use heuristics based on perceived similarities while making choices in complex environments, basing their judgments on the feeling that other persons or organizations have the same understanding of a specific situation. According to Siegrist et al. (2000) "Salient Values consist of the individual's sense of what the important goals (ends) and/or processes (means) are that should be followed in a particular situation" and are "an aspect of the individuals understanding of the meaning of a specific situation".

The idea of salient values will be introduced in this work as the carrier of individual characteristics on which cooperation can be built, alongside another parameter, called *general values* representing less stringent individual features that also affect, although to a minor degree, the perceived similarity across subjects. Through these two parameters we are able to endow members with multi-dimensional types. In fact, general values play their role in smoothing out partial differences in salient values: as an illustration, one can think about how cultural similarities (general values) may help in overcoming ethnic differences (salient values). This feature, to our knowledge, has not yet been proposed in the agent-based literature and has interesting implications for modeling cooperative and evolutionary processes somehow closer to reality.

As previously mentioned, the possibility of using similarity as a driver for cooperation is part of a significant strand of literature devoted to agent-based models (Edmonds, 2006; Kim,

2010). The evolutionary appeal of similarity has been established in the work of Riolo et al. (2001) and subsequent works by the same authors, which have shown in an evolutionary model with inheritable tags that similarity can indeed breed cooperation.

It is important to note that these results derive from setups in which homophily is based only on one dimension - there is one tag representing, for instance, only race or culture. Our setup improves from this state-of-the art proposing two dimensions of different nature: salient and general values. The introduction of a parameter summarizing general values, which typically cannot overcome the importance of extreme differences in salient values, is consistent with previous formalization of similarity found for instance in the mentioned Riolo et al. (2001), thus reinforcing the link between the present modeling exercise and the agent-based literature.

Given this general setup, the groups that emerge in our model can be described as resulting from voluntary interaction, deliberately formed without a formal structure and based on mutual recognition of membership -given by the similarity perception. The idea on which this paper is built draws from the possibility that group formation may be motivated by the reciprocal recognition of some shared individual features, a process of *similarity identification* able to overcome the tendency to refuse cooperation when the individual return to cooperative behavior is uncertain, perhaps because of different (or unknown) initial capabilities to contribute materially to the group.

Thus, our expectations are twofold: on one side, we expect to observe the emergence of groups of similar individuals able to overcome the risk of committing their resources to a group; on the other, we expect to find wealthier agents less willing to cooperate despite homophily preferences, due to the higher risk of being exploited by less wealthy individuals participating to the group.

Evidences about the detrimental effect of wealth differences on participation to cooperative groups are already present in the literature. For example, Lidenberg (1982), in his investigation of *sharing groups*, shows how "with increasing welfare per individual in a section of population, sharing groups will become smaller". Another similar conclusion is reached in the work by Hegselmann (1994), which discusses and presents the Humboldt's argument about the welfare state destroying networks of self-help through a modified version of the

Prisoner's Dilemma Game. Results show how the choice of cooperating in solidarity networks can become significantly less attractive if agents' wealth is beyond a certain threshold. In the work by Molinas (1998) it is discussed how empirical evidences about the effect of wealth differences on cooperation are still controversial, mainly due to the specific context in which studies are developed. But still, in his review, it emerges how the majority of studies agree on the harmful effect of wealth inequalities for the emergence of cooperative structures.

In the present work, we will analyze how preferences based on homophily considerations -which positively sustain cooperation- interact with contributions inequality -which, instead, have detrimental effect on participation-, and how the two are affected by changes of some parameters. In particular, we want to focus on participation levels resulting from the increment of the number of "races" and variety of "cultures" or the rate of information acquisition, and the introduction of a memory parameter for agents' previous choices -in the extended version of our model presented in section 3.4.1.

3.4 The model

In a nutshell, the model can be described as follows. A fixed number of heterogeneous agents are characterized by salient and general values. Agents consider the former as essential principles that are not subject to modifications or adaptation. General values, instead, are considered as less relevant issues. Groups are formed by agents that share their endowment, and give members a utility that increases with the size (the sum of individual contributions) and the overall similarity of the group.

In the presentation of the model, capital letters are assumed to denote quantities that stay constant, whereas small letters are assumed to denote variables that change with time.

Assume K agents have N salient values $S_{ij}, i = 1, \ldots, K, j = 1, \ldots, N$ and are given a non-perishable endowment $E_i, i = 1, \ldots, K$ that represents agent's potential contribution in joining a group. The stable, on-off nature of the salient values is stressed by supposing that they are drawn from the binary set $\{0, 1\}$ and denote with $\overline{S}_i = (S_{i1}, S_{i2}, \ldots, S_{iN})$ the vector of salient values of the ith subject. Agents are also equipped with general values that are

represented by a real variable $0 \leq V_i \leq \epsilon, i = 1, \ldots, K$ and ϵ is a scale parameter.

At any stage, agents can decide to stay alone or join one of the two groups: in the former case, they will keep their initial endowment, otherwise they will commit it as their individual contribution.

Each agent at time t can be a member of the first or second group or be on his own. Let $\mathcal{G}_t^1, \mathcal{G}_t^2, \mathcal{G}_t^0$ be a partition of $\{1, \ldots, K\}$ that keeps track of the choice of the agents at any given time t. In other words, $i \in \mathcal{G}_t^w$ if and only if the ith agent is in the wth group at time t (being the "zero-group" the set of people that decided to stay out of either group).

The participation to one group yields members utility through two components. The first one comes from the equal redistribution of the total contributions of the members of the group; the second is a non-material component that depends on the synergic interaction of the members that, in turn, is a function of the overall similarity of the characteristics of the agents (it can be thought as the benefit coming from homophily preferences).

Define a similarity function between agents i_1 and i_2 as

$$sim(i_1, i_2) = \sum_{j=1}^{N} \mathbf{1}(S_{i_1,j} = S_{i_2,j}) - \frac{N}{2} - (V_{i_1} - V_{i_2})^2.$$

The first term in the similarity function counts the number of equal salient values; the second term subtracts $N/2$, so that the sum of the first two terms is nonnegative when at least 50% of the salient values are concordant; finally, the third term is the squared difference of the general values of the agents.

It is worth noting that the two parameters N and ϵ are related to each other: for a fixed N, a larger ϵ increases the importance of general values with respect to the salient ones. This formulation of similarity allows to model the idea that people have homophily preferences and like being in a group with like-minded individuals, where this like-mindedness is measured along the two given dimensions of values -general and salient.

In our formulation, similarity increases with common salient values but (exclusively) decreases with more different general values. Hence, the higher ϵ with respect to N, the less

our agents will be willing to collaborate with other individuals, even in the presence of some consensus on salient matters.

As we will see later on, for our purpose, we set the parameters of our benchmark environment in such a way that even the complete disagreement on general values between two agents is more than compensated by the agreement on all salient values. This choice has been made to stress the relevance of salient values in the computation of similarity and, consequently, in terms of utility.

The utility of agent $i \in \mathcal{G}_t^w, w = 1, 2$ is then:

$$p_{it}^w = \frac{1}{|\mathcal{G}_t^w|} \sum_{i \in \mathcal{G}_t^w} E_i + \sum_{k \in \mathcal{G}_t^w, k \neq i} sim(k, i).$$

The two terms of the payoff incorporate on the one side, the fact that in a group "the more, the merrier"; on the other hand, it is of concern not only how many members there are, but who they are. The first term, $\frac{1}{|\mathcal{G}_t^w|} \sum_{i \in \mathcal{G}_t^w} E_i$, redistributes equal shares of the total amount of resources that all agents bring to a group: the decision to take part in a project implies an effort on the part of individuals and the risk of sharing one's own endowment to build the common pie that will be equally divided among all the participants. The second term, $\sum_{k \in \mathcal{G}_t^w, k \neq i} sim(k, i)$, adds to each agent's utility the total sum of the pairwise similarities. For each agent, this total sum can be considered as a measure of the overall coherence of the group, that results in a higher return in terms of synergies for all the members.

If $i \in \mathcal{G}_t^0$, the agent prefers to stay alone and his payoff for the current period is simply his own endowment E_i, i.e., $p_{it}^0 = E_i$.

The option to stay out, to join or leave one of the two groups is available, at no cost, at any time t. This setting represents the needed informality to model groups, defined without a formal structure (possibly acting within a more regulated environment). Agents' decisions will be based on partial information that is gathered at each time by randomly matching some members of groups (including agents "out" of any group). Hence, groups are dynamic structures that evolve and are shaped by in-group similarity and by the actions driven by the randomness of the matching process.

Being aware that utilities are stochastic and dependent on the fluctuating composition of the groups, at each time, every agent randomly and independently meets P other agents, exchanging information about the size of groups, the contribution and the similarity of the matches. This data are used to compute a myopic estimate of the utility of being in a given group.

Agents are myopic in the sense that they assume that the P agents they met are representative, in terms of values and contribution, of their whole group (i.e., they believe the sample has the same average value of similarity and the same average endowment of their group).

In particular, fix i and assume that $\mathcal{A}_t$ is the set of P agents that meet i. Let

$$\begin{aligned} \mathcal{A}_t^1 &= \mathcal{A}_t \cap \mathcal{G}_t^1, \\ \mathcal{A}_t^2 &= \mathcal{A}_t \cap \mathcal{G}_t^2, \\ \mathcal{A}_t^0 &= \mathcal{A}_t \cap \mathcal{G}_t^0, \end{aligned}$$

be the subsets of matched agents that are in three $\mathcal{G}_t$, where we drop the reference to i to simplify notation. The agent works out the average endowment of the members of each set and the average similarity with them. The aforementioned quantities $\hat{e}_t^w$ and $\hat{m}_t^w$ for $w = 1, 2$ are given by

$$\begin{aligned} \hat{e}_t^w &= \frac{1}{|\mathcal{A}_t^w|} \sum_{j \in \mathcal{A}_t^w} E_j; \\ \hat{m}_t^w &= \frac{1}{|\mathcal{A}_t^w|} \sum_{j \in \mathcal{A}_t^w} sim(i, j). \end{aligned}$$

Using this information, the ith agent can myopically estimate the utility that would result if he switches to one group, assuming the sample averages are representative of the whole group. Hence, estimated utilities in the three possible situations are

$$\pi_t^w = \hat{e}_t^w + |\mathcal{G}_t^w| \hat{m}_t^w, w = 1, 2$$

and

$$\pi_t^0 = E_i.$$

The utility of choosing to stay out is set equal to E_i, thus the always available exit option from an informal group corresponds to the sure alternative of keeping one's initial endowment. The reason why individual endowment is not affected positively or negatively by the participation (or lack thereof) in a group lies in the informality of the environment.

Nevertheless, agents exiting from a group are not able to keep the gains of the previous period, returning exactly to their initial state. This modeling choice wants to emphasize the fact that the benefits of being in a group come from the synergies among members and their pooling of resources. An agent who decides to stay on his own, exiting the group, can only count on its own resources.

At the end of period t, agent i chooses to move to another group or to abandon altogether any group based on the highest estimated utility. In more detail, agent ith will move to group w at $t+1$ if

$$\pi_t^w = \max\{\pi_t^1, \pi_t^2, \pi_t^0\}.$$

This simple setup, called *basic* in what follows, can be used to computationally study how groups emerge and evolve on the basis of the similarity in values, and how wealth heterogeneity affects levels of participation.

3.4.1 Extensions

As more refined forms of reciprocal influence among agents can be conjectured, an extended model can take into account *memory effects*.

Agents are likely to realize that better utility estimates can be obtained by blending past measures with the novel information derived from sampling. Hence, they update a running measure of the benefits arising from participating to each group and the ith agents takes the

decision to switch at time $t+1$ based on the highest among

$$\begin{aligned}
\widehat{\pi}_t^1 &= \alpha\pi_{t-1}^1 + (1-\alpha)\pi_t^1 \\
\widehat{\pi}_t^2 &= \alpha\pi_{t-1}^2 + (1-\alpha)\pi_t^2 \\
\widehat{\pi}_t^0 &= E_i,
\end{aligned}$$

where $0 \leq \alpha \leq 1$ is a memory-related coefficient. The basic setup can immediately be recovered by setting $\alpha = 0$ and the parameter α represents agents' memory, or stickiness: when $\alpha \cong 1$, agents will compute their estimates mainly using their previous results whereas for values of α close to zero, agents will rely more on their novel information.

It can be argued that the introduction of a memory parameter could be traced back to some forms of indirect reciprocity: in our opinion this is not the case, since its formalization do not allow to store precise information about other group's members and the estimation of future payoff is still myopic in this respect.

In the next sections, we will refer to the memory-extension as the *extended version* of the model.

Another promising avenue of investigation is offered by introducing the possibility of a contamination processes among cooperating agents, concerning their cultural traits. In fact, agents may reasonably be willing to adapt their general values which, by definition, are more volatile and possibly can be modified to better fit the general values of other members of the group. Thus, the multi-dimensionality of of this setup offers the chance to have semi-moving types in which salient values represent the unchangeable traits of agents. Preliminary results on the effects of the contamination processes are shown in Cruciani et al. (2013), where general values evolve towards the group members' average value depending on the time spent cooperating in the same group.

3.5 Results

This Section presents the simulation results for the basic and extended versions of the model, as described in Section 3.4.

It is difficult to give full account of a dynamic process like the one modeled in this paper using only static pictures and tables. Thus, selected movies and animations are available at `http://multimedia.dma.unive.it/groups/abmc/`. In this paper, results are presented in a specific instance in order to give the flavor of the main dynamics. The results of multiple simulations are then summarized in table form to provide a more comprehensive look at the average properties typically present in a large sample of groups that are generated for a given constellation of parameters' values.

Table 3.1 shows the reference, or benchmark, values for the parameters that define a reasonable starting point for our investigation. These values were determined by trial-and-error and then modified, one at a time, to assess the incremental effects of single parametric variations.

Name	Value	Description
K	50	Number of agents
N	2	Number of salient values
ϵ	1.0	Amplitude of general value
P	2	Number of agents sampled (in computing expected utility)
α	0.0	Memory (in estimating expected utility)
T	200	Periods
$\overline{E}$	10	Average initial endowment

Table 3.1: Parameters of the benchmark environment.

A number of 50 agents is considered, with 2 salient values and a real variable uniformly sampled in $[0, 1]$ summarizing their general values. Each run of the model lasts 200 periods and, unless stated otherwise, endowments of agents are uniformly sampled in the interval $[0.5\overline{E}, 1.5\overline{E}]$, where $\overline{E} = 10$.

3.5.1 The Basic Model

This Section reports results of simulations with the Basic formulation of the model. In particular, no memory is used by agents (i.e., $\alpha = 0$).

The left panel of Figure 3.1 depicts the time series of the number of participants belonging to each group (labeled with different colors, with green indicating individuals staying out of either group). The right panel shows the average utilities of the members at each given time.

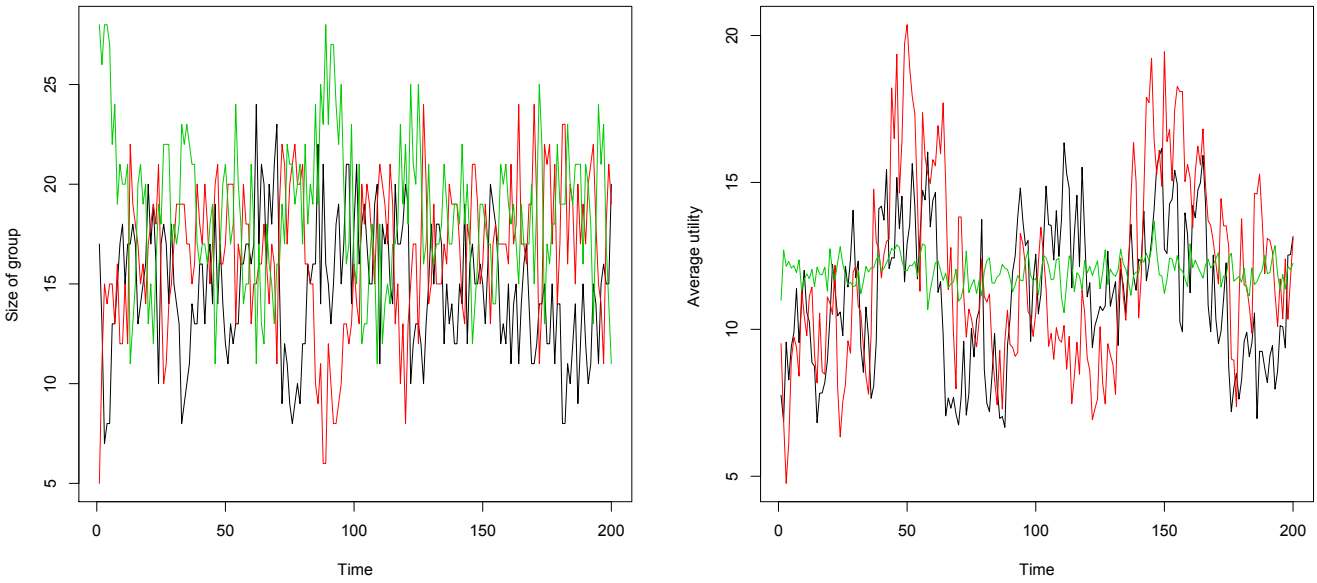

Figure 3.1: Time series of the number of members (left) and average utility (right) for each group. Black, red and green lines denote the first, second group and the number of those who stay out, respectively.

The sizes of groups fluctuate widely: out of the 50 agents populating the model, the number of members of one group frequently goes from over 20 to well below 10.

The reason of such marked fluctuation of groups' dimension is rooted in the volatile process of gathering information and in the resulting decision to join or abandon the groups they were in. The explorative nature of the group formation process is such that, interestingly, around period 90 most agents desert groups to stay on their own, as the green line clearly shows.

The average utility of group members is not strictly related to the size of the groups, as

the right panel of Figure 3.1 shows but, again, varies widely. While staying outside of any group yields roughly 12 on average, joining the second group around periods 50 or 150, say, produces a hefty utility close or even bigger than 20.

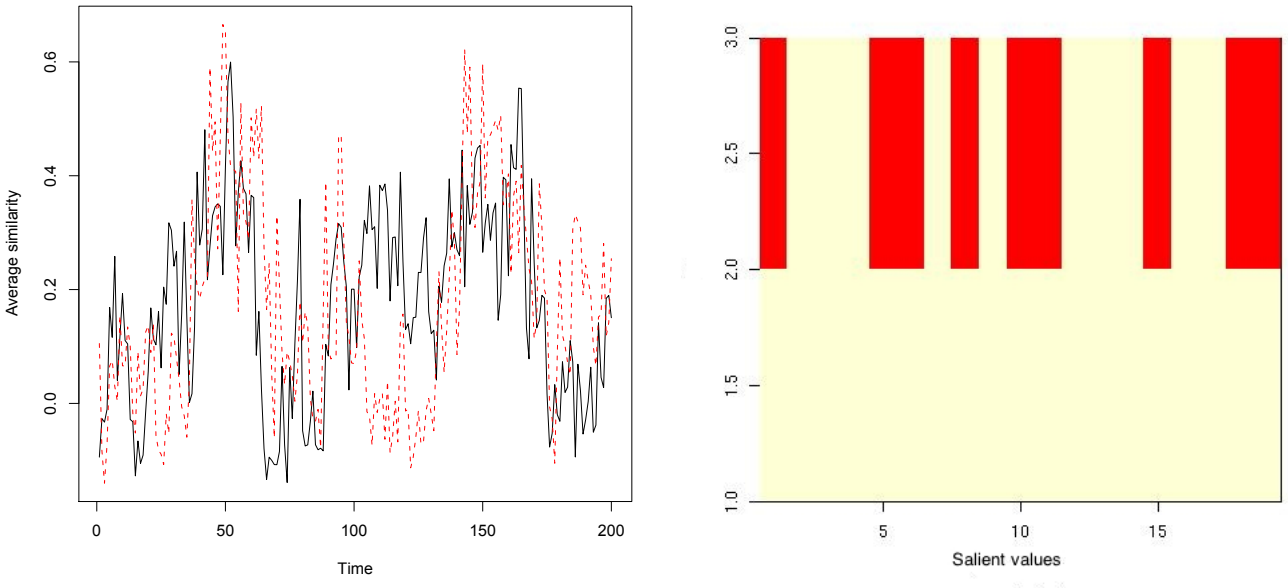

Figure 3.2: Average similarity of the first (black) and second (red) groups (left). Salient values for group 1 members, yellow and red denoting "1" and "0", respectively (right)

The left graph of Figure 3.2 depicts the average similarity of the members of the two groups. This quantity will be referred as *coherence* of the group in the following. Although there are significant variations in the average similarity over time, there are periods, like $t = 50$ or $t = 150$, where agents are grouped into fairly homogeneous groups.

The right panel of the figure represents the salient values of the members of the first group at time 154, when its coherence peaks around 0.55. The bits are color-coded, with yellow and red denoting "1" and "0", respectively. The picture shows that every member, at that time, shares at least one salient value (out of two) with every other peer, thus explaining the large average similarity.

A plot of the similarity matrix is a useful tool to shed further light on the dynamics of the groups, in terms of size and internal coherence. Figure 3.3 shows two color-coded similarity matrices, relative to periods 50 (left) and 87 (right). In the matrices, members of

the first, second and stay-out group are sequentially appended, and the (i, j) entry of the matrix represents the similarity of agents i and j, with yellow (red) denoting large (small) values. The first group is then shown on the bottom-left corner of the matrix whereas the second group is usually visible in the central part of the matrix, along the main diagonal. The upper-right corner represents the agents that do not belong to any group.

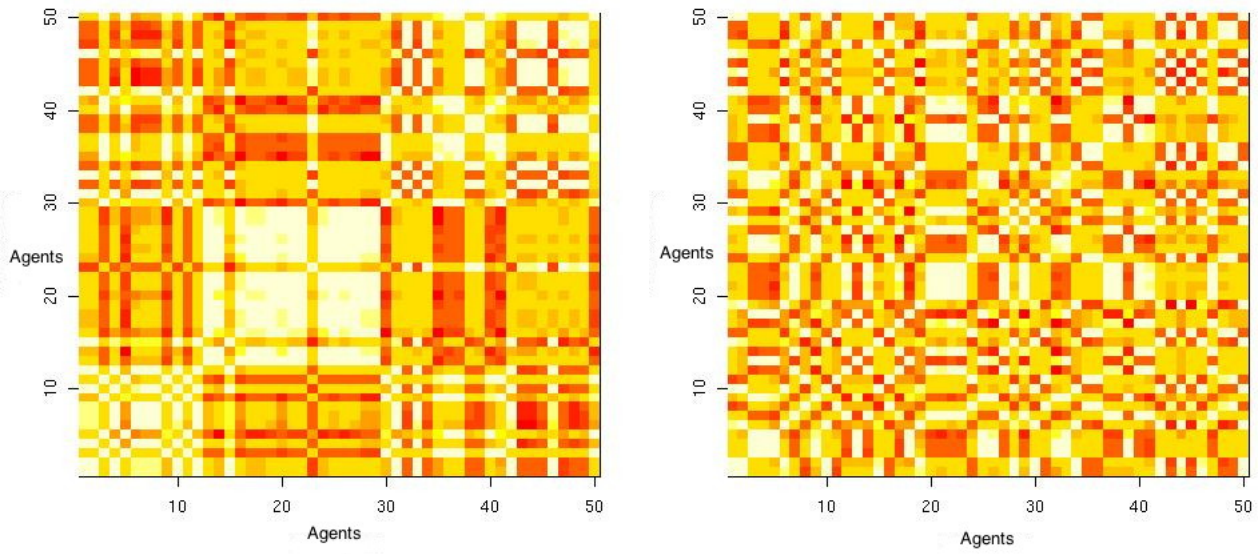

Figure 3.3: Similarity matrices at times 50 (left) and 87 (right). The hue of entry (i, j) smoothly blends from bright yellow to dark red as the similarity decreases.

The left panel shows the situation in period 50, where a homogenous second group can clearly be seen in the bright block of entries $\{(i, j) : 13 \leq i, j \leq 29\}$. The first group appears to be made of less uniform agents in the bottom-left corner, where $1 \leq i, j \leq 12$. The previous figures show that sizes at time 50 are 12 and 17, with average similarities of 0.42 and 0.65 and average utilities of 12.92 and 20.37.

The right panel of Figure 3.3 displays the similarity structure at time 87 when, basically, groups are dismantled and agents are still in the way to form uniform groups. The first and second groups are barely visible despite their 14 and 11 members, the average similarities are -0.08 within both groups and, hence, the utilities are (only) 7.03 and 7.29, respectively. The difference in the two plots of Figure 3.3 visually confirms the general outcome that there is a remarkable time-variability in the groups that emerge in a single simulation.

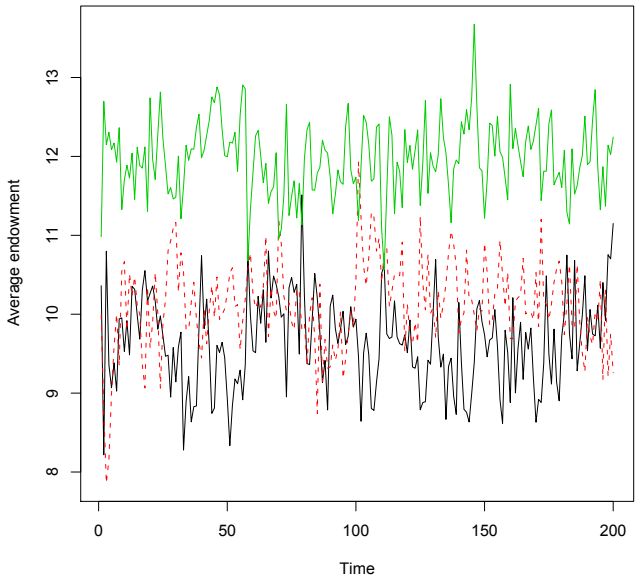

Figure 3.4: Average contribution of groups members: black, red and green lines refer to the first and second group and to those who stay out.

Figure 3.4 shows the time series of average contributions of the members of the groups. Typically, the endowments of agents that join in groups are smaller than the ones belonging to agents that opt to stay out. This result, depicted in a specific instance in Figure 3.4, is a very robust feature of the model (also with different configurations of parameters) and nicely matches already discussed results from previous studies (Lidenberg, 1982; Hegselmann, 1994; Molinas, 1998).

Multiple Simulations

This section is dedicated to the description of more general features of the groups generated by the model as we change the level of some key parameters.

We run 100 independent simulations and measure the average size of both groups, labeled generically "small" and "large", together with the average size of the set of agents that decided to stay out, in order to discuss participation levels as some parameters change. Moreover, we compute the average *coherence* of the groups, the fraction of times in which the largest

group changes (Sw), the average contribution of members (E) and their average utility (π). The last two values are normalized with the average endowment of the population $\overline{E}$. When computing any time-average, we discard the first 50 periods that are possibly affected by transient initial effects.

The first analysis concerns P, the number of individuals each agent randomly and independently meets when computing the expected utility of joining a different group, which proxies the level of information that can be acquired within the population.

P		Size	Cohe	Sw	E	π
	Small	14.65	0.12	0.26	0.93	1.00
1	Large	16.74	0.18	-	0.94	1.14
	Out	18.60	-	-	1.11	1.11
	Small	15.58	0.29	0.34	0.94	1.29
2	Large	18.79	0.38	-	0.95	1.56
	Out	15.63	-	-	1.12	1.12
	Small	16.90	0.43	0.22	0.94	1.57
4	Large	21.65	0.43	-	0.96	1.79
	Out	11.45	-	-	1.14	1.14

Table 3.2: Time-averaged quantities for different values of P.

The first panel of Table 3.2 shows, for example, that when agents sample $P = 1$ peer in each period, the smallest (largest) group has an average of 14.65 (16.74) members. The group of agents that stay out is normally larger (18.60 members) and the largest group changes on average every 4 periods (26%). Moreover, members of both groups are relatively poor, as shown by their endowments which is 93 or 94% of the average endowment of the population. The payoffs of agents belonging to either group is, however, substantially larger as they get a utility that is 100 and 114% of the average endowment of the population. Subjects that do not participate to groups are richer on average (1.11) and, by definition, get exactly the very same payoff.

The other panels show that the sizes of the groups are increasing in P. This result is likely to be related to better decisions taken by agents when a larger sample size is allowed for. This interpretation is corroborated by the higher utility for members of both small and large groups that is due in turn to the increased coherence of both groups.

The second parameter studied is ϵ (Table 3.3), the upper bound of the real variable rep-

resenting general values of the population. Notice that the second panel, relative to the benchmark case where $\epsilon = 1.0$, is exactly the same as in Table 3.2.

ϵ		Size	Cohe	Sw	E	π
	Small	16.37	0.23	0.33	0.93	1.20
0.5	Large	18.51	0.27	-	0.94	1.35
	Out	15.13	-	-	1.14	1.14
	Small	15.58	0.29	0.34	0.94	1.29
1.0	Large	18.79	0.38	-	0.95	1.56
	Out	15.63	-	-	1.12	1.12
	Small	10.02	-0.03	0.26	0.88	0.72
2.0	Large	12.78	-0.01	-	0.92	0.81
	Out	27.20	-	-	1.08	1.08

Table 3.3: Time-averaged quantities for different values of ϵ.

The Table shows that there are values of ϵ for which the coherence and size of both groups drops dramatically. When $\epsilon = 2.0$, the disruptive diversity in the general values is such that joining a group is actually harmful in terms of utilities (as the beneficial similarity in salient values is too weak and few reasons are left to call them "salient" in such a situation).

Once again, we find that richer individuals tend to remain out of the groups, looking at the average endowment of the stay-out group. Not surprisingly, the number of people choosing not to join either group increases with ϵ, for the reasons we have just discussed.

N		Size	Cohe	Sw	E	π
	Small	19.06	0.36	0.16	0.95	1.57
1	Large	25.32	0.36	-	0.99	1.84
	Out	5.61	-	-	1.17	1.17
	Small	15.58	0.29	0.34	0.94	1.29
2	Large	18.79	0.38	-	0.95	1.56
	Out	15.63	-	-	1.12	1.12
	Small	16.49	0.10	0.29	0.96	0.96
3	Large	18.34	0.12	-	0.97	1.04
	Out	15.18	-	-	1.06	1.06

Table 3.4: Time-averaged quantities for different values of N.

The last parameter studied is N, the number of salient values of agents (Table 3.4). As N grows, it is more difficult for agents to join the "right" group, given that in the current version they can choose between two groups only. As an example, the combinations of salient values can be interpreted as four different ethnic groups such as White, Blacks, Asian and

Latinos. The problem of cooperation arises from having the possibility to join only one of the two available organizations, which cannot perfectly resemble racial divisions. We feel this is a realistic feature of the model that would otherwise yield trivial results if the number of groups could accommodate all the different types with negligible discordance. As a result, Table 3.4 shows how the average coherence and utility decrease as the number of salient values increases.

From the joint inspection of Tables 3.2, 3.3 and 3.4, it appears that there is not a clear relationship between the switching measure Sw and P, N and ϵ. Such a link will instead be stronger in the model presented later.

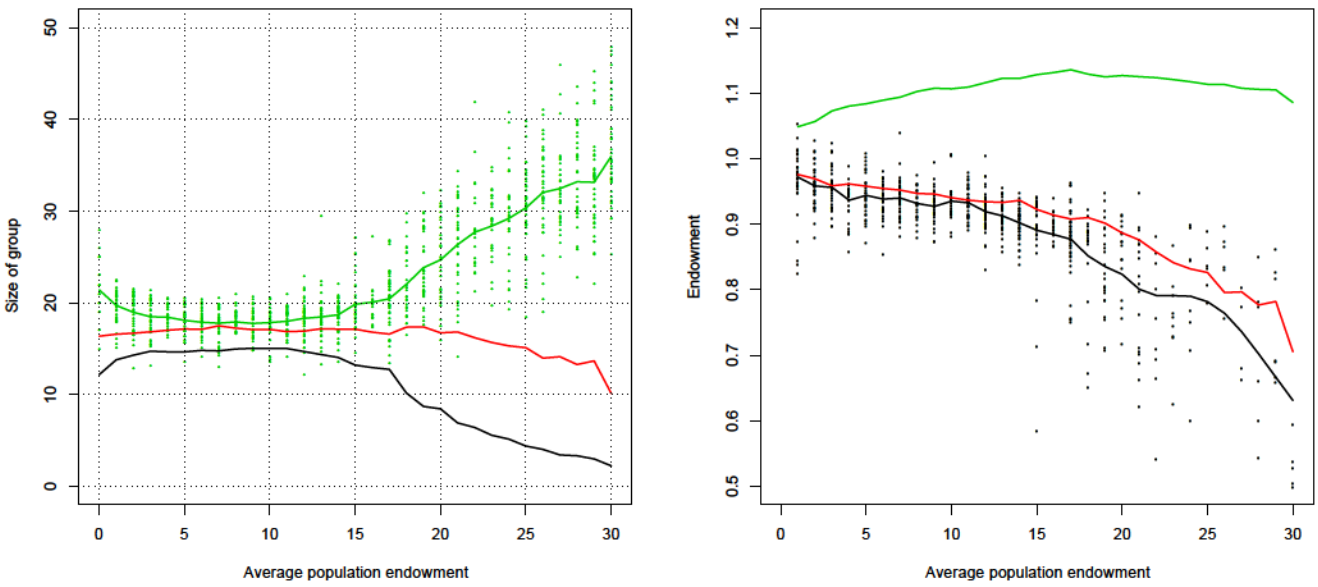

Figure 3.5: Size of groups (left) and average contribution of members (right) as a function of the average endowment of the population $\overline{E}$. Black, red and green lines refer to the small and large groups and to those who stay out, respectively. The figure is based on 1000 simulations with a randomly sampled $\overline{E} \in \{0, 1, \ldots, 30\}$. Variations are shown only for group "out" (small) in the left (right) panel, for clarity of exposition.

It is interesting to further explore the joint effect of the two components of the utility. Recall that one part is merely the equal share of the sum of the members' contributions, whereas the second (social) component is related to similarity. Figure 3.5 shows how the average size and the contribution of groups depend on the average endowment $\overline{E}$ of the population. Keeping fixed the other parameters, a larger (smaller) $\overline{E}$ makes joining a group less (more) convenient

on a relative basis, as the profit from interaction is a little (substantial) part of agents' wealth. It is interesting to note that for the case $\overline{E} = 0$, the agents' utility is determined purely by the non-material part, thus the choice of joining or not is driven exclusively by their evaluation of similarities.

The left panel of the Figure 3.5 shows that, as expected, an increase in the endowment pushes more agents to choose to stay out. The size of the two groups declines and, at the same time, the average endowment of the members of the groups shrinks, as can be seen on the right panel. In other words, a larger average endowment in the population reduces the size of the groups, which end up in attracting fewer and poorer agents.

Synergies here defined can be thought both in terms of benefits coming from homophily preferences (liking to be in a group with like-minded individuals) and, borrowing from a recent survey by Mesterton-Gibbons et al. (2011), in terms of the ability of a group to expand the pie of payoffs accessible to agents. The previous results show that N, ϵ, as well as $\overline{E}$, all have an impact on the immaterial part of the utility of the groups generated by the model. This outcome appears to be sensible, as the number of salient values in common is likely to shape the willingness of agents to join together with the (possibly adverse) effect of general values. At the same time, wealthy populations with large $\overline{E}$ reap relatively little benefits from grouping and ultimately stay out, whereas smaller average endowments push agents to join in order to increase their utilities.

3.5.2 The Extended Model

This Section describes the case in which agents have some memory, characterized by a coefficient $\alpha > 0$, and estimate utility using a weighted average of past utilities and inferred information based on P samples.

As for the previous model, we first present a specific run and then aggregate many simulations to provide large-sample evidence of typical behavior.

Let the parameters be given as in Table 3.1, with the exception that $\alpha = 0.4$. Figure 3.6 shows the size and average utilities of the three groups. The presence of memory produces a

large and stable group (red line) that is always dominant in size and quite often yields the highest average utility. The smallest group (black line) includes roughly 10 members, leaving on average 15 agents on their own (green line). The right panel shows, if the initial transient is discarded, approximately steady utility for all groups.

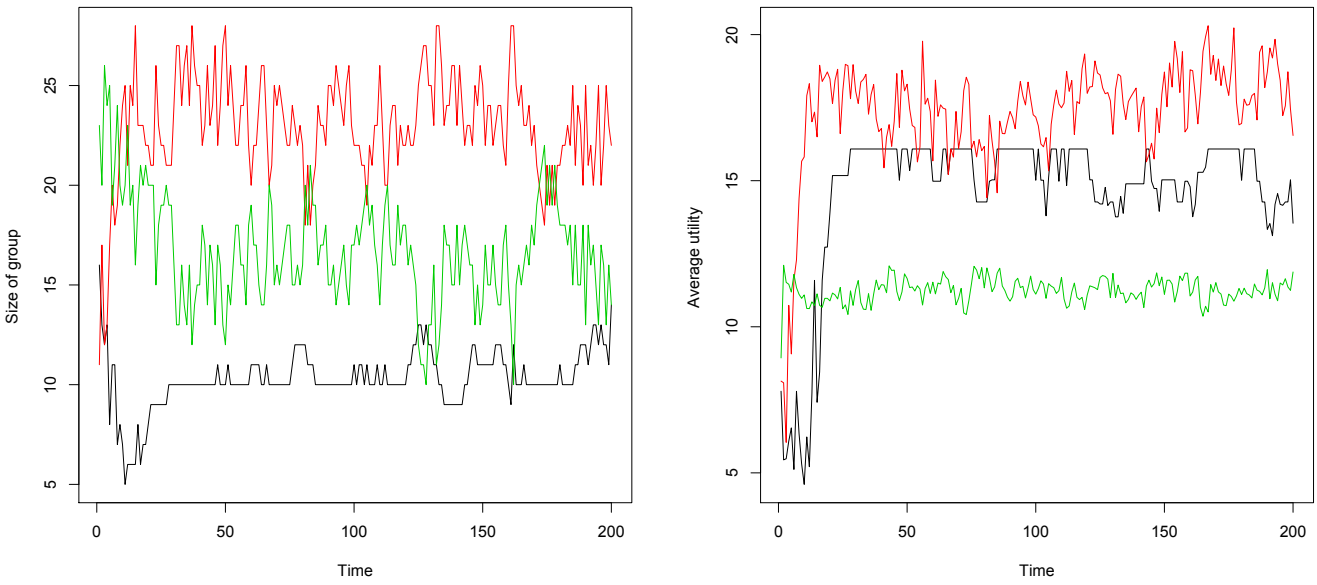

Figure 3.6: Time series of the number of members (left) and average utility (right) for the three groups when the memory coefficient is $\alpha = 0.4$. Black, red and green lines denote the Small, Large and Stay-out group, respectively.

In particular, the performance of the small group in terms of utility is relatively good, taking into account the difference in size with the dominant one. This is due to the internal large coherence of the smallest group that counterbalances its small size. Consistently with this result, we report that the average coherence of the two groups are 0.40 and 0.78 in this specific simulation.

The left panel of Figure 3.7 shows the similarity matrix of agents in period 160. There is a small but extremely coherent first group on the bottom-left corner and a larger second group characterized by less similar agents, as shown by several darker hues. The relative stability of the groups that are formed with such a level of memory translates into a higher degree of similarity that lasts over a number of periods.

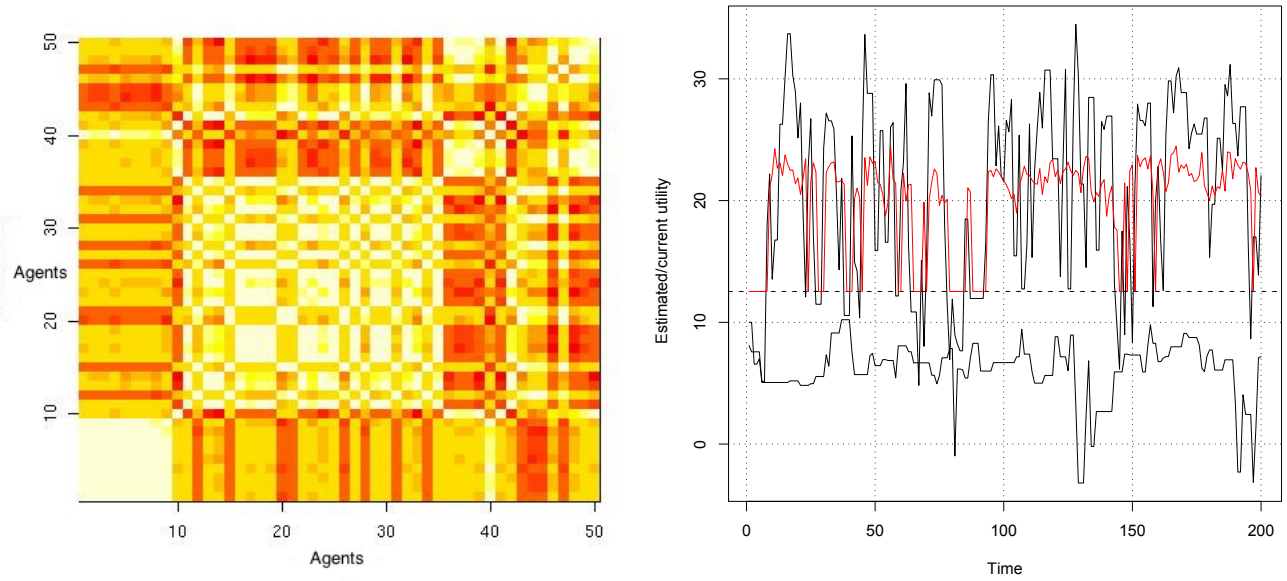

Figure 3.7: Similarity matrix in period 160 when $\alpha = 0.4$ (left panel). Time series of the estimated utilities q_t^1, q_t^2 for a given agent (right panel). Actual utility and endowment of the agent are shown with red and dashed lines respectively.

The right panel of Figure 3.7 displays several statistics for a specific agent whose endowment, equal to 12.53, is shown as a dashed line. In particular, the upper (lower) black line shows the estimated utilities of joining the second (first) groups. The red line, often superimposed on one of the previous estimates, depicts the utility actually enjoyed by the agent.

This individual mostly joins the second group, occasionally staying alone for brief periods. Clearly, the estimated utility to be in the first group (lower black line) never exceeds his endowment or the perceived benefit to join the second group (upper black line). Hence, the agent frequently stays in the second group, inflating his utilities that would have been much lower if alone or in the other group.

As this example shows, introducing some memory allows agents to act correctly even if their decisions are based on a myopic estimate. In fact, the estimated utility for joining the second group is a reasonable guess of the actual outcome, given the fact that only $P = 2$ agents are sampled in each period. In other words, a positive α improves the quality of the estimates, reducing their variance, even in a myopic setting.

Multiple simulations

This section describes the more general features of the groups generated by the model once a memory parameter has been introduced. The structure of the presentation of the results mirrors the one of the previous Section, in which no memory was present, and, when computing any time-average, we discard the first 50 periods to avoid transient initial effects.

α		Size	Cohe	Sw	E	π
	Small	15.00	0.31	0.27	0.92	1.28
0.1	Large	18.63	0.37	-	0.95	1.54
	Out	16.37	-	-	1.12	1.12
	Small	16.27	0.47	0.19	0.92	1.56
0.4	Large	20.81	0.45	-	0.96	1.79
	Out	12.92	-	-	1.15	1.15
	Small	13.73	0.57	0.05	0.85	1.45
0.8	Large	24.56	0.43	-	0.96	1.88
	Out	11.70	-	-	1.18	1.18

Table 3.5: Average dynamics for different values of α.

Table 3.5 shows the changes in key variables for three levels of the memory parameter α. As α grows to 0.4, the size, coherence and average utilities increase significantly for both groups. When α grows to 0.8, it is in particular the large group that benefits from this change, attracting a much larger number of individuals. In both cases the number of agents deciding to stay out, instead, decreases markedly, but they remain the wealthiest group in the population. Coherently with the results of the basic model, the members of the large group always achieve a larger utility on average. Moreover, being in a group is always better than remaining out even in this extended model.

Some memory appears to have long-lasting effects in that more stable groups are formed. This is confirmed by a dramatic drop in the switching rate pointing out that a dominant group quickly builds and persists for most periods.

3.6 Discussion and conclusion

We presented an agent-based model of groups in informal settings, in which cooperation is constructed through the flexible concept of perceived similarity. In our model, agents decide whether to join or abandon one of two possible groups, without any cost - due to the informality of the setting. At the end of each period, utilities are computed on the bases of the size of the group ("the more, the merrier") and the overall similarity of the group ("the more coherent, the better").

An innovative aspect of our model is the characterization of agents with some personal features, called *salient* and *general* values, which combine into what we called agents' multi-dimensional types: the former represent agents' characterizing traits (for example, race), whereas the latter describe agents' position about negotiable issues (which can be interpreted as agents' culture). Together with agents' (heterogeneously distributed) endowment, similarity in values drives successful or unsuccessful cooperation. Individuals will cooperate, joining forces and sharing resources, if they perceive the group can increase their utility, which has two components: the average contribution of the group, and the sum of all pairwise similarities. The latter component represents the immaterial utility of being in a group with people one likes -reflecting homophily preferences- as they share a combination of common values.

The model reproduces some known stylized facts, like the higher likelihood of poorer agents to join (Molinas, 1998; Lidenberg, 1982), and can be used to describe and interpret empirical examples of stable cooperative groups without direct or indirect reciprocity among members, or shadow of the future considerations.

The basic formulation of our model aims at contributing to the strand of literature dealing with the evolution of cooperation based on peers' similarity. The evolution of cooperation based on agents' common features has recently received some attention in agent-based research, mainly because it seems to better represent real situations. Specifically, much attention has been devoted to the research on homophily, which explores how perception of similarities between individuals can foster cooperation sustaining trust-building processes (without the introduction of incentive schemes or reciprocity concepts).

The work of Riolo et al. (2001), for example, has shown in an evolutionary model with inheritable tags that similarity can indeed breed cooperation. Our model is consistent with their formalization of similarity, which is enriched by multi-dimensional types that would allow for a "contamination process" keeping agents' characterizing traits immutable. Indeed, the distinction between general and salient values, where salient are unchangeable binary values whose importance can never be overcome by the parameter summarizing general values, leads to a sophistication of the concept of similarity towards a better representation of "real" economic agents.

The introduction of a memory parameter, in the extended version of the model, shows that the fewer agents deciding to stay out are still characterized by higher endowments than the rest of the population. More interestingly, some memory leads to the formation of more stable groups, with very low rates of switching and the presence of a dominant and persistent group for most of the periods.

There are a number of limitations in our work that point to potential avenues for future developments. Focusing on what we perceive are the most interesting issues, we plan to work on adaptation of general values and endogenization of the number of possible groups and of the memory coefficient α.

Assuming a fixed number of groups and a predetermined memory coefficient has clear shortcomings and may be inappropriate in certain circumstances. Some of the results suggest that the endogenization of α could be obtained letting agents choose which is the optimal level of memory they should have (with respect to their own characteristics) in order to maximize expected utility.

Moreover, standard clustering algorithms could be used to establish benchmark groups of agents that can be compared with the groups produced by our model of social interactions. Preliminary results (not shown here) point to subtle but persistent differences in the clusters/groups obtained with the two methods and suggest that this fact may be due to potential synergies among agents that are only captured when the similarity perception is used by agents in a dynamic way. This could have interesting potential applications in interpreting empirical facts, or even suggesting new solutions in a wide range of environments, such as

business organizations or socio-economic institutions.

One last point deserves mention. Although our setting does not currently allow for the emergence of trust in its most standard way, the introduction of salient values as a medium to facilitate cooperation certainly goes in the direction of investigating what ultimately motivates trust-building processes. In the model described in this paper, there is no possibility for trust to emerge, as agents do not recall specific characteristics of other agents, but simply sample and make inferences on the average similarity of the group. Nevertheless, the perception of similarity even with respect to a group of indistinguishable individuals is enough to foster more cooperative behavior, facilitating the emergence of profitable groups. This points to the need of further understanding what is the exact relationship between similarity and trust building, which could become a potential avenue for further development of the current model.

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