Theory Dec. (2012) 72:35–50
DOI 10.1007/s11238-010-9236-1

Why does myopia decrease the willingness to invest? Is it myopic loss aversion or myopic loss probability aversion?

Stefan Zeisberger · Thomas Langer · Martin Weber

Published online: 10 November 2010

Abstract For loss averse investors, a sequence of risky investments looks less attractive if it is evaluated myopically—an effect called myopic loss aversion (MLA). The consequences of this effect have been confirmed in several experiments and its robustness is largely undisputed. The effect's causes, however, have not been thoroughly examined with regard to one important aspect. Due to the construction of the lotteries that were used in the experiments, none of the studies is able to distinguish between MLA and an explanation based on (myopic) loss *probability* aversion (MLPA). This distinction is important, however, in discussion of the practical relevance and the generalizability of the phenomenon. We designed an experiment that is able to disentangle lottery attractiveness and loss probabilities. Our analysis reveals that mere loss probabilities are not as important in this dynamic context as previous findings in other domains suggest. The results favor the MLA over the MLPA explanation.

Keywords Myopic loss aversion · Prospect theory · Repeated investing · Experimental economics

JEL Classification D81 · G11

S. Zeisberger · T. Langer (✉)
Finance Center Münster, University of Münster, Universitätsstraße 14-16, 48143 Münster, Germany
e-mail: thomas.langer@wiwi.uni-muenster.de

M. Weber
Department of Banking and Finance, University of Mannheim,
Mannheim, Germany

1 Introduction

According to myopic loss aversion (MLA) a sequence of lotteries looks less attractive if it is evaluated myopically. The effect's consequences have been confirmed in several experimental studies with various settings. Less myopic people usually invest more in lotteries than their non-myopic counterparts. The robustness of this effect seems largely undisputed. The effect's *causes*, however, have not been thoroughly analyzed with regard to one important aspect—the probability characteristics of the lottery. Our argument can be exemplified by the frequently used lottery devised by Gneezy and Potters (1997), with a one-third chance of winning 2.5 times the investment amount and a two-thirds chance of losing the total amount, denoted by $\overset{1/3}{\underset{2/3}{<}}\begin{matrix}+2.5\\-1\end{matrix}$. Assuming a loss averse decision maker with the two-part value function $v(x) = \begin{cases} x & \text{if } x \geq 0 \\ -1.5x & \text{if } x < 0 \end{cases}$, for example, the prospective value that the decision maker assigns to the lottery is negative $(-1/6)$. If the decision maker plays the lottery twice and invests the same amount in each round the prospective value of the overall distribution is still slightly negative $(-1/9)$. For the frequently used case of a triple draw, however, the evaluation of the aggregated distribution increases to $+1/18$, even though it is composed of three draws that have a negative value in isolation. MLA can thus explain why decision makers might reject to play or invest less in the lottery if draws are evaluated separately (myopic decision maker) but accept it or invest more if draws are evaluated in an aggregated way (non-myopic decision maker). MLA, however, is not the only possible explanation.

Although in the given example the loss likelihood for a single draw is relatively high, namely 66.7% it reduces to 44.4% for two draws and to only 29.6% for three draws. Hence, the decision pattern described in the previous paragraph can also be attributed to differences in loss probabilities. We will call this explanation, where individuals simply focus on gain and loss probabilities, "myopic loss probability aversion" (MLPA). Importantly, this coherence applies to *any* lottery that has been used in the numerous studies on MLA presented in the literature. As a consequence, none of the studies is able to distinguish between MLA and MLPA. The importance of loss probabilities in decision making has already been emphasized and demonstrated (see, for example, Payne 2005 or Diecidue and van de Ven 2008). These studies, however, focus on a single decision and do not consider the context of repeated decision making. For the case of repeated investing, Langer and Weber (2005, p. 37) state in an analysis on MLA: "It seems that subjects pay more attention to the probabilities of gaining and losing than to the respective size of gains and losses." This intuition raises the question whether the experimental results presented in the literature are really driven by MLA as is frequently claimed or whether MLPA is a better explanation for the observed behavior. The key to this question is to disentangle the evaluation according to MLA from gain and loss probabilities. We will show that this can easily be achieved with lotteries similar to that one of Gneezy and Potters (1997). MLA and MLPA make different predictions for these lotteries and we can thus challenge the robustness of the MLA explanation. Somewhat surprisingly, our experimental analysis reveals that if we assume recently elicited cumulative prospect theory (CPT) preferences, the MLA explanation is favored over MLPA. In the dynamic context of repeated investment and myopia, the mere loss probabilities seem to play a more minor role than suggested by previous literature.

The remainder of this article is structured as follows. In Sect. 2 we briefly present the wealth of experimental analyses on MLA. Section 3 formally distinguishes between MLA and MLPA. Similarities in the probability characteristics of lotteries used in previous studies are discussed in Sect. 4. In Sect. 5, we disentangle lottery evaluation and loss probabilities before presenting the design and results of our experimental investigation in Sect. 6. We conclude in Sect. 7.

2 Related literature

Originally introduced by Benartzi and Thaler (1995) to explain the equity premium puzzle, MLA consists of the two behavioral components loss aversion (Kahneman and Tversky 1979) and myopia (Kahneman and Lovallo 1993). The first experimental studies on MLA were conducted by Gneezy and Potters (1997) and Thaler et al. (1997). The basic idea of these studies was to manipulate subjects' myopia and to analyze their willingness to invest in risky gambles. In line with the MLA explanation, participants of both the studies invested more in the risky lottery when they were manipulated to be less myopic. Later studies confirmed these findings and analyzed further aspects of MLA while the majority of studies were based on the original experimental setting of Gneezy and Potters (1997). Gneezy et al. (2003) confirmed the effect in a market setting. Here, myopia led to lower prices for risky assets. Haigh and List (2005) demonstrated the practical relevance of the phenomenon by showing that the effect is stronger for professional traders than for students. Bellemare et al. (2005), Langer and Weber (2008), and Fellner and Sutter (2009) analyzed whether the effect is driven by feedback frequency or investment flexibility. The results of these studies are ambiguous and give no clear answer to the question. Sutter (2007) confirmed the MLA effect for groups of individuals. Fellner and Sutter (2009) showed that if individuals are given the choice between high and low feedback frequency and investment flexibility, they prefer frequent feedback and high investment flexibility, even if informed that this might reduce their investment success by inducing myopia. In a study more closely related to our own study, Langer and Weber (2005) challenged the robustness of MLA by analyzing different lotteries. The study revealed theoretically and experimentally that there is a reverse effect for "loan-type" lotteries, i.e., lotteries with small loss probabilities in combination with relatively large losses. The results are explained by extending the MLA concept to myopic prospect theory (MPT), i.e., adding further elements of CPT, namely, diminishing value sensitivity and—not necessarily—probability weighting.[1] Haisley et al. (2008) reveal a myopic risk-seeking effect by analyzing purchases of state lottery tickets; the results are explained by the "peanuts effect" (Prelec and Loewenstein 1991). Hopfensitz and Wranik (2008, p. 1)

[1] Strictly speaking, loss aversion in (cumulative) prospect theory is not only determined by the shape of the utility function but also by the probability weighting function (see, for example, Schmidt and Zank 2005, 2008).

analyzed psychological reasons for the myopia effect. The authors found that "stable individual differences lead to different evaluations and emotional reactions concerning feedback." Papon (2008) confirmed the explanatory power of MLA within an insurance context. Redelmeier and Tversky (1992), Benartzi and Thaler (1999), and Langer and Weber (2001) demonstrated MLA for presentation modes. In their experiments, subjects usually showed higher acceptance rates for risky choices if aggregated rather than segregated return distributions were provided.

3 Loss aversion versus loss probability aversion

The difference between the two explanations MLA/MPT, on the one hand, and MLPA, on the other hand, is probably best illustrated by referring to the model proposed by Diecidue and van de Ven (2008). The attractiveness or valuation V of a prospect $X = (x_1, p_1, \ldots, x_n, p_n)$ with outcomes x_i and associated probabilities p_i is given in their model by:

$$V(X) = \sum_{i=1}^{n} p_i \cdot v(x_i) + \mu \cdot P(x^+) - \lambda \cdot P(x^-) \tag{1}$$

where v is a continuous value function with $v(0) = 0$, $P(x^+)$ and $P(x^-)$ denote the prospect's overall probability of gaining and losing, respectively, and $\mu \geq 0$ and $\lambda \geq 0$ are weights for these probabilities. Diecidue and van de Ven (2008) have shown that such a multi-component evaluation model can easily be transformed into a standard evaluation model of the form $V(X) = \sum_{i=1}^{n} p_i \cdot u(x_i)$ where the value function $u(x)$ features a specific type of discontinuity around the origin. More explicitly, it holds:

$$u(x) = \begin{cases} v(x) + \mu & \text{for } x > 0 \\ 0 & \text{for } x = 0 \\ v(x) - \lambda & \text{for } x < 0 \end{cases} \quad \text{with} \quad \mu, \lambda \geq 0. \tag{2}$$

An exemplary value function $u(x)$ is illustrated by the dotted line in Fig. 1.

CPT as proposed by Tversky and Kahneman (1992), on which *MLA/MPT* are based upon, does not put extra weights on mere gain and loss probabilities and thus does not assume a discontinuity of the evaluation around the reference point. Under MLA/MPT μ and λ are thus set to 0 and it holds $u(x) = v(x)$. For MLA, the value function v is linear in both gain and loss domain; for MPT diminishing value sensitivity is further assumed (see Fig. 1).[2] For both MLA and MPT, the value function is usually steeper in the loss than in the gain domain to induce loss aversion.

Under *MLPA*, individuals only focus on gain and loss probabilities and disregard the outcomes' size; $v(x)$ is set to 0 and the general model in Eq. 1 reduces to $V(X) = \mu \cdot P(x^+) - \lambda \cdot P(x^-)$. The higher the gain and lower the loss probability of the prospect, the higher is the associated attractiveness. While representing a relatively

[2] For MPT including probability weighting the probabilities p_i have to be substituted by weights w_i dependent on the probability weighting function.

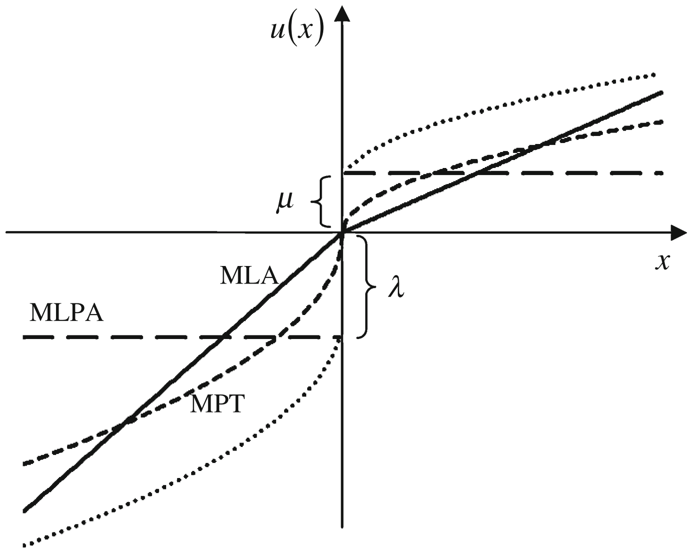


Fig. 1 Value function $u(x)$ for the general model of Diecidue and van de Ven (2008) (*dotted line*) and three value functions for the special cases of MLA, MPT, and MLPA

extreme definition, recall that MLPA preferences can explain all experimental studies on MLA/MPT presented in the literature as it predicts investment amounts of subjects to be higher for lower loss probabilities and vice versa (we will show this in detail in Sect. 4).

4 Loss probability characteristics in MLA experiments

The majority of experimental investigations on MLA rely on the original study design of Gneezy and Potters (1997) and their lottery, henceforth "GP lottery." Examples are the studies of Gneezy et al. (2003), Bellemare et al. (2005), Haigh and List (2005), Sutter (2007), and Fellner and Sutter (2009). As outlined in Sect. 1, the GP lottery has a high loss probability of 66.7% for a single draw when compared with only 29.6% for a triple draw. The reason is that an overall loss will only be realized in the case of three consecutive losses. Two gains and one loss still lead to a small overall gain. For the lottery $\begin{smallmatrix} 0.4 & +7\% \\ 0.6 & -3\% \end{smallmatrix}$, used by Langer and Weber (2008), loss probabilities are 60% (single draw) and 47.5% (fourfold draw).[3] Also the loss probabilities in Redelmeier and Tversky (1992) and in Langer and Weber (2001) are considerably lower in the multiple draw case: For the lottery $\begin{smallmatrix} 0.5 & +2000\$ \\ 0.5 & -200\$ \end{smallmatrix}$ the figures are 50.0% (single draw) versus 3.1% (five-fold draw). For the three lotteries of Langer and Weber (2001), i.e.,

[3] Experimental studies on MLA used different numbers of draws for the multiple draw case. We will only mention the number of draws that have actually been used in the respective experiment.

$\genfrac{}{}{0pt}{}{0.3}{0.7}\!<\!\genfrac{}{}{0pt}{}{+2200\,DM}{-200\,DM}$, $\genfrac{}{}{0pt}{}{0.2}{0.8}\!<\!\genfrac{}{}{0pt}{}{+2300\,DM}{-200\,DM}$, and $\genfrac{}{}{0pt}{}{0.7}{0.3}\!<\!\genfrac{}{}{0pt}{}{+1300\,DM}{-1200\,DM}$, loss likelihoods are substantially lower in the multiple draw case, too. The same argument applies to $\genfrac{}{}{0pt}{}{0.5}{0.5}\!<\!\genfrac{}{}{0pt}{}{+200\%}{-100\%}$ analyzed by Langer and Weber (2005). Evidently, in all cases, the loss probability for a single draw is considerably higher than the one for multiple draws in aggregated evaluation. An overview of lotteries with loss probabilities is presented in Table 1.

Our observation not only holds true for the typical MLA effect for which myopia decreases lotteries' attractiveness but also for the reverse case discussed by Langer and Weber (2001) and Langer and Weber (2005), for which myopia increases lotteries' attractiveness (the reverse case can only be explained by extending MLA to MPT). For the reverse effect, lotteries' loss probabilities are higher in the aggregated, i.e. non-myopic, case (and prospective values are lower here). For the lottery $\genfrac{}{}{0pt}{}{0.96}{0.04}\!<\!\genfrac{}{}{0pt}{}{+400\,DM}{-2100\,DM}$, used in Langer and Weber (2001), the loss probability increases from 4.0% (single draw) to 7.8% (double draw) and finally to 18.5% (fivefold draw). For the similar lotteries in the same authors' 2005 study, $\genfrac{}{}{0pt}{}{0.9}{0.1}\!<\!\genfrac{}{}{0pt}{}{+15\%}{-100\%}$ and $\genfrac{}{}{0pt}{}{0.9}{0.1}\!<\!\genfrac{}{}{0pt}{}{+30\%}{-100\%}$, loss probabilities equal 10.0% (single draw) and 27.1% (triple draw).

We conclude that for *all* lotteries used in previous studies, MLA/MPT, on the one hand, and MLPA, on the other hand, make the same predictions. Lower lottery attractiveness according to MLA/MPT always accompanies a higher loss probability and vice versa. As a consequence, although the myopia effect has been generally confirmed, none of the studies presented in the literature is able to distinguish between MLA/MPT and the MLPA explanation (since MPT includes MLA as a special case, we will only use the term MPT in the following unless we explicitly refer to MLA).

5 Lottery calibration

The question whether investments in the lottery are driven by MPT or MLPA can be addressed experimentally. A higher MPT evaluation (for the single or the multiple draw) is not necessarily accompanied by a lower loss probability. It is easy to construct examples of lotteries that have almost identical MPT evaluations whereas their loss probabilities are fundamentally different. A striking example is given by the lottery set G $\genfrac{}{}{0pt}{}{1/3}{2/3}\!<\!\genfrac{}{}{0pt}{}{+230\%}{-100\%}$ and Z $\genfrac{}{}{0pt}{}{0.4}{0.6}\!<\!\genfrac{}{}{0pt}{}{+190\%}{-100\%}$. G exhibits the same loss probabilities as the frequently used GP lottery and thus serves as a robustness check for our experimental results.[4] While G and Z show similar loss probabilities in the single draw case (66.7 vs 60.0%), the lotteries' loss probabilities differ substantially in the triple draw case, namely 29.6% for G when compared with 64.8% for Z (in the following we will refer to treatment L for the case of three draws and to treatment H for single draws). The reason is that for Z, two losses and one gain lead to a loss, whereas for G, two losses and one gain still lead to a gain. Table 2 summarizes key characteristics of our lottery set. According to MLPA, lottery Z is much more attractive in the multiple draw case than G predicting higher investment levels for Z compared with G.

4 We expect to observe a similar myopia effect for lottery G to that in other studies.

Table 1 Loss probabilities of lotteries used in experiments on myopic loss aversion

	Gneezy and Potters (1997) and others	Langer and Weber (2008)	Langer and Weber (2005)	Langer and Weber (2005) (reverse effect)	Langer and Weber (2005) (reverse effect)
Panel A: studies using intertemporal experimental design					
Lottery description	1/3: +250% 2/3: −100%	0.4: +7% 0.6: −3%	0.5: +200% 0.5: −100%	0.9: +15% 0.1: −100%	0.9: +30% 0.1: −100%
Loss probability single draw (%)	66.7	60.0	50.0	10.0	10.0
Loss probability multiple draw (%)	29.6 (3×)	47.5 (4×)	12.5 (3×)	27.1 (3×)	27.1 (3×)
	Redelmeier and Tversky (1992)	Langer and Weber (2001)	Langer and Weber (2001)	Langer and Weber (2001)	Langer and Weber (2001) (reverse effect)
Panel B: studies focusing on presentation forms					
Lottery description	0.5: +2000$ 0.5: −500$	0.3: +2200 *DM* 0.7: −300 *DM*	0.2: +2300 *DM* 0.8: −200 *DM*	0.7: +1300 *DM* 0.3: −1200 *DM*	0.96: +400 *DM* 0.04: −2100 *DM*
Loss probability single draw (%)	50.0	70.0	80.0	30.0	4.0
Loss probability multiple draw (%)	3.1 (5×)	49.0 (2×) 16.8 (5×)	64.0 (2×) 32.8 (5×)	9.0 (2×)	7.8 (2×) 18.5 (5×)

Panel A shows lotteries used within intertemporal experimental designs
Panel B shows lotteries of studies focusing on presentation forms
The number of draws for the multiple draw case is given in brackets

Table 2 Loss probability characteristics of lotteries G and Z in the segregated (single draw) and aggregated (triple draw) case

	Lottery G	Lottery Z
	1/3: +230% 2/3: −100%	0.4: +190% 0.6: −100%
Loss probability single draw (treatment H, %)	66.7	60.0
Loss probability triple draw (treatment L, %)	29.6	64.8

Remember that our main objective was to generate a lottery set with considerably different loss probabilities (and thus different evaluations according to MLPA) but identical attractiveness according to MPT. After having achieved the first objective of unequal loss probabilities, we have to assess how attractive G and Z are in a MPT valuation. One possibility would be to evaluate lotteries' attractiveness using CPT parameters of a representative individual.[5] This approach, however, would not account for preference heterogeneity. Therefore, we follow a more universal approach and employ a set of individually elicited CPT preference parameters. We use these preference parameters to calculate predicted investment amounts for G and Z. The set consists of 73 parameter combinations elicited by Zeisberger et al. (2011) and builds on the two-part value function (Eq. 3) and probability weighting function (Eq. 4, separately applied for gain and loss domain) as proposed by Tversky and Kahneman (1992)[6]:

$$v(x) = \begin{cases} x^{\alpha} & \text{if } x \geq 0 \\ -\lambda(-x)^{\beta} & \text{if } x < 0 \end{cases} \tag{3}$$

$$w(p) = \frac{p^{\delta}}{\left(p^{\delta}\,(1-p)^{\delta}\right)^{1/\delta}}. \tag{4}$$

Median values amount to $\alpha = 0.98, \beta = 0.88, \delta^{+} = 0.90, \delta^{-} = 0.76$, and $\lambda = 1.38$ (for individual parameters see Zeisberger et al. 2011). Employing this dataset we can calculate the theoretical attractiveness according to CPT for lotteries G and Z in both the treatments. As in other studies on MPT (e.g., Gneezy et al. 2003 or Langer and Weber 2005), we hereby assume individuals evaluate lottery sequences in treatment L in an aggregated (non-myopic) manner, i.e., evaluating the combined return distribution. In treatment H, we assume that individuals evaluate lottery draws in a segregated (myopic) way, i.e., each lottery by itself. Based on this setting, we calculate investment amounts predicted by CPT for both lotteries and both treatments,

[5] The most common parameters are the median parameters elicited by Tversky and Kahneman (1992), i.e., $\alpha = \beta = 0.88, \delta^{+} = 0.61, \delta^{-} = 0.69$, and $\lambda = 2.25$ (see Eqs. 3 and 4).

[6] As a robustness check we also analyzed the dataset that was used by Langer and Weber (2005) and provided by Wu. The results for the two datasets are very similar. We thus refrain from reporting respective results for the Wu dataset. The interested reader can obtain the data from the authors on request.

Table 3 Investment amounts in the lottery for lotteries G and Z predicted by CPT, based on a dataset by Zeisberger et al. (2011)

Lottery G			Lottery Z		
1/3 +230% 2/3 −100%			0.4 +190% 0.6 −100%		
Treatment L (%)	Treatment H (%)	Difference (%)	Treatment L (%)	Treatment H (%)	Difference (%)
56	41	15	62	49	13

The 56% for treatment L and lottery G, for example, indicates that employing the CPT preference dataset elicited by Zeisberger et al. (2011) the predicted average investment in the lottery is 56%

giving us a prediction of the myopia effect's strength. We assume that a subject will invest that amount of money that yields the highest CPT value.

Our assumption that individuals in treatment H (L) will strictly evaluate single (triple) draws might be seen as relatively restrictive. Relaxing this assumption and considering a probabilistic model of myopia as in Rabin and Weizsäcker (2009), however, would only lower the variance of our predicted investment amounts and would thus not change our qualitative results. Another critical aspect might be the poor forecasting abilities of CPT on the individual level as observed, for example, by Erner et al. (2009). We do not aim, however, at predicting exact investment amounts; we are only interested in the relative attractiveness of G and Z in both the treatments. Langer and Weber (2005) successfully applied the same approach to predict and validate a reverse myopia effect. Therefore, the direction and existence of the myopia effect might well be predicted by the method we apply.

Table 3 displays the predictions of investment amounts by CPT based on the above-mentioned preference set. The values and myopia effect are almost equal between both the lotteries, which was our second objective in the lottery calibration. The results show that lotteries G and Z are equally attractive according to CPT, whereas their loss likelihoods differ substantially (and thereby their attractiveness, according to MLPA). This conclusion does not only hold true for CPT with all its characteristics, i.e., loss aversion, value sensitivity, and probability weighting, but also for restricted forms of CPT, namely, assuming a linear value function and/or linear probability weighting.[7] These restricted forms of CPT can be motivated by findings of Blavatskyy and Pogrebna (2009), Haisley et al. (2008), and Hertwig et al. (2008). In a nutshell, the fact that lotteries G and Z are similarly attractive according to MPT is very robust also for variations of CPT functional specifications.

[7] For the calculation of these restricted CPT forms we fix particular variables of the value and probability weighting function at 1 and re-estimate all other variables using the estimation technique and data of Zeisberger et al. (2011). Based on these modified preference sets (accounting for linear value function and/or linear probability weighting) we again calculated predicted investment amounts.

Encouraged by a pre-test[8] of the experiment and the results observed in other domains, we have more confidence in the MLPA explanation rather than MPT (or restricted forms of MPT). Of course, (pure) MLPA as outlined in Sect. 3 represents a rather extreme case, but if loss probabilities play a role we should observe a difference in average investment amounts between G and Z in treatment L. Our first hypothesis is that the average (median) amount invested in the lottery ($\overline{r}$) is higher in treatment L than in H for lottery G, i.e., we expect the well-documented myopia effect (which is predicted by MPT as well as MLPA) also for this slight modification of the GP lottery. For lottery Z, however, the MLPA explanation predicts $\overline{r}$ to be slightly lower in treatment L than in H (Hypothesis 2). Owing to the large loss probability difference, MLPA furthermore makes the more explicit prediction that $\overline{r}$ is higher for lottery G than for Z in treatment L (Hypothesis 3).

Hypothesis 1: $\overline{r}(\mathrm{G_L}) > \overline{r}(\mathrm{G_H})$
Hypothesis 2: $\overline{r}(\mathrm{Z_L}) < \overline{r}(\mathrm{Z_H})$
Hypothesis 3: $\overline{r}(\mathrm{G_L}) > \overline{r}(\mathrm{Z_L})$

6 Experimental investigation

6.1 Experimental set-up

Our analysis of the suitability of the MLPA explanation is tested in a computerized laboratory experiment, building on the study design of Gneezy and Potters (1997). A total of 190 undergraduate students of the University of Münster (Germany) took part in the experiment in January 2009. The students were recruited from a finance course. The mean age of participants was 22.9 years (median: 23) and 27.2% were female. Subjects were randomly assigned in equal numbers to the four treatment–lottery combinations, i.e., treatments H and L in combination with lotteries G and Z. The experiment comprised 36 rounds in each of which subjects were endowed with a hypothetical 1€. Subjects repeatedly had to decide about the proportion to allocate to the lottery (between 0 and 1€; see Appendix A for a sample screen). Realized gains of the lottery and non-invested capital were not available in later rounds.

To manipulate myopia, high- and low-frequency groups were constructed as in Gneezy and Potters (1997). Hence, subjects in treatment H (high-frequency group) received feedback and were able to decide about the investment amount in each round. In treatment L (low-frequency group), feedback was only provided after three consecutive rounds and decisions were binding for the same interval. Instructions were provided on the computer screen (see Appendix B for full instructions). Participants were informed about the characteristics of the lottery and details of the treatment in advance and were also encouraged to ask questions at any time in case they did not understand the task.

[8] The results of the pre-test pointed rather in the direction of the MLPA explanation. The lottery calibration applied in the pre-test was based on the median CPT parameters elicited by Tversky and Kahneman (1992) only.

Table 4 Mean investment amounts in the lotteries G and Z for treatments L and H

Round	Lottery G			Lottery Z		
	Treatment L	Treatment H	Mann–Whitney z	Treatment L	Treatment H	Mann–Whitney z
1–3	48.4	50.1	−0.45 (0.672)	52.9	42.0	1.60 (0.055)
4–6	55.5	49.7	0.78 (0.218)	54.6	46.9	1.21 (0.113)
7–9	54.3	55.4	−0.35 (0.635)	51.7	51.7	0.06 (0.476)
10–12	58.8	47.5	1.55 (0.060)	54.8	48.3	0.98 (0.164)
13–15	55.2	48.1	0.84 (0.201)	58.8	51.6	1.07 (0.142)
16–18	55.8	46.1	1.30 (0.097)	53.6	46.3	1.02 (0.154)
19–21	60.6	51.1	1.46 (0.072)	56.6	50.3	0.93 (0.176)
22–24	55.8	45.9	1.15 (0.126)	61.4	47.8	2.16 (0.015)
25–27	55.4	44.9	1.56 (0.060)	61.3	47.3	2.10 (0.018)
28–30	55.9	45.7	1.38 (0.083)	56.4	50.0	1.01 (0.157)
31–33	51.7	48.8	0.42 (0.338)	52.7	51.1	0.32 (0.375)
34–36	63.3	53.4	1.35 (0.088)	55.3	50.9	0.70 (0.241)
1–36	55.9	48.9	1.39 (0.082)	55.8	48.7	1.63 (0.051)

The last column for each lottery shows Mann–Whitney z values and significance levels (p values) for the one-sided test in brackets; hypotheses: $\overline{r}(\mathrm{G_H}) < \overline{r}(\mathrm{G_L})$ and $\overline{r}(\mathrm{Z_H}) < \overline{r}(\mathrm{Z_L})$

To provide a monetary incentive, one-tenth of the subjects were randomly chosen to be paid in real money the amount they realized in the experiment (variable payment). In addition, a fixed amount of 5€ was paid to every subject for attending.[9] The experiment's duration was 15 min on average, and variable payment ranged from 23.25€ to 71.92€. All subjects were informed about payment details beforehand.

6.2 Results

The main results of the experiment are depicted in Table 4. We observe mean investment over all rounds in the lottery for G of 55.9% in treatment L when compared with 48.9% in treatment H (median figures: 52.5 vs. 46.5%). The difference is marginally significant (p value one-sided Mann–Whitney U test: 8.2%). We can thus reject the null hypothesis that $\overline{r}(\mathrm{G_L})$ is lower than $\overline{r}(\mathrm{G_H})$ and deliver some weak support for our Hypothesis 1. Hence, a myopia effect, even though less pronounced than in previous studies, is also observed for the minor variation of the frequently used GP lottery. In contrast with Hypothesis 2, and thus surprisingly, a myopia effect in the same direction is also observed for lottery Z, i.e., $\overline{r}(\mathrm{Z_L}) > \overline{r}(\mathrm{Z_H})$. The difference in investment values between treatments L and H for lottery Z is significant—but in the opposite direction from our hypothesis—with a p value of 5.1%.[10] Mean values amount to 55.8% in treatment L and 48.7% in H, the difference in medians being slightly higher (55.0 vs.

[9] The experiment was an independent part of a larger experiment which explains the relatively high fixed payment.

[10] Strictly speaking, this is the p value for the alternative hypothesis $\overline{r}(\mathrm{Z_H}) < \overline{r}(\mathrm{Z_L})$, which follows from the MPT explanation.

46.4%). Interestingly, the mean investment values for G and Z are almost identical, i.e., the myopia effect is equally pronounced.

The fact that average investment amounts do not differ for both the lotteries also indicates that our Hypothesis 3, namely that the average investment in the lottery in treatment L is lower for Z than for G, has to be rejected. The difference between median investment amounts for G and Z is negligible: 52.5% compared with 55.0% (p value: 34.5%). Hence, our MLPA argument does not hold for lotteries G and Z, and the decision behavior cannot be explained solely or primarily by loss likelihoods. On the contrary, our results give support to the MPT explanation. We observe very similar investment amounts between lotteries G and Z in treatment H, too. Summing up, our results correspond well with the qualitative predictions of Table 3, i.e., the existence of a myopia effect for both the lotteries regardless of the large difference in loss probabilities in treatment L. These results are robust over the 36 rounds of the experiment.

7 Conclusion

The relevance of myopia for the willingness to invest in risky assets was convincingly demonstrated in a number of experimental studies. MLA and the more general concept MPT are commonly used to explain the phenomenon. The robustness of the effect and its generalizability to various fields of application is rarely disputed in the literature. As we point out in this article, however, all experimental studies on MLA and MPT were constructed in such a way that higher evaluations under CPT accompany lower loss probabilities in the different treatments. As a consequence, none of the studies presented in the literature is able to distinguish between the MLA (MPT) concept and an explanation that we named MLPA. MLPA claims that the higher attractiveness of the investment options in non-myopic evaluation is driven by the lower loss probability rather than the higher CPT evaluation. It is important to distinguish between MLA (MPT) and MLPA, because the concepts make the same qualitative predictions for most, but not for all lottery types. Thus, attributing the empirical observations to the wrong explanation might lead to a misinterpretation of the robustness of the phenomenon and its generalizability.

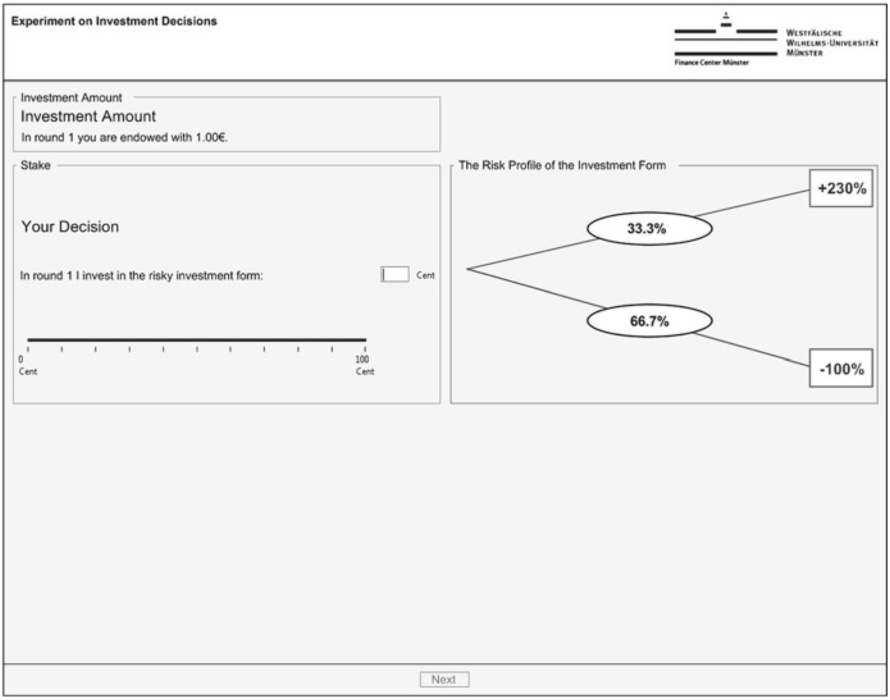
By a careful design of the lotteries in our study, we are able to distinguish between the competing explanations. Somewhat surprisingly, our results favor the MLA (MPT) over the MLPA argument. In this specific context, the attractiveness of lotteries seems to be better explained by CPT evaluations than by loss probabilities. The results are interesting, as previous studies in other domains revealed a strong influence of gain and loss probabilities on individual decision behavior (e.g., Payne 2005), although these findings refer to single decision making. We do not want to overplay our findings, though. What can be learned from the large body of research on myopia and investment is that there is obviously considerable heterogeneity in individual behavior and minor design issues that had not been considered to be relevant beforehand might have a major impact on the results.[11] We ourselves had this experience in a pre-test

[11] A good example is the research on the causes of myopia (feedback frequency vs. commitment) in this field. The findings of Bellemare et al. (2005) seemed to provide a clear and convincing picture, but were later challenged by Langer and Weber (2008) as well as Fellner and Sutter (2009).

for this study, in which MLPA was actually slightly favored over the MLA (MPT) explanation. Even though we have to underplay the relevance of the pre-test findings somewhat as the lotteries of that study were not as rigorously calibrated as the lotteries in the main study, it is still puzzling that such minor design modifications can cause such essential result changes. A possible explanation is that actual decision behavior might best be explained by a flexible model as proposed by Diecidue and van de Ven (2008), combining MLA (MPT) and MLPA. We thus hope that our research will be considered above all as an interesting starting point that inspires extended replications and further projects on this specific issue and on related questions.

Acknowledgments We are indebted to participants of the following conferences and seminars for their valuable comments and insights: Finance Center Münster research seminar (Germany, 2008), First International Summer School in Behavioral Economics and Retirement Savings held in Münster (Germany, 2008), SPUDM conference in Rovereto (Italy, 2009), INFORMS annual meeting in San Diego (USA, 2009), lab meeting of the psychology department of the University of Basel (Switzerland, 2010), Foundations and Applications of Utility, Risk and Decision Theory in Newcastle (Great Britain, 2010), and brown bag seminar of the Institute of Empirical Research of the University of Zurich (Switzerland, 2010). We would also like to thank Sebastian Dyck, Tobias Pfaff, and Martin Vanauer for their assistance with running the experiments.

Appendix A: Experiment example screen



This figure shows a sample screen as it appeared in the main part of the experiment (translated from German).

Appendix B: Experimental instructions (Translated from German)

Dear Participant,

Welcome to the experiment that was announced at the beginning. This experiment will take approx. 10–15 min time. It is independent of the other experiments and will also be paid independently. We will randomly draw one tenth of all subjects. This drawing is **independent of the drawing for the other experiment**. Your expected value for payment if you are chosen will be approx. 40 Euros.

The experiment comprises 36 rounds. In these rounds, you will have to make investment decisions, which will shortly be explained to you.

If you are randomly chosen for payment you will receive the amount you realized in the 36 rounds. Therefore, all rounds are relevant for the payment. As a consequence, you should think carefully about **all** of your decisions.

If there is still any lack of clarity at any point in the experiment, please raise your hand and the supervisor will help you immediately.

You will play a total of 36 rounds. In each round you will receive an investment amount of 1.00€.

You will have to decide how much of this monetary endowment you want to invest in a risky investment form. The risk profile of this investment form is identical in all rounds and is as follows:

There is a probability of 33.3% that you will win 2.3 times your investment (+230%) and a probability of 66.7% that you will lose the complete amount invested (−100%).

The actual results of the risky investments will be generated randomly and individually for you during the experiment by the computer, taking into account the given probabilities. We want to stress that there will be no manipulations. You can rely on the results from your investments being derived from the given probabilities. The results of successive rounds are independent of one another, i.e., the results of previous rounds do not influence the result-probabilities in the following rounds.

Let us look at three examples:

1st example: You do not invest anything in the risky investment form. In this case you keep your 1.00€, and you will thus neither make a gain nor a loss, regardless of the return of the risky investment form.

2nd example: You invest all of the 1.00€ in the risky investment form. If the risky investment form develops positively you will gain 2.3 times the amount invested, i.e. 2.30€, and will end up with 3.30€. If the risky investment form develops negatively you will lose the 1.00€ and will end up with nothing in that round.

3rd example: You invest half of the investment amount, i.e. 0.50€. If the investment form develops positively you will gain 2.3 times the amount invested, i.e. 1.15€, and will end up with 1.65€. If the risky investment form develops negatively you will lose the 0.50€ and will end up with the non-invested 0.50€ in that round.

The acquired capital will be credited to your payout account and will not be available for investment in later rounds. Instead, in each round you will be provided with a new endowment of 1.00€.

Treatment H

Before each round, you have to decide anew what amount (between 0 and 1€) you want to invest in the risky investment. After each round, you will be told how the investment developed and what gain or loss you made.

Treatment L

Your decision on what amount you invest in the risky investment form is binding for three rounds and cannot be changed within these three rounds. Not until after these three rounds, can you choose a new amount, which will then again be binding for the following three rounds. You will also not be told what gain or loss you made before the three rounds have ended. This means that, although 36 rounds will be played, you will only make 12 decisions for three rounds each.

General instruction (contd.):

You can either enter the desired investment amount via the keyboard or use the mouse to adjust the amount on the scrollbar. Please note that you can only enter whole amounts of cents (no decimal point).

References

Bellemare, C., Krause, M., Kröger, S., & Zhang, C. (2005). Myopic loss aversion: Information feedback vs. investment flexibility. *Economics Letters, 87*(3), 319–324.

Benartzi, S., & Thaler, R. H. (1995). Myopic loss aversion and the equity premium puzzle. *Quarterly Journal of Economics, 110*(1), 73–92.

Benartzi, S., & Thaler, R. H. (1999). Risk aversion or myopia? Choices in repeated gambles and retirement investments. *Management Science, 45*(3), 364–381.

Blavatskyy, P., & Pogrebna, G. (2009). Myopic Loss aversion revisited. *Economics Letters, 104*(1), 43–45.

Diecidue, E., & van de Ven, J. (2008). Aspiration Level, probability of success and failure, and expected utility. *International Economic Review, 49*(2), 683–700.

Erner, C., Klos, A., Langer, T. (2009). Can prospect theory be used to predict investor's willingness to pay? Working Paper, University of Münster.

Fellner, G., & Sutter, M. (2009). Causes, consequences, and cures of myopic loss aversion—an experimental investigation. *The Economic Journal, 119*(537), 900–916.

Gneezy, U., Kapteyn, A., & Potters, J. (2003). Evaluation periods and asset prices in a market experiment. *The Journal of Finance, 58*(2), 821–837.

Gneezy, U., & Potters, J. (1997). An experiment on risk taking and evaluation periods. *Quarterly Journal of Economics, 112*(2), 631–645.

Haigh, M.S., & List, J.A. (2005). Do professional traders exhibit myopic loss aversion? An experimental analysis. *The Journal of Finance, 60*(1), 523–534.

Haisley, E., Mostafa, R., & Loewenstein, G. (2008). Myopic risk-seeking: The impact of narrow decision bracketing on lottery play. *Journal of Risk and Uncertainty, 37*(1), 57–75.

Hertwig, R., Barron, G. M., Weber, E. U., & Erev, I. (2008). Decisions from experience and the effect of rare events in risky choice. *Psychological Science, 15*(8), 534–539.

Hopfensitz, A., Wranik, T. (2008). Psychological and environmental determinants of myopic loss aversion. Working Paper, University of Toulouse 1, University of Geneva.

Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts: A cognitive perspective on risk taking. *Management Science, 39*(1), 17–31.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263–291.
Langer, T., & Weber, M. (2001). Prospect theory, mental accounting, and differences in aggregated and segregated evaluation of lottery portfolios. *Management Science, 47*(5), 716–733.
Langer, T., & Weber, M. (2005). Myopic prospect theory vs myopic loss aversion: How general is the phenomenon. *Journal of Economic Behavior & Organization, 56*(1), 25–38.
Langer, T., & Weber, M. (2008). Does commitment or feedback influence myopic loss aversion? An experimental analysis. *Journal of Economic Behavior & Organization, 67*(3–4), 810–819.
Papon, T. (2008). The effect of precommitment and past-experience on insurance choices: An experimental study. *The Geneva Risk and Insurance Review, 33*(1), 47–73.
Payne, J. (2005). It is whether you win or lose: The importance of the overall probabilities of winning or losing in risky choice. *Journal of Risk and Uncertainty, 30*(1), 5–19.
Prelec, D., & Loewenstein, G. (1991). Decision making over time and under uncertainty: A common approach. *Management Science, 37*(7), 770–786.
Rabin, M., & Weizsäcker, G. (2009). Narrow bracketing and dominated choices. *American Economic Review, 99*(4), 1508–1543.
Redelmeier, D. A., & Tversky, A. (1992). On the framing of multiple prospects. *Psychological Science, 3*(3), 191–193.
Schmidt, U., & Zank, H. (2005). What is loss aversion? *Journal of Risk and Uncertainty, 30*(2), 157–167.
Schmidt, U., & Zank, H. (2008). Risk aversion in cumulative prospect theory. *Management Science, 54*(1), 208–216.
Sutter, M. (2007). Are teams prone to myopic loss aversion? An experimental study on individual versus team investment behavior. *Economics Letters, 97*(2), 128–132.
Thaler, R. H., Tversky, A., Kahneman, D., & Schwartz, A. (1997). The effect of myopia and loss aversion on risk taking: An experimental test. *Quarterly Journal of Economics, 112*(2), 647–661.
Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty, 5*(4), 297–323.
Zeisberger, S., Vrecko, D., & Langer, T. (2011). Measuring the time stability of Prospect Theory preferences. *Theory and Decision*. doi:10.1007/s11238-010-9234-3.