# Individual and Group Behaviour Toward Risk: A Short Survey

Temerario, Tiziana

Tilburg University School of Economics and Management

August 2014

# Individual and Group Behaviour Toward Risk: A Short Survey

Tiziana Temerario*

## Abstract

In the real life groups, rather than individuals, take the most part of decisions. So that it is useful to study how groups take a decision in different strategic environments. This paper provides an overview of previous research about groups' preferences over risk. I compare different experimental designs and examine their different results, focusing on how groups reach agreement in risky choices, compared with individuals.

* Tilburg School of Economics and Management (TiSEM). E-mail: tiziana.temerario@gmail.com

## 1. Introduction

For a long time economists have been studying how individual take decisions and which are their preference functions (Hey and Orme, 1994; Carbone and Hey, 1994 and 1995; Starmer, 2000; Sugden, 2004; Schmidt, 2004; Morone 2008 and 2010; Morone and Schmidt, 2008; and Hey et al., 2009). However, the most part of choices are made by groups and in-group interaction can involve other kind of preference functions. Therefore, over the years experimental research involved groups and investigated how they make a choice, compared with the decision-making process of individuals. This research has implications not only in economic field, but also in sociology, anthropology and politics.

A growing number of experimental economists have recently shown their interest towards differences between individuals and teams in different field. Examples are the beauty-contest games (Nagel et al., 1995; Kocher and Sutter, 2005; Morone and Morone, 2010; Morone and Morone, 2010; Morone el al., 2008), centipede games (Nagel and Tang, 1998; Bornstein et al., 2004), ultimatum games (Bornstein and Yaniv, 1998), dictator games (Cason and Mui, 1997), signalling games (Cooper and Kagel, 2005), traveler's dilemma (Morone et al., 2014; Morone and Morone, 2014a). Concerning risky choices, important references are Bone et al. (1999), Shupp and Williams (2008), Bone et al. (2000), Rockenbach et al. (2001), Bateman and Munro (2005), Masclet et al. (2009), Harrison et al. (2012) and Zhang and Casari (2012), Morone and Morone (2014a). They investigated whether teams make 'better choices', whether they are more rational and consistent than individuals or they just have investigated differences between individuals and groups. No consensus has been reached regarding either question, because it usually happened that results depended on the game tested (i.e. the lottery choice, auctions and maximum willingness to pay for testing risky decisions) and on the "default rules" used to solve disagreement in group decision (e.g. random choice, dictator choice, majority rule, unanimity, no choice). Each one produces an incentive to "talk" with other group members or to "listen" to them and so it does influence the internal dynamic in coming to the final decision. In Shupp and Williams (2008) groups exhibited a lower degree of risk aversion than individuals, but just for lotteries with high winning probabilities, while as the winning probabilities decreased (10-40%), groups tended to be more risk averse. Masclet et al. (2006) found that individuals were more risk-averse in groups than when they were alone, especially for high-risk lotteries. Consistently with them, in Ambrus et al. (2013) groups were used to keep out extreme positions showing a "caution shift".

On the contrary, Rockenbach et al. (2007) found that teams exhibit less risk aversion than individuals.

In this paper we briefly survey what economists have found about group and social (risk) preferences. We especially analyze in detail and compare three recent experimental works: "Preferences over social risk" by Harrison et al. (2012), "How groups reach agreement in risky choices: an experiment", by Zhang and Casari (2011) and "Estimating Individual and Group Preference Functionals Using Experimental Data" by Morone and Morone (2014b).

In order to get a useful overview of what has been already done in this field, the remainder of this work is organized as follows. In the first part we focused on individual and the group risk attitude. In the second part, we concentrated on preference functions, starting from the most common EUT violations and the performance of alternative theories both for individual and groups.

## 2. Individual *vs.* Group Preferences Toward Risk

In the 60s some psychologists studied differences between individuals' decision-making process and groups' one. They usually stated that groups are inclined to opt for riskier choices, showing the so-called "risky-shift".

On one hand, research over the past recent years confirmed that groups tend to behave differently than individuals, but on the other hand they do not always choose the riskier option. Kerr et al. (1996) concludes that "there are several demonstrations that group discussion can attenuate, amplify, or simply reproduce the judgment biases of individuals" and there is no a unique answer to this question because group interaction and discussion can lead them to different results. In 2008, Shupp and Williams conducted an experiment about risk preferences of individuals and three-member groups. In order to investigate whether small groups systematically showed different preferences, they used the certainty equivalent ratio[2], obtained by asking to participants a maximum willingness-to-pay for dichotomous lotteries. Shupp and Williams (2008) compared decisions of the same subjects both individually and in group, without bothering to isolate the "order effect"[3]. Indeed, "nine maximum willingness-to-pay decisions for the right to play each of nine different lotteries are elicited in a non-sequential repeated-measures experimental design"[4]. The range of lotteries was: 10% of possibilities to win 20$ per person up to 90% of chances to win 20$ per person. They recruited 100 students and they implemented a two-designs experiment. The first one focused on understanding whether there was a statistically difference between individual and group risk preferences. Sixty-four people made their choice as either a single subject (16 students) or a member of a group (48), in order to maintain independence between individual and group for every lottery. Indeed, in the first design, no communication was permitted between people involved in the individual treatment and people gathered in group one.

Instead, in the second design 36 subjects made their choice first as individual then as a member of a given group. This second phase aimed to explore how risk preferences of specific individuals were aggregated into a group risk preference. Note that participants were not informed that after individual decisions they would have run another one in group. Both in design 1 and 2, groups had 20 minutes for discussing face-to-face and coming to a unanimous decision, rather than the last WTP was calculated as average of individual WTPs.

The null hypothesis was that there were no significant differences between individual and groups' WTPs for a given lottery; the alternative hypothesis was that there is a systematic difference between them.

Shupp and Williams (2008) found that groups exhibited a lower degree of risk

[2] Certainty-equivalent/expected value

[3] Playing individually and then in team may influences the second treatments. See Masclet et al. (2009).

[4] Shupp and Williams (2009)

aversion than individuals just for lotteries with high winning probabilities (70-90%). On the contrary, as the winning probabilities decreased (10-40%), groups tended to be more cautious (more risk averse), maybe due to internal debate.

They also found that the lottery win-percentage effect was statistically significant ($p<0.1$), without considering group *vs.* individual distinction; on the contrary, it is not significant the effect group *vs.* individual ($p>0.1$), without considering the win-percentage distinction; finally, considering simultaneously the win-percentage and the group *vs.* individual effects their interaction resulted to be very significant ($p<0.05$). In short, there is a significant link between the lottery win-percentage and the effect of group decision-making process. Anyway, for individual data, the null hypothesis can be rejected for all lotteries but 10%-20% ones; for the group data, it is accepted just for lotteries between 70% and 90%. That is to say that for lotteries with win percentage of 50-60-70% the average group and the average individual are both risk averse and are not significantly different.

Afterwards, they calculated the coefficients of risk aversion, using the CRRA utility function. Coefficients was fairly steady for groups and individuals over the 10% up to 60% lotteries, but beyond this range groups show a lower risk aversion coefficient.

Finally, Shupp and Williams (2008) found that the variance of CERs was lower for groups than for individuals in all lotteries, suggesting that in-group discussion can help subjects to give steady values to lotteries. Moreover, predictably it tends to decrease as the lottery win percentage increases.

The method employed by Shupp and Williams (2008) denotes a weak point: an individual can be led to manipulate the group bid (overbidding or underbidding) in a way that the final group price lies in his/her preferred levels.

Also Cox and Hayne (2000) have used bids in order to elicit members' behavior in coming to a decision. Their goal was to know if group are more rational than individuals. They carried out an experiment on groups of five, comparing the bidding behavior of individuals and groups in first-price sealed-bid common-value auctions.

They did not found a univocal answer to their initial question. Their research showed that the level of rationality depends on features of group members. Moreover, they found that "more information about the value of the auctioned item causes both individuals and groups to deviate further from rational bidding and that this *curse of information* is worse for groups than for individuals" (Cox and Hayne, 2000).

Finally, demonstrated that the so called "winner's curse" was not a typical phenomenon of individual treatments: upward bias in bids carries also groups to over-pay and be subjected to losses.

Masclet et al. (2006), inspired by Holt and Laury (2002), compared individual and three-members groups risk preferences in a lottery-choice experiment. They tested 108 people in 6 sessions (18 subjects per session) of a lottery choice experiment with three treatments: individual one, participants made their choice on their own; group one, three people took part in an anonymous group and unanimous lottery choice decisions were made via voting; choice treatment, when subjects could choose whether to be on their own or in a group. People in group randomly changed for each lottery choice.

They run 6 sessions with each of 3 treatments. The first treatment consisted of 10 sequential binary lottery choices randomly presented one by one to every individual. Subjects should choose between a "safe" one (with payoffs 40€ and 32€) and a "risky" one (with payoffs 77€ and 2€), with probabilities ranging from 10% to 100%. Subjects had to choose which lottery they preferred step by step.

In group treatment participants vote their own choice, but final decision was taken only if unanimous. If not, they were informed of other group members' choices in current vote and voted again. They had five attempts to reach unanimity; otherwise the lottery option was randomly picked.

In the last treatment, every participant stated a maximum amount minded to pay for making their decision alone instead of the group's one.

The experimental structure was similar to the one used by Holt and Laury (2002). Individual treatment was composed by ten sequential choices between two lotteries: one *risky*, one *safe*. Anyway, unlike Holt and Laury experiment, every decision was shown sequentially and randomly in order to appreciate differences between group and individual process for each decision.

For the second treatment, people were gathered in anonymous groups of three and each of previous lotteries was displayed to them. If unanimous decision was not reached, they tried again but only after being informed of other members' vote. After 5 attempts, if unanimity was not reached, the final decision was randomly picked by the computer.

What it makes this work noteworthy is the *choice* treatment. It consists of two steps: in the first one, 10 units (2 units = 1 €) are provided to each individual. They had to state their willingness to pay for making their choice alone, considering that only three individuals who bade the highest values will be allowed to play the individual treatment. The price paid by each winner corresponded to the third highest bid. In the second step, every participant should chose between A or B, alone or in group, depending on the previous outcome.

Many experiments consider the individual and group treatments independently, i.e. the same subject takes part in only one of the two treatments. Consequently, we do not know how the same individual will behave in both two separate decision environments.

On the contrary, Masclet et. al (2006) groups were composed of the same subjects. However, as they pointed out, when the same people participate in both treatments, it comes up another critical issue: the order of the treatments. For example, Baker et al. (2008) decided to use the pattern individual/group/individual for decisions. They found that individuals were more risk-averse in groups than in the first treatment alone, especially for high-risk lotteries. Furthermore, they observed that choices in the second individual treatment had been influenced by the previous group treatment, because subjects showed a marked risk-aversion behavior rather than they did in the first treatment.

Masclet et al. (2006) took into account the order effect. Indeed, they implemented 6 sessions: from 1 to 4, subjects started experiment from individual treatment; they ran also two additional sessions (5 and 6) in which participant started from group treatment. In the end, the outcome of each treatment was randomly determined. In this way, they wanted to deaden differences to final outcome due to treatments order.

Masclet et al. (2006) came to these findings:

1. groups are more likely than individuals to choose safe lotteries for decision with low winning percentage; this is consistent with Shupp and Williams (2008) findings, but it is inconsistent with Harrison et al., whom experiment showed no group effect;
2. groups reveal a less-risky shift, because risk lover individual were more minded to change their choice than risk averse ones; as we can read in Masclet et al.'s (2006), "the probability of disagreement decreases with the number of voting rounds" and "most unanimous decisions involved the safe lottery"; this is an important results because it means that decision making process with unanimity rule carries to a safer final decision;
3. positive relationship between risk-loving and willingness to decide alone: the average bid is 1,9 units over all participants, but it rose to 5,71 for those who decided individually and 1,14 for those who chose the group.

As Masclet et al. (2006), also Rockenbach et al. (2007) compared individual and team decisions over risky lotteries, without using same subjects. They elicited group choices over pairs of lotteries and the evaluation of specific lotteries by requiring subjects to all agree on the decision. All decisions were paid out and each team member received the same payoff in the group decision tasks. There were no restrictions placed on discussions within the group, nor any time limit on discussion. Thus, their group decisions are more like three-person bargaining outcomes than three-member voting outcomes. They found that teams exhibit less risk aversion. In particular, groups accumulated significantly higher expected value than individual did, but groups did it at a significantly lower total risk.

Until now we analyzed differences between individual choices and groups' ones.

Anyway, it is also useful understanding how individual preferences match the social ones. For this purpose, it is important to consider the experiment conducted by Harrison et al. (2012). They arranged a laboratory test over small and anonymous groups, however this method they applied could be applied be extended also to social groups such as family and consumer communities, where people know each other. Their purpose was to elicit individual preferences over social risk and how these preferences are correlated with preferences over individual risk and the well-being of others.

As written above, Shupp e Williams tested directly differences between individual and group preferences in risky choices. In their experiment, every subject should state the maximum amount they would pay for each of 9 lotteries. In one treatment, decisional unit was individual, while in an other treatment it was the group. Anyway, differently from Harrison's work, every group's member could talk each other and make evaluation since the goal was reaching unanimous decision. This procedure was set up for eliciting group preferences towards social risk, but this setting does not provide information about single preferences over social risk.

Also in Baker's paper three-members groups should express their intention in an unanimous way, after talking for maximum 20 minutes and in Rockenbach et al. (2007) group members talk to each other without any time limits in order to come to a decision. Although both Baker et al. (2006) and Rockenbach et al. (2007) tested groups' decision, they cannot say whether it actually reflected what Harrison et al. (2012) wanted to investigate (preferences over social risk), because the final choice of groups they tested could not be a signal of individual risk preferences over social risk, but it could represent the outcome of bargaining process.

Harrison's experiment derives from the following big question: are individual preferences towards own individual risk different from those expressed towards social risk by a group?

In order to figure it out the risk attitude, Harrison applied the MPL[5] method for collecting choices and regression model CRRA for studying statistical effects.

The structure was composed by three different tasks:

1. iRA (individual risk attitude): understanding individual risk attitudes over binary choices for 10 decision problems
2. gRA or gRA* (group risk attitude): eliciting group preferences with the same previous procedure, but involving small groups of three anonymous members who would vote to reach the final outcome, chosen by the majority of them;
3. Dictator game was useful to investigate altruistic preferences of participants, because if altruism were an important variable, then individual and group choices would have been different. People with even ID were randomly matched with odd ID ones. Even ID subjects are asked to allocate between themselves and the others a casual endowment chosen by a 10-face dice, from 16$ to 25$. The goal of this task was to isolate altruistic variable from social risk settings.

Each of 108 subjects (or group) chose between lottery A and B. The first is the "safe" one, the second the "risky" one. They have different expected value (EV) that increase problem after problem, with a really different pace. The model is that illustrated in Table 4. In the end, one of lotteries chosen is payout for real.

A perfect risk neutral subject will switch from A to B when EV (B) overcomes EV (A). In this case, the "switching point" lies within the fourth and the fifth lines (Table 4). To every choice corresponds an interval of CRRA, which denotes the degree of individual risk aversion defined by:

$$\mathbf{U\ (y) = (y^{1-r})\ /\ (1 - r)}$$

where *r* is the CRRA coefficient.

They elaborated three treatments: iRA/gRA, gRA/iRA and iRA/gRA* (in the last treatment group members were previously informed of individual

[5] Multiple Price List is an experimental measure for risk aversion. See Holt and Laury (2002)

preferences).

**Tab. 4:** Lottery Choice Task Prospect

| Lottery A | | | | Lottery B | | | | $EV^A$ | $EV^B$ | Difference | Open CRRA interval if subject switches to lottery B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| p($50) | | p($40) | | p($96.25) | | p($2.50) | | | | | |
| 0.1 | 50 | 0.9 | 40 | 0.1 | 96.25 | 0.9 | 2.50 | 41 | 11.88 | 29.12 | −∞, −1.71 |
| 0.2 | 50 | 0.8 | 40 | 0.2 | 96.25 | 0.8 | 2.50 | 42 | 21.25 | 20.75 | −1.71, −0.95 |
| 0.3 | 50 | 0.7 | 40 | 0.3 | 96.25 | 0.7 | 2.50 | 43 | 30.62 | 12.37 | −0.95, −0.49 |
| 0.4 | 50 | 0.6 | 40 | 0.4 | 96.25 | 0.6 | 2.50 | 44 | 40.00 | 4.00 | −0.49, −0.15 |
| 0.5 | 50 | 0.5 | 40 | 0.5 | 96.25 | 0.5 | 2.50 | 45 | 49.37 | −4.37 | −0.14, 0.14 |
| 0.6 | 50 | 0.4 | 40 | 0.6 | 96.25 | 0.4 | 2.50 | 46 | 58.75 | −12.75 | 0.15, 0.41 |
| 0.7 | 50 | 0.3 | 40 | 0.7 | 96.25 | 0.3 | 2.50 | 47 | 68.12 | −21.12 | 0.41, 0.68 |
| 0.8 | 50 | 0.2 | 40 | 0.8 | 96.25 | 0.2 | 2.50 | 48 | 77.50 | −29.50 | 0.68, 0.97 |
| 0.9 | 50 | 0.1 | 40 | 0.9 | 96.25 | 0.1 | 2.50 | 49 | 86.87 | −37.87 | 0.97, 1.37 |
| 1 | 50 | 0 | 40 | 1 | 96.25 | 0 | 2.50 | 50 | 96.25 | −46.25 | 1.37, ∞ |

*Notes*: The last four columns in this table, showing the expected values of the lotteries and the implied CRRA intervals, were not shown to subjects.

Source: Harrison et al. (2012)

Therefore, participants first filled a questionnaire about their profile, secondly half of them played the Dictator game, than they took part in the respective treatment.

As results, Dictator task denoted a wide distribution of altruistic preferences: 81% of participants randomly picked to be a dictator chose to pass a positive amount to another one; in particular, 22% contributed with a pass rate of 40-50% and a very generous subject give away 85% of his dotation (Figure 1).

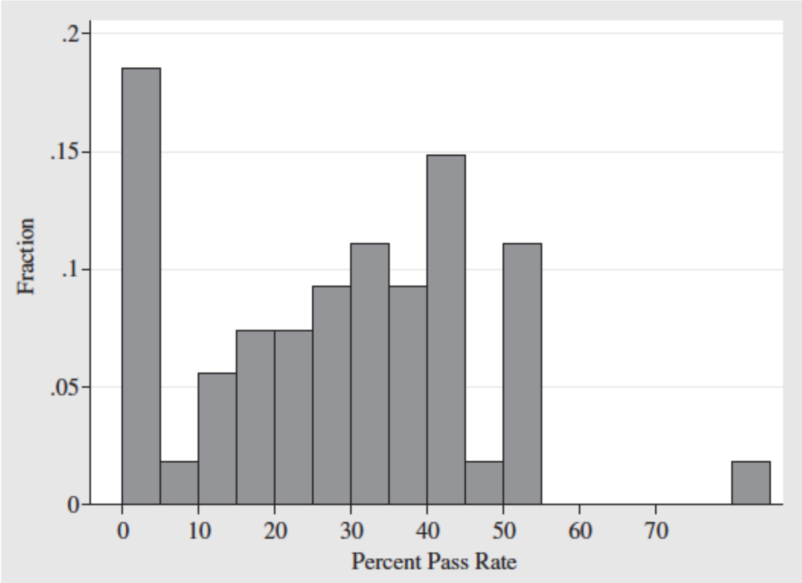



**Figure 1:** Distribution of amounts passed in Dictator Task

Moreover, Figure 2 shows that subjects who are risk averse when they make choices on their own are also risk averse when they make a decision on group's money that is similar to what Baker reported in his work. Therefore, with majority rule, preferences over social risk can be closely described by individual risk attitudes, especially when subjects have not got any information about other members' attitudes.

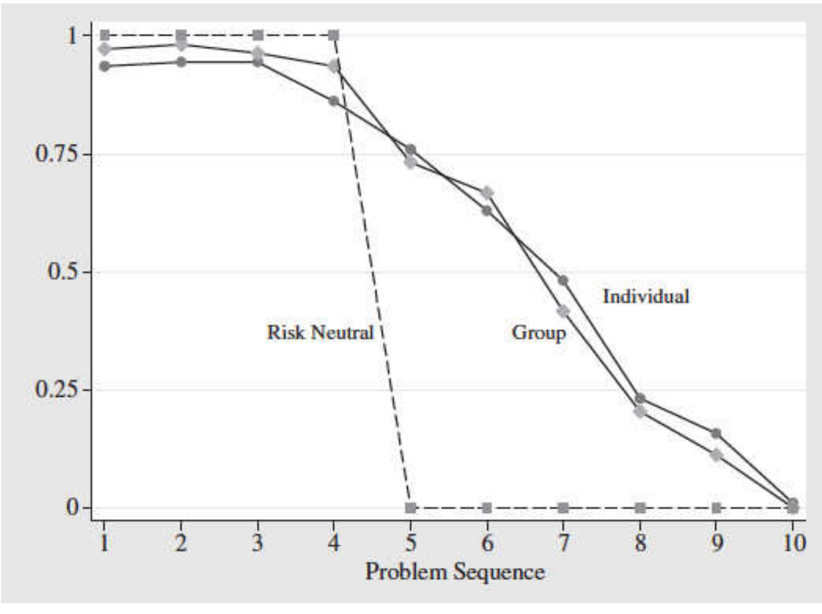



**Figure 2:** Choices in risk aversion tasks,

fraction choosing safe option A in each choice problem.

Indeed, they also found a different behavior in gRA and gRA* treatments: subjects tend to be more risk averse in gRA* treatment, i.e. when they know other people's preferences (Figure 3). Providing information on others risk attitude had a positive marginal effect and resulted to be statistically significant, with a p-value of 0,17.

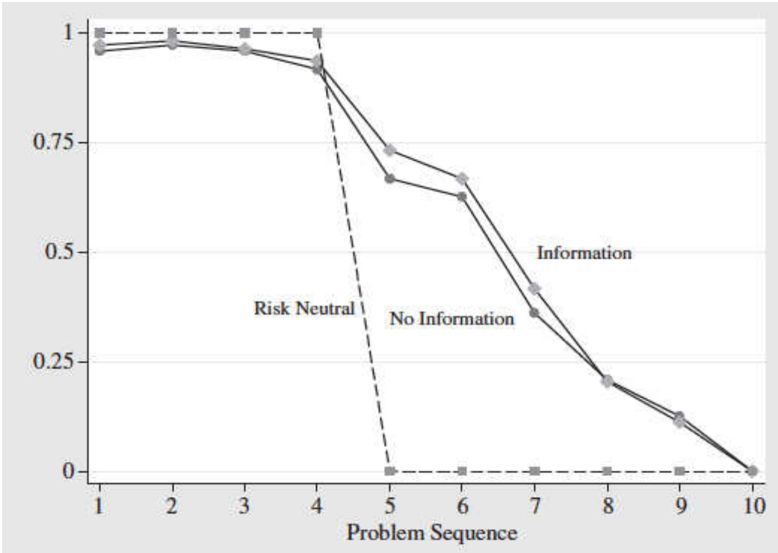



**Figure 3:** Choices in group tasks,
fraction choosing safe option A in each choice problem[6].

Before analyzing CRRA values, we have to recall that a positive CRRA means that subjects are generally more risk averse. Harrison did not found significant differences between individual values and social ones. Indeed, the former distribution registered an average of CRRA of 0,47, the latter 0,46 (Figure 4).
Within-simple analysis behaviors in gRA and gRA* compared to iRA shows that CRRA tends to increase in the second case rather than in the first. "Subjects become more risk averse in the group task when they know the risk preferences of other group members and this marginal effect is statistically significant" (Harrison, p. 41).
Finally, they noticed that the more incomes from Dictator game increased, the more people had a little switch towards risk adverse attitude.

6 Source Fig. 2 and 3: Harrison et. al. (2012)

Overall, their findings suggest that "in presence of financial consequences to the decision maker" other motivations such as social reputation or the fear of judgment, "if they exist, are dominated by financial ones" (Harrison, p. 43).

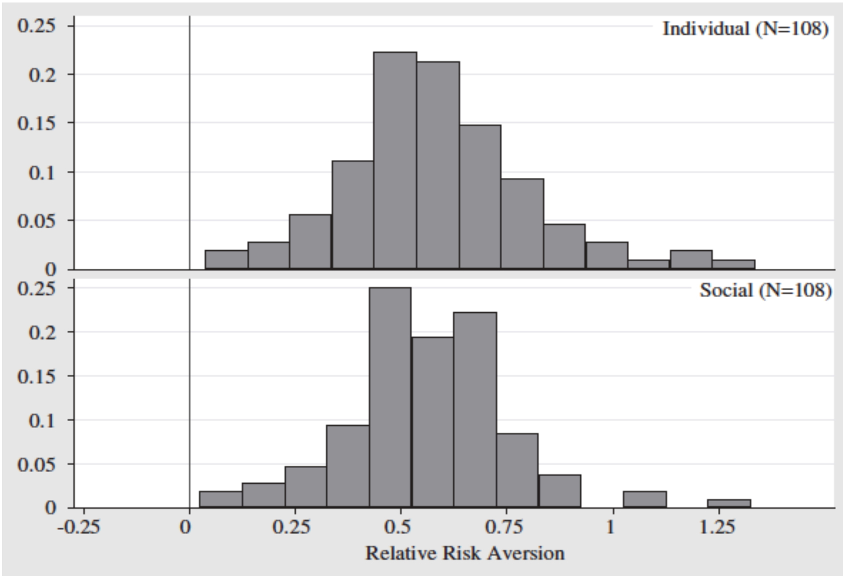



**Figure 4:** Estimated individual and social risk aversion, predicted from interval regression model[7].

A lot of experiments provide informal discussions between group members for solving disagreement in lottery choices[8]. However, this way does not allow to track *how* teams come to final decision. Zhang and Casari (2012) produced a noteworthy paper that addresses this problem with a new kind of in-group interaction. They provided 2 minutes of written chat that participants should use to come to a decision: during this time box economists were able to track the most used words and understand how the group was reaching the agreement inch by inch.

Indeed, their research question was: how do groups of three members resolve disagreement in lottery choices?

In order to answer this issue, they structured a laboratory experiment that allows them to know individual and groups proposal. They elicited risk attitudes for

[7] Source: Harrison et. al. (2012)

[8] See, for example, Baker et al (2008), Shupp and Williams (2008), Ambrus et al. (2013).

groups and check when majority proposal prevails and when minority one did it. The final purpose was to understand whether groups' decisions denoted a "risk shift" or a "caution shift". The "risky shift" occurs when groups tend to make riskier decisions than individuals, and "cautious shift" otherwise. We can anticipate that results of this experiment revealed a "risky shift": group choices were actually closer to **risk neutrality** than individuals'.

The experimental design of this test deserves a special attention because it is the first time that participants are allowed to enter their proposal before discussion start[9]. In this step, it is possible to extrapolate individual preferences and proceed with a comparative analysis. Another distinctive trait of this design is the veto power of minority: in order to approve group decision, unanimity is needed. These rules let researchers count how many times minority preference prevails on majority one. Moreover, the sanction for disagreement was *no choice* and *zero earnings*: it represents an incentive to discuss and make a choice. The sample included 120 students, 15 per session that consisted of 2 parts. In the first part, they measured individual risk attitude[10]. In the second part, the group treatment took place: participants were randomly gathered in groups of three and asked to play the same task of part 1.

Lottery A was the "safe" option, Lottery B the "risky" one, with three possible payoffs: 50€, 150€ and 0€ (Figure 5).

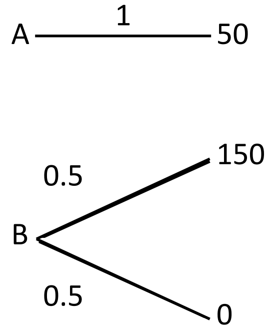



**Figure 5**: example of binary lottery choice

[9] It is a way to avoid shyness and bring out the real individual preferences on lotteries.
[10] People entered their preference over 15 binary lotteries.

However, while 50€ was deterministic, the probability of earning 150€ increased at a pace of 1/20, so that the EV of Option B changed over the 15 choices (Table 5).

Five teams per session took part in the group treatment. It was structured as follows: first of all, there was a proposal phase, in which every member moved for his preferred option; if there was not unanimity, a chat box opened on every member's computer and they have 2 minutes for freely discussing[11] and reaching agreement; finally, it came the choice phase: it is curious to notice that "no choice and zero earnings" rule generated a strong incentive to talk and it caused the typical *battle of the sexes* game, because a "wrong" choice would be ever better than no-choice.

**Tab. 5:** Lottery choice task

| | Option A | Option B | | |
|---|---|---|---|---|
| Lottery Number | Payoffs | Payoffs | Probability of Getting 150 Tokens | Expected Payoff of Option B |
| 1 | 50 | 150 or 0 | 0 | 0 |
| 2 | 50 | 150 or 0 | 0.05 | 7.5 |
| 3 | 50 | 150 or 0 | 0.1 | 15 |
| 4 | 50 | 150 or 0 | 0.15 | 22.5 |
| 5 | 50 | 150 or 0 | 0.2 | 30 |
| 6 | 50 | 150 or 0 | 0.25 | 37.5 |
| 7 | 50 | 150 or 0 | 0.3 | 45 |
| 8 | 50 | 150 or 0 | 0.35 | 52.5 |
| 9 | 50 | 150 or 0 | 0.4 | 60 |
| 10 | 50 | 150 or 0 | 0.45 | 67.5 |
| 11 | 50 | 150 or 0 | 0.5 | 75 |
| 12 | 50 | 150 or 0 | 0.55 | 82.5 |
| 13 | 50 | 150 or 0 | 0.6 | 90 |
| 14 | 50 | 150 or 0 | 0.65 | 97.5 |
| 15 | 50 | 150 or 0 | 0.7 | 105 |
| | | Percentage of monotonic decision makers | | |

Source: Zhang and Casari (2012)

Zhang and Casari came to five interesting results. The monotonicity of lottery

[11] For chatting rules, see Zhang and Casari (2012)

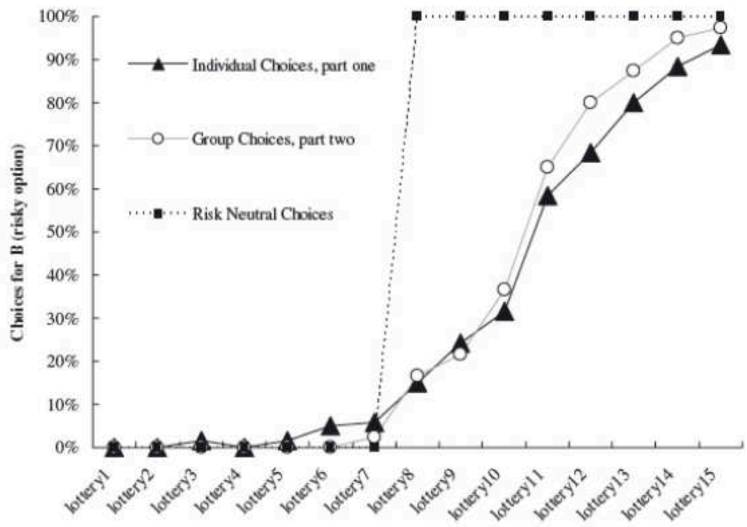
choices[12] increased from the individual treatment to the group one. They registered 87,5% of monotonicity for individual choices and 95% for the groups. It meant that groups tend to be more rational and focused than individual maybe thanks to the interaction between members' ideas. Another noteworthy result is that group choices appeared closer to risk neutrality than individual ones. In particular, group choices exhibited the so-called "risky shift" from individual choices. We can represent this shift on the Marschak-Machina Triangle[13]: the line of the perfect risk-neutral subject will lie on one of the indifference curves, while the risk-lover line tends to be more positively inclined than indifference ones. Zhang and Casari (2012) found that groups were closer to risk neutrality than individuals, denoting that it occurs a "risky shift".

In lotteries 1–7, only a risk-seeking agent would choose the risky Option B. Differences here were rather limited because risk seeking behavior was rare: on average, only 2% of individual choices and 0.4% of group choices were for B. In these first lotteries, groups were less risk seeking than individuals. Anyway, significant differences came from lotteries 8–15. In these lotteries, groups were more risky than individuals.

On average, 57.4% of individual entered Option B versus 61.7% of group who did it. This second result could be a linear consequence of the default rule adopted in the design.

[12] Since the lottery choice was between a "safe" option and a "risky" one, and because of the increasing probability to obtain the highest payoff problem after problem, a rational agent should choose Ain the first lines and then switch to B, according to his/her risk attitudes. This behaviour denoted a monotonic trend. On the contrary, switching from A to B and then again to A denoted a non-monotonic behaviour.

[13] The Marschak-Machina triangle illustrates all the possible lotteries that involve 3 payoffs (with $x_3>x_2>x_1$). Every point inside the triangle is a single lottery, because x-axis shows probabilities of obtaining the worst payoff ($x_1$), while y-axis the probabilities to get the best ($x_3$) and the probability of $x_2$ arises solving this simple equation: $1 - (p_1 + p_3)$. Therefore, points in the top left are preferred to those in the bottom right. It results that thin lines stands for indifference curves. They are straight and parallels assuming that lotteries are perfect substitutes. The bold lines represent preferences of risk-averse, risk-neutral and risk-lover subject respectively.




*Notes:* $N = 120$. One group did not agree on three lottery decisions. For those decisions, the graph employed their individual third attempt proposals. Lottery numbers are the same as in Table 2.

**Figure 6:** Individual versus Groups risk Attitude per each lottery

Source: Zhang and Casari (2012)

As already said, the "no choice" rule usually takes people to talk and this could have be generated a particular in-group dynamic. More risk-averse subjects may have taken a step back because they actually have not too much to lose from switching from their choice rather than the risk-lover.

Limiting the analysis to those cases of disagreement[14], Zhang and Casari highlighted that it is not true that majority proposal always prevails. They demonstrated that it tended to prevail when riskier (Table 7). Actually, all groups disagree at least once. Specifically, 77,5% of them found an agreement on the first round, 20% at the second or the third and only one group never found a complete agreement so it took the sanction of "zero earnings". The major number of disagreements occurs on lotteries 8-13. The proposal of majority gets the better in 81.1% of cases, while the minority does it in about 20%(Table 6)[15].

[14] There was disagreement when three proposals were not equal (AAB or ABB).

[15] Source for tab. 6-7: Zhang and Casari (2012)

**Tab. 6**
Risk Neutrality when Disagreement

| | Majority Prevailed | Minority Prevailed | |
|---|---|---|---|
| Majority at risk neutrality | 79 | 12 | 91 (57.2%) |
| Minority at risk neutrality | 50 | 18 | 68 (42.8%) |
| Totals | 129 (81.1%) | 30 (18.9%) | 159 (100%) |

**Tab. 7**
Risk Shift when Disagreement

| | Majority Prevailed | Minority Prevailed | |
|---|---|---|---|
| Majority more risky | 68 | 11 | 79 (49.7%) |
| Minority more risky | 61 | 19 | 80 (50.3%) |
| Totals | 129 | 30 | 159 |

There are also some interesting personality and demographic effects on internal dynamic of decisional process. Indeed, personal traits and skills had a significant influence on reaching agreement: 1/3 of groups did not find agreement immediately

after communication, but groups were more likely to find an immediate agreement if composed by high skilled members, science and engineering members, monotonic and more extrovert students. Overall, skills are not so important: low skilled subjects were likely to prevail.

Finally, we come to the core of this work: how groups reach agreement?

Zhang and Casari tracked chat activity and they counted that on average a person intervened 4.3 times and wrote a total of 23.9 words. The number of words increased as the number of disagreement increased too. Moreover, Zhang and Casari tracked chat activity and reported the most used words in a word-cloud in which word's dimension is proportional to the frequency of its use. Words like "Ok", "should", "chance", "last", "go", denote how strong was incentive to find a final agreement and notice that central lotteries are the most quoted, because of their high degree of difficulty (Figure 7).

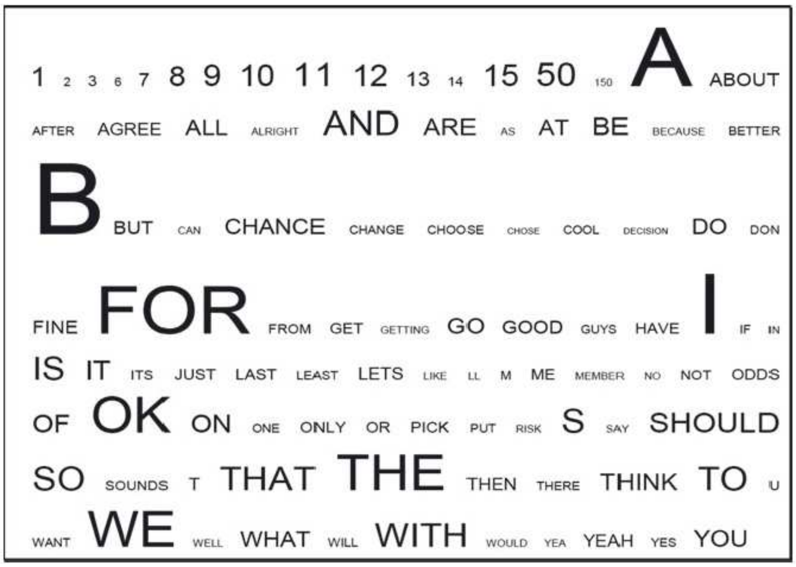



**Figure 7:** Most Used Words in Chat Activity

Source: Zhang and Casari (2012)

## 3. The most common EUT violations

An increasing part of research is focusing on preference functions that describe individual and group choices.

In their work, Rockenbach et al. (2007) noticed frequent inconsistencies with Expected Utility Theory (Common Ratio Effect, Preference Reversal Effect, and so on)[16] and substantial consistency with Portfolio Selection Theory[17].

On EUT inconsistencies, **Bone, Suckling and Hey (1999)** provided the evidence that subjects usually violate EUT axioms. In particular, in their experiment pairs of individual are tested for the Common-Ratio effect.

This experiment had two goals: first was to verify whether groups violated EUT like individual seemed to do and second to verify whether discussion might increase EU-consistency of individuals. Using CR-set[18], they found that groups

---

[16] In 1944, Von Neumann and Morgenstern elaborated the Expected Utility. It is the typical model used by economists for representing individual decisional process for uncertainty choices. According to this theory, individual preferences between different lotteries are due to his or her Utility Function that assigns a value to every level of money: this value is the utility for the decision-maker. This model is based on a couple of assumptions: firstly, consumer always aims at expected utility maximization and secondly the Utility Function just helps to order different values of utility. Anyway, many economists highlighted weak point of this (e.g. Common-Ratio Effect, Allais Paradox, Ellsberg Paradox).

[17] Markowitz (1952).

[18] Set of prospect-pairs $\{R_i, S_i\}$ for testing Common-Ratio effect

are usually inconsistent as individuals are and discussion usually does not help people to be more consistent.

Elements of CR-set were:

- X>Y>Z monetary prizes (£)
- positive scalar $a<1$
- $m$ probability values $p_1 > p_2 >, ..., > p_m$

These elements determine a set of $m$ prospect-pairs $\{R_i, S_i\}$ , comprehending one "Risky" and one "Safe" prospect:

$R_i$ £X with probability $a$ $p_i$ ; £Z otherwise

$S_i$ £Y with probability $p_i$ ; £Z otherwise

This way, $a$ is the common-ratio of winning probabilities in each prospect pairs. These prospect-pairs are called CR-set. In this experiment $m$=3 (three pairs), therefore they deal with CR-triple.

According to EUT axioms, if subject gives his preference to a given prospect-pair, this would be the same afterwards. Indeed, the Reduction axiom implies that:

$R_i$ $R_1$ with probability $p_i/p_1$; £Z otherwise

$S_i$ $S_1$ with probability $p_i/p_1$; £Z otherwise

Moreover, the indipendence axiom requires that the preference over these two prospects $\{R_i, S_i\}$ is the same over $\{R_1, S_1\}$ .

In contrast with EUT rules, people tended to have different preferences over CR-set. Economists observed that individuals preferred $S_i$ for high values of $p_i$ and $R_i$ for low values of $p_i$: that actually is the Common-Ratio effect.

In this experiment, people were asked to agree choices from CR-triples, given a joint stake in the individual prizes.

Where, r = ratio of the expected monetary values of $R_i$ and $S_i$ in a given triple that represents the attractiveness of $R_{it}$ relative to the corresponding $S_{it}$; $a$ = 0,5; Probability parameters for each triple are: $p_1 = 1$; $p_2 = 0,5$; $p_3 = 0,2$.

Every subjects registered choices from each CR-triple (12 prospect-pairs), table 8.

The experiment was composed of three steps: in the first and third steps subjects should choose between the twelve prospect-pairs; in the second step, every individual randomly joined another to come to an agreed choice for every lottery.

**Tab. 8:** Prospective of prizes (£) for the four triples:

| **Triple** | **X** | **Y** | **Z** | **r** |
|---|---|---|---|---|
| triple 1 | 30 | 15 | 0 | 1 |
| triple 2 | 35 | 15 | 0 | 1,17 |
| triple 3 | 30 | 12 | 0 | 1,25 |
| triple 4 | 35 | 12 | 5 | 1,67 |

At second step, compound prospect-pairs looked this way:

$R_{it}$ £2X with probability $a\ p_i$ ; £2Z otherwise

$S_{it}$ £2Y with probability $p_i$ ; £2Z otherwise

They were also asked to sign their division of prizes each other.

Results showed that only one individual was EU-consistent in every step. Consistency actually decreased from stage 1 to 3. However, the most important result is that couples followed a GCR (group common ratio) pattern demonstrating EU-inconsistency also in groups. Moreover, this experiment pointed out that there is not a learning process that increases individual consistency.

Bone et al. (2000) also carried another experiment on group decision-making in financial field as a mere application of membership interaction rules**.**

In a previous experiment, they had asked pairs of subjects to agree choices from among various uncertain financial prospects. As we can read, their purpose was "to investigate the incidence of Common-Ratio (CR) inconsistencies in the pattern of their agreed choices". Moreover, they also asked pairs to "register an agreed allocation of their chosen prospect". On 23 pairs, all but one agreed an unconditionally equal allocation of each of their twelve chosen prospects. How did economists explain that result? They supposed "equal division has some distinguishing property which, for these subjects, generally prevailed over any consideration of ex ante efficiency".

In 2000 Bone, Suckling and Hey decided to implemented a new experiment in order to address these questions:

- are partners attracted by ex ante efficiency at all?
- do they recognize opportunities for achieving it?
- what is the counterattraction of the equal allocation and, in particular, is it related to fairness?

In their paper, Bone et al. (2000) described an experiment in order to know whether couples were able to take advantage of efficiency gains in the sharing of a risky financial prospect. Results seem to suggest not: they registered an overall rejection of efficiency in favor of ex post equality. Trying to explain why, Bone, Suckling and Hey found that "fairness is not a significant consideration, but rather that having to choose between prospects diverts partners from allocating the chosen prospect efficiently".

Given that EUT sometimes cannot describe perfectly every decisional behavior of individuals (or groups), now, we will focus on alternative functions that can be used in place of EUT. Indeed, there are different utility functions that describe individual preferences under risk and uncertainty. However, so far no one has compared these alternative theories for group preferences. Hence, let us examine the experiment that Morone and Morone (2014b) have carried out.

They had two goals: the first one was understanding which theory fits better group's pattern of decisions, comparing Expected Utility, Disappointment Aversion and Rank-Dependent in its two variants (RP and RQ)[19], secondly investigating whether there were differences between individual and group

[19] Decisional behaviour of different subjects can be explained best by different functionals. Introduced by Gul (1991), Disappointment Aversion theory is based on the main assumption that individual behaviour in decision-making processes depend on feeling of disappointment that could result if the final outcome of the lottery were lower than certainty equivalent. DA is a particular case of EU, when$\beta$= 0. Rank-dependent expected utility theory is a wider model than EU because is has been designed to consider also Allais Paradox. Therefore, EU is a particular case of RD when $\gamma$= 0.

choices under risk. As we saw, until now different studies leaded to different results: according to Baker et al. (2008), Shupp and Williams (2008), Masclet et al. (2009) groups are more risk averse, while according to Zhang and Casari (2012) groups show a risky shift and Harrison et al. (2012) comes to the conclusion that there are no significant differences between individual and group risk aversion.

In order to address their research questions, Morone and Morone (2014b) gathered 76 students from University of Bari and they randomly couple them obtaining 38 groups. They conducted 2 treatments: individuals and groups faced a set of 100 pairwise choice questions, each one composed of two lotteries, A and B, as reported in Figure 8.

Four possible outcomes: 25€, 75€, 125€ and 175€, where p and q indicate probability of A-outcomes and B-outcomes, respectively.

In the first treatment, each subject should report his/her preference about lotteries. In the second treatment, the same subjects played the same lotteries in couples. Interaction between group members was allowed, but only by anonymous chat, in order to avoid "beauty effect"[20] and without time limits. Once they agreed, they could move to the next pairwise choice.

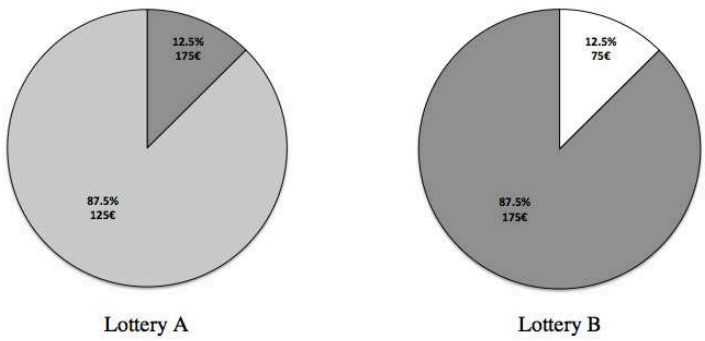



**Figure 8:** Examples of Lotteries Presented

In order to esteem the more fitting preference functionals, they first evaluated the

[20] One member's beauty can influence the final outcome of group decisional process. For this and other stereotypes on group decisions, see Andreoni and Petrie, 2008.

preferences between A and B for every subjects[21], then they esteemed parameters maximising the likelihood function.
The EU, DA, RP and RQ are examined and estimated subjects per subjects and for each group using the *net preference functional*:

$$\mathbf{V^*(p,q)= W(p) - W(q) + \varepsilon}$$ [22]

where, W is the subject's preference functional, *p* and *q* are vectors denoted probabilities of lottery A and B respectively, and ε is the omoschedastic error[23].
Afterwards, they carried out the log-likelihood test (LL) at 5% level of significance between EU and non-EU theories.
As we can see in the following Table 9, DA shows a performance better than EU (31,6%) and other models.

**Tab. 9**

Alternative Functionals vs. Expected Utility
Percentage of subjects for whom test significant at 5%

| | Individuals | Groups |
|---|---|---|
| DA | 0.316 | 0.474 |
| RP | 0.237 | 0.263 |
| RQ | 0.237 | 0.316 |

Source: A. Morone and P. Morone (2014)

Furthermore, DA values registered a noticeable increase passing from individuals to groups. Since it is not possible comparing all the preference functionals just with LL method, Morone and Morone (2014) chose to use the CAIC[24] = LL - k, where k is the number of esteemed parameters. The smaller

[21] The probability that the subjects preferred A was: Prob{$\epsilon$ > E[u(B) - u(A)]}.
[22] When V(p,q) > 0 then A was preferred to B. When V(p,q) < 0, then B was preferred to A. If V(p,q) = 0, participants were indifferent between A and B.
[23] The error spreads out like a normal curve with average 0 and variance s.
[24] Corrected-log-likelihood Akaike Cnformation Criterion, see Hey and Orme (1994)

CAIC is, the better the model is.
Indeed, we can easily note that EU plays the best performance (average rank of 2.17) based on individual data (Table 10).

**Tab. 10:** Performance (%) of the four Preference Functionals Based on Individual Data

| Preference functional | Rank 1st | 2nd | 3rd | 4th | Average rank |
|---|---|---|---|---|---|
| EU | 0.34 | 0.28 | 0.25 | 0.13 | 2.17 |
| DA | 0.28 | 0.29 | 0.08 | 0.36 | 2.51 |
| RP | 0.17 | 0.26 | 0.36 | 0.21 | 2.61 |
| RQ | 0.21 | 0.17 | 0.32 | 0.30 | 2.71 |

Source: A. Morone and P. Morone (2014)

EU ranks in the first two positions for 62% of cases.
On the contrary, group data showed a different picture: the best performing model is the Disappointment Aversion, with an average rank of 2.24 it gets before the others in 58% of cases (Table 11).

**Tab. 11:** Performance (%) of the four Preference Functionals Based on Group data

| Preference functional | Rank 1st | 2nd | 3rd | 4th | Average rank |
|---|---|---|---|---|---|
| EU | 0.26 | 0.24 | 0.24 | 0.26 | 2.50 |
| DA | 0.37 | 0.21 | 0.24 | 0.18 | 2.24 |
| RP | 0.18 | 0.24 | 0.26 | 0.32 | 2.71 |
| RQ | 0.18 | 0.32 | 0.26 | 0.24 | 2.55 |

Source: A. Morone and P. Morone (2014)

Overall, with this experiment Morone and Morone (2014) confirmed EU supremacy in representing decisional process, not only because it fits better than others decision-making processes for individual, but it also outperforms them for small group. Anyway, researchers also come to another important result: they pointed out that DA actually improves its performance in group treatment (Table 12). This phenomenon highlights the presence of a noteworthy difference between individual and group choices: maybe feelings disappointment and loss aversion become stronger when it passes from individual dimension to a group one.

**Tab. 12:** percentage of “winners” for individual and group treatments at 5%

| Model | "Winners" at 5% | |
|---|---|---|
| | Individual | Group |
| EU | 0.66 | 0.47 |
| DA | 0.16 | 0.24 |
| RP | 0.09 | 0.13 |
| RQ | 0.09 | 0.16 |

Source: A. Morone and P. Morone (2014)

## 6. Conclusions

This digression over the previous works in the field of groups’ decisions over risk and uncertainty denotes that there are many ways to elicit preferences: Moreover, there are different “default rule” in order to come to a group decision (majority rule, unanimity, dictator rule, etc.) that can be used. Both experimental design and default rules may affect the final results of the experiments. Indeed, this overview leads us to different results that may be explained considering the different experimental designs. For example, in Masclet et al.’s, Baker et al.’s and Shupp and William’s works, unanimous default rule leads to the conclusion that groups are more risk-averse and it is also occurs in Ambrus et al.’s paper; conversely, in Harrison at al. (2012), the majority rule tends to hold steady individual preferences; finally, Zhang and Casari with their “zero earnings” pushed groups to reach agreement at any cost, so that even more risk-averse people were incline to make a riskier decision.

## References

Ambrus A., Greiner B., Pathak P., "How individual preferences get aggregated in groups - An experimental study", Working Paper, No. 158, Economic Research Initiatives at Duke, 2013

Baker, R. J., S. K. Laury, and A. W. Williams. "Comparing Small-Group and Individual Behavior in Lottery-Choice Experiments." Southern Economic Journal, 75(2), 2008, 367–382.

Bateman, I. and A. Munro, "An Experiment on Risky Choice Amongst Households" Economic Journal, 115(502): 176-189, 2005.

Bone, J., Hey J. D. and J. Suckling. "Are Groups More (or Less) Consistent Than Individuals?" Journal of Risk and Uncertainty, 18(1) 1999, 63–81.

Bone, J., Hey J. D. and J. Suckling. "A Simple Risk-Sharing Experiment". Journal of Risk and Uncertainty, 28(1), 2004, 23-38.

Bornstein, G., and Yaniv, I., "Individual and Group Behavior in the Ultimatum Game: Are Groups More "Rational" Players?", Experimental Economics, 1(1): 101-108, 1998.

Bornstein, G., Kugler, T., and Ziegelmeyer, A., "Individual and Group Decisions in the Centipede Game: Are Groups More "Rational" Players?", Journal of Experimental Social Psychology, 40(5): 599–605, 2004.

Carbone, E., and Hey J. D., "Estimation of Expected Utility and Non-Expected Utility Preference Functionals Using Complete Ranking Data", In B. Munier and M.J. Machina (eds.), Models and Experiments on Risk and Rationality, Kluwer, Boston, 1994, 119-39.

Carbone, E., and Hey J. D., "A Comparison of the Estimates of EU and non-EU Preference Functionals Using Data from Pairwise Choice and Complete Ranking Experiments", Geneva Papers on Risk and Insurance Theory, 20: 111-133, 1995.

Cason, T. N., and Mui, V., "A Laboratory Study of Group Polarisation in the Team Dictator Game", Economic Journal, 107(444): 1465-83, 1997.

Charness, G., Rigotti, L. and A. Rustichini. "Individual Behavior and Group

Membership." American Economic Review, 97(4), 2007, 1340–1352.

Cooper, D. J., and Kagel, J. H., "Are Two Heads Better Than One? Team versus Individual Play in Signaling Games", American Economic Review, 95(3): 477-509, 2005.

Hayne, S., and J. Cox. “Barking Up the Right Tree: Are Small Groups Rational Agents?”, Experimental Economics, 9, 2006, 209–222.

Harrison, G. W., Morton, I. L., Rutström, E. E. and M. Tarazona-Gomez. “Preferences over Social Risk”, Oxford Economic Papers, 65(1), 2012, 25–46.

Hey, J.D., and Orme, C., “Investigating Generalizations of Expected Utility Theory Using Experimental Data”, Econometrica, 62: 1291-1326, 1994.

Hey, J.D., Morone A. and U. Schmidt. “Noise and bias in eliciting preferences”. Journal of Risk and Uncertainty, 39, 2009, 213–235.

Holt, C. A. and S. K. Laury. “Risk Aversion and Incentive Effects”, American Economic Review, 92, 2002, 1644–1655.

Jacobson, S. and R. Petrie. “Inconsistent Choices in Lottery Experiments: Evidence from Rwanda”. Working Paper No. 3, Experimental Economics Center, Georgia State University, 2007.

Kocher, M. G., and Sutter, M., "The Decision Maker Matters: Individual Versus Group Behaviour in Experimental Beauty-Contest Games", Economic Journal, 115(500): 200-223, 2005.

Kugler T., Kausel E. and M. G. Kocher. “Are group more rational than individual? A review of interactive decision making in groups”. Wiley Interdisciplinary Reviews: Cognitive Science, 3(4), 2012, 471–482.

Masclet, D. Loheac, Y., Denant-Boemont, L. and N. Colombier. “Group and Individual Risk Preferences: a Lottery-Choice Experiment”. Journal of Economic Behavior and Organization, 70(3), 2009, 470–484.

Morone, A., “Comparison of Mean-Variance Theory and Expected-Utility Theory Through a Laboratory Experiment”, Economics Bulletin, 3(40): 1-7, 2008.

Morone, A., “On price data elicitation: A laboratory investigation”. The Journal of Socio-Economics, 39(5), 2010, 540-545.

Morone, A. and P. Morone, "Guessing Games and People Behaviours: What Can we Learn?", in: M. Abdellaboui and J.D. Hey (eds.), Advances in Decision Making under Risk and Uncertainty, Springer, 2008.

Morone A. and P. Morone, "Boundary and interior equilibria: what drives convergence in a 'beauty contest'?". *Economics Bulletin*, 30(3), 2010, 2097-2106.

Morone, A. and P. Morone, "Estimating Individual and Group Preference Functionals Using Experimental Data". *Theory and Decision*, 2014, 1–20.

Morone, A., P. Morone, "The focal point in the Traveller's Dilemma: An Experimental Study" MPRA Paper No. 58071, 2014b.

Morone A. and U. Schmidt, "An Experimental Investigation of Alternatives to Expected Utility Using Pricing Data," Economics Bulletin, AccessEcon, vol. 4(20), 2008, pages 1-12.

Morone, A., P. Morone, A.R. Germani, "Individual and group behavior in the traveler's dilemma: An experimental study", Journal of Behavioral and Experimental Economics. Volume 49, April 2014, Pages 1–7

Morone, A., S. Sandri and T. Uske, "On the absorbability of the Guessing Game Theory - A Theoretical and Experimental Analysis", in: A. Innocenti and P. Sbriglia (eds.), Games, Rationality and Behaviour, Palgrave, 2008.

Nagel, R., "Unraveling in Guessing Games: An Experimental Study", American Economic Review, 85(5): 1313-1326, 1995.

Nagel, R. and F.F. Tang, "An Experimental Study on the Centipede Game in Normal Form: An Investigation on Learning", Journal of Mathematical Psychology, 42(2-3): 356-384, 1998.

Rockenbach, B., Sadrieh, A. and B. Mathauschek, B. "Teams take the better risks". Journal of Economic Behavior and Organization, 63, 2007, 412–

22.

Schmidt, U., “Alternatives to Expected Utility: Some Formal Theories”, in: P.J. Hammond, S. Barberá, and C. Seidl (eds.), Handbook of Utility Theory Vol. II, Kluwer, Boston, 2004.

Shupp, R.S. and A. W. Williams. “Risk preference differentials of small groups and individuals”, The Economic Journal, 118 (525), 2008, 258–283.

Starmer, C., “Developments in Non-Expected Utility Theory: The Hunt for a Descriptive Theory of Choice under Risk”, Journal of Economic Literature, 38: 332-382, 2000.

Sugden, R., “Alternatives to Expected Utility: Foundations”, in: P.J. Hammond, S. Barberá, and C. Seidl (eds.), Handbook of Utility Theory Vol. II, Kluwer, Boston, 2004.

Von Neumann, J. and O. Morgenstern. Theory of Games and Economic Behavior, Princeton University Press, Princeton, 1944.

Zhang, J., and M. Casari. "How Groups Reach Agreement In Risky Choices: An Experiment", Economic Inquiry, 50(2), 2012, 502–515.