Team decision making under risk and myopic loss aversion

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Abstract

Myopic loss aversion has been put forward by Benartzi and Thaler (1995) as an explanation for the equity premium puzzle. Several studies have shown that myopic loss aversion is, indeed, a persistent phenomenon in *individual* decision making under risk. We examine in an experimental study whether investment decisions of *teams* are equally affected by myopic loss aversion and whether teams make different decisions than individuals. Our major findings are that (1) team decisions are also characterized by myopic loss aversion, and that (2) teams invest higher amounts than individuals do. We discuss several implications of these findings.

JEL-classification: C91, C92, D80, G10

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1 Introduction

Benartzi and Thaler (1995) have put forward the concept of myopic loss aversion (MLA) as an explanation for one of the most intriguing puzzles in finance, i.e. the equity premium puzzle. This puzzle refers to the fact that given the long-term returns of stocks and bonds one would have to assume unreasonably high levels of risk aversion to explain why investors are willing to hold bonds at all (Mehra and Prescott, 1985; Kocherlakota, 1996; Siegel and Thaler, 1997). To resolve the puzzle, Benartzi and Thaler (1995) have combined the behavioral concepts of loss aversion (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992) and mental accounting (Kahneman and Tversky, 1984; Thaler, 1985) into MLA. In short, MLA assumes that people are myopic in evaluating outcomes over time, and are more sensitive to losses than to gains.[1] In the context of financial decision making, MLA implies that shorter evaluation periods and a shorter period of commitment to an investment make a risky option (with positive expected value) look less attractive than longer evaluation periods and a longer commitment would do, because with longer evaluation periods and commitment aggregate losses occur less frequently in case of risky investments with a positive expected value. As a consequence, subjects exhibiting MLA can be expected to invest less in risky options the more frequently returns are evaluated and the more often they can change their investment decision.

In this study, we examine financial decision making of teams and in particular whether decisions taken by teams – rather than individuals – are prone to myopic loss aversion. In their seminal paper, Benartzi and Thaler (1995) raise the question whether organizations (like pension funds, foundations or university endowments) display MLA. In addressing the question – and providing an affirmative answer – they recur to individual fund managers, but

[1] As such, MLA can be considered an example for what Kahneman and Lovallo (1993) have called "narrow framing", i.e. to think about gambles or investments one at a time rather than aggregating them into a portfolio.

do not consider the case of teams making financial decisions within organizations. Yet, many organizations rely on a "four eyes principle" or a team-management approach when making investment decisions in stocks and bonds (Prather and Middleton, 2002). Therefore, it seems of imminent practical importance to examine whether teams take different investment decisions than individuals and whether teams are also susceptible to MLA.

So far, the prevalence of MLA has only been examined for *individual* decision makers. In recent years, several experimental studies have provided robust evidence for the existence of MLA. Gneezy and Potters (1997), Thaler et al. (1997), Barron and Erev (2003), Langer and Weber (2003), Bellemare et al. (2005) or Fellner and Sutter (2005) have found that in an individual decision making task subjects invest less in risky assets (with positive expected return) with shorter evaluation and commitment periods than in case of longer evaluation and commitment periods. The effects of MLA even carry over to market conditions, as has been shown by Gneezy et al. (2003) who have found lower market prices in an experimental asset market when evaluation and commitment periods are shorter.

Given that the experimental evidence has been gathered only with students who have no (or at best marginal) experience in real financial markets, Haigh and List (2005) have put forward the conjecture that the effects of MLA might be severely attenuated when real market players act in an experiment. To test this conjecture, they have exposed professional futures and options pit traders from the Chicago Board of Trade to the experimental design of Gneezy and Potters (1997). Much to their surprise, they have found that professional traders exhibit MLA to an even *greater* extent than a control group of undergraduate students. This result implies that the negative impact of MLA on investments in risky assets is not confined to student participants only and can not be attenuated simply by letting *more experienced subjects* make investment decisions.

However, the effects MLA might be avoided or limited by letting *more subjects*, i.e. *teams*, make a (single) decision. One major purpose of this paper is to test this conjecture which might have important practical implications for the institutional choice of the appropriate type of decision maker for financial decisions. If we found teams to be immune to or less affected by MLA, this would provide an important rationale for entrusting decisions under risk – like financial decisions of investment companies or investment decisions of corporations – to teams rather than to individuals. Furthermore, the issue of team decision making and MLA is important from a theoretical point of view because it examines the range of applicability of the concept of MLA.

Since we gather also individual data to compare our team data on MLA to, this study also serves a second major purpose of investigating differences in decision making under risk between individuals and teams. Even if both individuals and teams were prone to MLA, their decisions might still be different, for instance with respect to maximizing the expected value of financial decisions.

To address the purposes of this paper, we will present a series of three different experimental studies. Study S1 examines whether individuals and teams take different decisions and whether both types of decision makers exhibit MLA. Using a between-subjects design we find that teams make higher investments in the experimental lottery than individuals do, such that teams are closer to maximizing their expected value. But we also find that teams are as prone to MLA as individuals are. Study S2 addresses the question whether team decision making has a persistent effect on individual decision making when subjects experience both individual and team decision making. Using a within-subjects design we can replicate the basic findings of study S1 and show that individuals raise their investments when they switch from individual to team decision making, but that the reverse does not occur. Hence, team decision making has persistent effects on ensuing individual decision making. Given the robust findings on differences between individual and team decision making we try to pin down the causes for these differences in study S3. For this purpose, we design an experiment where we can isolate two important aspects of team decision making: first, the fact that members of teams are equally affected by the team's decision, in particular that they have the same payoffs from a given decision; second, the fact that team decision making involves the exchange of information and advice among team members. We find that both factors contribute (more or less equally) to the higher investments of teams than of individuals.

The rest of the paper is organized as follows. Section 2 discusses related literature and derives some hypotheses. Section 3 describes the main elements of the experimental design and procedure that is common in all three experimental studies. Section 4 is devoted to the specific details and results of the three experimental studies. Section 5 summarizes and concludes the paper.

2 Team decision making under risk

The issue of individual versus team decision making under risk has caught considerable attention in social psychology. Stoner's (1961) seminal finding of a risky shift in teams – meaning that teams make riskier decisions than the average group member – has received a great deal of attention, but it has not been established as a general phenomenon of decision making in teams, because subsequent research has observed both risky and cautious shifts in team decision making under risk (Davies, 1992; Kerr et al., 1996; Levine and Moreland, 1998).

In economics, the traditional view is that the type of decision maker – individual or team – should not matter systematically for decision making. From the classical expected utility theory perspective the ultimate decision should lead to the same maximizing choice (Arrow, 1987). Only very recently, Eliaz et al. (2005) have presented a theoretical model which predicts choice shifts in team decision making under certain conditions. The model is very general and captures both the possibility of risky as well as cautious shifts within teams, with the direction of the shift depending crucially on the expectation of a team member on the other team members' probability for taking either a safe or a risky decision. Even though its generality is appealing, the model of Eliaz et al. (2005) does not provide an equilibrium analysis of how team members react optimally to their expectation of other members' decisions. Given this limitation, it is impractical to come up with a clear hypothesis on team decision making under risk and it is hard to devise a precise empirical or experimental test of the model.

Therefore, we resort to experimental work on team and individual decision making under risk to derive behaviorally motivated expectations about the possible differences. Even though we are not aware of any paper on the existence of MLA in team decisions, there are a few papers on the question whether team decisions comply better with expected utility theory than individual decisions. Bone et al. (1999) test for common-ratio effects of teams and individuals, finding that both types of decision makers are basically equally likely to fall prey to this violation of the axioms of expected utility theory. However, Bone et al. (1999) also find that teams choose more often a riskier decision than individuals, implying a higher expected value from the lotteries chosen by teams than by individuals. Very similar results have been reported in Rockenbach et al. (2001) who also find teams not to be more consistent with the axioms of expected utility theory when testing for preference reversal, common ratio, or reference point effects. However, teams take the better risks in their lottery choices by accumulating a significantly higher expected value from the lotteries at a significantly lower risk. They explain this latter finding by a team decision algorithm which combines majority voting on lottery choices with the right to veto alternative choices which provide additional risk that is not compensated by additional expected value. In sum, the experimental evidence of Bone et al. (1999) and Rockenbach et al. (2001) suggests that teams are better in maximizing expected value. Therefore, we put forward as a first expectation for our experimental study:

Expectation 1*: Teams take decisions which generate a higher expected value than the decisions of individuals.*

Turning to the issue of MLA and team decision making, we start with the observation that from the viewpoint of expected utility theory, a variation in the evaluation frequency and in the length of commitment should not lead to different investment levels. The concept of MLA, however, explains why differences in the evaluation frequency or commitment length might matter after all and predicts that longer commitment and evaluation periods should lead to higher investments. Yet, MLA provides no cue whether to expect differences between teams and individuals.

If the existence of MLA were classified as a bias in judgment – which can be justified if expected utility theory is taken as the normative benchmark – then the more general question would be whether teams are more or less prone to judgmental biases and violations of expected utility theory than individuals are. The predominant view in social psychology is that there is no clear or general pattern with respect to judgmental biases (Kerr et al., 1996), meaning that teams have in many respects the same degree of biases as individuals, for instance with regards to the law of small numbers bias, illusion of control or overconfidence (Houghton et al., 2000). Likewise, the studies of Bone et al. (1999) and Rockenbach et al. (2001) have failed to find significant differences between teams and individuals with respect to the frequency of violating the axioms of expected utility theory. Therefore, it seems reasonable not to expect any differences between teams and individuals concerning the existence of MLA, which we summarize in our second expectation:

Expectation 2*: Individuals and teams are equally prone to MLA.*

3 Basic experimental design

All three experimental studies reported below rely on the design introduced by Gneezy and Potters (1997).[2] Subjects receive an endowment of 100 Euro-cents (i.e. 1€) in each out of 9 rounds in total. Then they have to choose in each round how much to invest in a lottery with the following characteristics: With a probability of 1/3 the lottery returns two and a half times the invested amount X in addition to the initial endowment, yielding a round payoff of 100 + 2.5X Euro-cents. With a probability of 2/3 the invested amount is lost, yielding 100 – X Euro-cent as payoff in the respective round.[3]

There are two *conditions* under which subjects have to make their decision in each of the experimental treatments introduced below. The amount X has to be chosen round by round in condition *SHORT*.[4] This is the condition with a short-term commitment with respect to financial investments. In condition *LONG*, decisions on X have to be made in sequences of three rounds each, hence for rounds 1-3, rounds 4-6, and rounds 7-9 separately. This

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[2] Langer and Weber (2003) have shown that the effects of MLA prevail not only in additive investment tasks (as in the design of Gneezy and Potters, 1997), but also in a more realistic, but also considerably more complex multiplicative setting, where earnings in one round carry over to all subsequent rounds. Given that Langer and Weber's (more complex) examination of the influence of MLA on investment decisions yields the same conclusions as Gneezy and Potters (1997) or Thaler et al. (1997), for example, we stick to the (relatively simpler) additive design of Gneezy and Potters (1997) for the purpose of our study.

[3] Note that decision-makers in the experiment invest their 'own' money (given to them by the experimenter), which is typically not the case for agents (brokers) on financial markets. Yet, the agents' earnings depend very often on the performance of their investments (through the use of proportional commissions, for instance). Therefore, it seems a reasonable approach to let subjects invest their 'own' money in the experiment.

[4] We italicize the two conditions (*SHORT* and *LONG*) throughout the text in order to distinguish these conditions from the experimental treatments that are denoted in regular capital letters. Of course, *SHORT* and *LONG* might also be called treatments, but we would like to reserve the latter term for the variations in the experimental conditions of studies S1 to S3.

represents the long-term commitment condition, because the invested amount X is fixed for three rounds.

As regards the information conditions, subjects are informed about the lottery's outcome[5], the resulting payoff in each single round and the sum of accumulated payoffs up to the present round under both conditions. Under the *LONG* condition subjects are additionally informed about the sum of payoffs earned in a sequence of three rounds.[6]

All experimental sessions were programmed with z-Tree (Fischbacher, 1999) and conducted at the Max Planck Institute for Economics in Jena. Sessions lasted between 35 and 50 minutes. The recruitment of the 822 subjects who participated in at most one session was greatly facilitated by the online recruitment system ORSEE (Greiner, 2004). On average participants earned 9.8 €, plus a show-up fee of 2 €.

[5] The lottery's outcome depended on a subject's randomly assigned type and a uniformly distributed random number from the interval [0,3]. Type A-players won the lottery if the random number $r \in [0, 1]$, type B-players if $r \in (1, 2]$, and type C-players if $r \in (2, 3]$. In order to check whether the determination of the lottery's outcome via computer influenced subjects's behaviour we also ran some control sessions in study S1 with paper and pen where the lottery's outcome was determined by drawing any of three balls (labelled A, B, or C) out of an urn. Investment decisions in the paper and pen sessions are very similar to and not significantly different from those in the computerized sessions which allowed us to pool these data.

[6] That means that subjects in the *LONG* are not only informed about the aggregated outcome of a sequences of three rounds with respect to payoffs, but get to know in addition the outcome of each single round. Langer and Weber (2003), Bellemare et al. (2005) and Fellner and Sutter (2005) examine in more detail the influence of the feedback frequency (either for each single round or as an aggregated measure for a sequence of three rounds) on investment decisions and disentangle the effects of the length of commitment and the frequency of feedback.

4 The three experimental studies

4.1 Study S1: Are there differences between individuals and teams?

4.1.1 Treatments and procedure

The treatment variable in study S1 is the type of decision maker being either an individual or a team of three subjects who can communicate and discuss their decisions face-to-face. We denote these treatments INDIVIDUALS, respectively TEAMS. Experimental instructions were identical in both treatments, with two exceptions.[7] First, teams of three subjects each were requested to arrive at a team decision which was binding for all team members.[8] Second, in the team sessions it was made clear that *each* of the three team members would get paid the full amount earned by the team in the 9 rounds. This procedure holds the per capita payoffs and marginal incentives constant across both treatments.

The experimental sessions were run in December 2003. A total of 294 participants were randomly assigned to the two treatments and the two different conditions per treatment. In each of the TEAMS-conditions we had 28 teams of three subjects each. In the INDIVIDUAL treatment we had 64 subjects in *SHORT*, and 62 in *LONG*.

4.1.2 Results

Figure 1 shows the average investment levels per round, depending upon the type of decision maker (INDIVIDUALS vs. TEAMS) and the condition (*SHORT* vs. *LONG*). The first thing to notice is that teams invest significantly higher amounts than individuals under

[7] The experimental instructions are given in the Appendix for referees' use.

[8] Teams – like individuals – had 3 minutes time in *SHORT* (9 minutes in *LONG*) to arrive at a decision. This time limit was not strictly enforced, but a message showed up on the computer screen when this time was up, indicating that the team – or individual – should make a decision in short time. Only in the first round of the *SHORT*-condition, some teams needed up to 4 minutes before entering a decision. No team exceeded the time limit in the *LONG*-condition. Individuals stayed within the time limit in all instances.

both conditions. The average investment in *SHORT* is 39.4 in INDIVIDUALS and 55.7 in TEAMS ($p < 0.05$; $N = 92$; Mann-Whitney U-test[9]). The corresponding figures in *LONG* are 54.7 vs. 76.8 ($p < 0.01$; $N = 90$; Mann-Whitney U-test). These results indicate that teams make riskier decisions and, thereby, accumulate more expected value than individuals do. This is in line with our Expectation 1.

Result 1A*: Controlling for the length of commitment, teams invest significantly higher amounts than individuals do.*

Figure 1 and Table 1 about here

The second thing to notice from Figure 1 is the difference between investment levels in *SHORT* and in *LONG*. Individuals invest on average 39.4 in *SHORT*, but 54.7 in *LONG* ($p < 0.05$; $N = 126$; Mann-Whitney U-test), and teams invest 55.7 in *SHORT*, but 76.8 in *LONG* ($p < 0.01$; $N = 56$).

It is remarkable that both individuals and teams invest about 38% higher amounts when the length of commitment is long than when it is short, showing that the influence of MLA on investment decisions of individuals and teams is practically the same and not significantly different. This is in line with our Expectation 2.

Result 1B*: The investment decisions of both teams and individuals are equally affected by myopic loss aversion.*

Our Result 1A of teams making higher investments can be further qualified by checking whether it is mainly due to less individuals investing at all (meaning that it could be caused by a larger fraction of individuals shying away from positive investments) or whether also those individuals investing positive amounts invest less than teams. It turns out that both

[9] All tests reported in this paper are two-sided. Panel A of Table 1 also reports the average investments in the different sequences of three rounds.

explanations are valid. About 17.5% of individual choices in *SHORT* are zero investments (X = 0), whereas only 4.4% of teams choose not to invest at all. In *LONG*, 10.2% of individual choices are zero investments, compared to 1.2% of team choices. In both conditions, the fraction of individuals completely abstaining from investment is significantly higher than those of teams ($p < 0.05$; χ^2-test). However, even those individuals who invest positive amounts invest less than teams. If we consider only the positive investments, we find individuals investing 47.8, but teams 58.2 in *SHORT* ($p = 0.10$; Mann-Whitney U-test). In *LONG*, the difference is even larger (61.0 vs. 77.8; $p < 0.05$). Since the risk of investing positive amounts is fixed across treatments and conditions, our Result 1A is not only driven by what psychologists would call risky shift (more teams making strictly positive investments), but also by teams making significantly higher investments than even those individuals who invest a positive amount at all.

4.2 Study S2: Does team decision making have an effect on individual decision making?

4.2.1 Treatments and procedure

Study S2 examines whether the experience of team decision making has any spillovers on subsequent individual decision making. By using a within-subjects design it also can serve as a control whether the results obtained in the between-subjects design of study S1 extend to a within-subjects setting.

We have two experimental treatments which we denote ITI and TIT. The “I” in the treatment abbreviation stands for three rounds of individual decision making, whereas the “T” indicates three rounds of decision making in teams of three subjects. That means that participants in the ITI-treatment start with three rounds of individual decision making. Thereafter they are linked together as teams of three subjects and have to make decisions for rounds 4-6 as a team. A final phase of individual decision making in rounds 7-9 then completes the experiment. In the TIT-treatment, the order is reversed, with subjects making decisions in (fixed) teams in rounds 1-3 and rounds 7-9, and individually in rounds 4-6.

The team decision making process was organized as follows. The three members of a team were connected via an electronic chat in which they could exchange any messages (that did not reveal their identity) in real-time. Team decisions were only valid if all team members entered the same decision on their computer.[10]

It is important to stress that subjects were not aware of the changes in how to make a decision in the course of the experiment before these changes actually occurred. This means that participants in the ITI-treatment received the same instructions as those in INDIVIDUALS, and the participants in the TIT-treatment basically those from the TEAMS-treatment (except that an electronic chat was used for communication in TIT). Only after round 3 – and later on after round 6 – participants got to know the changes in how to make a decision. We opted for this procedure of not announcing the whole structure of decision making right from the beginning, because we wanted to avoid that (individual or team) decisions were confounded by the prospect of deciding later on in a team or as an individual.

Given the evidence from study S1 we should expect an increase in investments when subjects experience the first (surprise) switch from individual to team decision making. It is less clear whether switching from team decision making to individual decision making has the reverse effect, because team decisions might set a reference point for subsequent individual decisions.

The sessions for study S2 were run in February and March 2005 with a total of 276 participants. In treatment TIT we had 63 subjects (i.e. 21 teams) both in *SHORT* and in

[10] Actually, there were four teams (out of 96 participating teams) in which subjects could not agree on a joint decision, but entered different decisions. All data from the 12 subjects in these four teams have been excluded from the analysis.

LONG. In treatment ITI 72 subjects participated in the *SHORT* condition and 78 subjects in the *LONG* condition.

4.2.2 Results

The left-hand side of Figure 2 shows the average investments in sequences of three rounds in the ITI-treatment under the conditions *SHORT* and *LONG*. As expected, we observe a marked increase of investments after round 3 when subjects switch from individual to team decision making. In *SHORT* investments increase from 44.7 in rounds 1-3 to 55.6 in round 4-6 ($p = 0.04$; $N = 24$; Wilcoxon signed-ranks test)[11]. The same pattern is observed in *LONG* with investments of 52.3 in rounds 1-3, but 61.8 in rounds 4-6 ($p = 0.012$; $N = 26$). The decrease of investment levels when switching back from team decision making to individual decision making, however, is not significant ($p > 0.2$ both in *SHORT* and in *LONG*).

Result 2A*: When starting with individual decision making (in ITI), subjects increase their investments significantly when they switch from individual to team decision making, but they do not decrease investments significantly when switching back.*

Figure 2 about here

The right-hand side of Figure 2 addresses the TIT-treatments. When switching from team to individual decision making after round 3, there is a decrease of investments in *SHORT* and an increase in *LONG*. However, none of both changes is significant, nor are the changes when switching back from individual to team decision making after round 6. The experience of team decisions seems to set a kind of anchor which persists even if subsequent decisions have

[11] We use a conservative measure for testing, because we match the investments of a team in rounds 4-6 with the average investments of the three members in rounds 1-3. Hence, each team of three members constitutes one independent unit of observation.

to be made individually. This finding is consistent with the pattern associated with the switch after round 6 in the ITI-treatment. After subjects have experienced team decision making they do not decrease their investments significantly when returning to individual decision making.

Result 2B: *After having experienced team decision making (both in ITI and TIT), subjects do* not *decrease their investments significantly when switching back to individual decision making.*

Comparing data in the *SHORT* and *LONG* conditions of both treatments shows that MLA is also prevalent in study S2, which confirms the earlier findings of study S1. Both in ITI and TIT the overall average investments are significantly lower in *SHORT* than in *LONG* ($p <$ 0.07 in both treatments; Mann-Whitney U-test).

Result 2C: *Myopic loss aversion is also existent in treatments ITI and TIT.*

We now turn to the contents of communication in the team decision phases of treatments ITI and TIT. We concentrate on the first decision made in a team (round 1 in TIT, and round 4 in ITI) and examine the importance of proposals and arguments exchanged in the electronic chat. Looking at the first decision of a team is justified on the following grounds. First, in the *LONG*-condition of the ITI-treatment, teams actually only have to make one decision after using the electronic chat. Hence, it is the cleanest test of the effects of proposals and arguments across all treatments and conditions when one considers only the communication preceding the first decision. Second, when teams have to make several decisions (as in ITI-*SHORT* or in the TIT-treatments) the arguments discussed before the first team decision are seldom repeated in later rounds. That makes the coding problematic, because then one can no longer discriminate whether the absence of an argument that has been put forward in earlier decisions means that the argument still affects the decision or whether it is no longer considered of being important.

Table 2 about here

Table 2 reports in the upper part of panel A the average of the very first proposals made in the electronic chat.[12] The first proposals are not significantly different between any of the 4 experimental settings (2 treatments × 2 conditions), even though they are about 20% lower in *SHORT* than in *LONG*. The very first proposals are on average lower than the actual investments of the team (with $p = 0.10$ in ITI-*SHORT*, $p < 0.1$ in TIT-*LONG*, and $p < 0.01$ if we pool all data; Wilcoxon-signed ranks tests). This result indicates that the first proposals generally establish a lower limit for the team decision. Typically, first proposals are made before arguments for or against any proposal are put forward. These arguments are then important for the final team decision.

Panel A of Table 2 also includes the relative frequency of the three most frequently mentioned types of arguments. Argument A1 proposes to make high investments, because the expected payoff is maximized with maximum investment. This argument is mentioned in 29% to 38% of teams in the four experimental settings, but its frequency does not differ significantly across settings. Neither do the frequencies of the other two most important arguments. Argument A2 claims that investments pay off, because one can expect to win on average in 3 out of 9 rounds. It is raised in 5% to 13% of teams. Argument A3 stresses to invest little, because the probability of losing is double the one of winning in the lottery. This argument is invoked in 17% to 24% of cases.

Panel B of Table 2 reports an OLS-regression with the team's first investment decision as the dependent variable and the first proposal and the three selected arguments as independent variables. Dummies for the different experimental settings are also included. The very first proposal has a significantly positive influence on the team decision. The higher the initial proposal, the higher is the actual investment. The fact that actual investments are even higher

[12] We concentrate on the very first proposal that is made within a team, because these proposals provide a (lower limit) anchor for the ensuing discussion, as will be discussed in the text.

than the initial proposals is mainly due to the arguments exchanged in the chat. If a team member mentions that the expected value is maximized with full investment then actual investments go up significantly. The same holds true if a member states that the expected number of wins is equal to 3 out of 9 rounds. The latter argument A2 is an indication that the short-term focus on the winning or losing probability in a single round is abandoned in favor of a longer-term perspective, which supports higher investments. This causal mechanism seems to be equivalent to the effects elicited by requiring a long-term commitment in *LONG*, compared to the short-term commitment in *SHORT*.

The importance of the first proposals for the team decision needs some qualification, though, when we consider only the ITI-treatments, where the first proposals are dependent on team members' individual investments in the first three rounds. If we control for these individual investments, first proposals are no longer significant for the team decision in the "T"-part of ITI. Rather the average investment of the member with the lowest average investment in rounds 1-3 becomes significant for the team decision, whereas the average investments of the two other members are not significant. Hence, it is the most risk-averse subject which is decisive for the investment level in a team.[13]

4.3 Study S3: What are the driving factors for the higher investments of teams?

4.3.1 Treatments and procedure

The results in studies S1 and S2 have shown that team decision making leads to higher investments than individual decision making. Study S3 has been designed in order to analyze why this is the case. From our point of view team decision making is influenced by two major factors in our context: First, team members have the same payoffs from a given decision. Second, team members can communicate with each other. In order to examine the marginal

[13] Detailed results are available upon request.

effect of both factors, we 'add' both factors step by step to *individual* decision making in two different treatments.

The first factor is addressed in the treatment PAYOFF where three subjects are linked and ordered as members 1, 2, and 3. Decisions are made subsequently and independently, with each member being responsible for three rounds.[14] I.e., member 1 decides in the beginning for rounds 1-3. The other two members are informed about the decisions and the outcome of the lottery. The resulting payoffs accrue to all linked members. Hence, members 2 and 3 earn the same amount as member 1 has earned through his investments. Then member 2 decides for rounds 4-6, and member 3 for rounds 7-9, with the same information and payoff conditions as in rounds 1-3. Other than the mutual accrual of payoffs, there is no interaction between the linked members, and members remain anonymous.

The second factor is added in the treatment ADVICE which is identical to PAYOFF, except that members can give each other advice before and after making decisions. In detail, members can write down suggestions for investments or any other advice to their predecessors (i.e. members with a lower number) or their successors (i.e. members with a higher number). For instance, member 1 receives two separate sheets of paper with suggestions and advice from member 2, respectively member 3, before member 1 can make his decision. Subsequently, member 2 receives one sheet from member 3 and one from member 1. Information conditions concerning the lottery's outcome are as in PAYOFF, i.e. all linked members get to know the outcome as soon as a given round is over.

The experimental sessions were run from January to April 2005. A total of 252 participants were randomly assigned to our treatments and conditions in a between-subjects

[14] The feature of members making decisions for three rounds only – instead of nine rounds – is motivated by letting each member be responsible for one third of the decisions that real teams of three subjects make in TEAMS and ITI and TIT.

design. We had 18 groups of three linked subjects in PAYOFF-*SHORT*, 24 groups in PAYOFF-*LONG*, 24 groups in ADVICE-*SHORT*, and 18 groups in ADVICE-*LONG*.

4.3.2 Results

Figure 3 shows the average investments in PAYOFF and ADVICE in comparison to those in INDIVIDUALS. The *SHORT*-condition is illustrated on the left-hand side, and the *LONG*-condition on the right-hand side.[15] The first thing to notice from Figure 3 is that we find higher investments in PAYOFF than in INDIVIDUALS under both conditions. Concerning the overall average investment, we find that the difference is significant in *SHORT* (50.3 vs. 39.4; $p < 0.05$; $N = 82$; Mann-Whitney U-test). In the *LONG*-condition we find a significant difference in rounds 7-9 only (73.5 vs. 54.1; $p < 0.05$; $N = 86$), but not for the overall average investments. Nevertheless, these results seem to indicate that the mere fact of letting subjects make decisions which are directly payoff-relevant for other subjects leads to higher investment levels. It seems as if the fact that others depend on one's own decision induces subjects to make decisions which are more beneficial for the group of linked members as a whole (in PAYOFF) than the decisions they make when they are isolated from other subjects (in INDIVIDUALS).

Figure 3 about here

The second important property of Figure 3 is that investments are higher in ADVICE than in PAYOFF. The difference is significant in condition *SHORT* (61.4 vs. 50.3; $p < 0.07$; $N = 42$), but not in the condition *LONG*, even though average investments are always higher in

[15] Panel C of Table 1 also reports the averages in the sequences of three rounds.

ADVICE than in PAYOFF in rounds 1-3, rounds 4-6, and rounds 7-9.[16] Adding the second factor of exchanging suggestions and advice raises investments above the level when only joint payoffs apply. Investments in ADVICE are not significantly different from those in TEAMS (both in *SHORT* and in *LONG*), meaning that the conditions in ADVICE capture the main elements of team decision making.

***Result 3A**: Our results in study S3 suggest that the higher investments of teams – compared to individuals – are caused approximately equally by the fact of having joint payoffs in teams and by the opportunity to exchange suggestions and advice in teams.*

Myopic loss aversion is also persistent in our treatments PAYOFF and ADVICE. Investments are, in fact, significantly higher in *LONG* than in *SHORT* in both treatments (62.5 vs. 50.3 in PAYOFF; $p < 0.01$; $N = 42$; and 72.9 vs. 61.4 in ADVICE; $p < 0.1$; $N = 42$). This finding further corroborates the earlier findings of studies S1 and S2.

***Result 3B**: Myopic loss aversion is also prevalent in the treatments PAYOFF and ADVICE.*

We now turn to the suggestions and advice exchanged in ADVICE. In panel A of Table 3 we report the average of the actually invested amounts and the average suggested amounts. There is no significant difference between suggested amounts in *SHORT* (67.6) and *LONG* (66.9). Furthermore, suggested amounts do not differ significantly from the actually invested amounts (61.4 in *SHORT*, and 72.8 in *LONG*).

It is interesting to note, though, that the amounts *suggested* in ADVICE are significantly higher than the amounts actually *invested* in treatment INDIVIDUALS ($p < 0.05$ both in *SHORT* and *LONG*; Mann-Whitney U-tests). This indicates that when individual subjects depend on others' decisions they recommend much higher investments (in ADVICE) than individuals actually choose when they act in isolation (in INDIVIDUALS). Obviously, subjects recognize in ADVICE that investing more yields higher expected payoffs.

[16] Investments are significantly higher in ADVICE than in INDIVIDUALS both under *SHORT* and *LONG* ($p < 0.05$ under both conditions).

Table 3 about here

Panel A of Table 3 also contains the relative frequency of invoking the previously introduced arguments A1 to A3. Argument A1 on maximizing expected value is again the most frequent one and mentioned equally likely in *SHORT* (30%) and in *LONG* (31%). The only significant difference between both conditions can be found for argument A3. The suggestion to invest little because the probability of losing in the lottery is twice as high as the probability of winning in a *single* round is put forward in 18% of cases in *SHORT*, but only in 7% of cases in *LONG* ($p < 0.05$; χ^2-test). Hence, the higher probability of losses is much more prominent and a topic of advice in *SHORT*, where subjects have to make decisions on investments in each single round.

Panel B of Table 3 reports the results of an OLS-estimation of suggestions and arguments on the actual investment decision of a subject. The dummy for the *LONG*-condition is significantly positive, as one should expect in the presence of myopic loss aversion. The argument A1 on maximizing expected value has also a positive effect on investment levels. All other regressors are insignificant, including the suggested effort. It turns out, however, that suggested effort is very highly correlated with the presence or absence of argument A1 (with a Pearson correlation coefficient of 0.72; $p < 0.01$). That means that those subjects invoking argument A1 are predominantly those that actually suggest very high investments.[17]

[17] Argument A2 is also positively correlated with the suggested investment ($r = 0.20$; $p < 0.05$), whereas argument A3 is weakly significantly negatively correlated ($r = -0.15$; $p = 0.1$).

5 Conclusion

In this paper we have addressed two research questions on whether teams are also prone to the effects of myopic loss aversion and whether teams make different decisions under risk than individuals do. Implicitly, the first question has already been raised in the seminal paper by Benartzi and Thaler (1995) who wonder whether organizations display MLA. They have arrived at an affirmative answer by recurring to individual decision makers in organizations.

We have now provided robust experimental evidence that team decision making is also prone to MLA. Given that we have recorded the communication within teams in studies S2 and S3 we had initially hoped that the sources for MLA could be pinned down by finding a different content of communication in the two conditions *SHORT* and *LONG*. If that had been the case, we might have been able to explain the different investment levels between *SHORT* and *LONG* as a consequence of different aspects of the decision being emphasized under both conditions. However, the contents of communication and the suggestions and the advice given in teams do practically not differ between *SHORT* and *LONG*. Only in the ADVICE treatment we found the argument A3 concerning the higher probability of a loss more prominent in *SHORT* than in *LONG*. However, the frequency of mentioning this argument did not emerge as a significant factor for explaining investment levels in the econometric analysis. Therefore, it seems that the mere fact of having a longer commitment in *LONG* than in *SHORT* is the decisive point for higher investments in *LONG*.[18]

Our first major result on the existence of MLA also in team decision making has three main implications. First, it supports the validity and applicability of the theoretical concept of MLA for a broader range of decision makers, encompassing both individuals as well as teams.

[18] In a sense this is related to Benartzi and Thaler's (1999) finding that the repeated play of a positive expected value gamble is more attractive for individuals if they are shown the explicit distribution of possible overall outcomes than if they are only informed about the possible outcomes of a single gamble.

Second, it shows that MLA is a valid explanation for the equity premium puzzle, irrespective of which type of decision maker is actually present on financial markets. In the original paper of Benartzi and Thaler (1995), it was implicitly assumed that financial investment decisions are typically made by individuals. If they have MLA, the equity premium puzzle can be explained. Our findings imply that even if most financial decisions were made by teams we would probably still observe the equity premium. Third, our first result has some practical relevance for organizations since many important financial decisions in the real world are actually taken by teams rather than by individuals, for instance in team-managed funds or when a board of financial officers decides on a company's investments. Judging simply from the viewpoint of the influence of MLA on financial decisions, there does not seem to be a compelling reason to entrust financial decisions to teams, because our first result has shown teams to be as prone to MLA as individuals are.

However, the second major result of our paper is that teams invest significantly higher amounts than individuals do. This result has been found both in the *SHORT* and *LONG* condition. Given that the lotteries in the experiment had a positive expected value, this result indicates that teams are able to accumulate a significantly higher expected value than individuals – at the *same* level of risk. From study S1 we have learned that the reason for the higher investment of teams is not only that teams make more often risky investments than individuals – what psychologists would call risky shift – but also that teams make higher investments than even those individuals who *do* invest positive amounts – what might be called a shift in maximizing expected value at the same level of risk. Study S3 has tried to further disentangle the factors contributing to the higher investments of teams. The experimental results lend support to the view that team decisions are different from individual ones due to team members having joint payoffs, and due to the exchange of information and advice within teams.

The second factor seems to be an obvious candidate for differences between individual and team decisions. Actually, several recent experiments have shown that giving or receiving naïve advice increases the efficiency of economic interaction in a broad variety of games, like public goods games or coordination games (see, e.g. Chaudhuri et al., 2001, 2005; Schotter and Sopher, 2001). Advice makes subjects think once more about the structure of an interaction and the possible efficiency gains that might be exploited. In our study S3 we have shown that investments increase significantly when the argument of maximizing the expected value in case of full investment is invoked. Even though subjects who received the advice were in no way committed to follow it (this was clearly mentioned in the instructions) they often followed suit.

The first factor of inducing higher investments by making payoffs interdependent in the sense that one member's decisions determine also the linked members' payoffs is a less obvious candidate for explaining differences between individuals and teams. Yet, our results demonstrate that this factor has approximately an equally strong influence on team decisions as giving advice. It seems to be an interesting question for future research why imposing joint payoffs is so influential. It might have to do with group identification (even though there is no direct interaction) and the wish to make a decision which is good for the group as a whole. If such a wish was promoted by joint payoffs, the action of investing a high or the full amount in order to maximize the expected value not only for oneself, but also for the linked members, might look more attractive. As a first indication that this might be the case, we note that the relative frequency of investing the full endowment (X = 100) is significantly higher in PAYOFF than in INDIVIDUALS (with a significant difference in *SHORT*: 18.5% vs. 12.5%; $p < 0.05$; χ^2-test).

In sum, our second result of teams investing higher amounts in the lottery has the following implications. First, teams lean more towards maximization of expected value than individuals do. Even though teams need not be more consistent than individuals with respect to the axioms of expected utility theory (Bone et al., 1999; Rockenbach et al., 2001), they accumulate more expected value at the same level of risk. Second, from an organizational perspective our results seem to suggest that it is, in principle, wise to use teams for making investment decisions. However, whether using teams really pays off for an organization also depends upon the additional costs (of manpower, for instance) associated with team decision making. Weighing these costs and the possible benefits of team decision making has been beyond the scope of this paper, but might also be an interesting topic for future research.

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Figures and Tables

Figure 1. Investments in INDIVIDUALS and TEAMS

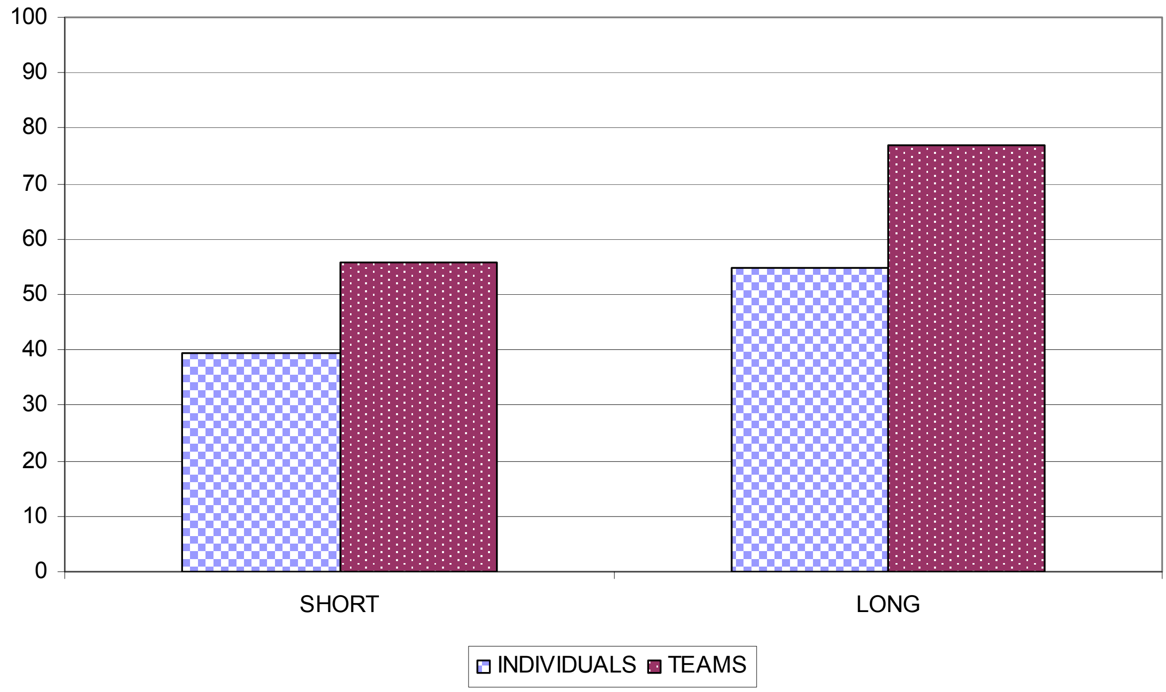

Figure 2. Investments in sequences of 3 rounds in ITI and TIT

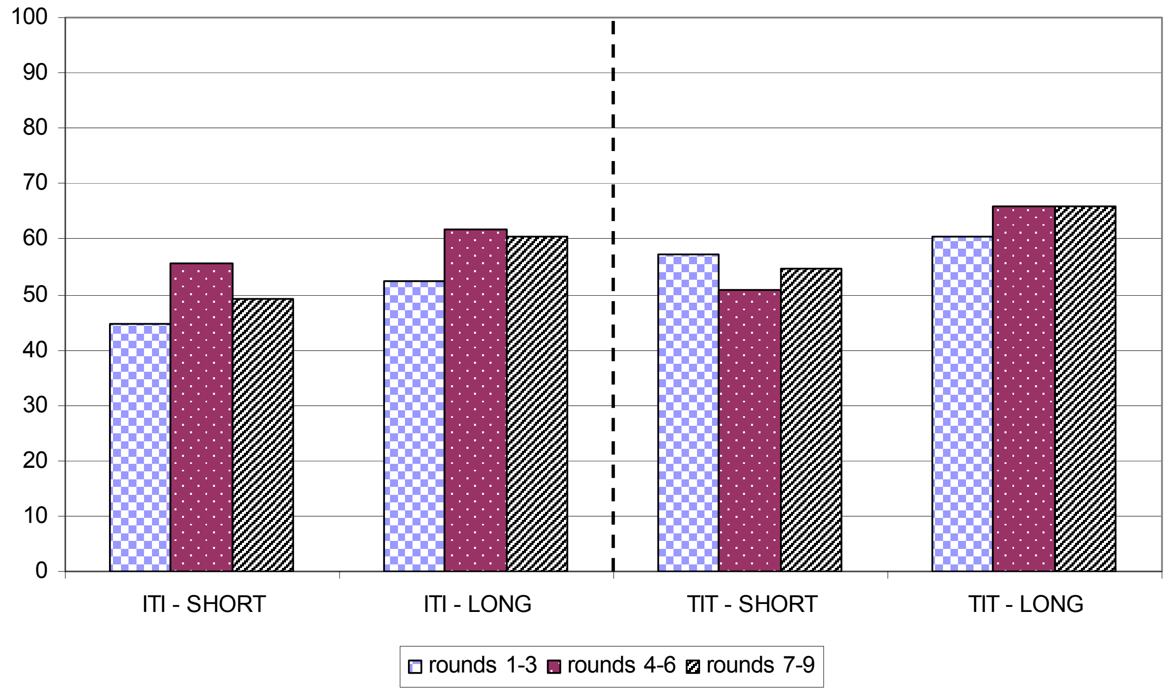

Figure 3. Investments in INDIVIDUALS, PAYOFF and ADVICE

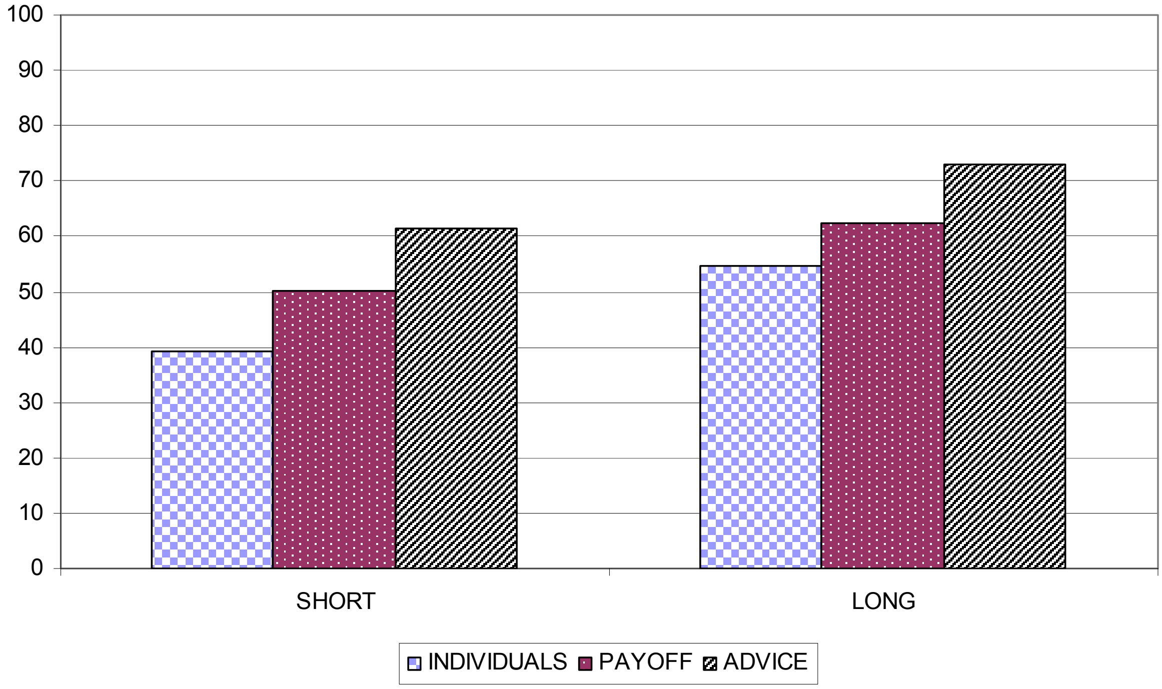

Table 1. Investments

A. Study S1	INDIVIDUALS-*SHORT* $N = 64$	INDIVIDUALS-*LONG* $N = 62$	TEAMS-*SHORT* $N = 28$	TEAMS-*LONG* $N = 28$
OVERALL	**39.4**	**54.7**	**55.7**	**76.8**
Rounds 1 – 3	39.6	55.0	53.4	70.2
Rounds 4 – 6	38.5	55.1	56.1	78.2
Rounds 7 – 9	40.1	54.1	57.6	82.1

B. Study S2	ITI-*SHORT* $N = 72$	ITI-*LONG* $N = 63$	TIT-*SHORT* $N = 78$	TIT-*LONG* $N = 63$
OVERALL	**49.8**	**58.2**	**54.1**	**64.2**
Rounds 1 – 3	44.7	52.3	57.1	60.6
Rounds 4 – 6	55.6	61.8	50.8	66.0
Rounds 7 – 9	49.3	60.5	54.6	65.9

C. Study S3	PAYOFF-*SHORT* $N = 18$	PAYOFF-*LONG* $N = 24$	ADVICE-*SHORT* $N = 24$	ADVICE-*LONG* $N = 18$
OVERALL	**50.3**	**62.5**	**61.4**	**72.9**
Rounds 1 – 3	41.1	57.2	57.2	68.9
Rounds 4 – 6	48.8	56.7	65.4	70.1
Rounds 7 – 9	60.9	73.5	61.5	79.7

Table 2. The contents and role of communication in treatments ITI and TIT

A. Proposals and arguments	ITI-*SHORT*	ITI-*LONG*	TIT-*SHORT*	TIT-*LONG*
First proposal for team investment	42.5	55.3	46.0	54.3
Actual investment (in first round as team)	55.0	61.8	51.7	60.6
Relative frequency of argument				
A1. Invest high, because maximum expected payoff with X=100	0.38	0.38	0.29	0.33
A2. Invest high, because expected frequency of winning is three times	0.13	0.12	0.05	0.10
A3. Invest little, because p(losing) = 2*p(winning)	0.17	0.23	0.19	0.24

B. OLS-regression		
Dependent variable: First investment of team (round 1 in TIT; round 4 in ITI)	coefficient	standard error
Constant	29.74***	5.68
First proposal for investment	0.38***	0.07
Argument A1	30.89***	4.45
Argument A2	15.11**	6.92
Argument A3	-6.45	5.10
Dummy for ITI-*SHORT*	-3.31	5.84
Dummy for ITI-*LONG*	-1.14	5.65
Dummy for TIT-*SHORT*	-3.90	5.97
N = 92 (teams); Adjusted R^2 = 0.60		

Significant at 10% (*), 5% (**), or 1% (***)

Table 3. Suggestions and advice in treatment ADVICE

A. Suggestions and arguments	*SHORT*	*LONG*
Average suggestion for investment	67.6	66.9
Actual investment	61.4	72.8
Relative frequency of argument		
A1. Invest high, because maximum expected payoff with X=100	0.30	0.31
A2. Invest high, because expected frequency of winning is three times	0.14	0.14
A3. Invest little, because p(losing) = 2*p(winning)	0.18	0.07

B. OLS-regression		
Dependent variable: Investment of subject (teams as cluster)	coefficient	standard error
Constant	68.5***	8.7
Condition (1 = *LONG*)	10.9**	5.0
Suggestion for investment	-0.02	0.1
Argument A1	19.8*	10.4
Argument A2	8.4	9.6
Argument A3	-8.3	10.3

N = 126; Adjusted R^2 *= 0.08*

Significant at 10% (*), 5% (**), or 1% (***)

Appendix: Experimental instructions for study S1 (for referees' use)

The following instructions are for INDIVIDUALS in the *SHORT*-condition. *Modifications for the LONG-condition are in italics*. Additions for the TEAMS-treatment are included in {arial font in brackets}.

Instructions for the experiment

This experiment consists of 9 successive rounds. In each round you {your team} will receive an endowment of 100 Euro-cents. You {Your team} must decide which part of this endowment (between 0 Euro-cents and 100 Euro-cents) you wish to invest in a lottery. The investment will be denoted as amount X. You have 3 minutes time *(9 minutes time)* to {discuss and} make a decision. Please note that the time limit will not be enforced, but that you are kindly requested to arrive at a decision within this time or shortly thereafter. {Within your team, you have to agree on a single choice of the amount X.}

The outcome of the lottery is as follows:

- With a chance of 2/3 (66.67%) you lose the amount X you have invested and your payoff in the respective round is Payoff = 100 – X Euro-cents.
- With a chance of 1/3 (33.33%) you win two and a half times the amount X you have invested and your payoff in the respective round is Payoff = 100 + 2.5X Euro-cents.

The actual outcome of the lottery depends on a randomly drawn number out of the uniformly distributed interval [0, 3] and on your type. There are three possible types: Type 1, 2, and 3. In the first round, you will be informed about your type, which remains fixed for all 9 rounds.

Type 1 wins if the random number in a given round is from the interval [0, 1].

Type 2 wins if the random number in a given round is from the interval (1, 2].

Type 3 wins if the random number in a given round is from the interval (2, 3].

The random number in a given round is identical for all participants in the experiment and it will be independently drawn anew in each consecutive round. We will draw 10 different random numbers in each round, but only the tenth random number will be decisive for the lottery's outcome.

In the experiment, you have to decide on your investment X in blocks of three rounds each. That means that at the beginning of the first, fourth, and seventh round you {your team} have to decide on the amount X, which then applies for the respective block (i.e. for rounds 1-3 or 4-6 or 7-9). Whereas the random number is independently drawn in each single round, you have to decide on X for three consecutive rounds.

After all individuals {teams} have entered their decision, you will be informed about the outcome of the random draw *(in each of the three rounds of a block)*, about whether you have won or lost in the respective round *(in each single round of a block)*, about your round payoff *(in each round of the block)* and your accumulated payoff in the whole experiment. For your final earnings, we will add up your payoffs in all 9 rounds. {Please note that each single member of a team will be paid the full earnings, which, of course, are identical for all team members.}