Myopic risk-taking in tournaments

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Abstract

There is a common notion that incentive schemes in the financial industry trigger myopia and risk-taking. In some sense this contrasts with the concept of myopic loss aversion (MLA), which implies that myopia mitigates risk-taking. A number of experimental studies support the MLA-hypothesis by showing that people take less risk the more frequently their investments are evaluated. In this paper we show experimentally that if subjects are exposed to tournament incentives, they take *more* risk the more frequently investments are evaluated. We explain our main finding with what we call myopic trailing aversion.

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An interesting aspect with the analyses of the 2007/2008 financial crisis is the notion that incentive schemes in the finance industry trigger both myopia and risk-taking. For instance, Tabellini (2008) argues that management compensation schemes "reward myopic risk-taking behavior" and Bueiter (2008) states that "One of the key drivers of the excesses of the most recent (and earlier) financial crisis has been the myopic and asymmetric reward structure in many financial institutions. (...) Poorly structured reward systems encourage excessive risk-taking and the pursuit of short term profits."

There are indeed several incentive models that separately can account for both excessive risk-taking and myopic behavior. It is well known that option contracts and tournament incentives may trigger risk (see Haugen and Senbet, 1981, and Bronars, 1986, respectively), and of course, if incentive contracts are short-term, they may also create a myopic "pursuit of short-term profits". Hence, incentives may clearly create a positive correlation between myopia and risk-taking. But could it also be a casual relationship?

In the outset, one should not expect so. In fact, from the concepts of loss aversion and mental accounting, we have learned that myopia mitigates risk-taking. Loss aversion implies that the disutility from suffering a loss is higher than the utility from receiving an equally high gain (see Kahneman and Tversky, 1979, and Tversky and Kahneman, 1992), while mental accounting implies that people evaluate their investments frequently and independently (see Kahneman and Tversky, 1984, and Thaler, 1985). By combining these two behavioral hypotheses, Benartzi and Thaler (1995) introduced the concept of myopic loss aversion (MLA) in order to explain the equity premium puzzle.[1] MLA's clear implication is that people take less risk the more often they evaluate their investments. In other words, myopia reduces risk-taking. Behavior consistent with MLA is supported by a number of experiments, see Gneezy and Potters (1997), Thaler, Tversky, Kahneman and Schwartz (1997), Gneezy, Kapteyn and Potters (2003), Haigh and List (2005), Sutter (2007), Langer and Weber (2008) and Fellner and Sutter (2009). But in all these experiments, subjects are exposed to simple individual piece-rate incentives. Could it be that under some incentive regimes, myopia triggers risk-taking?

In this paper we investigate experimentally how myopia - or narrow framing - affects risk-taking when subjects are exposed to incentives commonly used in finance. In particular, we adopt tournament incentives in which subjects are evaluated and rewarded on the basis of their relative performance (relative performance evaluation - RPE). It is well documented that money managers have relative performance objectives, not only since bonuses are partly based on relative performance, but more importantly because investors allocate money into funds according to their past relative performance (see e.g. Goriaev, Palomino and Prat, 2003). Both theoretically and empirically it is shown that RPE schemes may increase risk-taking (Bonars, 1986, Hvide, 2002), but we do not know how this relates to myopia. The notion that incentives in the financial industry create "myopic risk-taking behavior" calls for an experimental study into whether myopia

[1] The equity premium puzzle was put forward by Mehra and Prescott in 1985, and refers to the unreasonable high levels of risk aversion needed to explain why investors are willing to hold bonds and not put everything in stocks. Several possible explanations for the equity premium puzzle have been proposed, see Siegel and Thaler (1997) and Mehra (2008) for an overview.

can increase risk-taking if subjects are exposed to tournament incentives.

Our results are striking: In contrast to standard experimental results on myopic loss aversion, we find that if subjects are exposed to tournament-incentives, they take more risk the more frequently they evaluate their investment returns. Moreover, we find that tournament incentives - compared to independent incentives[2] - increase risk-taking when investments are evaluated frequently, while they reduce risk-taking when investments are evaluated infrequently.

Our experimental design is based on Gneezy and Potters (1997). Subjects were confronted with nine rounds in which they could invest their endowment in a risky lottery. In the "frequent treatment", subjects could decide how much to invest in every round and received feedback about the return after each round. In the "infrequent treatment", subjects could decide on their investment amount only every third round (which was then fixed for the next three rounds) and also received aggregated feedback after three rounds. In these baseline treatments, subjects were exposed to independent incentives and we attained the standard result with lower risk-taking in the frequent treatment. In addition we had two treatments where subjects were exposed to tournament incentives. In the tournament treatments subjects were exposed to the same manipulation of feedback frequency as our baseline treatments, but here subjects were randomly matched into groups of three, and only the one with the highest payoff after nine rounds received a prize. Average investments in the risky lottery were then higher in the

[2] With "independent incentives" we here mean incentives that do not depend on the performance of peers or competitors.

frequent treatment than in the infrequent treatment.

An important aspect of tournament incentives is that subjects must take into account the behavior of their opponents, i.e. they must behave strategically. And since they learn about their opponents' investments during the experiment, they may also feel losses and gains from comparing themselves with their opponents. As we will show, myopia combined with strategic sophistication predicts higher investments in the infrequent treatment than in the frequent treatment. But if subjects exhibit what we call myopic trailing aversion, we can attain the opposite result. Trailing aversion implies that the disutility from trailing is higher than the utility from leading the tournament. If subjects are also myopic, i.e. if they frame their decisions narrowly, then a high risk strategy for three rounds is less attractive than a high risk strategy for one round, since in the former case this can put them too far behind the front runner. Now, trailing aversion should only be relevant in the first rounds of the experiment, where distance to the front runner affects the probability of winning the tournament. In the end, it does not matter how far behind you are since the winner takes all anyway. Interestingly, we find that the investment levels are significantly lower in the infrequent treatment than in the frequent treatment in the first 6 rounds, while in the last 3 rounds, where trailing aversion should not kick in, average investment levels are practically the same in the two treatments.

We also study how risk-taking is affected by whether subjects are trailing or leading the tournament. Tournament theory conjectures that front runners should reduce risk-taking, while trailing parties should "gamble for resurrection". In the empirical literature on mutual funds' investment strategies, there is mixed evidence on whether funds that underperform during the first part of the year actually increase risk in the second part of the year in order to try to catch up (see Brown, Harlow and Starks, 1996, Koski and Pontiff, 1999, and Busse 2001). Our controlled experiment supports the catching-up hypothesis. Trailing subjects take significantly more risk than the front runners, and distance to front runner has a significant positive effect on risk-taking.

In addition to the literature on myopic loss aversion, our paper is related to the extensive literature on tournaments. Since the seminal article of Lazear and Rosen (1981), most tournament papers have focused on optimal effort choices. However, the recognition of relative performance objectives in the finance industry has increased focus on risk-taking in tournaments. Starting with Bronars (1986), more recent theoretical papers include Hvide (2002), Hvide and Kristiansen (2003), Taylor (2003) and Kräkel and Sliwka (2004). There is also an extensive empirical literature on tournament incentives in finance, e.g. Brown, Harlow and Starks (1996), Cevalier and Ellison (1997) and Goriaev, Palomino and Prat (2003). Tournaments have been investigated in laboratory experiments as well (e.g. Bull, Schotter, Weigelt, 1987; Harbring and Ihlenbush 2003, and Eriksen, Kvaløy and Olsen, 2011), but except for recent papers by Nieken (2010) and Nieken and Sliwka (2010), all the existing contributions focus on effort rather than risk-taking. And no one considers the effect of myopia and feedback frequency under tournament incentives, which is the main focus of our paper.

The rest of the paper is organized as follows. In Section 1 we present the experimental design and procedure, while in Section 2 we derive the theoretical predictions. In Section 3 we present the experimental results, while in Section 4 we compare the experimental results with the theoretical predictions. Section 5 concludes.

1. Experimental design and procedure

While several experiments have been designed to test whether people exhibit behavior consistent with MLA, Gneezy and Potter's (GP) design is the most well known. Their idea is not to try to estimate the period over which subjects evaluate financial outcomes, but rather to use the strength of the experimental method and manipulate subjects' evaluation period. In our baseline treatments, which we denote IPE (independent performance evaluation), we followed GP's design by manipulating the evaluation period of subjects with a frequent evaluation treatment (F^{IPE}) and an infrequent evaluation treatment (I^{IPE}). In Treatment F^{IPE} subjects were confronted with a sequence of nine identical and independent rounds of an investment game (lottery), in which there was a probability of 2/3 to lose the amount invested and a probability of 1/3 to win 2.5 times the amount invested. The lottery drawings where independent both between rounds and subjects. In each round subjects were endowed with 100 units of our experimental currency, denoted EK, and asked how much to invest.[3] Earnings per round were given by the sum of money not invested and the resulting outcome of the invested money (see instructions in appendix for details). After each round, the subjects observed the outcome of the investment and accumulated earn-

[3] EK = Experimental kroner. 100 EK = 25 NOK (Norwegian kroner) = $4.50 at the time of the experiment.

ings, and by the end of the experiment the subjects were paid their total earnings in cash.

Treatment I^{IPE} was identical to Treatment F^{IPE}, except that subjects invested money and received feedback in blocks of three rounds. Like GP, we restricted the invested amount to be equal within each block. At the start of rounds 1, 4 and 7, subjects were endowed with 100 EK for each of the next three rounds (a total of 300 EK) and chose how much to invest. After rounds 3, 6 and 9, the subjects were informed about the aggregated outcome for the three preceding rounds, as well as single-round earnings.[4]

In our tournament treatments, which we denote RPE (relative performance evaluation), subjects were randomly matched into groups of three, and only the one with the highest payoff after 9 rounds received a prize (if payoffs were equal, the winner was chosen by drawing lots).[5]The subjects were confronted with the same lottery as under IPE, and the drawings of the lottery were random and independent both between rounds and subjects. Subjects were endowed with 100 EK each round, and the one with most EK after nine rounds received a prize of NOK 600. In addition each subject received a participation fee of NOK 50. So expected payoff was $50 + \frac{1}{3}600 =$ NOK 250 $\approx$ \$ 45, approximately the same as under IPE. As under IPE, we ran one treatment (F^{RPE}) where subjects made investments each round, and one treatment (I^{RPE}) where subjects made investments for blocks of three rounds. In Treatment F^{RPE}, the subjects could also observe

[4]GP also had three additional rounds (10-12) where subjects invested money they had earned in rounds 1-9.

[5]This is, of course, a starker RPE scheme than what we observe in practice, but we implement it here in order to highlight the difference between tournament incentives and independent incentives.

the outcome of their opponents every round, while in Treatment I^{RPE} they could observe the outcome of their opponents every third round.

The 2 x 2 design is illustrated in Table I.

Table I. Experimental design

	Frequent Evaluation	Infrequent Evaluation
IPE	Treatment F^{IPE}	Treatment I^{IPE}
RPE	Treatment F^{RPE}	Treatment I^{RPE}

Altogether 280 undergraduate students from the University of Stavanger, Norway participated in the experiment. They were recruited by E-mail and told that they had the opportunity to participate in an economic experiment where they could earn a nice sum of money. The experiment was computerized using Z-tree (Fischbacher, 2007). We had 160 subjects in IPE (80 in Treatment F^{IPE} and 80 in Treatment I^{IPE}), and 120 subjects in RPE (60 in Treatment F^{rPE} and 60 in Treatment I^{RPE}). All instructions were given both written and verbally.

2. Theoretical predictions

Now, what treatment effects should we expect? Let us first examine predictions under individual performance evaluation, IPE. Assume that subjects have prospect theory preferences, given by the value function

$$U(\omega) = \omega^{\alpha} \quad \text{if } \omega \geq 0 \tag{1}$$

$$U(\omega) = -\lambda(-\omega)^{\beta} \quad \text{if } \omega < 0 \tag{2}$$

where ω is the difference in wealth with respect to the last time wealth was evaluated. When investing an amount $x \in [0, 100]$ in the lottery just once, a gain then yields $\omega = 2.5x$, while a loss yields $\omega = -x$. Let S^n denote the value of the aggregated distribution of n independent draws of the lottery, and let p_k^n denote the probability that player i wins k times in the lottery with n independent draws.[6] Under IPE an individual then obtains

$$S^1 = p_1^1(2.5x)^\alpha - p_0^1\lambda x^\beta \tag{3}$$

$$S^3 = p_3^3(7.5x)^\alpha + p_2^3(4x)^\alpha + p_1^3(0.5x)^\alpha - p_0^3\lambda(3x)^\beta \tag{4}$$

from investing x in the lottery for one (S^1) and three (S^3) rounds, respectively. Prospect theory preferences imply loss aversion ($\lambda > 1$), risk aversion in gain domain ($\alpha < 1$) and risk loving in loss domain ($\beta < 1$). With $\alpha = \beta = 0.88$ (as the average estimate by Kahneman and Tversky) then a low risk strategy $x = 0$ maximizes S^1 for $\lambda > 1.1$, while a high risk strategy $x = 100$ maximizes S^3 for $\lambda < 1.56$. If subjects frame narrowly, i.e. if they care about S^1 in Treatment F and S^3 in Treatment 3 (rather than S^9), we should expect lower average investments in Treatment F^{IPE} than in Treatment I^{IPE}, which is what Gneezy and Potters (and several others) find.

We will now show that narrow framing may imply lower average investments when returns are evaluated frequently. In contrast to the IPE

[6] Hence, in the experiment we have $p_1^1 = \frac{1}{3}$, $p_0^1 = \frac{2}{3}$, $p_3^3 = \frac{1}{27}$, $p_2^3 = \frac{6}{27}$, $p_1^3 = \frac{12}{27}$, $p_0^3 = \frac{8}{27}$.

treatments, subjects do not accumulate earnings until after the nine rounds are finished and it is clear who has won the prize. Hence, regardless of risk preferences, they should simply maximize the probability of winning, since they earn nothing if they do not win.

Now, if subjects are myopic, they care about winning the one round games in Treatment F^{RPE} or the three rounds games in Treatment I^{RPE}. Observe then that if the three competing subjects are playing the lottery once, then the strategy profile $(0, 0, 0)$ is an equilibrium. i.e. the three competitors invest nothing in the risky lottery. The probability of winning is then $\frac{1}{3}$. No one can do better by deviating and play $x > 0$, since the probability of winning is then still $\frac{1}{3}$. Moreover, observe that $(100, 100, 100)$ is not an equilibrium, since there is a probability $\frac{4}{9} > \frac{1}{3}$ of winning if one deviates and plays $x < 100$.[7]

Next, consider the game in which investments are made for three rounds. Clearly $(0, 0, 0)$ is now not an equilibrium profile, since there is a probability $\frac{19}{27} > \frac{1}{3}$ of winning if one deviates and plays $x > 0$. Moreover, $(100, 100, 100)$ is an equilibrium since there is a probability $(\frac{4}{9})^3 < \frac{1}{3}$ of winning if one deviates and plays $x < 100$. It can thus be easily shown that $(100, 100, 100)$ is the only equilibrium in this game. *Given this simple equilibrium analysis, myopia implies higher investments in Treatment I^{RPE} than in Treatment F^{RPE}*

[7] For other equlibria, let x_i denote investment level for player i, $i = 1, 2, 3$. One can see that $(x_i, 0, 0)$, where $x_i > 0$, is an equilibrium, but that $(x_i, x_j, 0)$ where $x_i > 0$ and $x_j > 0$ is not: If player i plays $x_i > 0$ while player j and k plays $x_j > x_i > 0$ and $x_k = 0$, respectively, it gives victory to player i with probability $\frac{2}{9} < \frac{1}{3}$. Moreover, playing $x_i > 0$ while the others play $x_j = x_i > 0$ and $x_k = 0$ gives victory to player i with probability $\frac{5}{18} < \frac{1}{3}$.

Let us also briefly consider what happens when the subjects are uneven at the start of a given round. In Treatment F^{RPE} there is no equilibrium in pure strategies if the front runner's lead is sufficiently small. But it is never a best response for the front runner to bet more than the trailing parties, while it may be a best response for a trailing party to bet more than the front runner.[8] Treatment I^{RPE} is less complicated. We have seen that $(100, 100, 100)$ is an equilibrium profile when the players are even, so clearly the trailing players will play $x = 100$. Now, the front runner will still play $x = 100$ if his lead is sufficiently small. Only when the lead is sufficiently large, the front runner will play $x < 100$ in order to secure victory even he loses.

Myopic trailing aversion: An (implicit) assumption behind the analysis above is that subjects do not care about distance to front runner. And in fact, if they frame narrowly, and focus on either winning a one round or three round game, respectively, they should not care about distance to front runner. However, subjects may be myopic, but still care about distance to front runner because it affects their prospects of winning the whole tournament. We will now show that if subjects have preferences over their relative position, and are afraid of getting too far behind the front runner,

[8] To see this, consider the game between the front runner, player i, and a trailing player j. It cannot be an equilibrium strategy for the latter to play $x_j = 0$. If he plays $x_j = 0$, then the front runner's best response is to play $x_i = 0$. But then the trailing player cannot win and will therefore play $x_j > 0$. The front runner will then raise his bet so that it is sufficiently high, $\widetilde{x}_i$, to secure victory in the tournament if he wins the lottery draw. But he will play $x_i < x_j$ in order to secure victory in the tournament if everyone loses the lottery draw. However, if $\widetilde{x}_i > 0$, then a trailing player's best reponse is to play $x_j < \widetilde{x}_i$ so that he can win the tournament if the front runner loses the lotter draw. The front runner will then respond by lowering his bet, ectetra. Hence, for $\widetilde{x}_i > 0$, there are no equlibrium in pure strategies.

investments can be higher in Treatment F^{RPE} than in Treatment F^{RPE}.

Assume that the subjects have prospect theory preferences over the relative amount of EK during the experiment. We will analyze how this affects the prospects for player i from a comparison with a given opponent j. If player i compares himself with two players, as in the experiment, this does not alter the qualitative results of the proceeding analysis.

We assume that player i's value function is given by

$$U(z) = z^{\alpha} \quad \text{if } z \geq 0 \tag{5}$$

$$U(z) = -\lambda(-z)^{\beta} \quad \text{if } z < 0 \tag{6}$$

where z is the difference between player i and player's j wealth (EK) compared to the last time wealth was evaluated. While the value function under IPE measures the (dis)utility from real losses and gains, this value function measures the disutility from trailing and the pleasures from leading.[9]

Let z^n_{kl} denote the difference between player i and player's j wealth when player i wins k times and j wins l times in a lottery with n independent draws, and let x and y denote player i and j's investment in the risky lottery, respectively. In Treatment I this gives $z^3_{31} = 7.5x - 0.5y$, $z^3_{21} = 4x - 0.5y$, $z^3_{20} = 4x + 3y$ and so one . For given lottery outcomes, we see that the players' investment levels (in most cases) determines whether or not z is

[9] Hence, we should not necessarily expect the parameters α, β and λ to be identical under IPE and RPE since these parameters measure sensitivity to different kinds of gains and losses. Note also that the new value function cannot predict outcomes under IPE, since the players do not know (and do not care) about the outcome of others under IPE.

negative (i.e. player i is trailing or not) and hence whether λ and β applies. When player i makes a decision, he has a belief $\overline{y}$ about the opponent's investment level. In expectation, z is thus a function of x and $\overline{y}$, i.e. $z(x, \overline{y})$. Let p^n_{kl} denote the probability that player i wins k times and j wins l times in a lottery with n independent draws.[10] The prospects for player i from a comparison with player j from investing an amount $x \in [0, 100]$ in the lottery for one (S^1) and three (S^3) rounds, respectively, is then

$$S^1 = \sum_{k=0}^{1}\sum_{l=0}^{1} p^1_{kl}\lambda_{kl} \left|z^1_{kl}(x, \overline{y})\right|^{\alpha_{kl}} \quad (7)$$

$$S^3 = \sum_{k=0}^{3}\sum_{l=0}^{3} p^3_{kl}\lambda_{kl} \left|z^3_{kl}(x, \overline{y})\right|^{\alpha_{kl}} \quad (8)$$

$$\text{where } \alpha_{kl} = \alpha \text{ and } \lambda_{kl} = 1 \text{ if } z_{kl}(x, \overline{y}) \geq 0,$$

$$\text{while } \alpha_{kl} = \beta \text{ and } \lambda_{kl} = -\lambda \text{ if } z_{kl}(x, \overline{y}) < 0$$

Now, if player i assumes that player j plays a low risk strategy $\overline{y} = 0$, then the expected value from having the relative amount of EK is equal to the prospects under IPE, i.e. (3) and (4), since the reference point is then the same under both schemes. Hence, there are parameters where a low risk strategy profile $(0, 0, 0)$ is an equilibrium in Treatment F^{RPE}, but not in Treatment I^{RPE}. However, if player i assumes that player j plays a high risk strategy $\overline{y} = 100$, then for standard parameter values, the high risk strategy $x = 100$ is always maximizing S^1 under RPE.[11] This implies that a

[10] Hence, in the experiment we have $p^1_{10} = p^1_{01} = \frac{2}{9}$, $p^1_{00} = \frac{4}{9}$, $p^1_{11} = \frac{1}{9}$, $p^3_{30} = p^3_{03} = \frac{8}{729}$, $p^3_{31} = p^3_{13} = \frac{4}{243}$, $p^3_{20} = p^3_{02} = \frac{16}{243}$, $p^3_{32} = p^3_{23} = \frac{2}{243}$, $p^3_{21} = p^3_{12} = \frac{8}{81}$, $p^3_{10} = p^3_{01} = \frac{32}{243}$, $p^3_{00} = \frac{64}{729}$, $p^3_{11} = \frac{16}{81}$, $p^3_{22} = \frac{4}{81}$, $p^3_{33} = \frac{1}{729}$

[11] When the opponent plays a high risk strategy, the prospects are negative for all x when $\lambda > 1$ and $\alpha \leq \beta$. But even if S^1 and S^3 are negative, we can assume that the

high risk strategy profile $(100, 100, 100)$ can be an equilibrium in Treatment F^{RPE}, which was not the case if players did not care about relative position. Moreover, the investment level x that maximizes S^3 will typically be lower for λ and $\beta - \alpha$ sufficiently high, implying that a high risk strategy profile do not need to be an equilibrium in Treatment I^{RPE}, which also contrasts the analysis from above. *Hence, a model in which subjects are myopic, but care about relative position, can account for higher investment levels in Treatment F^{RPE} than in Treatment I^{RPE}.* Note, however, that the prospects (7) and (8) are not relevant prior to the last investment decisions. Since the winner takes all, it does not matter how far a player is behind the front runner at the end of the game. Hence, one should not expect higher investments in Treatment F^{RPE} than in Treatment F^{RPE} in the last rounds of the game.

3. Experimental results

In this section we present the main experimental findings. Table II presents the mean and standard deviation for the amount invested in the risky lottery under the four treatments. For Treatment F^{IPE} and F^{RPE} we present average investments by averaging the investments in blocks of three rounds, and then compare these investments with the block investments in Treatment I^{IPE} and I^{RPE}.[12]

players maximize these values. And by adding a constant, like we actually do in our experiment via the participation fee, the prospects can be positive.

[12] The findings from the IPE treatments are also reported in Eriksen and Kvaløy (2010).

Table II. Average amount invested

Rounds	Treatment F^{IPE}	Treatment F^{RPE}	Treatment I^{IPE}	Treatment I^{RPE}
1 - 3	46.06 (27.23)	53.06 (36.20)	55.08 (35.11)	43.42 (34.79)
4 - 6	46.61 (30.55)	58.59 (33.59)	58.73 (36.32)	51.00 (37.22)
7 - 9	54.73 (33.33)	68.00 (31.90)	63.39 (35.45)	69.70 (36.28)
1 - 9	49.16 (35.28)	59.89 (39.72)	59.06 (35.66)	54.71 (37.51)
1 - 6	46.38 (33.80)	55.83 (39.39)	56.90 (35.76)	47.21 (36.08)

Notes: The table presents mean (standard deviation) for the amount invested in the four treatments. We present average investments for rounds 1 - 3, 4 - 6 and 7 - 9, as well as the average investments for rounds 1-6 and rounds 1-9.

We start by looking at average investments for rounds 1 - 9. From Table II we see that average amount invested in the risky lottery is *higher* under Treatment F^{RPE} than under Treatment I^{RPE}. This is in stark contrast to the standard result obtained in the IPE treatments, where average investments are lower under Treatment F^{IPE} compared to Treatment I^{IPE}. Breaking the investments into blocks of three rounds, we see that the RPE participants invest more when investments are evaluated frequently in rounds 1 - 3 and rounds 4 - 6, with differences of EK 9.64 and EK 7.73 respectively, while in rounds 7 - 9 the average invested amount is approximately the same. The differences between the incentive regimes are in particularly striking in rounds 1 - 6. Figure 1 illustrates how the classic framing effect that appears under IPE is totally reversed under RPE. We also see that when investments are evaluated frequently, investment levels are higher under RPE than under IPE, while it is the other way around when investments are evaluated infrequently.

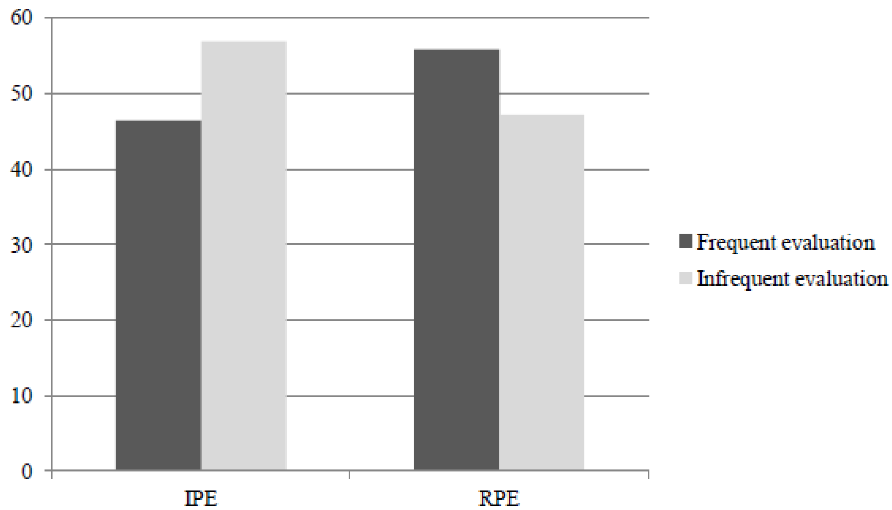

Figure 1. Average amount invested (Rounds 1 - 6)
The figure presents average investments in the lottery for rounds 1 - 6 by frequent and infrequent evaluation , under both the IPE and RPE incentive scheme.

To examine the statistical significance of the differences observed in Table II we make use of the Mann-Whitney U-test. The z-values and corresponding two-tailed p-values are presented in Table III.

Table III. Mann-Whitney U-tests of differences in investments across treatments

	Treatment F^{RPE} vs. Treatment I^{RPE}	Treatment F^{IPE} vs. Treatment I^{IPE}	Treatment F^{RPE} vs. Treatment F^{IPE}	Treatment I^{RPE} vs. Treatment I^{IPE}
Round 1	-1.706 [0.0881]	1.545 [0.1223]	-1.284 [0.1992]	1.968 [0.0491]
Rounds 1 - 6	-2.121 [0.0339]	3.388 [0.0007]	-3.428 [0.0006]	2.295 [0.0217]
Rounds 1 - 9	-1.713 [0.0867]	3.885 [<0.001]	-4.982 [<0.001]	1.301 [0.1932]

By and large, the differences are statistically significant. Importantly, we find the difference between Treatment F^{RPE} and Treatment I^{RPE} to be significant ($p = 0.087$ for rounds 1 - 9, and $p = 0.034$ for rounds 1 - 6). Note also that the difference between the RPE treatments is significant already in round one ($p = 0.088$). Overall the tests indicate that high risk choices are less attractive in Treatment I^{RPE} compared to Treatment F^{RPE}, with the strongest effect in the first six rounds.

Table IV presents estimates from a Tobit regression where we check the robustness of the results by controlling for gender. The dependent variable is the amount invested in the lottery. The reference group consists of subjects in Treatment I^{IPE}. The independent variables included in the regression are the dummy variables, *RPE, Frequent evaluation*, their interaction *RPE x Frequent evaluation*, a gender variable *Male* and finally an *Age* variable.

Table IV: Tobit Regression

Dependent variable:	Full model		Reduced model	
Lottery investment	Coef.	Std. Err.	Coef.	Std. Err.
Constant	71.53***	14.55	66.93***	15.22
RPE	-9.83	8.12	-18.45**	8.75
Frequent evaluation	-14.54**	7.39	-13.34*	7.30
RPE x Frequent evaluation	24.22**	11.44	32.63***	11.89
Male	25.72***	6.18	24.87***	6.35
Age	-0,62	0,54	-0,57	0,57
Pseudo R^2	0.0094		0.0099	
χ^2	5.64***		5.42***	
No of observations	1680		###	
No. of subjects	280		280	
No. uncensored	973		844	
No. left censored	217		186	
No. right censored	490		370	

Note: Full model: Data from rounds 1 - 9. Reduced model: The last decision of each subject is excluded. Standard errors are corrected for clustering at the individual level.
Statistical significance; (***): p<0.01, (**): p<0.05 and *: p<0.10.

The "full model" refers to data from rounds 1 - 9, while in the "reduced model" we exclude the last investment decision for each subject from the estimation. The regressions reproduce the differences presented in Table II and Table III. The standard MLA result is obtained for the IPE experiment, as can be seen by the negative and significant coefficient *Frequent evaluation.* Thus we have that subjects invest less in Treatment F^{IPE} than in Treatment I^{IPE} also when controlling for gender differences.

Under RPE the opposite result is obtained for the reduced model, with subjects investing more in Treatment F^{RPE} than in Treatment I^{RPE}. The difference between Treatment F^{RPE} and Treatment I^{RPE} can be seen by adding together the coefficients *Frequent evaluation* and *RPE x Frequent evaluation*. For the reduced model this difference is significant, and estimated to be EK 19.3 ($-13.34 + 32.63 = 19.29$), while for the full model the difference is not significant. Hence, controlling for gender differences, we still see than when excluding the last investment decision, investment-levels are higher in Treatment F^{RPE} than in Treatment I^{RPE}.

The variable *RPE* measures the difference in invested amount between Treatment I^{RPE} and Treatment I^{IPE}. The difference is significant for the reduced model, where subjects in Treatment I^{RPE} invest a significantly 18.45 less than subjects in I^{IPE}. Also, the positive and significant interaction term shows that the difference between treatments under RPE, though smaller, goes in the opposite direction compared to the difference under IPE, supporting our findings above. Not surprisingly we also find that male subjects take significantly more risk than their female fellows, which is consistent with previous findings (Charness and Gneezy, 2007; Charness and

Sutter, 2010).

Finally, we studied how risk-taking is affected by whether subjects are trailing or leading the tournament. Figure 2 and 3 shows the different investment levels for front runners (lead) and trailing subjects (behind) in Treatment F^{RPE} and Treatment I^{RPE}, respectively. We see that those who are trailing invest more than those who are leading, but this effect is clearest in Treatment F^{RPE}.

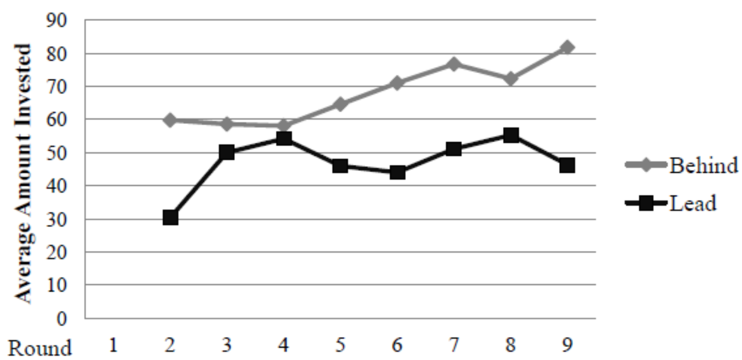

Figure 2. Treatment $\mathbf{F^{RPE}}$
The figure presents the average investments for frontrunners (Lead) and trailing subjects (Behind) for Treatment F^{RPE}.

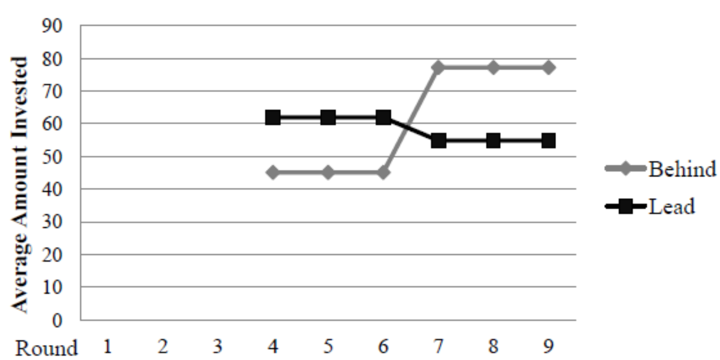

Figure 3. Treatment $\mathbf{I^{RPE}}$
The figure presents the average investments for frontrunners (Lead) and trailing subjects (Behind) for Treatment I^{RPE}.

On average front runners invested only EK 47.2 in Treatment F^{RPE}, while trailing subjects invested EK 68.2. This difference is statistically significant $(Mann - Whitney, z = 5.502, p < 0.001)$. In Treatment I^{RPE} we find that front runners invest significantly less than their trailing opponents in rounds 7 - 9 $(54.8 vs. 77.2; Mann - Whitney, z = 2.362, p < 0.018))$, but more, though not significant, in rounds 4 - 6 $(61.9 vs. 45.1; Mann - Whitney, z = -1.557, p < 0.120)$.

Table V: Tobit Panel Regression. Lead versus Behind in Treatment F^{RPE}

Dependent variable:	Rounds 1 - 9		Rounds 1 - 8	
Lottery investment	Coef.	Std. Err.	Coef.	Std. Err.
Constant	56.43*	29.39	55.37*	30.97
Lead	-40.75***	7.14	-40.01***	7.75
Behind	0.035**	0.02	0.04**	0.02
Lag Investment	0.70***	0.11	0.63***	0.12
Male	22.60**	11.42	21.74*	12.12
Age	-1.04	1,07	-0.92	1.13
σ_u^2	37.047***	6.572	39.578***	6.964
σ_i^2	45.883***	2.639	43.594***	2.689
ρ	0.394		0.452	
Log likelihood	-1320.6893		-1176.3599	
No of observations	480		480	
No of observations	480		420	
No. of subjects	60		60	
No. uncensored	216		194	
No. left censored	70		63	
No. right censored	194		163	

Note: Statistical significance; (***): p<0.01, (**): p<0.05 and *:p<0.10.

Table V presents estimates from a Tobit panel regression using data from Treatment F^{RPE}. The dependent variable is the amount invested in the lottery, and the independent variables include (i) a dummy variable (*Lead*) equal to one if a subject is leading the tournament and zero if a subject is trailing a leader, (ii) a variable (*Behind*) measuring the amount a subject is behind the leader of the tournament, (iii) the invested amount in the previous period (*Lag Investment),* and (iv) a dummy (*Male*) controlling for gender. Table VI presents estimates from a Tobit panel regression using data from Treatment I^{RPE} and include the same variables as in the regression in Table V.

Table VI: Tobit Regression. Lead versus Behind in Treatment I^{RPE}

Dependent variable:	Rounds 1 - 9		Rounds 1 - 6	
Lottery investment	Coef.	Std. Err.	Coef.	Std. Err.
Constant	34.69	30.72	42.88	40.59
Lead	-15.93	12.33	4.18	14.96
Behind	0.12***	0.25	0.07**	0.035
Lag Investment	1.03***	0.14	1.05***	0.20
Male	33.49***	10.05	32.86***	11.44
Age	-1.88	1,37	-2.58	1.84
R^2	0.086		0.095	
χ^2	14.77***		8.68***	
No of observations	120		60	
No. of subjects	60		60	
No. uncensored	65		37	
No. left censored	14		9	
No. right censored	41		14	

Note: Standard errors are corrected for clustering at the individual level. Statistical significance; (***): p<0.01, (**): p<0.05 and *:p<0.10.

Controlling for gender and invested amount in the previous round (block of three rounds), we see that subjects both in Treatment F^{RPE} and Treatment I^{RPE} increase their investments if they are behind the leader. From

Table V we see that front runners in Treatment F^{RPE} invest 40.75 less than trailing subjects, keeping everything else constant. Also, subjects who are trailing increase (on average) their investments by a factor of 0.035 the amount they are behind. A similar pattern appears in Treatment I^{RPE} (Table VI). Subjects who are trailing increase their investments by a factor of 0.12 the amount they are behind. Hence, relative position and distance to front runner has a significant effect on risk-taking in both treatments.

4. Theory versus evidence

By and large, the main theoretical predictions are supported by the experiment. First, theory predicts that if subjects do not frame narrowly, then there should be no treatment effects, except that front runners in the RPE treatments may reduce risk-taking in the last rounds. In the experiment, front runners reduce risk-taking, but we also found significant treatment effects in the first rounds, both under RPE and IPE. This clearly suggests that subjects are myopic - they frame their investments decisions narrowly.

Second, theory predicts if subjects are myopic, then investments in the risky lottery should be higher in Treatment I^{IPE} than in Treatment F^{IPE}. This is the standard MLA effect, and it is supported by our baseline experiment.

Third, theory predicts that if subjects are myopic and do not care about relative position under the RPE scheme, then investments in the risky lottery should be higher in Treatment I^{RPE} than in Treatment F^{RPE}. The experiment showed the opposite. There certainly are treatment effects under RPE, indicating myopia, but investments in the risky lottery are higher in Treatment F^{RPE} than in Treatment I^{RPE}.

This leads us to the fourth theoretical prediction: If subjects are myopic, *but at the same time care about relative position*, then theory can account for higher risk-taking in Treatment F^{RPE} than in Treatment I^{RPE}. The reason is that a high risk strategy for a long period is less attractive than a high risk strategy for a short period, since in the former case this can put them too far behind the front runner. Interestingly, this treatment effect is significant in rounds 1-6, but disappear in rounds 7-9. This fits with theory. Aversion from trailing should only be relevant in the first rounds of the experiment where distance to the front runner affects the probability of winning the tournament. Since the winner takes all, it does not matter how far a player is behind the front runner at the end of the game.

Finally, theory predicts that front runners will take less risk than trailing subjects. This is supported by the experiment. The effect is clearest in Treatment F^{RPE}, but in both RPE treatments we find that distance to front runner has a significant positive effect on risk-taking. In Treatment I^{RPE}, front runners actually invest significantly more than their trailing opponents in the beginning of the game. But a high risk strategy yields a higher probability of leading the tournament than a low risk strategy, hence, those who are trailing in the tournament after rounds 1-3 are, on average, less willing to invest in the risky lottery. Presumably, they are not willing to take too much risk when there are still 6 rounds to go. First after six rounds those who are trailing increase their investments, while the front runners are trying to secure the victory.

5. Conclusion

In this paper we present experimental evidence that the classical MLA result, where subjects take less risk if investment decisions are framed narrowly, does not prevail when subjects are exposed to tournament incentives. In fact, the results are turned upside down. Under tournament incentives, those who invest and evaluate outcomes frequently take more risk. This finding has important implications. First, when analyzing how MLA contributes to explaining the equity premium puzzle, one has to take into account that many of the players in the stock market, in particular those who manage other people's money, are exposed to incentive regimes that do not create the classical MLA implications. Second, the notion that myopia triggers risk-taking (a notion that has been especially popular in the aftermath of the financial crisis) may not be just a spurious relationship. Under tournament incentives, which are common in finance, a casual positive relationship may exist between myopia and risk-taking.

How can we explain this? It turns out that prospect theory and mental accounting may actually be fruitful also with respect to these new results. We have shown that a simple game theoretic analysis of the tournament experiment predicts higher risk-taking when investments are evaluated infrequently. However, if we assume that subjects have prospect theory preferences over their relative standing during the experiment, then aversion from trailing may give lower risk-taking under infrequent evaluation. If subjects are myopic, then a high risk strategy for a long period is less attractive than a high risk strategy for a short period, since in the former case this can put them too far behind the front runner. As we have also noted, trailing aversion should be most relevant in the first rounds of the experiment, where distance to the front runner affects the probability of winning the tournament. Our experimental results support this conjecture since our main treatment effects disappear in the last rounds of the experiment.

There is a large body of literature on incentives and risk-taking, and myopia and risk-taking, but surprisingly little has been done to analyze how these three interact. Our paper suggests that more should be done both experimentally and theoretically in this respect. The interaction between incentives, risk-taking and myopia is important for understanding both incentive design and financial markets.

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Appendix: Instructions

Here we present the instructions for the RPE treatments, which have been translated from Norwegian. The instructions for the baseline treatments (IPE) can be found in Eriksen and Kvaløy (2010).

The experiment consists of 9 successive rounds. In each round you will receive 100 EK (experimental currency unit). You must decide how much of this amount you wish to invest in a lottery. The lottery is the same for all rounds and goes as follows:

Assume you choose to invest an amount X in the lottery:

- With a probability of 2/3 (66.7%), you lose the amount X invested in the lottery. Your payoff in the respective round is then 100 - X.
- With a probability of 1/3 (33.3%), you win 2.5 times the amount X invested in the lottery in addition to your initial endowment. Your payoff in the respective round is then 100 + 2.5 X.

You will thus earn 900 EK during the 9 rounds if you never invest in the lottery. If you choose to invest in the lottery during the 9 rounds, you can earn more or less than 900 EK depending on the outcome of the lottery.

The outcome of the lottery depends on a random drawing made by the computer. In each consecutive round the computer will make a new draw, and each draw is random and independent between rounds and participants.

Throughout the 9 rounds, you compete with two other randomly drawn participants. The one with most EK after 9 rounds are paid 600 (Norwegian) kroner in addition to a participation fee of 50 kroner. If there is a tie, the winner is chosen by a random draw. Those of you that end up second or third are only paid the participation fee of 50 kroner.

(Treatment F^{RPE}): In every round you must decide on how much you wish to invest in the lottery, and then you will be informed about the outcome of the lottery for the respective round you and your competitors

(Treatment I^{RPE}): You have to decide on your investment X in blocks of three rounds each: If you choose to invest X in the lottery in round 1, X will also be invested in the lottery in rounds 2 and 3. When round 3 is over you will get to see the outcome of the first three rounds for you and your competitors. Then round 4 starts and again you have to decide on how much to invest in the lottery for the next block of three rounds (rounds 4, 5 and 6). You and your competitors will then see the outcome for the preceding rounds (rounds 4, 5 and 6). The same procedure applies for rounds 7, 8 and 9. Note that the computer makes a random draw each round, but that you decide on X for three consecutive rounds.

(Both treatments): During the experiment a history table will keep track of your earlier choices. The history table gives you round number, the amount invested in the lottery, the lottery outcome, your client's earnings for each round and accumulated earnings.

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