Altruism without reciprocation in children*

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Abstract

The focus of this paper is on altruism and coordination among children. A special form of altruism (ethical altruism) is investigated by means of experiments. The definition of altruism used here follows from A. Sen's concept of *obligation*, i.e. behaviour that produces advantage for someone whose welfare is not important for the agent's well-being. In this sense, the paper investigates altruism *without reciprocity*. The experiment discussed was originally developed to test adult behaviour, whereas the experimental subjects in this case are two samples of children aged respectively 9 and 12 years old. The aim of the analysis was to verify whether the findings of the previous experiments with adults were confirmed when the subjects were much younger.

* The first results from a pilot experiment originally developed by the present writer were used by Barbara Ferro for her degree thesis, of which I was the supervisor. Assistance in the construction of the pilot experiment was provided by Barbara Ferro herself, who designed the puzzle and by the staff of the Experimental Economics Laboratory of the University of Trento, and in particular by Marco Tecilla, who subsequently wrote the software used to conduct the final version of the experiment to which this paper refers. My especial thanks go to Dominique Cappelletti and Ivan Soraperra for their helpful support both in the practical conduct of the experiments and in the statistical analysis of the results. A special thank goes to the teachers and the pupils of the school Crispi and Bresadola of Trento for their participation. Of course, responsibility for any errors or omissions is entirely mine.

1. Introduction: altruism without reciprocation

This paper is the third of a series (Mittone, 2002, 2003)[1] which investigates the spontaneous onset of altruistic behaviours within small groups of people. All these papers are grounded on a specific definition of altruism first suggested by Sen (1986) which I shall here call *ethical altruism*. Following Sen, there is only one cooperative, individually expensive, behaviour that can be considered as non self-interested. This non selfish behaviour is defined by Sen as "obligate" in the sense that agents are compelled to behave in favour of someone else by some form of moral obligation. More precisely, the difference is between behaviours produced by "sympathy" and by obligation. Feeling sympathy for someone means deriving some personal utility from her/his welfare, so that a costly action motivated by sympathy is not altruism but a rather sophisticated form of selfishness. More detailed discussion of Sen's definition of non egoistic behaviours is conducted in the papers just mentioned (Mittone, 2002, 2003).

Another form of spurious altruism is represented by behaviours induced by reciprocation. Most, if not all, co-ordination/cooperation games imply some form of reciprocity, either negative and/or positive. Repeated prisoners' dilemma games (experiments) are typical examples of individually risky cooperation (not choosing the Nash equilibrium choice means taking the risk of obtaining a worse payoff) motivated by the fear of being punished by the others (negative reciprocation) or by the expectation of receiving a reward? (positive reciprocation). When some form of reciprocating mechanism, either negative or positive, is embodied in a game, the agents cannot be seen as behaving altruistically, not even when they choose the Pareto dominant strategy – i.e. the choice most oriented towards a collective welfare – because they are in some way constrained by the others, who are able to punish them. The well known tit-for-tat strategy (Axelrod, 1984) is a good example of a Pareto efficient outcome 'forced' by the fear of a reprisal and therefore not attributable to the spontaneous onset of altruistic behaviour.

Similarly, also experiments on the voluntary provision of public goods with repeated choices may give rise to some form of reciprocation (Fischbacher, U., Gächter S., and Fehr E., 2001). Not surprisingly, these kinds of experiments are comparable to the prisoners' dilemma or to the game of chicken, as pointed out by Ledyard (1995, p. 144): "*Without a threshold the voluntary contributions mechanism is usually a prisoners' dilemma game; with a threshold it becomes a game of chicken*".

[1] Some parts of the present paper are taken from Mittone, 2003.

The literature on public goods experiments is very wide-ranging, and it is also very difficult to organise. Put more precisely, and once again quoting Ledyard (1995, p. 112), "*it is difficult to identify a typical public goods experiment. ... there are as many variations in procedures and treatments as there are research groups*". The only characteristic shared by the majority of experiments on public goods is that the subjects do not know the others' individual contributions but always know the total contribution. In a repeated choices context, knowing the total contribution, round by round, enables the player? to punish or to reward the group by increasing or decreasing her/his individual contribution over time. Not surprisingly, most public goods experiments with repeated choices display a decreasing rate of contribution (e.g. Isaac, Walker and Thomas, 1984; Isaac, McCue, and Plott 1985; for an extensive review of this literature see the already mentioned Ledyard 1995).

The progressive increase of free riding over time (widely discussed by the literature but still not explained unanimously) may be due to the negative reciprocation mechanism that has induced the subjects to react negatively to a collective contribution which is lower than expected. Imagine a situation where a subject contributes a sum which is 60% of the maximum in round 1, and then, at the end of the round discovers that the total contribution of the group has been 40%. It is likely that in round 2 s/he will decide to contribute less, possibly a sum close to 40% of the maximum, thereby "punishing" those who are free riding more than her/him. On the other hand it is quite unlikely that the opposite can happen. In other words, if the subject discovers at the end of round 1 that the group has contributed an amount close to her/his contribution, there is little chance that s/he will increase her/his contribution, because s/he may reasonably think that the others are individually behaving in the same way as s/he is behaving. This obviously happens only in very special cases: most of the time there is quite high variance in behaviours and therefore **there will be someone who will fall in the situation initially described** [non capisco].[2]

On the other hand if the subject has contributed less than the group and therefore decides to increase her/his contribution, we are back to the other form of reciprocity, i.e. positive rather than negative reciprocity. The onset of a positive reciprocation effect, instead of a negative one, should produce virtuous results, but with a lower degree of stability because it only needs someone in the group to start free riding in a marked manner for the positive reciprocation cycle to weaken, giving rise to some form of fluctuation. In fact, some experiments (Isaac, Walker and Williams, 1990; Palfrey and Prisbrey, 1993) report that

[2] The situation depicted here has some analogies with the discussion on the effects produced by modifications of the marginal per capita return: see Ledyard 1995 for a review.

repetition has no effect, i.e. there is neither an increase nor a decrease in the average rate of contribution.

To find experiments that analyse situations comprising behaviours coherent with our definition of pure altruism, we must look at the one-shot game family, to which the well-known ultimatum game belongs.

Although the ultimatum game was the forerunner of its genus, it cannot be considered a game free from reciprocation. In the ultimatum game there is a subject that plays the leader role by offering to a subordinate partner a fraction of a sum of money that s/he has received from the researchers. The subordinate partner can only accept or refuse the leader's offer. If s/he refuses, both players lose the reward and obtain a zero payoff. When the leader behaves in an apparently altruistic way, giving the subordinate an amount of money higher than the minimum (a situation that arises very frequently in experimental contexts: see e.g. Güth et al. 1982, or Roth et al. 1991), this may be due to the special relationship that ties her/him to her/his partner in the game. The dictator's partner, in fact, is able to inflict severe damage on the dictator simply by refusing to accept her/his decisions, and in this way reducing the dictator's payoff to zero. Egoistic behaviour is therefore once again very risky because negative reciprocation is at work.

The only games that seem able to isolate the phenomenon of ethical altruism unconstrained by the fear of reprisal are the 'dictator game' and the 'impunity game', which are both variants of the 'ultimatum game'. In the dictator game, too, a leader player (the dictator) receives a given sum of money and must decide how much to give to her/his subordinate partner. This time, however, the subordinate cannot refuse. Note that considering the dictator game to be a 'game' is misleading because it involves a purely individual choice problem: one, that is to say, without complications of a strategic nature due to interaction with other agents.

Finally, the impunity game (Bolton, Katok, Zwick, 1998) is very similar to the dictator game, with two differences. The first is that the dictator must choose between two possible ways to split the prize: keep most of it but leave a substantial part for the partner, or divide it into two equal parts. The second difference with respect to the dictator game is that in the impunity game the dictator's partner may decide to reject the offer even if this option – as in the dictator game – does not have consequences for the dictator, who in any case collects her/his prize.

A survey of the main results from experiments using the dictator and the impunity games is contained in Bolton, Katok and Zwick (1998), to which the reader is referred for details. Here I shall merely point out some of the features and shortcomings shared by experiments which have used these games.

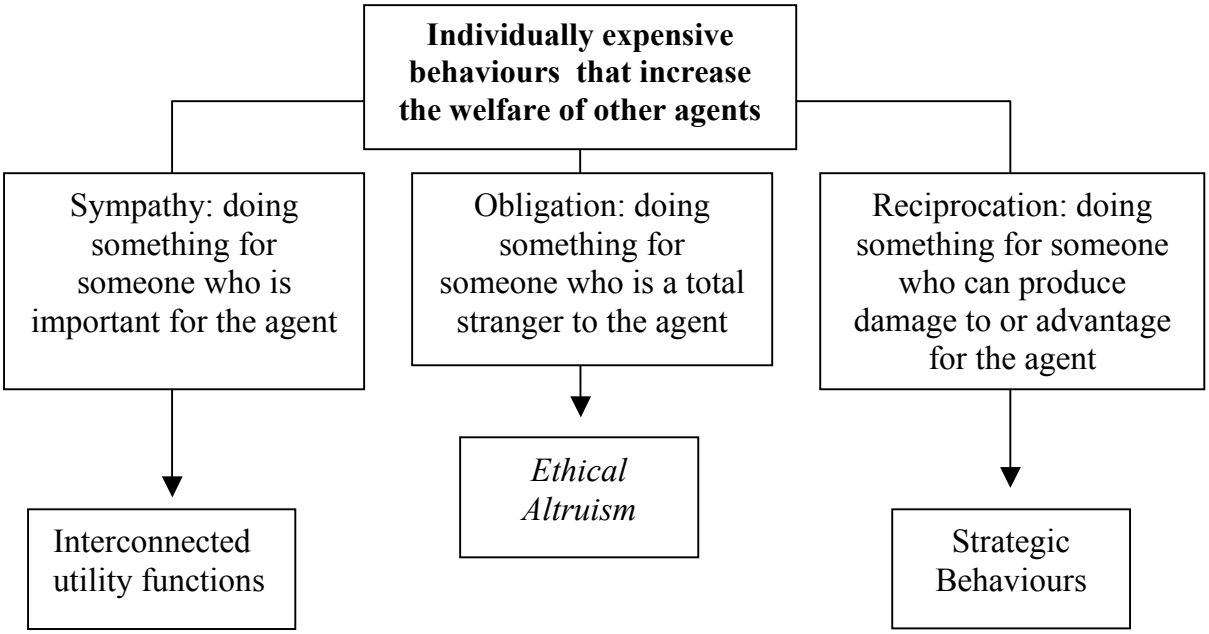
The main feature shared by experiments based on the dictator game is that they look for explanations of behaviour 'unforeseen' by the theory – which predicts that the dictator will keep as much of the money as possible – solely by examining the role played by anonymity. In fact, anonymity as a potential determinant of purely egoistic behaviour (and therefore coherent with the theory) has been tested both with reference to the players alone – i.e. by ensuring that the dictator does not know who her/his partner is and vice versa (Forsythe, Horowitz, Savin and Sefton, 1994) – and by extending anonymity to the experimenters as well – i.e. by ensuring that not even the experimenters were able the reconstruct the identities of the subjects of the experiment (Hoffman, McCabe, Shachat and Vernon Smith, 1994; Bolton and Zwick, 1995). The idea behind the hypothesis that anonymity is important is that the experimental subjects (obviously when they perform the role of dictator) are loath to appear greedy, either to the partner or to the experimenter, for fear of acquiring a bad reputation and also for purely psychological reasons of self-representation.

The differences between the experiments just mentioned consist of various devices introduced into the experimental design: for example, the contextualization of the game in a market (Hoffman, McCabe, Shachat and Vernon Smith). The two shortcomings shared by these experiments are, first, the use of a game that might be already known to the players – although this was a very remote possibility, at least for the first experiments – and second the static nature of both the dictator and the impunity game. A number of experimenters have sought to remedy this second shortcoming, for example Bolton and Zwick, who repeated the game ten times but with experimental subjects who never met more than once.

The main conclusion to be drawn from the experimental literature on the dictator game is that the impossibility of designing a truly dynamic version of the game, combined with the lack of real strategic interactions among the players, prevents the transfer of the results from these experiments to contexts typically characterized both by the repetition of choices over time and by strategic interaction among players.

The general conceptual scheme followed in this paper is shown in fig. 1.1, which illustrates the clear distinction between the three mechanisms that may induce an agent to behave in favour of someone else, accepting to pay a cost.

Fig. 1.1 Ethical altruism



All the three mechanisms that give rise to cooperative behaviour are relevant to the understanding of many economic phenomena. The one investigated here is particularly interesting when it is applied to organisations, because ethical altruism is the only one of the determinants shown in fig. 1.1 which is not context dependent. Being context dependent means that the causes that activate the cooperative behaviour are endogenously determined by the environment, whilst behaviour which is not context dependent is activated by exogenous factors. Within an organisation, the distinction between context and non context dependent individual strategy is of crucial importance because the first family of behaviours can be in some way controlled by working on the organisational relationships, while the second group of behaviours cannot be internally influenced.

2. Children, ethical altruism and trust

If we take Sen's definition of non selfish behaviour as the benchmark for the discussion on altruism, it is of interest to investigate the moment in the life of a human being when this kind of behavioural pattern starts to operate. Under the definition of ethical altruism used

here, one may say that a given action is altruistic only when it is produced by some "built in" mechanism. Sen probably draws for his definition on the Kantian concept of the categorical imperative, but he does not clarify the exact origin of what he calls obligation.

When investigating the possible source of this feeling of obligation towards someone else, it is useful to distinguish between culturally acquired behaviours and biologically inherited ones. The existence of biological behavioural patterns in animals is well known, and detailed discussion of the topic would be beyond the scope of this paper. I shall therefore restrict myself to some very brief considerations.

Not coincidentally, altruism is one of the most widely analysed forms of biologically transmitted behaviour in animals. Examples of altruism have been observed in numerous mammals that live in groups: wolves, for instance, where certain (generally young) members of the pack take care of the cubs even though they are not their parents. It could be argued that this kind of behaviour is spurious altruism, because the members of the pack are usually close relatives, so that looking after someone else's cubs means increasing the chance of continuing one's?? own genetic inheritance. Nevertheless, this argument does not change the point: a wolf does not know that a particular cub is a close relative, and is therefore behaving in accordance with the obligation mechanism, even if the natural selection process that has fixed this compulsory behaviour has a selfish matrix.

Can we assume that something similar is to be found in our genetic inheritance? If the answer is 'yes', then we can expect young humans to show a greater propensity to ethical altruism than adults. On the other hand, if adults are more altruistic than children, this may mean that ethical altruism is culturally grounded and that long training is required to learn and internalise this behaviour until it becomes some sort of automatic behavioural mechanism, or a "super-routine".

Whilst psychologists have analysed children's behaviour from many perspectives, the economic literature, and in particular the experimental economic literature, on altruism in children is meagre. I shall mention the two most interesting studies on the topic: the first investigates children's altruism? in public goods experiments (Harbaugh and Krause, 1999; HK99 henceforth); the second investigates trust in children (Harbaugh, Krause, Liday and Vesterlunf , 2002; HKLV02 henceforth).

HK99 also reviews experiments on public goods with children, reporting the results of two of them: the first was a repeated public good game, while the second was a dictator game. The public good experiment, carried out by Harbaugh and Krause, followed what is a quite standard procedure for this kind of experiment. It used tokens for contributions and

then allowed children to use these tokens to purchase goods (pencils, small animals, etc.) from a store set up for the purpose. The experiment also tested the effects produced by different marginal private returns for the donor by modifying the ratio between the individual cost (a token) for cooperation and the individual gain from cooperation (the individual fraction of the token gained individually as a return from cooperation).

The dictator game used by HK99 was intended to separate the effects produced by confusion from those due to altruistic behaviour. It was mainly a revealed preference experiment and was based on Andreoni and Miller (1998).

The results from both the experiments seemed to be not particularly different from those obtained from previous experiments using adults. The most important difference reported by the authors was that the children seemed more disturbed by repetition than adults. More precisely, and following HK99, it seems that repetition induced the children to learn to cooperate rather than to free ride.

HK02 is the paper that comes closest to the topic treated here, in that it investigates the mechanisms that produce trustworthy behaviour. Trust can be seen as one of the possible implicit reasons for the existence of ethical altruism. Ethical altruism may in fact be the result of a 'natural selection' of behaviours intended, in the long run, to produce improvements for society as a whole. When the level of trust in a society is high, one may expect there to be a high level of spontaneous coordination among the citizens, i.e. of routinised altruistic behaviours.

HKLV02 used the trust game designed by Kreps (1989), which is very similar to the so-called centipede game (for an example of an experiment using this game see Fey et al. 1994). HKLV02 describe the game as follows:

> *"Each participant was to be matched with another anonymous participant. One person in the pair was assigned the role of truster and the other the role of trustee. For each decision each participant was given an endowment of 4 tokens. There were two stages to the task. At the first stage the individual in the role of truster decided how many if ant of the four tokens she wanted to pass to the trustee in the pair. Every token passed to a trustee tripled in value. At the second stage the trustee was asked how many of her total tokens she would want to pass back to the truster. Each token sacrificed by the trustee increased the truster's payoff by one token." (Harbaugh, Krause, Liday and Vesterlunf , 2002, p. 8-9)*

The game is a sort of repeated sequence of one-shot decisions, because HKLV02 did not tell the trustee the actual decision of the truster with whom s/he was matched. Instead, they asked the trustee how much s/he would decide to pass if the transfer received was respectively 0, 1, 2, 3 and 4. Consequently, there was no really dynamic interaction between the two players.

The main result reported by HKLV02 is that there is little variation in trusting and trustworthy behaviour among children of different ages.

3. The experiments

Four experimental sessions with the same design but the following differences were carried out at the Computable and Experimental Economics Laboratory of the University of Trento:

Exp1_09_P – Experiment with 9-year-old children using pencils as rewards (20 subjects);

Exp1_09_C – Experiment with 9-year-old children using chocolate as rewards (20 subjects);

Exp2_12_P – Experiment with 12-year-old children using pencils as rewards (20 subjects);

Exp2_12_C – Experiment with 12-year-old children using chocolates as rewards (20 subjects).

The results from the experiments were matched with the results from three previous experiments carried out using adults (undergraduate university students):

Exp_Ba[3] – Base experiment, design identical to the children experiments (20 subjects);

Exp_Wo – Experiment with total anonymity (double blind) but using only women as experimental subjects (24 subjects);

Exp_Me – Experiment with total anonymity (double blind) but using only men as experimental subjects (24 subjects).

The experimental sessions carried out using adults were identical to those using children, with the exception of the anonymity condition for Exp_Wo and Exp_Me. In Exp_Wo and Exp_Me anonymity was double blind, while in the children experiments, as well as in Exp_Ba, it was restricted to the players but not to the experimenters.

We recruited a total of 80 children from two schools in Trento, the first group (Exp1_09_C and Exp1_09_P) came from a primary school (*scuola elementare*), and the second group (Exp2_12_C and Exp2_12_P) from a lower-secondary school (*scuola media*). Each group of players was made up of children from different classes.

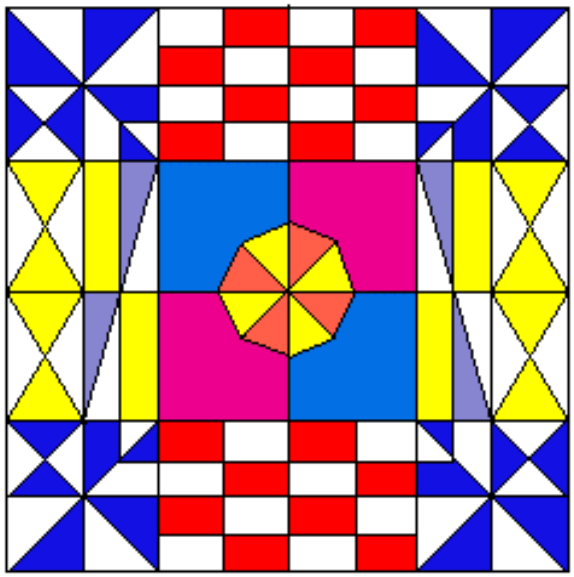
It was decided to use pencils and chocolates as rewards instead of tokens on the assumption that children react more efficiently to a direct relationship between the game and a real prize than they do to an indirect one (like a token to be transformed into a prize).

[3] The results from this experiment have also been utilised in Mittone 2002.

4. The puzzle experiment

The game used for the experiment was a puzzle. Four players worked together to construct the puzzle. Each of them could place only one piece of the puzzle in each round of the game. The basic rule of the game was that the players had to start from the central triangles and work anticlockwise towards the outer parts of the design. The pattern of the puzzle is shown in Figure 4.1.

Fig. 4.1. The design of the puzzle



The experiment continued until the entire puzzle had been completed. Different quantities of the various kinds of pieces were distributed among the players, so that it might happen that a player was unable to contribute to the puzzle when it was his/her turn to make a move. Failure to make a move caused a delay in completion of the game and affected the collective prize which was distributed in equal parts among all the players at the end of the experiment. More specifically, every missed turn reduced the amount of the final prize by a fixed number of pieces (pencils or chocolates).

The experiment was conducted using computers. Each player saw the pattern of the puzzle and the pieces in his/her possession on the screen but did not know the number and composition of the pieces possessed by his/her partners. For each round, the software showed the space in the puzzle pattern to be filled, and the player whose turn it was had to indicate with the mouse pointer the piece in his/her possession to be inserted in the pattern. If the player did not have the piece required, s/he clicked a button which told the other players that s/he would have to miss his/her turn. The next player could insert one of his/her pieces

instead of the missing one, and in this way the final reward was not reduced. However, the player who inserted a piece when it was not his/her turn incurred a penalty (s/he lost one pencil/chocolate). Thus, by inserting an optional piece the 'altruist' player suffered more damage to his/her individual return than s/he obtained from sharing the common prize without the reduction due to the lost piece (to be precise, s/he lost half a pencil/chocolate). It should also be pointed out that it was impossible to determine whether the choice of behaving altruistically for the whole duration of the experiment would not prove less advantageous – individually – than non-cooperative behaviour, not even in the case in which a situation of close cooperation – choice of altruistic moves – arose among all players. In fact, not knowing what pieces were possessed by the other players meant that there was a risk of being called upon to cooperate much more frequently than the others, thus generating a result which was collectively better but individually worse than that obtainable by opportunistic behaviour.

The four players sat at an equal number of computer screens together with other experimental subjects, so that no player knew exactly with whom s/he was playing and could count on remaining anonymous. Because of anonymity and the fact that nobody knew what pieces the other players possessed, it was not possible to enforce cooperative behaviour by punishing free riders. Likewise, if a player decided to cooperate by inserting his/her piece in the place of another player, s/he knew that s/he would incur a cost without being able to count on any form of reciprocity, because s/he did not know the distribution of the pieces among the players. Furthermore, a player who chose to cooperate could not hope to obtain some form of solidaristic recompense for his/her sacrifice from the group as a whole because no one ever knew that s/he had cooperated.

The experiment thus made it possible to observe the onset of altruistic behaviour in the absence of both the fear of being punished for non-cooperation and of sympathy for the other players, who remained strictly anonymous.

5. Analysis of the results

Tables 5.1 and 5.2 show the percentages of altruistic moves reported by the puzzle experiment carried out respectively with the 9-year-old children and with the 12-year-old ones. A value of 100 means that the subject always cooperated, i.e. whenever s/he had a chance to help one of her/his mates, s/he did so.

Tab. 5.1 Percentages of altruistic moves Exp1_09_P and Exp1_09_C

Exp1_09_P

(9 yars pencils)

	Player	Grp1.9	Player	Grp2.9	Player	Grp3.9	Player	Grp4.9	Player	Grp5.9
	G1.1.9	100	G1.2.9	44	G1.3.9	0	G1.4.9	22	G1.5.9	22
	G2.1.9	33	G2.2.9	78	G2.3.9	44	G2.4.9	100	G2.5.9	100
	G3.1.9	100	G3.2.9	100	G3.3.9	100	G3.4.9	90	G3.5.9	90
	G4.1.9	100	G4.2.9	100	G4.3.9	100	G4.4.9	100	G4.5.9	100
Grp. Averages		**83,25**		**80,5**		**61**		**78**		**78**
Tot. Average	**76,15**									

Exp1_09_C

(9 years chocolate)

	Player	Grp6.9	Player	Grp7.9	Player	Grp8.9	Player	Grp9.9	Player	Grp10.9
	G1.6.9	0	G1.7.9	100	G1.8.9	67	G1.9.9	100	G1.10.9	100
	G2.6.9	100	G2.7.9	11	G2.8.9	100	G2.9.9	56	G2.10.9	0
	G3.6.9	70	G3.7.9	50	G3.8.9	40	G3.9.9	100	G3.10.9	20
	G4.6.9	22	G4.7.9	67	G4.8.9	56	G4.9.9	100	G4.10.9	89
Grp. Averages		**48**		**57**		**65,75**		**89**		**52,25**
Tot. Average	**62,4**									

Tab. 5.2 Percentages of altruistic moves Exp2_12_P and Exp2_12_C

Exp2_12_P

(12 years pencils)

	Player	Grp1.10	Player	Grp2.10	Player	Grp3.10	Player	Grp4.10	Player	Grp5.10
	G1.1.10	100	G1.2.10	100	G1.3.10	44	G1.4.10	33	G1.5.10	100
	G2.1.10	89	G2.2.10	56	G2.3.10	100	G2.4.10	100	G2.5.10	56
	G3.1.10	80	G3.2.10	50	G3.3.10	90	G3.4.10	40	G3.5.10	50
	G4.1.10	100	G4.2.10	89	G4.3.10	89	G4.4.10	56	G4.5.10	44
Grp. Averages		**92,25**		**73,75**		**80,75**		**57,25**		**62,5**
Tot. Average	**73,3**									

Exp2_12_P

(12 years chocolate)

	Player	Grp6.10	Player	Grp7.10	Player	Grp8.10	Player	Grp9.10	Player	Grp10.10
	G1.6.10	67	G1.7.10	89	G1.8.10	100	G1.9.10	100	G1.10.10	78
	G2.6.10	100	G2.7.10	100	G2.8.10	22	G2.9.10	33	G2.10.10	100
	G3.6.10	100	G3.7.10	60	G3.8.10	100	G3.9.10	100	G3.10.10	100
	G4.6.10	100	G4.7.10	100	G4.8.10	78	G4.9.10	100	G4.10.10	100
Grp. Averages		**91,75**		**87,25**		**75**		**83,25**		**94,5**
Tot. Average	**86,35**									

The group averages and the total average of the entire experiment are reported respectively at the bottom of the tables and on the bottom left.

Three impressions immediately emerge from analysis of the tables: the first is that children display a very high propensity to cooperate; the second is that moving from 9-year-old children to 12-yea-olds does not make a great deal of difference; and the third is that the nature of the prize matters. Evaluation of the robustness of these first impressions can be assisted by introducing data from the experiments using adults. Tab. 5.3 reports the results from the previous experiments.

Tab. 5.3 Percentages of altruistic moves Exp_Ba, Exp_Wo and Exp_Me

Exp_Ba											
Player	Grp1.1	Player	Grp2.1	Player	Grp3.1	Player	Grp4.1	Player	Grp5.1		
G1.1.1	89	G1.2.1	100	G1.3.1	100	G1.4.1	78	G1.5.1	0		
G2.1.1	44	G2.2.1	0	G2.3.1	33	G2.4.1	0	G2.5.1	0		
G3.1.1	10	G3.2.1	20	G3.3.1	100	G3.4.1	90	G3.5.1	100		
G4.1.1	0	G4.2.1	0	G4.3.1	78	G4.4.1	11	G4.5.1	56		
Grp. Avrgs.	**35.75**		**30**		**77.75**		**44.75**		**39**		
Tot. Avrg.	**45.45**										
Exp_Wo											
Player	Grp1.5	Player	Grp2.5	Player	Grp3.5	Player	Grp4.5	Player	Grp5.5	Player	Grp6.5
G1.1.5	78	G1.2.5	78	G1.3.5	100	G1.4.5	56	G1.5.5	89	G1.6.5	100
G2.1.5	67	G2.2.5	11	G2.3.5	78	G2.4.5	0	G2.5.5	56	G2.6.5	0
G3.1.5	70	G3.2.5	90	G3.3.5	50	G3.4.5	90	G3.5.5	70	G3.6.5	40
G4.1.5	89	G4.2.5	100	G4.3.5	78	G4.4.5	56	G4.5.5	56	G4.6.5	33
Grp. Avrgs.	**76**		**69.75**		**76.5**		**50.5**		**67.75**		**43.25**
Tot. Avrg.	**63.96**										
Exp_Me											
Player	Grp1.6	Player	Grp2.6	Player	Grp3.6	Player	Grp4.6	Player	Grp5.6	Player	Grp6.6
G1.1.6	67	G1.2.6	100	G1.3.6	100	G1.4.6	56	G1.5.6	100	G1.6.6	100
G2.1.6	100	G2.2.6	100	G2.3.6	67	G2.4.6	100	G2.5.6	11	G2.6.6	56
G3.1.6	40	G3.2.6	20	G3.3.6	90	G3.4.6	30	G3.5.6	40	G3.6.6	70
G4.1.6	100	G4.2.6	100	G4.3.6	10	G4.4.6	11	G4.5.6	100	G4.6.6	44
Grp. Avrgs.	**76,75**		**80**		**89,25**		**49,25**		**62,75**		**67,5**
Tot. Avrg.	**70,92**										

The data reported in fig. 5.3 confirm the first of the above considerations, namely that children have a much stronger propensity for altruism than adults. The most relevant comparison is between the total average percentage of altruistic moves by both the children samples and the adults sample of the base experiment. The Exp_Ba design, in fact, is

identical to the design used for the children samples not only because it does not have the double blind condition but also because the adults sample was made up of both males and females, like the children samples. The difference between the total average percentage reported by Exp_Ba and the total average percentage recorded in all the four experimental sessions with children is always marked (never below 17 points).

On computing a maximum likelihood test of statistical significance,[4] we found that the results (the comparison between the individual average percentages) reported by Exp_Ba and the results recorded by all the children experiments were always significantly different (95% significance level). Likewise, the differences between the samples made up of children were also statistically significant, so that one can conclude that the nature of the prize (pencils versus chocolates) mattered. Not surprisingly, the preference for the two kinds of prize used "switched" between the younger and the older children. The 9-year-olds preferred chocolates while the 12-year-olds preferred pencils.

More complex is comparison between the data from the adult experiments carried out using only women and only men and the data from the children experiments. The total average percentages for Exp_Wo and by Exp_Me are very close to (if not higher than) the percentages for the children experiments. The reason for this similarity between the results from the groups made up of only men or only women and the children's groups is probably some group membership effect. Social identity theory might be able to explain this phenomenon. On the other hand, it is important to bear in mind that the experimental conditions of Exp_Wo and Exp_Me were not identical to the experimental conditions of the children experiments because there was a double blind anonymity situation which was absent in the children's experiments.

A final consideration concerns the learning effect. As regards the frequency over time of altruistic moves, none of the children samples showed any significant increase or decrease in the frequency of altruistic moves. The absence of learning to free ride or to cooperate can be taken to confirm that the design of the experiment reproduced a non reciprocating environment. Without reciprocation it is impossible to learn or to modify a strategy, simply because there is no feedback from the strategy itself. Therefore each subject can only behave in accordingance with some inner behavioural pattern. On the other hand, the results reported by HK99 seemed to show a similar pattern – no learning – also in a standard public good game setting.

[4] The test used was based on the assumption that a subject's decision to cooperate or to defect was independent of the choices made by the other participants because of the anonymity condition. We then assumed that each

6. Conclusions

The puzzle experiment sought to transfer the non reciprocity condition designed in the dictator game to a dynamic frame of interpersonal interaction. Combining these two features enables exploration of the onset of ethical altruism in an artificial setting.

The results show that children are more oriented towards ethical altruism than adults, but small differences in age do not introduce any important change in the behaviours observed. The temptation to reach the conclusion that ethical altruism is genetically inherited, rather than being culturally learnt, is strong; yet the results from this kind of experiment are not sufficiently robust to allow such a bold claim to be made.

individual choice – help; non help – was a Bernoullian with parameter θ. For a detailed description of the test see Mittone 2003.

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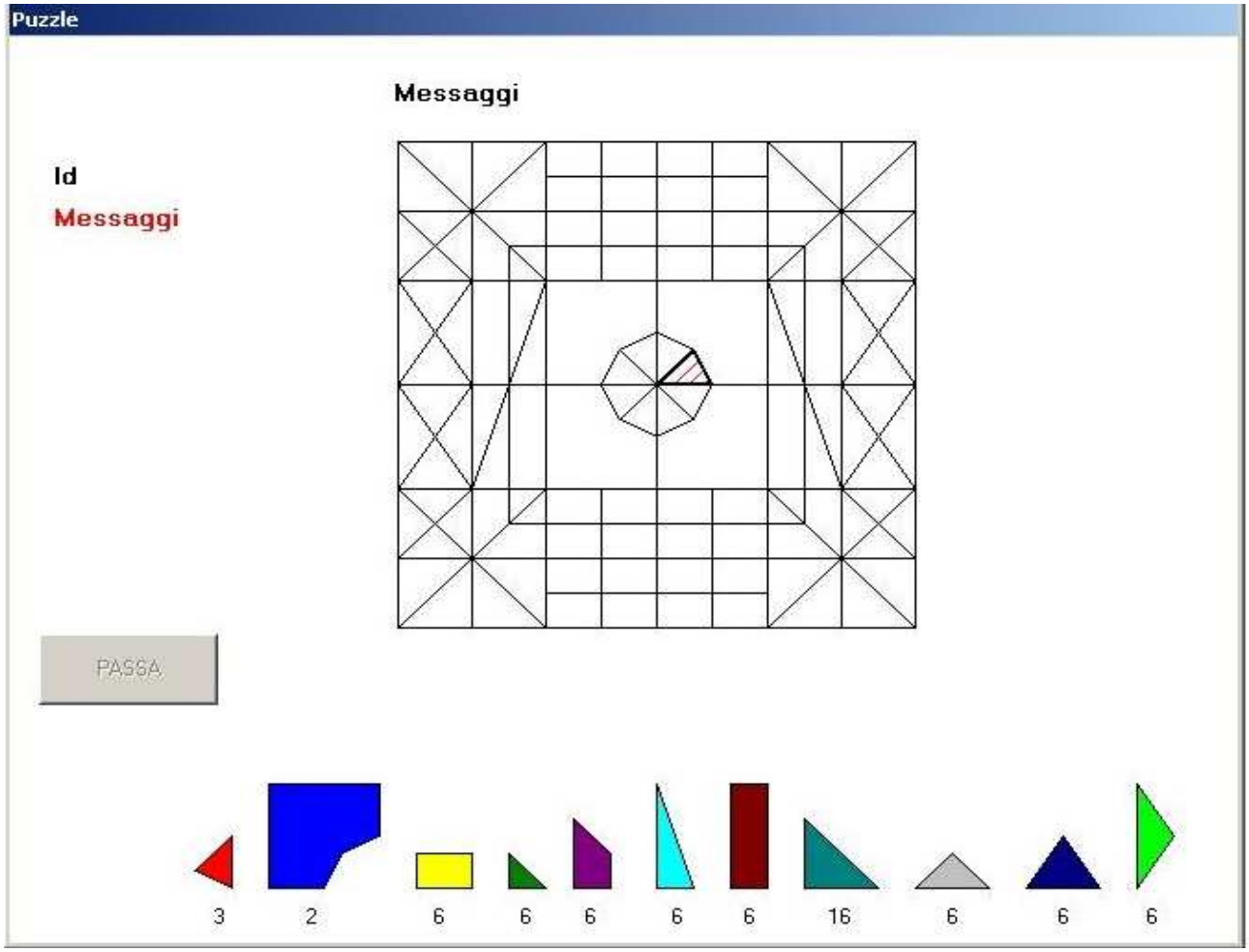
Appendix – Instructions given to the participants

You are about to take part in an experiment intended to study the behaviour of people when they cooperate.

Each of you will belong to a group of 4 players chosen at random by computer. No player will know who the other members of his/her group are. Communication will take place solely via your computer screen.

The experiment consists of completing a puzzle of 120 pieces in as few moves as possible. The pieces divide into 11 types which differ by colour and shape. The number of pieces allocated to each player are shown at the bottom of the screen. The numbers written beneath each piece state how many pieces of that type are available to each player.



The puzzle must be assembled following a fixed sequence. The puzzle can be divided into 5 sub-puzzles and it must be assembled in the following order:

- the central octagon;

- the square with the octagon at its centre;

- the first frame of the square;

- the frame of the first frame;

- the frame of the second frame.

Each sub-puzzle is assembled anticlockwise by means of the computer.

Each group has an initial account of 240 pencils/chocolates. Every move in excess of the minimum of 120 moves necessary to complete the puzzle will entail the deduction of 2 pencils/chocolates from the group's account, which will be divided equally among the 4 players at the end of the experiment.

Each player in turn inserts the right piece in the corresponding area of the puzzle grid. If the player does not have this piece, s/he misses his/her turn and the next player receives a request for help. At this point s/he may choose between the two following alternatives:

- Help the previous player and put the piece in its place on the grid. In this case the person that has helped must pay a penalty of 1 pencil/chocolate which will be deduced from his/her final personal reward. This action counts as 1 move, so that the player prevents 2 pencils/chocolates being deducted from the group's account.
- Not help the previous player. In this case the player inserts the requisite piece in the puzzle grid, only when is her/his time to play. This behaviour counts as 2 moves. This means that the minimum number of moves necessary to complete the puzzle increases. 2 pencils/chocolates are deducted from the group's account.

It may happen that the next player does not have the requisite piece either. In this case, s/he passes the turn to the next player by clicking on the 'pass' button.

To sum up, the final amount of the group's account is calculating by deducting 2 pencils/chocolates from the initial 240 pencils/chocolates every time a player does not help the previous player who does not have the piece required. This account is then divided equally among the four players in the group. Deducted from the individual accounts are 1 pencil/chocolate for every time that a player has helped the previous player.