Do changes in reporting frequency really influence investors' risk taking behavior? Myopic loss aversion revisited*

Stefan Zeisberger
Corresponding author, Department of Banking and Finance, University of Zurich, Switzerland
Tel.: +41 44 634 54 36, e-mail: stefan.zeisberger@uzh.de

Thomas Langer
Finance Center Münster, University of Münster, Germany, e-mail: thomas.langer@uni-muenster.de

Martin Weber
Department of Banking and Finance, University of Mannheim, Germany,
e-mail: weber@bank.bwl.uni-mannheim.de

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Abstract

According to the behavioral concept of myopic loss aversion (MLA), investors are more willing to take risks if they are less frequently informed about their portfolio performance. This prediction of MLA has been confirmed in various experimental studies and the conclusion has been drawn that banks could in fact influence investors' risk taking behavior by adjusting the frequency with which they give feedback. However, none of the existing studies has really provided an explicit test of this dynamic prediction. Instead it is simply assumed that the results from between-subject experiments translate to a within-subject scenario in which feedback frequency changes over time. To examine the scope of the phenomenon and to assess its practical relevance, we present the first experimental study of MLA that directly addresses the dynamic prediction and manipulates feedback frequency (and investment flexibility) within-subject. Our analysis reveals that the impact of such dynamic changes is not as straightforward as commonly assumed. Stickiness and a general introspection component superimpose the standard MLA effect and generate unexpected dynamic patterns of risk taking behavior.

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1. Introduction

Investors are commonly assumed to be more willing to take risks if they evaluate their portfolio performance less frequently. This assumption is based on the behavioral concept of myopic loss aversion (MLA) as introduced by Benartzi and Thaler (1995). The reason is that for longer evaluation periods, gains and losses can cancel each other out and losses will become less apparent than in shorter time horizons. A longer evaluation period will thus increase the attractiveness of risky assets for loss-averse investors, and a higher attractiveness should, in turn, lead to a higher willingness to invest (see also Dierkes et al., 2010). MLA has far-reaching implications. It serves, for example, as a partial explanation for the equity premium puzzle (Benartzi and Thaler, 1995) and the stock market participation puzzle (Barberis et al., 2006).

Numerous experimental studies have examined the consequences of MLA (starting with Gneezy and Potters, 1997, and Thaler et al., 1997). In these experiments, participants were faced with a sequence of investment decision problems and repeatedly had to allocate a monetary endowment between a risky and a safe asset. Myopia manipulation was achieved primarily by confronting participants with different combinations of return feedback frequency (feedback on the return on the risky option in every period vs. for some periods combined) and investment flexibility (the possibility of allocating the endowment in every period vs. only after some periods).[1] The main effect of a higher willingness to take risks in less myopic evaluations has been shown to be robust. It persists for professional traders (Haigh and List, 2005), for financial advisors (Eriksen and Kvaløy, 2010a), in market settings (Gneezy et al., 2003),

[1] The use of terminology is not consistent in the MLA literature. The feedback frequency is sometimes also referred to as evaluation frequency while investment flexibility is also called period of commitment, investment horizon or decision frequency.

for teams (Sutter, 2007), in an insurance context (Papon, 2008) and for delegated portfolio management (Eriksen and Kvaløy, 2010b).[2] First external validity of the usefulness of these effects in business practice was given by Looney and Hardin (2009).

Importantly, however, none of the studies has analyzed whether investors will *adapt* their investments in the risky asset when they are faced with a *change* in investment flexibility and/or feedback frequency ("treatment change").[3] Despite this lack of evidence, it is commonly assumed that investors will change their investment behavior when faced with a change in the investment environment. For example, Gneezy and Potters (1997) conclude that "Manipulating the evaluation period of prospective clients could be a useful marketing strategy for fund managers" (p. 641). Furthermore, Haigh and List (2005) write "In a positive sense, these findings have direct implications on the communication strategies for fund managers" and "Moreover, providing less freedom to adjust […] might reduce the likelihood that a sell-off ensues after a minor setback" (p. 531). Gneezy et al. (2003) point to the case of Bank Hapoalim in Israel which considered that a reduction in the feedback frequency of performance reporting for its clients from a monthly to a quarterly interval would increase investors' willingness to invest in risky funds. Whether the Bank Hapoalim policy change was "successful"—if actually conducted—is not known. Even if the willingness to hold risky assets did increase, it would be hardly possible to attribute this effect to the policy change as other factors, such as overall economic development, further marketing

[2] In a closely related strand of literature, MLA is related to different aggregation levels in the presentation of return information. Investors are typically more willing to invest if they are presented with aggregated return information, e.g., several years instead of only one year of return information on a stock investment (see, for example, Benartzi and Thaler, 1999; Langer and Weber, 2001). Recently, Klos (2013) found that effects attributed to myopic loss aversion are partly driven by the fact that return distribution properties are simply easier to grasp if they are presented in a long-term frame.

[3] The only related study is by Fellner and Sutter (2009). However, in their experiment, treatment changes were endogenous: Participants were able to choose and switch their treatment. As a result of this specific experimental setup, and also as only very few subjects switched from one treatment to the other, the study cannot answer our research question.

activities by the bank, or the relative costs of purchasing and holding mutual funds, might have had a much greater impact on the clients' investment behavior than the policy change. Given the debate in the literature on the distinction between feedback frequency and investment flexibility as potential drivers of myopia, it is noteworthy that the proposed policy change of Bank Hapoalim only addressed feedback frequency but not investment flexibility.[4]

Focusing on investment flexibility, Kliger and Levit (2009) aim to explore MLA using empirical data and investigate stock return changes after shifts from daily to weekly trading or *vice versa* for individual stocks (the stock exchange's motivation being to improve liquidity in stock trading). The results are interesting in so far as they are not in line with the typical MLA patterns—stock returns *de*crease for shifts from daily to weekly trading (and they increase in the opposite case). However, it is unlikely that these short-term changes can be attributed to MLA as they do not have a considerable impact on the loss frequency. It is more likely that these results are driven by investors' desire for high investment flexibility. This would be in line with the experimental findings of Charness and Gneezy (2010), who demonstrate that investors prefer higher over lower investment flexibility and higher over lower information frequency when they are given the choice between the options. Similarly, Looney and Hardin (2009) show that restricting investment flexibility may lead to client dissatisfaction. Nonetheless, these results highlight the need for a further investigation of our research question as they demonstrate that the consequences of *changes* in the investment environment might not be as straightforward as assumed.

[4] Bellemare et al. (2005), Langer and Weber (2008), Fellner and Sutter (2009) and Hardin and Looney (2012) analyze experimentally which of the two factors—feedback frequency or investment flexibility—mostly drive the MLA effect. The studies show conflicting results, but also use different experimental procedures.

Overall, the MLA literature seems to suggest that the results of between-subject experimental studies can be transferred to a dynamic setting in which the investment environment is changed over time. More precisely, it is assumed that when investors are manipulated to be more myopic (e.g., by a higher frequency of performance reporting), investment levels decrease (and *vice versa*). We call this the “MLA adaptation hypothesis” as investments adapt to changes in the investment environment (information feedback frequency and/or investment flexibility). Importantly, however, there is an alternative hypothesis. Investors might perceive the change in the investment environment as normatively irrelevant. Such a change would thus have no effect on investment behavior and investment levels in risky assets would remain constant or “sticky” after a policy change. We call this the “stickiness hypothesis”. This implies, for example, that investors’ will not increase risk taking and invest more in risky assets when they are less frequently informed about the performance of their portfolio.

In this paper, we try to contrast these two conflicting hypotheses using a series of clean within-subject experimental tests. In Section 2, we introduce our general experimental design and hypotheses. In our first study (Section 3), we follow the most frequently used experimental design of Gneezy and Potters (1997) and simultaneously change feedback frequency and investment flexibility. Previous literature has shown the strongest base effects for this double manipulation. As most of the previous MLA literature seems to suggest that the effect is driven primarily by the frequency of feedback on portfolio performance rather than investment flexibility, we conduct a second study (Section 4) in which we only change the feedback frequency, leaving the subjects with full investment flexibility. This manipulation resembles the situation in the Bank Hapoalim example. In general, it should be easier for financial institutions and other authorities to change the feedback frequency than to alter trading possibilities. As the downside of this attenuated modification, we have to expect that the myopia manipulation and effect sizes will be less pronounced. In a third study (Section 5), we further analyze the robustness of our results by implementing a change in our experimental design that improves participants' ability to compare the two investment scenarios they face. We conclude in Section 6.

2. Experimental Design and Hypotheses

2.1 General Experimental Design and Study Overview

Our experimental setup builds on the study of Gneezy and Potters (1997), which has been the basis for the vast majority of studies on MLA. This facilitates comparison with the results of previous studies. In our Experiments 1 and 2, there were 36 periods in each of which the subjects' task was to allocate a monetary endowment of €0.40 between a risky and a risk-free option (see Appendix A for a screenshot of the main part of the experiment). The amount invested in the risky option yielded a return of +250% with a probability of 1/3, or –100% with a probability of 2/3; the expected return was thus +17%. Non-invested capital and gains/losses from the risky investment were set aside; participants were provided with an endowment of €0.40 in each new period.

Based on previous literature, we applied a double myopia manipulation for Experiment 1, i.e., we jointly changed feedback frequency and investment flexibility. In treatment H (high frequency), subjects received feedback in each period about the realized returns of the risky investment option and they were also able to decide about the endowment allocation in each period anew. In treatment L (low frequency), feedback was only provided after three periods and investment decisions were binding for the same time interval.

The main feature of our experiments is the existence of two scenarios, named LH and HL. Each scenario consists of two consecutive parts (treatments) of 36 investment periods. In scenario LH, participants started in Part 1 with treatment L and after 36 periods switched to treatment H (Part 2). In scenario HL, subjects analogously started with treatment H and then switched to L. Subjects were randomly assigned to scenarios LH and HL. Instructions were given on the computer screen (see Appendix B).

Previous research on MLA has documented the importance of distinguishing between the impact of feedback frequency and investment flexibility on myopia. Therefore, a different myopia manipulation was used in Experiment 2. We only changed feedback frequency but left subjects with total investment flexibility and called this treatment M for “mixed”. Consequently, subjects were only informed about their investment returns every third period but were still able to change their investment in each period. To analyze the pure feedback frequency effect, we combined treatment M with treatment H, resulting in scenarios HM and MH.

The exact experimental procedure of the treatment change can be challenging. Our aim was to create a level playing field for both competing hypotheses: MLA adaptation and stickiness. To avoid providing excessive support for the stickiness hypothesis, we introduced a time lag of two weeks between the parts in Experiment 1 and 2. Participants thus had to come to the laboratory twice. As a result of the time lag, the particular decision situation in the first part and the chosen investment amounts had the opportunity to fall somewhat into oblivion and we deliberately chose a relatively long period to induce this effect. The inclusion of the time lag is also supposed to mimic reality to a greater extent in that a policy change does not directly follow a previous investment decision. However, as a possible negative side effect of our design choice, subjects had sufficient time between the parts for general introspection about the investment problem. After the first part, some might have recognized that the probability of facing a loss after all the periods was in fact very low and it would thus have been most attractive for them to invest the maximum amount. Therefore, behavior in Part 2 could be influenced by this general introspection and reflection on Part 1. Importantly, however, this effect would be independent of any specific scenario. Nonetheless, as a result of these possible concerns, we conducted a further experiment (Experiment 3) in which the treatment change occurred without a time lag. Both changes should prevent a potential introspection effect. We also restricted the number of investment periods to 15. To keep the expected payout per subject at a comparable level to Experiments 1 and 2 we used a higher monetary endowment of €1.00 rather than the €0.40 per period in Experiment 3, resulting in a total endowment of €15.00 compared to €14.40 in Experiments 1 and 2. Experiment 3 was conducted using treatments LH and HL.

Before the beginning of the experiment, all subjects were fully informed about Part 1 and also about the fact that Part 2 would follow. However, it was never explicitly mentioned that a treatment change would occur between the two parts. In Experiments 1 and 2, the participants could only discover that the decision scenario had changed when they returned to the lab and in Experiment 3 only after the first part was over. All experiments were computerized and run at the University of Muenster, Germany. To guarantee comparability for all experiments we recruited our subjects from undergraduate finance courses. In the three experiments, the number of participants was 101, 108, and 69. Nearly a third of the participants were female.

The experiment took, on average, approximately 30 to 35 minutes including the payment procedure. To incentivize subjects, a third of them were randomly chosen to receive a real payment according to the amount they earned in one of the two experimental parts; the part was also randomly determined. The expected value, if chosen for payment, ranged from €14.40 to €16.80 (€15.00 to €17.50 in Experiment 3) depending on investments in the risky option. The actual variable payments ranged from €12.11 to €25.20 (€4.50 to €35.98). In addition, there was a fixed payment of €5.00 for each participant. The subjects were informed about all payment details beforehand. The random selection of the winning subjects was conducted after the experiment was over. We refrained from paying every subject (a third of these amounts) as the endowment per period would have been very low.

2.2 Hypotheses: Possible Patterns of Treatment Change Reactions

As outlined in the introduction, we contrast two hypotheses:

(1) "MLA adaptation hypothesis": Investors adapt their risk taking in a way that previous MLA literature suggests. Average investment amounts are expected to decrease after the treatment change in scenario LH and to increase after the treatment change in scenario HL. Equivalent results—albeit possibly of a smaller scale—are expected in scenarios MH and HM, i.e., when only the feedback frequency changes but not the investment flexibility. Formally, the MLA adaptation hypothesis predicts for scenarios LH and HL $\bar{r}_{HL}^{1} < \bar{r}_{HL}^{2}$ and $\bar{r}_{LH}^{1} > \bar{r}_{LH}^{2}$ (equivalently for MH and HM) where the average investment amounts in scenario XY and part i (i=1..2) are denoted by $\bar{r}_{XY}^{i}$. In its strongest form, the MLA adaptation hypothesis would predict that we see in Part 2 the same investment amounts as in Part 1, only interchanged between groups (i.e., $\bar{r}_{HL}^{1} = \bar{r}_{LH}^{2}$ and $\bar{r}_{LH}^{1} = \bar{r}_{HL}^{2}$).

(2) "Stickiness hypothesis": It might become clear to participants that the treatment change does not generate a normatively relevant modification in the investment

environment. As a result, they have no reason to change their investment behavior. In its strongest form, this hypothesis implies that investment amounts should stay constant ("sticky") directly after the treatment change in both scenarios. Formally, we expect for scenarios LH and HL that $\bar{r}_{HL}^{1} = \bar{r}_{HL}^{2}$ and $\bar{r}_{LH}^{1} = \bar{r}_{LH}^{2}$ (equivalently for MH and HM).

It should be noted that the two hypotheses do not only make the above-mentioned "within treatment predictions" for the investment amounts in the two parts. In their strong form, they also predict for both parts specific patterns across treatments. While these predictions coincide for Part 1 in that both hypotheses expect observation of the well-documented MLA base effect $\bar{r}_{LH}^{1} > \bar{r}_{HL}^{1}$, the predictions are distinct for Part 2. While the MLA adaptation hypothesis expects to find the same MLA base effect in Part 2, i.e., $\bar{r}_{LH}^{2} < \bar{r}_{HL}^{2}$, the stickiness hypothesis suggests an effect in the opposite direction (see Figure 1).

Figure 1: Hypotheses — Exemplary Investment Patterns

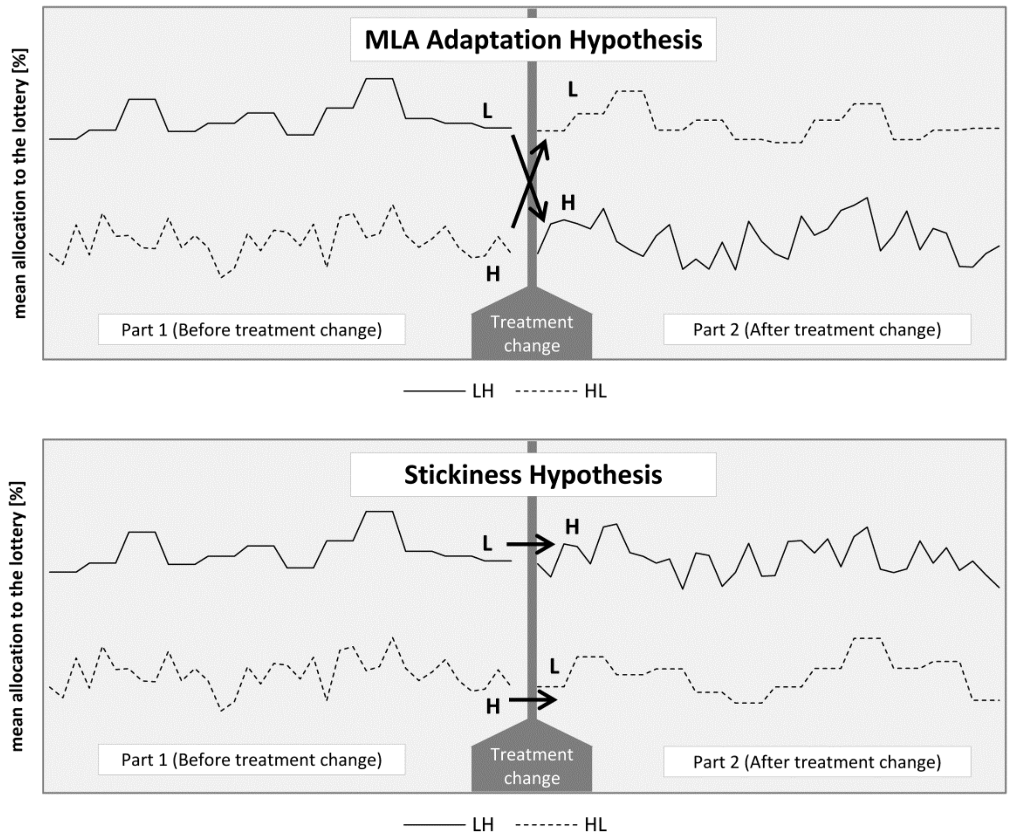

Figure 1 illustrates exemplary investment pattern for our two contrasting hypotheses: "General MLA hypothesis" vs. "stickiness hypothesis" in their strong form.

The stickiness will transmit the Part 1 difference to Part 2 and produce the pattern $\bar{r}_{LH}^{2} > \bar{r}_{HL}^{2}$. This difference in Part 2 predictions, which should also occur for the H and M comparison, provides a simple and direct test of the strong forms of the competing hypotheses.

3. Experiment 1: Joint Change in Information Feedback and Investment Flexibility with Time Lag

As outlined before, we analyzed scenarios LH and HL with a time lag of two weeks between the two parts in Experiment 1. We observe a pronounced and statistically significant MLA base effect in Part 1. Investments in treatment L are 8.9 percentage points (pp) higher than in treatment H: $\bar{r}_{LH}^{1}$=67.2% [median: 67.5%] (*SD*=22.6%) vs.

$\bar{r}_{HL}^{1}$=58.3% [median: 54.2%] (SD=20.0%).[5] The difference is statistically significant using a one-sided Mann-Whitney U test (p=0.017). This is consistent with previous literature and thus gives some indication that our experimental environment and student population seem to be similar to previous studies.

Importantly, we also observe a general trend of increasing investments over periods. Mean investments are 4 pp higher in the second half of Part 1 compared with the first part of Part 1. We are not the first to report such a trend in experimental MLA research (see, e.g., Langer and Weber, 2008). However, it turns out to be particularly relevant to our specific research question. If investment amounts generally increase over time, we have to expect higher investments in Part 2 independent of any treatment change. To disentangle this general trend effect from the treatment change effect, we fit our investment data by piecewise linear functions (the same slope for both treatments and scenarios). We receive four line segments with equal slopes (the general time trend) but different intercepts/elevations.[6] We measure the effect of the treatment change by the "jump" in the increasing lines between Parts 1 and 2, i.e., at the time of the treatment change.

[5] Generally, our results are robust with regard to which average measure we use (mean vs. median).
[6] Note that the trend component is calculated for H using each periods and for L using each block of three periods. As a robustness check, we also estimated the trend using blocks of three periods for both treatments. The results are nearly unchanged.

Figure 2 illustrates the development of average investment amounts by period and also shows the fitted line segments. The fact that we observe a significant positive trend in the full data set requires us to re-specify our earlier measures and hypotheses. To capture the pure treatment effect (the jump in the line segments from Part 1 to Part 2), we have to interpret the $\bar{r}^i_{XY}$ in the hypotheses of subsection 2.2 as the average investment amounts net of the general trend effect (and refer to net investment amounts whenever this distinction is important).

Figure 2: Development of Mean Investment Amounts Over Rounds (Exp. 1)

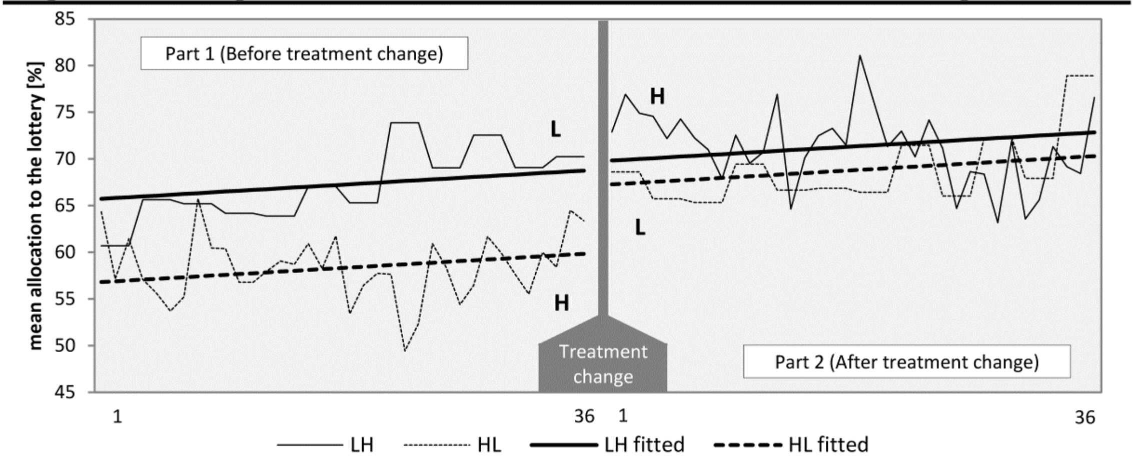

Figure 2 shows the actual development of mean amounts invested in the risky investment alternative over two parts with 36 periods each in Experiment 1. The fitted linear curves are calculated by minimizing squared deviations of the fitted and actual values. The fitting assumes a general temporal trend (increasing familiarity) plus an independent elevation for each linear piece.

We begin our analysis by looking at scenario LH. We cannot observe any significant influence of the treatment change on investment behavior; the fitted lines in Figure 2 suggest that subjects keep their net investment amounts almost constant (on average). Somewhat surprisingly, investments even went up a little (n.s.), thereby not even supporting the conjecture of heterogeneous behavior with some subjects showing stickiness and others the MLA adaptation pattern. The results support the stickiness hypothesis as, on average, subjects do not seem to be affected by a combined change of feedback frequency and investment flexibility from L to H.

For scenario HL we observe an increase in investments after the treatment change—even accounting for the general trend of increasing investment amounts—which is more consistent with the MLA adaptation hypothesis. The average (fitted) investment amount increases by 7.1 pp as a result of the treatment change, this change is statistically significant (one-sided Mann-Whitney *U* test, p=0.008).[7]

If we turn to the discriminating Part 2 hypothesis ($\bar{r}^2_{LH} < \bar{r}^2_{HL}$ or $\bar{r}^2_{LH} > \bar{r}^2_{HL}$), we observe an overall pattern that is qualitatively in favor of the stickiness hypothesis rather than the MLA adaptation hypothesis. Investments are 2.5 pp higher in treatment H than in treatment L, i.e., $\bar{r}^2_{LH} > \bar{r}^2_{HL}$ (the difference is, however, not significant). This constitutes an interesting finding that would not have been predicted by any previous MLA research. Overall, and taking into account the general tendency to increase investments over time, our results thus give more support to the stickiness hypothesis.

Individual-level analysis

Before we turn to Experiment 2 and the HM and MH scenarios, we should take a closer look at the individual data. Our experiment is the first that allows such an analysis of individual reactions to a treatment change. Figure 3 displays the average investment amounts for each individual subject in the two parts. By plotting each subject's average investment in Part 1 on the *x*-axis and the corresponding investment in Part 2 on the *y*-axis, it also illustrates individual changes in investment behavior from Part 1 to Part 2 (larger bubble sizes indicate more subjects at a certain point in the diagram). The data support our introspection conjecture. Approximately 25% of the subjects in scenario HL

[7] To test the significance of this treatment change, i.e., the induced level change in investments between Part 1 and 2, we estimated trend and level changes using an OLS regression for each subject individually and tested whether the average level change coefficient for all subjects was different from zero with a Mann-Whitney *U* test.

and 16% in LH invested an amount of 95% or more in Part 2 but did not do so in Part 1.

Figure 3: Single subject investment change (Exp. 1)

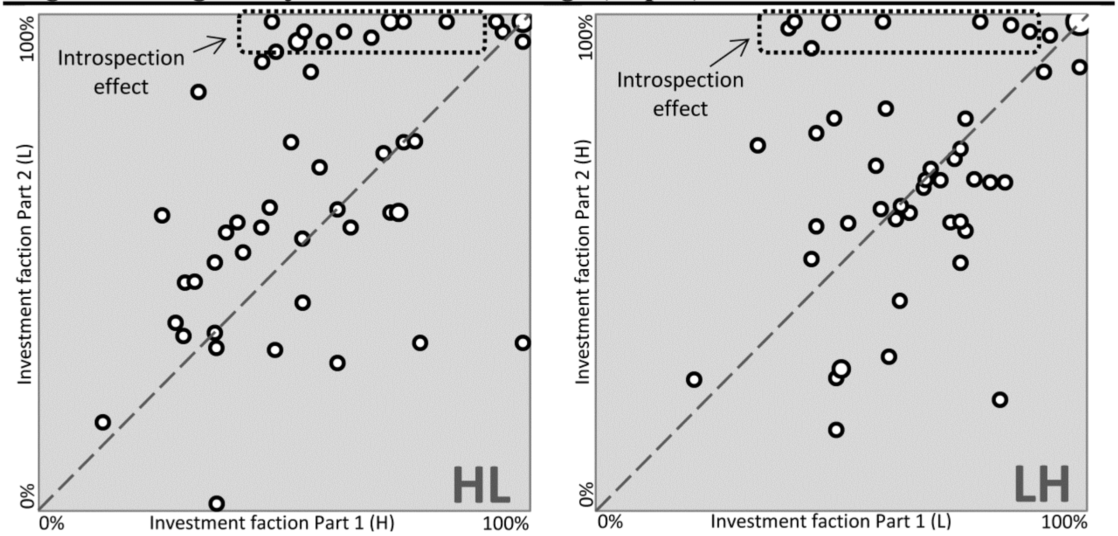

Figure 3 shows changes in investments from Part 1 to Part 2 for the two scenarios HL and LH in Experiment 1. Each bubble represents one subject (or more subjects grouped together, the bubble size represents the number of grouped subjects). The position of the dot is determined by the subject's investment in Part 1 (*x*-axis) and Part 2 (*y*-axis). The distance of the bubbles from the diagonal line thus indicates the individual change in investments from Part 1 to Part 2.

The observed difference between aggregate investment amounts in Part 1 and Part 2 seems to be partly generated by these insightful subjects and less so by a broadly-based tendency to increase investment amounts in Part 2. It should be noted, however, that this observation in individual investment behavior does not challenge the previous finding with respect to the Part 2 predictions of the competing hypotheses. As the introspection effect occurs for both the HL and the LH scenarios alike, the $\bar{r}^2_{LH} > \bar{r}^2_{HL}$ finding still provides more support for the stickiness hypothesis.

4. Experiment 2: Change Only in Information Feedback

Experiment 2 was designed to disentangle the combined effect of a change in information feedback and investment flexibility. In treatment M, subjects could change their investment in each period, but they were only informed about their investment success after three consecutive periods (combined feedback). The two resulting scenarios are HM and MH.

In contrast to Experiment 1, we do not observe a successful myopia manipulation in Part 1. The effect of the lowered information frequency only amounts to an (insignificant) 1.5 pp difference in average investments.[8] The average investments are 61.4% [median: 62.2%] (*SD*=25.8%) in H and 62.9% [median: 62.6%] (*SD*=21.5%) in M. Investments in H are not significantly different from Experiment 1. Although the absence of an MLA base effect is problematic for our main research question and the distinction between the MLA adaptation hypothesis and the stickiness hypothesis, it is an interesting observation. The comparison between treatments H and M is possibly closer to a real-world application than the comparison between treatments H and L. As it will be easier for banks to change the feedback frequency than investor's decision flexibility, the robustness and practical relevance of MLA might be overemphasized in the literature. Our results on a pure manipulation of feedback frequency contribute to a literature picture of rather ambiguous evidence. Details of the experimental design seem to play a major role for these effects and it should be noted that the majority of previous studies on this topic used a different treatment M, namely one in which information feedback frequency was kept at a high level while investment flexibility was lowered. A notable exception is Langer and Weber's (2008) study, which finds a significant MLA effect. However, the authors used a design in which returns are cumulated over investment periods and participants only receive an initial endowment instead of receiving new capital for investment in each period.

[8] Our qualitative results generally also hold true when controlling for gender. Generally, we find a significant gender difference in risk taking in our experiments, consistent with the findings of Charness and Gneezy (2012). Regressing average investments (in Part 1) on gender, treatment, and experiment—all as dummy variables—we observe male participants investing 9.4 pp more than female counterparts (p=0.007).

Regarding our main research question, Figure 4 illustrates a similar (albeit much less pronounced) pattern of stickiness as in Experiment 1, with investment amounts being slightly higher in treatment H compared to treatment M. We do not want to overplay these findings as the Part 2 difference is not significant (and could not be expected to be, given the weak Part 1 findings). Nevertheless, it is interesting that there does seem to be more support for the stickiness hypothesis. Regardless of the direction of the treatment change, we observe a considerable increase in investments after the treatment change. The upward jump is 6.1 pp in scenario HM (p=0.092) and 6.9 pp in scenario MH (p=0.193).

Figure 4: Development of Mean Investment Amounts Over Rounds (Exp. 2)

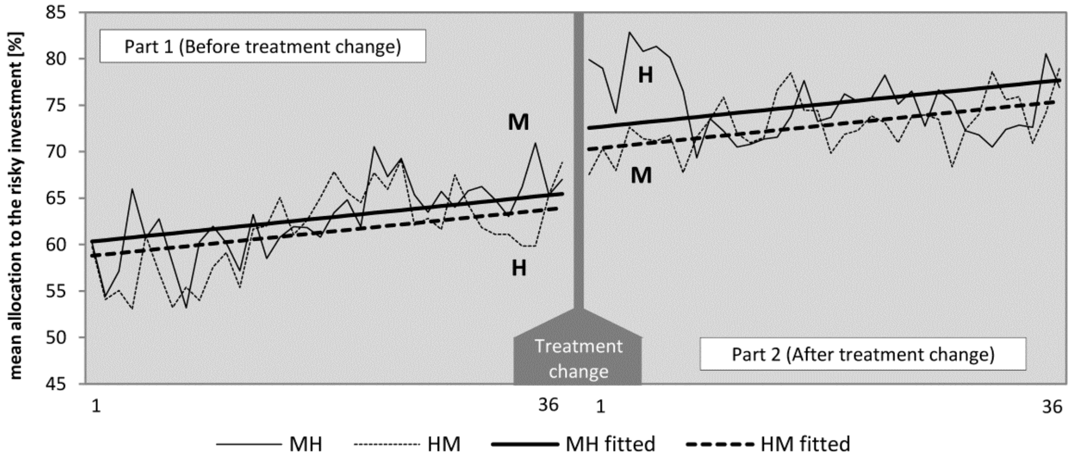

Figure 4 shows the actual development of mean amounts invested in the risky investment alternative over two parts with 36 periods each in Experiment 2. The fitted linear curves are calculated by minimizing squared deviations of the fitted and actual values. The fitting assumes a general temporal trend (increasing familiarity) plus an independent elevation for each linear piece.

Individual-level analysis

Again, a within-subject analysis allows further insights (see Figure 5). Similar to Experiment 1, a considerable proportion of subjects (29%) invest nearly the full endowment (>95%) in the risky investment in Part 2 but not in Part 1. In scenario HM, 62% of subjects increased their investments from Part 1 to Part 2, whereas only 23% decreased their investments. The numbers for scenario MH are of comparable size: 71%

and 23%, respectively. Both differences are highly significant (Mann-Whitney *U* test $p<0.01$). Thus, our analysis provides some support for the premise that subjects generally become less myopic after a long break, such as that between Parts 1 and 2,

Figure 5: Single subject investment change (Exp. 2)

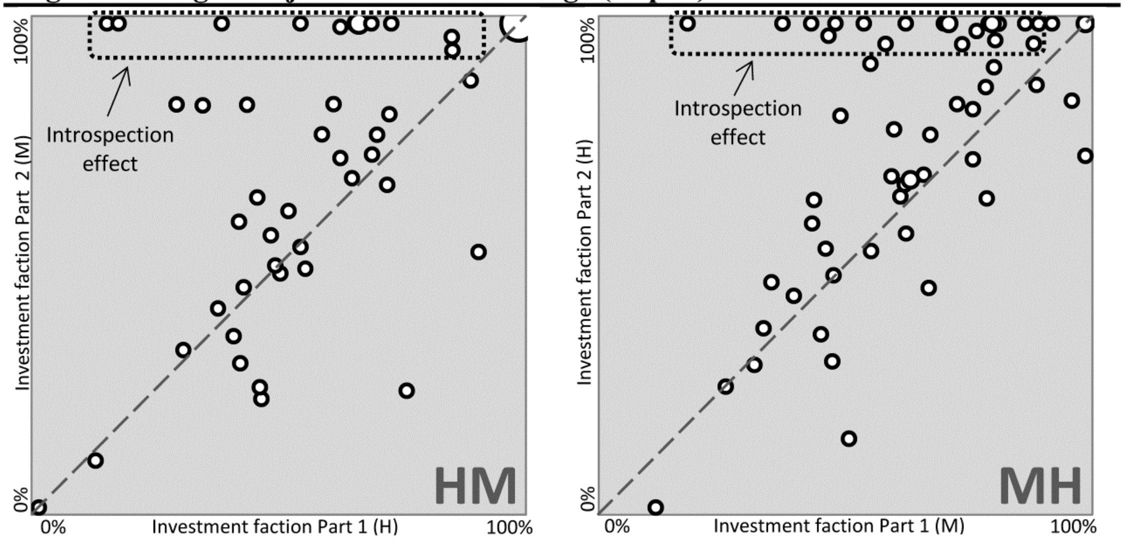

Figure 5 shows changes in investments from Part 1 to Part 2 for the two scenarios HM and MH in Experiment 2. Each bubble represents one subject (or more subjects grouped together, the bubble size represents the number of grouped subjects). The position of the dot is determined by the subject's investment in Part 1 (*x*-axis) and Part 2 (*y*-axis). The distance of the bubbles from the diagonal line thus indicates the individual change in investments from Part 1 to Part 2.

and evaluate periods in a more aggregated manner.

To gain greater understanding of our participants' decision behavior, we asked them to fill out a questionnaire after Part 2 in Experiment 2 (the idea to implement such a questionnaire came only after conducting Experiment 1). For the most part, the subjects were asked to indicate the extent of their agreement with statements on a seven-point Likert scale (1 = not at all, 7 = very strong). An interesting result is that, overall, 70% of subjects answered that they were well able to remember their average investment in Part 1 two weeks previously, but only 39% stated that they orientated their investments in

Part 2 based on their behavior in Part 1.[9] These answers provide some evidence that subjects actually thought they should behave differently from a normative perspective.

Generally speaking, our results from Experiments 1 and 2 are slightly more in favor of the stickiness hypothesis than the MLA adaptation hypothesis. In both studies, the treatment change does not change the qualitative difference we observe in Part 1. We thus observe higher average investments for a shorter evaluation period—contrary to what is typically observed in between-subject studies and conjectures derived from the MLA adaptation hypothesis. At least, we do not observe a significant change between treatments induced by the policy change. However, our experimental design with the time lag between both treatments resulted in generally increased risk taking after the treatment change driven by an introspection effect. To deal with this side effect of our experimental design, we ran an additional experiment without a time lag. As we have not found any significant results for the comparison between treatments H and M, we concentrate on the LH/HL scenarios in this additional study.

5. Experiment 3: Joint Change in Information Feedback and Investment Flexibility without Time Lag

In Experiment 3, we repeated Experiment 1 with two changes. First, we eliminated the time lag so that subjects were not given any additional time for introspection and reflection on the decision situation between Parts 1 and 2. Second, we reduced the number of periods from 36 to 15 since the high number of investment periods could induce boredom if the two parts follow directly after each other. Also, the high number

[9] We interpreted answers of 6 or 7 on the Likert scale as “can readily remember investment in Part 1”, and as “orientated investment based on behavior in Part 1.”

of periods might have lowered the perceived risk of the overall investment task, possibly increasing the introspection effect.

As expected and in line with the findings of Experiment 1, we observe a significant between-subject MLA base effect in Part 1. Average investments amount to 42.3% [median: 41.0%] (*SD*=19.0%) in H and 54.5% [median: 50.0%] (*SD*=25.0%) in L. Investments are thus 12.2 pp higher in treatment L compared to H (*p*=0.012). Average investments are significantly lower than in Experiment 1. We identify two reasons: 1. Due to the lower number of periods, the increase in investments is smaller. 2. Investments also begin at a lower level. This implies that the reduced overall investment period also decreases the perceived attractiveness of the risky asset. Generally, subjects seem to account for the overall length of the investment task—an observation that has not been documented in the MLA literature so far. Concerning our main research question, Figure 6 shows a pattern that is clearly in favor of our stickiness hypothesis. The difference between the average investments of the two groups remains virtually unchanged, amounting to 12.0 pp in Part 2 with $\bar{r}_{LH}^2 > \bar{r}_{HL}^2$, and is thus very close to the 12.2 pp in Part 1 (the Part 2 difference slightly misses significance though, *p*=0.124). Interestingly, taking into account the general trend of increasing investments, we observe some conservatism after the treatment change in both scenarios. Investments decrease by 7.9 pp in LH (two-sided Mann-Whitney *U* test *p*=0.007) and by 7.7 pp in HL (*p*=0.097) from Part 1 to Part 2. These significant decreases are in contrast to the upward jumps we observed after the treatment change in Experiments 1 and 2. The treatment change effects thus seem to be manifold. The base treatment effect in which we are interested (MLA adaptation or stickiness) is overlaid by some early conservatism and caution in the face of a sudden design change (in the no time lag setup). However, if there is some time for reflection (in the time lag setup), a positive introspection effect superimposes and veils the other mechanisms.

Figure 6: Development of Mean Investment Amounts over Rounds (Exp. 3)

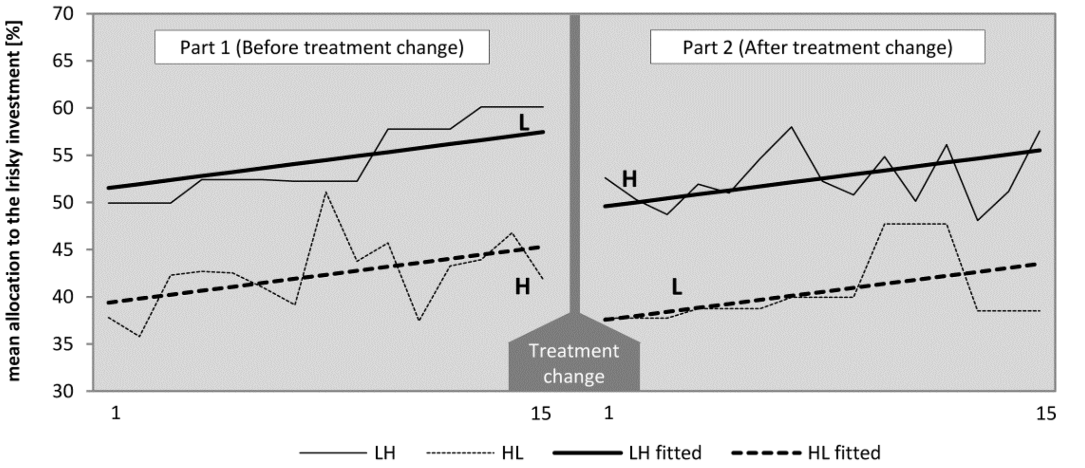

Figure 6 shows the actual development of mean amounts invested in the risky investment alternative over two parts with 15 periods each in Experiment 3. The fitted linear curves are calculated by minimizing squared deviations of the fitted and actual values. The fitting assumes a general temporal trend (increasing familiarity) plus an independent elevation for each linear piece.

Fortunately, our Part 2 predictions are neither influenced by conservatism nor by introspection effects. There is no reason why these two effects should work asymmetrically for the LH and HL scenarios. Thus, the Part 2 prediction is most suitable for discriminating between the MLA adaptation and the stickiness hypothesis. The finding that the average investment amounts in Part 2 are higher in the LH scenarios in all three experiments (albeit not significant in all cases) provides overall support for the stickiness hypothesis and little support for the MLA adaptation hypothesis. Our results also suggest that details of the treatment change can be highly influential in relation to investment behavior.

Individual-level analysis

To verify our conjecture that introspection effects are indeed driven by the time lag and not simply by the treatment change, we present within-subject results for Experiment 3 in Figure 7. Over both treatments, only 6% of all subjects switch to a full-risk strategy ($\bar{r}$ >95%) after the treatment change (for Experiments 1 and 2, this value is 24.5% on average).

Figure 7: Single subject investment change (Exp. 3)

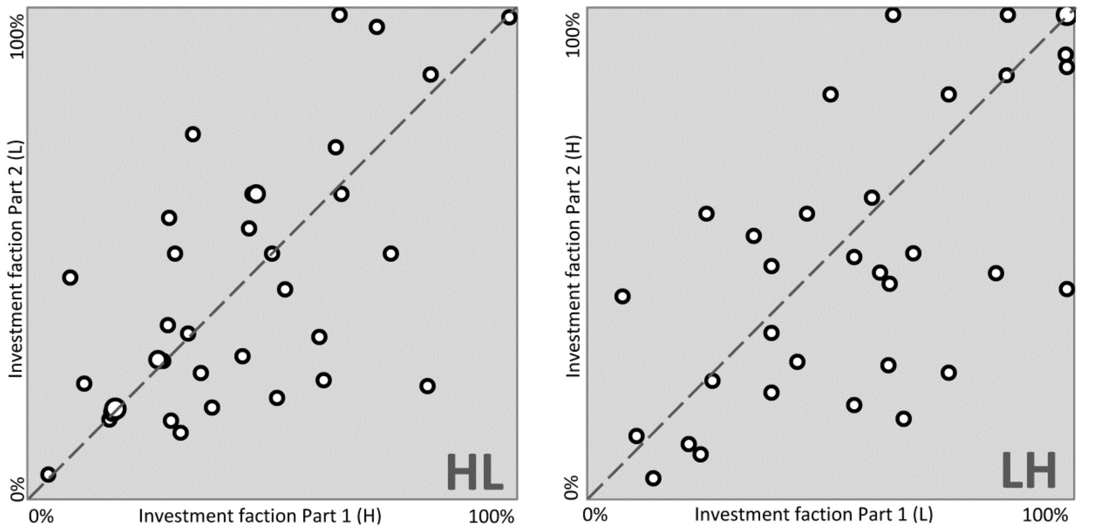

Figure 7 shows changes in investments from Part 1 to Part 2 for the two scenarios HL and LH in Experiment 3. Each bubble represents one subject (or more subjects grouped together, the bubble size represents the number of grouped subjects). The position of the dot is determined by the subject's investment in Part 1 (*x*-axis) and Part 2 (*y*-axis). The distance of the bubbles from the diagonal line thus indicates the individual change in investments from Part 1 to Part 2.

6. Conclusion

Several experimental studies have corroborated that in the case of repeated investing, myopia can considerably reduce an investor's willingness to invest in risky alternatives—an effect based on the behavioral concept of "myopic loss aversion" (MLA), as proposed by Benartzi and Thaler (1995). This can have far-reaching consequences. For example, private investors might hold extremely conservative pension plans, a fact that considerably reduces their return potential. From the literature on MLA, it seems largely undisputed that investors will adapt their investment behavior if information feedback frequency and/or investment flexibility are *changed* in order to influence investors' degree of myopia. It is argued that investors will increase their willingness to hold risky assets, such as stocks or mutual funds, when provided with less frequent feedback concerning the development of their portfolios. Importantly, however, these assumptions can scarcely be verified in the field. Furthermore, no corresponding experimental investigation exists.

With this paper, we aim to fill this gap and present the first series of experimental studies that explicitly examine how changes in the investment environment concerning myopia affect investment behavior within-subject. Our results indicate that the effects are more complex than previous literature suggests. Contrasting an "MLA adaptation hypothesis" and a "stickiness hypothesis," we find more support for the latter. In none of our three experiments participants invested more in the non-myopic treatment after the investment environment was changed. This states that myopia-driven investment behavior is sticky, and treatment changes seem to have little or no effect on risk taking. This even holds for the case in which a time lag separates the two different myopia treatments. We find that the originally induced myopia and resulting investment behavior is most relevant in continued decision making. A subsequent change in the investment environment in an attempt to manipulate myopia and thereby investment behavior seems to be much less fruitful than commonly assumed in the literature. None of the existing papers on MLA explicitly points to the possibility of sticky investments.

Of course, we do not want to overstate our findings. The possible shortcomings of previous experimental investigations also apply to our study, in particular the fact that we have a stylized investment environment. However, our results should provide some important insights into the possible mechanisms governing changes in investment behavior. Our results demonstrate that these mechanisms are not as straightforward as the previous literature suggests and that they might be superimposed by cautious reactions to obvious treatment changes or the general effects of introspection and reflection. Changing the frequency with which financial institutions send out portfolio performance reports to their client investors to alter their degree of myopia, as suggested by some studies, or even changing the flexibility with which investors can change their portfolios and asset allocations, might have different effects on investors' willingness to hold risky assets than intended and such policy changes might be much less effective than intended. Financial institutions should be cautious in estimating possible effects of changes in information provision for their clients.

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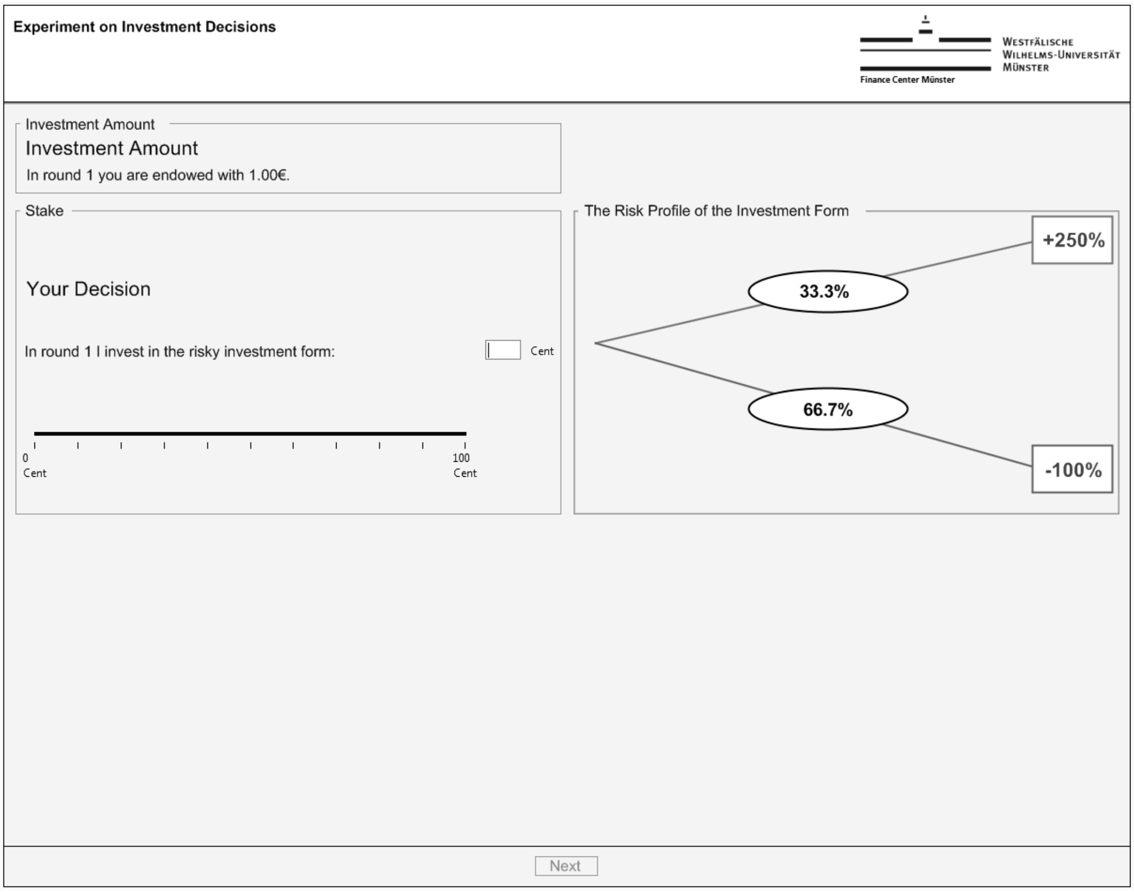
Appendix A: Screenshot of Experimental Software



This figure shows an example screen as it appeared in the main part of Experiment 3 (translated from German). In Experiments 1 and 2, the endowment per round was €0.40; in Experiment 3, it was €1.00.

Appendix B: Experiment Instructions (translated from German)

Dear Participant,

We would be very happy and you would help us considerably if you would give a little more time (only approximately 5 to 10 minutes, including the time to read these instructions) to participate in another experiment right here and now. For your participation, you will be financially rewarded. We will again select exactly one-tenth of all participants at random, this selection being independent of the selection for the other experiment. If you are selected, the expected value of the reward amounts to approximately €33. The drawing of the “winners” of this experiment will take place during the lecture “Behavioral Finance” on 14 July 2008 at around 5.30 pm.

The experiment consists of two parts with 15 rounds each. In these rounds, you will have to make investment decisions that will be explained to you below. If you are selected for financial reward, one of the two parts will be chosen randomly and you will receive a payment in Euros of the whole amount attained in that part. All 15 rounds in this part will be considered for your payment. Thus, you should think thoroughly about all of your decisions.

If you have any questions during this experiment, please raise your hand and the supervisor of the experiment will attend to you immediately.

Click “continue” to read the instructions for the first part of the experiment.

You will play a total of 15 rounds. In each round you will receive a monetary endowment of €2.00. You have to decide how much of this amount you want to invest in the risky investment. The risk profile of the investment form is identical in all rounds and is as follows:

There is a probability of 33.3% that you will win 2.5 times your investment amount and a probability of 66.7% that you will lose the total amount invested.

Let’s have a look at three examples:

- Example 1: You do not invest anything in the risky investment. In this case, you will keep the €2.00 and thus you neither make a gain nor a loss regardless of the outcome of the risky investment.
- Example 2: You invest all of the €2.00 in the risky investment. If it develops positively, you receive 2.5 times this amount as profit, i.e., €5.00, and your €2.00 turns into €7.00. If the risky investment develops negatively, you will lose the €2.00 and receive nothing in this round.
- Example 3: You invest half of your monetary endowment, i.e., €1.00. If the investment develops positively, you receive 2.5 times the amount as profit, i.e., €2.50, and your €2.00 turns into €4.50. If the risky investment develops negatively, you will lose the €1.00 and in this round you will be left with the €1.00 that you did not invest.

The acquired capital will be booked 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 €2.00.

Treatment H:

Before each round you have to decide anew what amount you want to invest in the risky investment. After each round, you will receive feedback about the investment outcome and about the size of your gain or loss.

Treatment L:

Your decision about the amount you invest in the risky investment 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. Also, you will not receive information concerning your investment outcomes until the three rounds have ended.

This means that although there will be 15 rounds, you will only make five decisions each for three rounds.

General Instructions (continued):

You can make entries either using the input box via the keyboard, or use the mouse and adjust the amount via the scroll bar. Please note that you can only enter whole amounts in cents (no decimal point).

If you understood the instructions, you can now start the experiment. Click "continue" to start the first part of the experiment.

Experiment Part 2:

The first 15 rounds are now over.

You will now receive the instructions for the second part of the experiment. Please read these instructions carefully too!

There will again be 15 rounds in which you will have to make investment decisions.

The risk profile of the risky investment form stays the same: There is a probability of 33.3% you will win 2.5 times your investment and a probability of 66.7% that you will lose the total amount invested.

Treatment change from H to L:

In the following 15 rounds, your decision on what amount you invest in the risky investment is binding for three rounds and cannot be changed within these three rounds. The investment amounts you choose will thus be binding for three rounds. You will also not receive any information concerning the investment outcome until the three rounds have ended.

Treatment change from L to H:

In the following 15 rounds, you will have the opportunity to choose your investment amount in each round. Your decisions thus affect just the next round. Furthermore, you will receive information concerning the investment outcome after each round.

General Instructions (continued):

Please note that you can only enter whole amounts in cents (no decimal point).

Click "continue" to start the second part of the experiment.