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How Past Performance Framing Impacts Investors' Belief Updating[1]

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Abstract: Individual investors' beliefs (return expectations and risk perceptions) drive investment decisions, with larger updates of beliefs leading to more active trading, hurting performance. We examine how framing of past performance information affects investors' belief formation. In particular, we analyze whether presenting longer information horizons as a default option leads to smaller updates in beliefs. In a six-round experiment, we present 377 subjects with past performance information and subsequently measure updates of their beliefs. We employ three different frames, varying the default information horizon subjects are exposed to (annual, monthly, daily). Different from previous work, we allow subjects to easily and without costs opt out of the default and obtain past performance information on each of the three information horizons. In such a setting which more closely resembles investors' actual decision-making environment, we find that in contrast to previous work, presenting returns over a longer information horizon is not necessarily beneficial. Only for subjects staying in their default information horizon, presenting portfolio performance over a longer information horizon has a mitigating effect on the magnitude of their belief updates. For subjects opting out of the default, we find the opposite effect. Especially more financially literate subjects switch out of the default.

JEL Classification: D14, D81, D83, D84, G02, G21, M31

Keywords: Default Options, Framing, Household Finance, Investor Beliefs, Belief Updating.

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1. Introduction

Updates in individual investors' beliefs, such as return expectations and risk perceptions, drive investment decisions (Hoffmann, Post, and Pennings 2013). Prior work shows that individual investors rely on naïve reinforcement learning when updating beliefs (Dominitz and Manski 2011; Hoffmann and Post 2012; Greenwood and Shleifer 2014). Accordingly, investors update beliefs by extrapolating past return experiences. Importantly, larger updates of beliefs lead to more active trading, hurting investment performance (Hoffmann and Post 2015). We examine how framing of past performance information affects belief formation. In particular, we analyze whether presenting longer information horizons as a default option leads to smaller updates in beliefs. Doing so is important, as finding such an effect would suggest an easy-to-implement behavioral nudge that can positively affect investor welfare by reducing their trading activity.

To answer our research question, we perform an experiment in which we place subjects in a situation closely resembling an online brokerage environment. We present subjects with a stock portfolio that they should imagine to own, and assess their belief updates over six evaluation rounds, while showing the performance of this portfolio. Subjects are randomly assigned to three experimental conditions, which differ with regard to the default information horizon (annual, monthly, daily) at which portfolio performance is shown. The treatment group determines the default information presented in each evaluation round and does not change over the course of the experiment. Subjects can, however, easily and without costs opt out of the default and obtain past performance information on each of the three information horizons in each round.

We find that across treatments, varying the default does, on average, not impact the magnitude of belief updating. However, an important result emerges when dividing the sample into subjects staying in the default vs. those opting out of the default. Over all rounds and treatments, about half of the subjects opt out of their default information horizon. Specifically, for subjects staying in the default condition, showing returns over a longer information horizon reduces the magnitude of their belief updating. We find the opposite result for subjects opting out of the default. For subjects originally assigned to the longer information horizon default, opting out confronts them with returns over a *shorter* horizon, leading to *larger* updates in their beliefs. For subjects originally assigned to the shorter information horizon default, however, opting out confronts them with returns over a *longer* horizon, leading to *smaller* updates in their beliefs.

Our paper builds on previous work that examines how different evaluation horizons influence individual investors' decision-making, such as Benartzi and Thaler (1995), Beshears et al. (2014), and Gneezy and Potters (1997). These studies typically recommend longer evaluation periods to improve individual investor decision-making. However, the results of these previous studies are based on experiments which restrict access to information and make it cumbersome or even impossible for subjects to opt out of the default. In a setting that more closely resembles individual investors' actual decision-making environment, in which subjects have immediate access to alternative information horizons and can easily opt of the default, we find that presenting returns over a longer information horizon is not necessarily beneficial. That is, only for subjects staying in their default information horizon, presenting portfolio performance over a longer information horizon has a mitigating effect on the magnitude of their belief updates.

Our results imply that showing a longer information horizon as a default option does not help or harm investors on average. In order to implement an effective nudge, however, it is important to gather evidence which fraction of the investor population will stick to the default and find out their particular characteristics. In our sample, especially subjects with high financial literacy opt out of the default. This finding implies that long default information horizons will be primarily effective for populations of investors that score relatively low on financial literacy.

2. Literature and Research Questions

Investors have a tendency to trade frequently, which can be attributed to updating of beliefs (Hoffmann et al. 2013). Beliefs themselves are updated by extrapolating past returns (Dominitz and Manski 2011; Hoffmann and Post 2012; Greenwood and Shleifer 2014). How can investors be nudged to update less strongly, while considering that in reality it is unrealistic to restrict investors' access to information? Previous work studies how defaults and framing regarding evaluation horizons influences investor behavior. In general, longer evaluation horizons are found to be beneficial, as they reduce investors' trading frequency. Typically, however, prior studies have restricted subjects' access to information. Thus, it is unclear whether these results generalize to settings where subjects can easily opt out of the default. Our approach extends previous works to a setting which is more ecologically valid, by not restricting subjects' access to information.

A default option is an option which is automatically chosen for the decision-maker, so that (s)he has to become active if (s)he prefers another option and move out of the default. Framing and default options lead to different perceptions and alter the likelihood of certain options chosen. Individuals tend to anchor on information which is easier to retrieve, better available, more salient, or more representative of a given type of situation (Tversky and Kahneman 1981).

In a brokerage account, investors have the ability to view their portfolio performance for different time periods, such as the last day, month, or year. Brokers generally decide which time horizon to present as the default. Usually, different performance horizons are available with a few mouse clicks, so information search costs are negligible. Nonetheless, due to anchoring, investors are typically influenced by the default, which is the first information available to them (Tversky and Kahneman 1974, Stracca 2004, Epley and Gilovich 2006, Oechssler et al. 2009).

Gneezy and Potters (1997) experimentally test myopic loss aversion and show that subjects are more willing to engage in risky lotteries for longer evaluation horizons. A longer horizon puts subjects in a broader frame, which leads to increased risk-taking. These authors restrict the decision-making freedom of their subjects in a way that does not allow them to switch between evaluation horizons. In Gneezy and Potters' experiment, half of the subjects are able to make a decision each round, whereas the other half always has to decide for three subsequent periods before being able to make a new decision. Beshears et al. (2014) address myopic loss aversion using a large-scale field experiment in which subjects invest in existing mutual funds. They modify the degree of information given to participants and observe the resulting equity allocation in a self-managed portfolio over the course of one year. Their results show that, in contrast to not providing any past return information, presenting information about historical returns significantly increases the share of wealth allocated to equities. Showing one-year past return graphs versus five-year return graphs does not make a difference in terms of wealth allocation.

Benartzi and Thaler (1995) show that investors who evaluate their investment portfolios more frequently are less willing to invest in risky securities. Although objectively, risk in terms of return variance is independent of the evaluation horizon, perceived risk differs among portfolio evaluation frequencies. This is due to the smoothing effect of longer time periods for risky securities. For shorter periods, securities such as stocks appear more risky, as there is a higher chance of reviewing the portfolio at a paper loss. With longer horizons, temporary losses are more likely to have already recovered and the stock portfolio appears more favorable to investors. Benartzi and Thaler document that investors hold less conservative portfolios in case of longer evaluation horizons. Based on Benartzi and Thaler's findings, Looney and Hardin (2009) analyze default options for 401k retirement accounts in the US and find that decision support systems can help to overcome myopic loss aversion. They employ simulations of retirement investments and investigate information horizons and system restrictiveness. Their results show that longer information horizons reduce conservatism in retirement portfolios. Overall, system restrictiveness can counteract a risk aversion-induced short-term focus of investors. Just as the above-mentioned studies, Looney and Hardin impose restrictions on subjects' decision-making freedom.

Based on the prior discussion, we expect that presenting longer portfolio evaluation horizons has a mitigating effect on individual investors' belief updating. That is, being exposed to a longer default information horizon reduces belief updating as compared to viewing a shorter information horizon. As returns appear less volatile in the longer-term, we expect subjects to update their return expectations and risk perceptions less between the evaluation rounds when presented with their portfolio performance over a longer information horizon as compared to a shorter information horizon. Hence, we are interested in answering the following research questions: Does presenting a longer information horizon as a default exert a mitigating effect on individual investors' belief updating if opting out is easy? Furthermore, we are interested to which extent investors stick to the default information presented to them or opt out, and how opting out impacts belief updating. Is opting out of the default, for example, more pronounced if the forecast period (the period to formulate beliefs on) does not match the information horizon for past returns? Intuitively, subjects might feel that a one-month period to formulate beliefs matches best with one-month information about portfolio returns. If this would indeed be the case, we expect less pronounced opting-out of the default information horizon for the monthly treatment group.

3. Experimental Design

Our experimental setup resembles an online brokerage environment. We confront subjects with a stock portfolio's performance and analyze the updating of their beliefs (return expectations and risk perceptions) over six evaluation rounds. Before the first round, we randomly allocate subjects to one of three treatments. Over all rounds, subjects stay in the same treatment. The treatments differ in their default information horizon regarding past portfolio performance, which is daily, monthly, or yearly. Hence, each subject will see as a default either the last day's return, the last month's return, or the last year's return of their portfolio, together with the Euro-values of their holdings. This scenario is ecologically valid, as online brokerage interfaces as well as the annual or quarterly brokerage statements that banks send to investors usually summarize portfolio performance for individual securities on an aggregate level and across different time frames.

We recruit subjects from a pool of business students who complete the experiment in exchange for partial course credit. The experiment ran on four days with nine sessions per day with a maximum occupancy of 20 subjects per session. Before signing up, we informed subjects that the experiment would be about decision-making behavior. At the beginning of the experiment, subjects were seated in a cubicle equipped with a computer and were instructed not to interact with each other and remain silent. In case there was a problem, or any instructions were unclear, subjects should remain seated, raise their hand, and wait for the assistance of a proctor. Completion of the experiment took 7 minutes on average. In total, 339 subjects completed the experiment. Hundred-and-fourteen subjects (33.63%) got assigned to the daily condition, 113 subjects to the monthly condition (33.33%), and 112 subjects (33.04%) to the yearly condition.

We are interested in subjects' belief updates, and it is hard, if not impossible, to judge the correctness of individual beliefs. A performance-based incentive scheme could provide subjects with an incentive to deviate from expressing their own beliefs and instead start answering questions in a strategic way to maximize their expected payoff from the experiment. Therefore, we chose not to implement a performance-based incentivization with a monetary reward, but instead offer subjects course credit in exchange for their participation in the experiment.

At the beginning of the experiment, subjects read an introductory text explaining that in the upcoming tasks they would be presented with a stock portfolio that they should imagine to be theirs. They were informed that they will be asked a series of questions concerning their beliefs and then shown their stock portfolio again. We briefed subjects to imagine that for each evaluation round, one month has passed since they evaluated their stock portfolio for the last time.

To prevent subjects' beliefs being influenced by unobservable affective evaluation beyond mere financial returns (cf. Aspara and Tikkanen 2010), the portfolio presentations do not contain any information about which stocks comprise the portfolio. To rule out any possible identification effects in return patterns presented to subjects, we generate portfolio performance by a random draw from a return distribution with a daily mean return of 0.03% and a daily standard deviation of 1.26%. These values resemble the realized return and standard deviation of the S&P 500 over the 10-year period preceding the experiment. On a one-month rolling window over this time period, the S&P 500 return switched signs on 59.63% (45.87%, 3.67%) of cases on a daily (monthly, yearly) return basis. We restrict the draw so that it has similar characteristics and return patterns as the S&P 500. Hence, sign switches in returns are observable most frequently on a daily basis, less so on a monthly basis, and least frequently on a yearly basis.

[Insert Figure 1 here]

We present portfolio performance information to subjects in a table (Figure 1), which indicates the total portfolio value in Euro, the last percentage change, as well as the last Euro change. Initially, the information horizon of the "last" percentage and Euro change in portfolio value refers to the respective experimental treatment group a subject got allocated to. Thus, each subject either gets to see performance of the last day, last month, or last year. Beneath the table summarizing the portfolio, each participant has three radio buttons enabling an easy switch between the three different information horizons. Upon clicking on one of the buttons, the table provides information about the corresponding information horizon. Thus, all subjects have the same information at hand, as information acquisition costs are negligible. The only difference between treatment groups is that the default information horizon is different. We track whether subjects opt out of the default and which information horizon they view last.

Below the table summarizing portfolio performance, we confront each subject with two statements adapted from previous research on investor beliefs by Hoffmann et al. (2013). These statements gauge subjects' beliefs in terms of return expectations and risk perception, and have been shown to be reliable measures of those beliefs. The first statement measures subjects' return expectations and asks how much a subject agrees with the statement: "I expect my investment portfolio to have good returns next month". We measure risk perceptions by the second statement: "I consider investing to be risky next month". Answers are recorded on a seven-point Likert scale, anchored at 1="totally disagree" and 7="totally agree".

We measure risk aversion with a single-question general statement, taken from Dohmen et al. (2011). To measure financial literacy and the degree of subjects' financial sophistication, we use eight questions. A correct answer to each question counts as one point on a financial literacy scale. Hence, in total, each subject achieves a score between 0 and 8. We use the three basic financial literacy questions from Lusardi and Mitchell (2007a; 2007b). We add five advanced financial literacy questions from the list of van Rooij, Lusardi, and Alessi (2011), as subjects in our experiment are business students, and thus expected to uniformly score high on basic financial literacy. In their study, van Rooij et al. employ a set of 16 financial literacy questions specifically tailored towards stock-market investments, which they split up in basic and advanced financial literacy. For brevity, we do not include all the questions in our experiment, but instead use a subset of five advanced literacy questions. We base our decision on which questions to include on the expert judgment of a panel of 13 senior researchers, with varying backgrounds, including decision-making, economics, econometrics, finance, and marketing.

Finally, we ask subjects to indicate their age, gender, and nationality. Due to the homogeneity of the subject pool regarding available income, wealth, and education, we do not elicit such information. Table 1 presents an overview of questions asked and the answer options.

[Insert Table 1 here]

4. Results

4.1 Descriptive Statistics and Data Quality

Table 1 presents summary statistics, as well as an overview of the variables used in later analyses and their definitions. Around 42% of subjects are female. Mean age is 22.1 years. Compared to other studies on financial literacy, which mostly document widespread financial illiteracy (cf. Lusardi and Mitchell 2011), financial literacy is rather high amongst our subjects. In particular, the mean (median) financial literacy score is 6.15 (7) out of a maximum of 8 points. Fifty-two percent of subjects click to view a different return horizon than the default. The three treatment groups do not differ significantly regarding age, gender, risk aversion, or financial literacy, indicating that the random allocation of subjects to the experimental conditions was successful.

In general, individual investors tend to update their beliefs according to naïve reinforcement learning (Dominitz and Manski 2011; Hoffmann and Post 2012; Greenwood and Shleifer 2014). To confirm the ecological validity of our experiment, we verify whether the experimental subjects behave similarly. To do so, we run several regressions. Table 2 summarizes random-effects panel regressions using belief updates as dependent variables. Belief updates are defined as the difference between the belief expressed in one round and the previous round. In Panel A, the dependent variable is updates of return expectations, whereas updates in risk perceptions are the dependent variable in Panel B. Model (1) employs returns as covariate and model (2) adds the variable "click", which is a dummy variable that indicates whether a subject opted out of the default information horizon. According to Panel A, returns have a strong and significant positive effect on updates of return expectations. Hence, a higher past return leads to increased expectations about future returns. Thus, as their counterparts outside the lab, our subjects rely on naïve reinforcement learning, updating their beliefs by extrapolating past returns.

[Insert Table 2 here]

Panel B shows that returns are significantly negatively related to updates in risk perceptions. Thus, higher past returns correspond with lower subsequent risk perceptions. A stock portfolio is regarded as less risky if returns have been higher in the preceding round. This finding is consistent with the stylized fact that individuals implicitly perceive a negative risk-return relationship (Fischhoff et al. 1978, Ganzach 2000, and Shefrin 2001), which contrasts standard economic theory, but is consistent with reliance on affect and representativeness.

Figure 2 plots subjects' beliefs over the different evaluation rounds of the experiment, divided in return expectations in the left panel and risk perceptions in the right panel. Each panel contains a separate graph for each default information horizon and also plots the returns which are associated with each treatment group. The positive association between past returns and subsequent updates of return expectations can be seen in the left panel, whereas the negative relationship between past returns and risk perceptions is visible in the right panel. Overall, the experimental subjects behave in line with previously reported findings on belief updating (cf. Hoffmann et al. 2013). That is, our experimental subjects behave similarly to actual investors.

[Insert Figure 2 here]

Model (2) in Table 2 reveals that, over the whole sample and across all treatments, opting out of the default information horizon has no effect on belief updating, as the coefficients for “click” are insignificant for both return expectations and risk perceptions. Based on Figure 2, it is not clear if there are differences between treatment groups in terms of their beliefs. We analyze such differences in the next section.

4.2 Belief Updating Across Treatments

Panel A of Figure 3 highlights differences in belief updating for the whole sample across treatments. From here onwards, we use the absolute changes in beliefs as dependent variable of interest, as both positive and negative belief updates provide reason to trade (cf. Hoffmann and Post 2015). That is, belief updates are defined as the absolute value of the difference between the belief expressed in one evaluation round compared to the previous round. The left graph refers to updates in subjects’ return expectations, the right one depicts updates in their risk perceptions.

[Insert Figure 3 here]

As Figure 3 illustrates, differences between treatment groups for both changes in return expectations and risk perceptions are very small, when we examine changes across all experimental subjects (i.e., including both those that opt out of the default information horizon and those that do not opt out). The monthly treatment group appears to express slightly lower belief updates than the daily and yearly groups. However, this difference is insignificant. Table 3 shows statistics on belief updating across treatments. Panels A1 and B1 summarize belief updating in terms of mean absolute changes in return expectations (Panel A1) and risk perceptions (Panel B1), respectively. The first column gives an overview of the treatment groups and the second column provides mean values for the whole sample of subjects. Column (2) of Table 3 confirms that differences between treatment groups are very small, which shows that belief updating is not different when comparing the treatment groups across all experimental subjects. This finding is surprising, as we expected that showing different information horizons would influence subjects' belief updating. Panels A2 and B2 focus alternatively on the within-subject standard deviation as an alternative measure of belief updating. The results using this measure are in line with mean absolute changes, which indicates that our results are robust to alternative specifications.

Finding no significant differences between treatment groups initially appears puzzling. Potentially, it can be explained by the fact that we analyze aggregate values only. Besides the treatment itself, belief updating might be influenced by whether subjects remain in the default option or decide to take action and switch into another information horizon. Therefore, we next analyze differences in subjects' opting-out of the default and its impact on belief updating.

[Insert Table 3 here]

4.3 Opting Out of the Default Information Horizon and Belief Updating

The bottom part of Figure 3 plots subjects' belief updates by their decision to opt out of the default information horizon or not. For both return expectations and risk perceptions, the same pattern emerges. First, belief updating for subjects who opted out of the default information horizon is positively associated with the length of the information horizon. For the yearly group, belief updates are larger than for the monthly group, which are again larger than for the daily group. That is, opting out of the default treatment increases updates of return expectations for the yearly group as compared to the monthly and daily group. Second, when turning towards subjects who do not opt out of the default information horizon, the pattern reverts. For those staying in the default, there is a negative relation between belief updating and length of information horizon. That is, subjects in the yearly treatment update their beliefs less than those in the shorter information horizon treatments. The above-mentioned differences are all statistically significant, as summarized in Table 3, columns (3) to (7). Column (3) contains values for subjects who opted out of the default ("click"), Column (4) presents the corresponding values for those who did not opt out ("no click"). Columns (5) to (7) show the difference in means between columns (3) and (4) as well as the *t*-statistic and *p*-value.

The expected mitigating effect of a longer information horizon on the magnitude of belief updating can be seen strongly for subjects who remain in their default information horizon. Subjects who do not opt out of their default, update their return expectations by 0.43 points less on the 1-7 return expectations scale when shown yearly versus daily returns for their stock portfolio. This decrease corresponds to slightly less than a one-third lower update of return expectations. The effect reverts for subjects who do not stay in their default information horizon. For these subjects, being originally assigned to a default information horizon presenting yearly returns and subsequently viewing different return horizons increases return expectations by 0.28 points or one-fifth, as compared to those subjects who opted out of the shortest (daily) horizon. Whereas opting out of the default reduces belief updating for subjects assigned to the daily treatment by 0.18 points ($t=2.63$, $p<0.01$), belief updating is increased by 0.53 points for those subjects who opted out of the yearly information horizon default condition ($t=9.22$, $p<0.001$).

That is, presenting subjects with longer return horizons does not have an effect on subjects' belief updating when we do not distinguish between subjects who remain in the default versus those who opt out of the default horizon to view additional return horizons (see Figure 3). However, when we do divide the sample into these two groups, we find remarkable differences in belief updating. The mitigating effect due to a longer evaluation period is only observable for the subsample of subjects who decide to remain in the (long) default information horizon. If subjects opt out of their default information horizon, however, belief updating exhibits the opposite effect: subjects have larger belief updates, both for return expectations and risk perceptions. Looking at the subsample of subjects who were randomly allocated to be in the daily default group, their pattern reverses compared to the yearly group. That is, those viewing the shortest information horizon update less when they decide to switch to a different (i.e., longer) information horizon.

A potential concern regarding the above mentioned effects might be that those subjects who do not opt out of the default are simply "clicking through" the different rounds of the experiment without paying attention to the questions posed, often giving the same or almost the same response. Such behavior would then lead to incorrectly characterizing subjects who did not take the experimental task seriously as having little or no belief updates. Column (3) in Table 4 shows that time needed to complete the experiment is significantly and positively associated with subjects' tendency to opt out of the default. The data on belief updates gathered in the experiment, however, are not consistent with such a concern. When comparing subjects assigned to the different treatments groups, those who opt out of their treatment exhibit similar or even slightly higher (for the daily treatment group) variation in levels of beliefs (see Figure 2). Furthermore, as visible from Figure 3, subjects in the daily treatment who decide to stick with the default, actually express larger belief updates compared to subjects who opt out of the treatment. Additionally, we find no statistically significant differences between the fraction of subjects in each treatment who do not update their beliefs at all. For return expectations, this fraction is

28.2% (S.E. = 0.019) for the daily group, 32.6% (S.E. = 0.020) for the monthly group, and 30.5% (S.E. = 0.020) for the yearly group.

4.4 Determinants of Opting Out of the Default

We now analyze subjects' opting out behavior over the six evaluation rounds for the different treatment groups, as graphically summarized in Figure 4. Across all evaluation rounds and treatment conditions, more than half of subjects (51.47%) opt out of their default information horizon presented and view different information horizons. Of the subjects in the monthly treatment, on average 27.14% opt out of the default condition, which is less than in the daily (71.35%) or yearly (55.80%) treatment.

[Insert Figure 4 here]

As there are differences in belief updating between subjects who opt out of the default information horizon versus those who do not, an important question is: Who opts out? To identify determinants of opting out of the default, we employ the variable "average click" as a summary of clicking behavior across all evaluation rounds for each subject as dependent variable and regress it on subject-specific attributes. Average click is constructed as the average within-subject decision to opt out of the default over the evaluation rounds. As it is constructed as the average, it varies between 0 (for subjects who never opt out of the default) and 1 (for subjects who opt out of the default every single round). Results in Table 4 indicate that risk aversion is slightly negatively associated with subjects' decision to opt out of the default information horizon, while financial literacy is positively related to opting out. As the insignificant interaction effects in column (2) indicate, it is financial literacy that influences the decision to opt out of the default and not merely realizing that another information horizon might be needed to form beliefs about the portfolio. The effect of financial literacy is consistent with recent findings by van Rooij and Teppa (2014). These authors find that financial literacy is positively related with the tendency to opt out of default options in economic decision-making. One potential reason according to these authors is that more financially literate individuals have lower costs of information processing, whereas less literate individuals are more likely to shy away from these decisions. This is also in line with the study by Agnew and Szykman (2005), who show that for complicated tasks, financial literacy is associated with a more pronounced tendency to opt out of the default. Finally, being assigned to either the daily or yearly treatment increases subjects' likelihood to opt out of the default. Thus, fewest subjects switch to another information horizon when the default information horizon matches the time horizon they are asked to express their beliefs for.

[Insert Table 4 here]

5. Conclusion

In an experimental environment resembling an online brokerage environment, we confront subjects with the performance of a stock portfolio over six evaluation rounds. We measure their beliefs in terms of return expectations and risk perceptions and analyze the effect of different default information horizons on the magnitude of belief updating. Consistent with previous work on individual investor behavior, we find that experimental subjects rely on naïve reinforcement learning and extrapolate past returns when updating their beliefs. More importantly, we find that the default option does, on average, not impact the magnitude of belief updating. However, an important result emerges when we divide the sample into subjects staying in the default vs. those opting out of the default. For subjects who stay in the default condition, showing returns over a longer information horizon reduces the magnitude of their belief updating. For subjects who opt out of this default condition we find the opposite result. Our results extend previous work that examines how different evaluation horizons influence individual investors' decision-making (e.g., Benartzi and Thaler 1995, Beshears et al. 2014, Gneezy and Potters 1997). These studies typically recommend longer evaluation periods to improve individual investor decision-making (e.g., to increase their stock-market participation). The results of these previous studies, however, are based on restricting access to information and making it very cumbersome or even impossible for experimental subjects to opt out of the default. According to our findings, when subjects have immediate access to alternative information horizons and can easily opt out of the default, presenting returns over a longer information horizon is not always beneficial. In this case, only for subjects staying in their default information horizon, presenting portfolio performance over a longer horizon has a mitigating effect on the magnitude of belief updates.

Since financial literacy is positively related to opting out of the default, our findings suggest that showing long information horizon returns are an effective default only if investors have low financial literacy. Our findings imply that for setting the right information horizon default regarding past returns, it is crucial to understand and assess if the majority of investors will remain in a default condition or not and what are the characteristics associated with this tendency.

References

Agnew, J. R., and Szykman, L. R. (2005). “Asset Allocation and Information Overload: The Influence of Information Display, Asset Choice, and Investor Experience.” *Journal of Behavioral Finance,* 6(2): 57-70.

Aspara, J., and Tikkanen, H. (2010), “Consumers’ Stock Preferences Beyond Expected Financial Returns.” *International Journal of Bank Marketing,* 28 (3): 193-221.

Benartzi, S., and Thaler, R. H. (1995), “Myopic Loss Aversion and the Equity Premium Puzzle.” *Quarterly Journal of Economics,* 110 (1): 73-92.

Beshears, J., Choi, J. J., Laibson, D., and Madrian, B. C. (2014), “Does Aggregated Returns Disclosure Increase Portfolio Risk-Taking?” *Working Paper.*

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011), “Individual Risk Attitudes: Measurement, Determinants, and Behavioral Consequences.” *Journal of the European Economic Association,* 9(3): 522-550.

Dominitz, J. and Manski, C. F. (2011), “Measuring and Interpreting Expectations of Equity Returns.” *Journal of Applied Econometrics,* 26(3): 352-370.

Epley, N., and Gilovich, T. (2006), “The Anchoring-and-Underadjustment Heuristic.” *Psychological Science,* 17(4): 311-318.

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., Combs, B. (1978), “How Safe is Safe Enough? A Psychometric Study of Attitudes Towards Technological Risks and Benefits.” *Policy Sciences,* 9: 127-152.

Ganzach, Y. (2000), “Judging Risk and Return of Financial Assets.” *Organizational Behavior and Human Decision Processes,* 83(2): 353-370.

Gneezy, U., and Potters, J. (1997), “An Experiment on Risk Taking and Evaluation Periods.” *Quarterly Journal of Economics,* 112(2): 631-645.

Greenwood, R., and Shleifer, A. (2014), "Expectations of Returns and Expected Returns." *Review of Financial Studies*, 27(3): 714-746.

Hoffmann, A. O. I., and Post, T. (2012), "How Return and Risk Experiences Shape Investor Beliefs and Preferences." *Working Paper, Maastricht University*.

Hoffmann, A. O. I., and Post, T. (2015), "How Does Investor Confidence Lead to Trading? Linking Investor Return Experiences, Confidence, and Investment Beliefs." *Working Paper, Maastricht University*.

Hoffmann, A. O. I., Post, T., and Pennings, J. M. E. (2013), "Individual Investor Perceptions and Behavior During the Financial Crisis." *Journal of Banking and Finance*, 37 (1): 60-74.

Kühberger, A. (1998), "The Influence of Framing on Risky Decisions: A Meta-analysis." *Organizational Behavior and Human Decision Processes*, 75(1): 23-55.

Looney, C. A., and Hardin, A. M. (2009), "Decision Support for Retirement Portfolio Management: Overcoming Myopic Loss Aversion via Technology Design." *Management Science*, 55(10): 1688-1703.

Lusardi, A. and Mitchell, O. S. (2007a), "Baby Boomer Retirement Security: The Roles of Planning, Financial Literacy, and Housing Wealth." *Journal of Monetary Economics*, 54 (1): 205-224.

Lusardi, A. and Mitchell, O. S. (2007b), "Financial Literacy and Retirement Preparedness: Evidence and Implications for Financial Education." *Business Economics*, 42 (1): 35-44.

Lusardi, A. and Mitchell, O. S. (2011), "Financial Literacy Around the World: An Overview." *Journal of Pension Economics and Finance*, 10 (4): 497-508.

Oechssler, J., Roider, A., and Schmitz, P. W. (2009), "Cognitive Abilities and Behavioral Biases." *Journal of Economic Behavior & Organization*, 72(1): 147-152.

Shefrin, H. (2001), "Editorial Comment: Do Investors Expect Higher Returns From Safer Stocks Than From Riskier Stocks?" *Journal of Behavioral Finance,* 2(4): 176-181.

Stracca, L. (2004), "Behavioral Finance and Asset Prices: Where do we stand?" *Journal of Economic Psychology,* 25(3): 373-405.

Thaler, R. H., and Sunstein, C. R. (2003), "Libertarian Paternalism." *American Economic Review,* 93 (2): 175-179.

Tversky, A., and Kahneman, D. (1974), "Judgment under Uncertainty: Heuristics and Biases." *Science,* 185 (4157): 1124-1131.

Tversky, A., and Kahneman, D. (1981). "The Framing of Decisions and the Psychology of Choice." *Science*, 211(4481): 453-458.

Van Rooij, M., Lusardi, A., and Alessie, R. (2011). "Financial Literacy, Retirement Planning, and Household Wealth." *DNB Working Paper No.313*.

Van Rooij, M., and Teppa, F. (2014). "Personal Traits and Individual Choices: Taking Action in Economic and Non-Economic Decisions." *Journal of Economic Behavior & Organization,* 100: 33-43.

Table 1 Summary Statistics and Question Wordings

Variable	Definition	mean	fraction	std	median
Age	Age in years	22.10		2.71	23.00
Gender	Indicator variable: 1=subject being female, 0=otherwise	0.42			
Financial literacy	Aggregate financial literacy score ranging from 0 to 8, based on the number of correctly answered questions	6.15		1.66	7.00
Basic financial literacy	Aggregate basic financial literacy score based on three basic questions from Lusardi and Mitchell (2008)	2.61		0.65	3.00
1	Suppose you had 100€ in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? [More than 102€] [Exactly 102€] [Less than 102€] [Do not know] [Refuse to answer]		97%		
2	Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? [More than today] [Exactly the same] [Less than today] [Do not know] [Refuse to answer]		89%		
3	Please tell me whether this statement is true or false. 'Buying a single stock usually provides a safer return than a stock mutual fund'. [True] [False] [Do not know] [Refuse to answer].		75%		
Advanced financial literacy	Aggregate advanced financial literacy score based on five advanced question from van Rooij et al. (2011)	3.54		1.23	3.00
1	Which of the following statements is correct? If somebody buys the stock of firm B in the stock market: [He owns part of form B] [He has lent money to firm B] [He is liable for B's debts] [None of the above] [Don't know]		84%		
2	Considering a long time period (for example 10 or 20 years), which asset normally gives the highest return? [Savings accounts] [Bonds] [Stocks] [Don't know]		56%		
3	Normally, which asset displays the highest fluctuations over time? [Savings accounts] [Bonds] [Stocks] [Don't know]		84%		
4	When an investor spreads his money across different assets, the risk of losing money: [Increases] [Decreases] [Stays the same] [Don't know]		88%		
5	If the interest rate falls, what should happen to bond prices? [Rise] [Fall] [Stay the same] [None of the above] [Don't know]		42%		
Risk aversion	Risk aversion based on response to the following question: "Are you generally a person who is willing to take risk or do you try to avoid taking risks?" 1 = completely unwilling to take risks … 11 = fully prepared to take risks (Dohmen et al. 2011)	6.59		2.28	7.00
1			1%		
2			3%		
3			8%		
4			12%		
5			7%		
6			7%		
7			18%		
8			19%		
9			19%		
10			4%		
11			1%		

Click	Indicator variable: 1=subject expressed beliefs in different treatment than default, 0=otherwise		52%	0.38	0.50
Time	Time needed to complete experiment (in minutes)	6.90		1.77	7.00
Nationality	Dummy variables taking the value 1 if subject's nationality is either Dutch, German, or another nationality ("Other")				
Dutch			32%		
German			43%		
Other			24%		
Treatment	Subject's randomly assigned treatment group (determines default return horizon presented)				
Daily			34%		
Monthly			33%		
Yearly			33%		
Return Expectation	Return expectation, based on the statement "I expect my investment portfolio to have good returns next month." (1 = totally disagree … 7 = totally agree) (adopted from Hoffmann et al. 2013)	4.13		1.49	4.00
Risk Perception	Risk Perception, based on the statement "I consider investing to be risky next month." (1 = totally disagree … 7 = totally agree) (adapted from Hoffmann et al. 2013)	3.83		1.49	4.00
Returns	Portfolio returns	n/a	n/a		
N			339		

Notes: This table presents summary statistics, variable definitions, and an overview of the questions posed to subjects. Possible answers to multiple choice questions are shown in brackets, the correct answer is underlined. "std" abbreviates "standard deviation". Percentages correspond to the fraction of correct answers for financial literacy questions and to the fraction of respondents who select a certain answer or belong to a certain group (for risk aversion, click, nationality and treatment).

Table 2 Impact of Returns and Clicking Behavior on Belief Updating

	(1)	(2)
Panel A: updates of return expectations		
Returns	2.56***	2.56***
	(0.36)	(0.36)
Click		0.07
		-0.09
Constant	-0.01	-0.05
	-0.05	-0.07
Panel B: updates of risk perception		
Returns	-1.74***	-1.74***
	-0.35	(0.35)
Click		-0.06
		-0.09
Constant	-0.03	-0.00
	-0.05	-0.07
Observations	1,695	1,695
N	339	339

Notes: This table presents random-effects panel regression results with robust standard errors (in parentheses) clustered at the individual level. The dependent variables are updates of return expectations (Panel A) and updates of risk perceptions (Panel B).Updates are defined as the difference between beliefs in round t and round t+1. Click refers to whether subjects opted out of the default condition they were assigned to. Due to analyzing the data as panel, and having six evaluation rounds, we have five belief updates per subject, which is why the number of observations is five-times the number of subjects. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 3 Belief Updating Across Treatments

	all	click	no click	difference	*t*-stat	*p*-value
Panel A1: mean absolute changes in return expectations						
daily	1.38	1.33	1.51	-0.18	-2.63	0.01***
monthly	1.27	1.36	1.24	0.12	1.88	0.06*
yearly	1.38	1.61	1.08	0.53	9.22	0.00***
Panel A2: average within subject standard deviation of return expectations						
daily	1.21	1.16	1.32	-0.16	-3.07	0.00***
monthly	1.18	1.26	1.15	0.11	2.22	0.03**
yearly	1.24	1.40	1.05	0.35	7.42	0.00***
Panel B1: mean absolute changes in risk perceptions						
daily	1.32	1.24	1.52	-0.29	-4.14	0.00***
monthly	1.21	1.33	1.17	0.16	2.60	0.01***
yearly	1.29	1.43	1.11	0.31	5.20	0.00***
Panel B2: average within subject standard deviation of risk perceptions						
daily	1.21	1.16	1.31	-0.15	-2.68	0.01***
monthly	1.12	1.23	1.08	0.14	2.86	0.00***
yearly	1.25	1.36	1.10	0.26	5.18	0.00***

Notes: This table provides an overview of belief updating across treatment groups. "Click" refers to subjects deciding to opt out of the default treatment imposed on them, whereas "no click" captures those subjects who do not opt out of the default presentation format. "difference" refers to the difference between "click" and "no click". T-statistics and p-values shown refer to t-tests for difference in means between "click" and "no click" subgroups for each treatment group. Updates are defined as the difference between beliefs in round t and round t+1. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

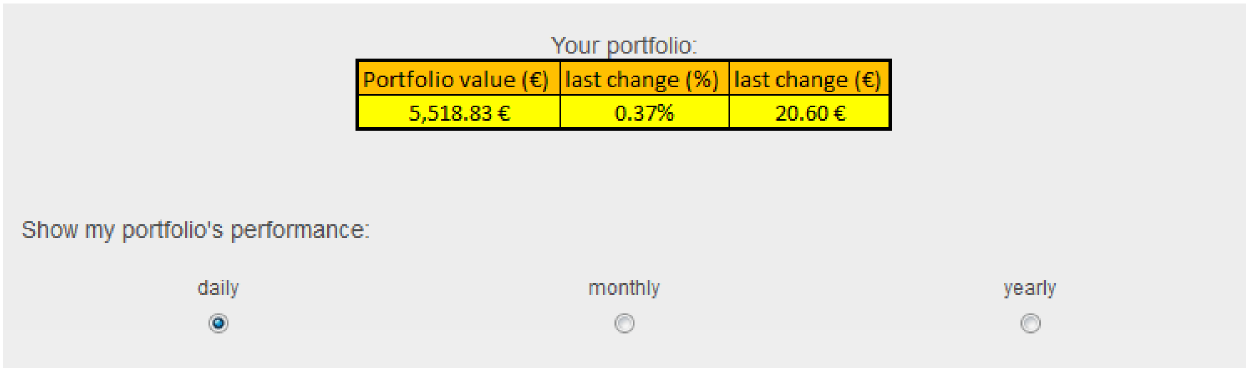
Table 4 Determinants of Opting Out

	average click (1)	average click (2)	average click (3)
Age	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)
Gender	-0.05	-0.05	-0.05
	(0.04)	(0.04)	(0.04)
Risk aversion	-0.02*	-0.01*	-0.02*
	(0.01)	(0.01)	(0.01)
Financial literacy	0.03**	0.04*	0.04*
	(0.01)	(0.02)	(0.02)
Treatment: daily	0.44***	0.52***	0.51***
	(0.04)	(0.16)	(0.16)
Treatment: yearly	0.28***	0.40**	0.41**
	(0.04)	(0.17)	(0.17)
Financial literacy * Treatment: daily		-0.01	-0.01
		(0.03)	(0.03)
Financial literacy * Treatment: yearly		-0.02	-0.02
		(0.03)	(0.03)
Time (minutes)			0.02**
			(0.01)
Constant	0.49***	0.42**	0.20
	(0.16)	(0.19)	(0.21)
Observations	339	339	339
adjusted R^2	0.24	0.24	0.27

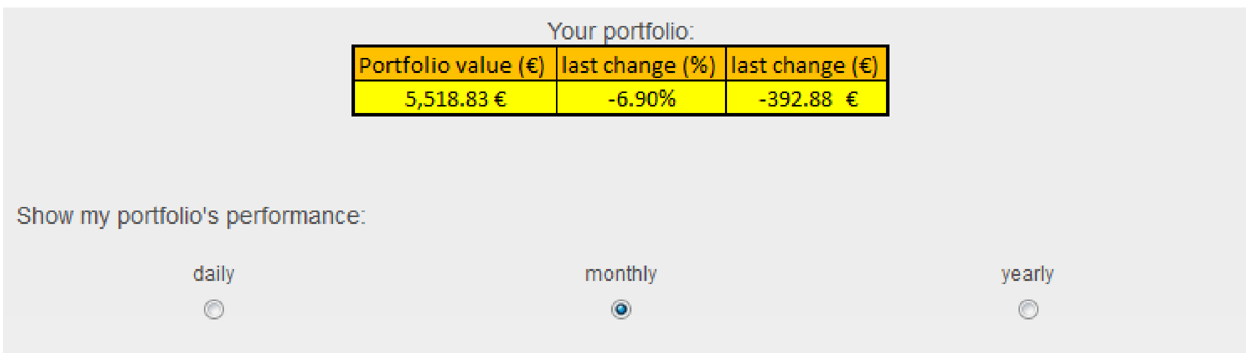
Notes: This table presents Ordinary Least Squares regression results. The dependent variable is the average within-subject clicking behavior over the six experimental rounds. Thus, "average click" indicates the fraction of total rounds a subject decided to opt out of the default. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Figure 1: Examples of Returns Presented in Different Treatments

a. Daily information horizon



b. Monthly information horizon



c. Yearly information horizon

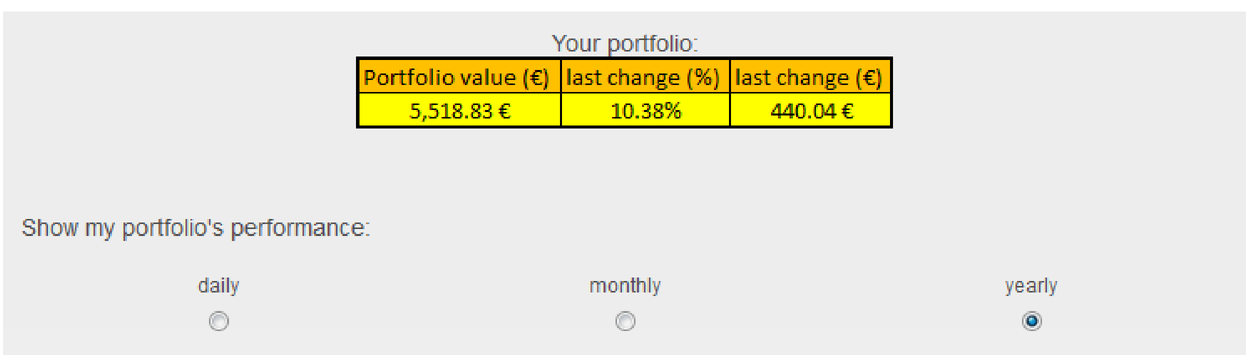
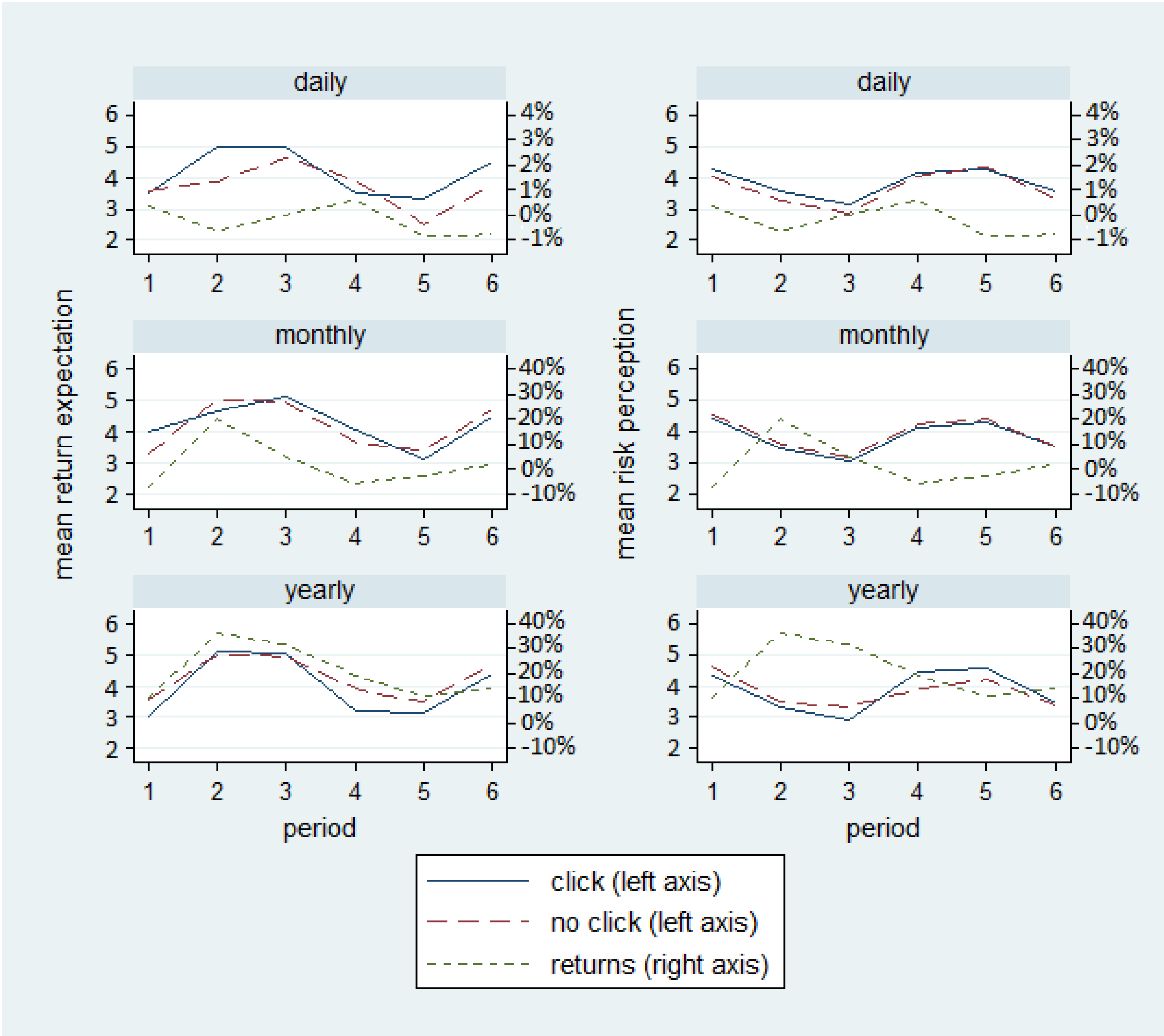
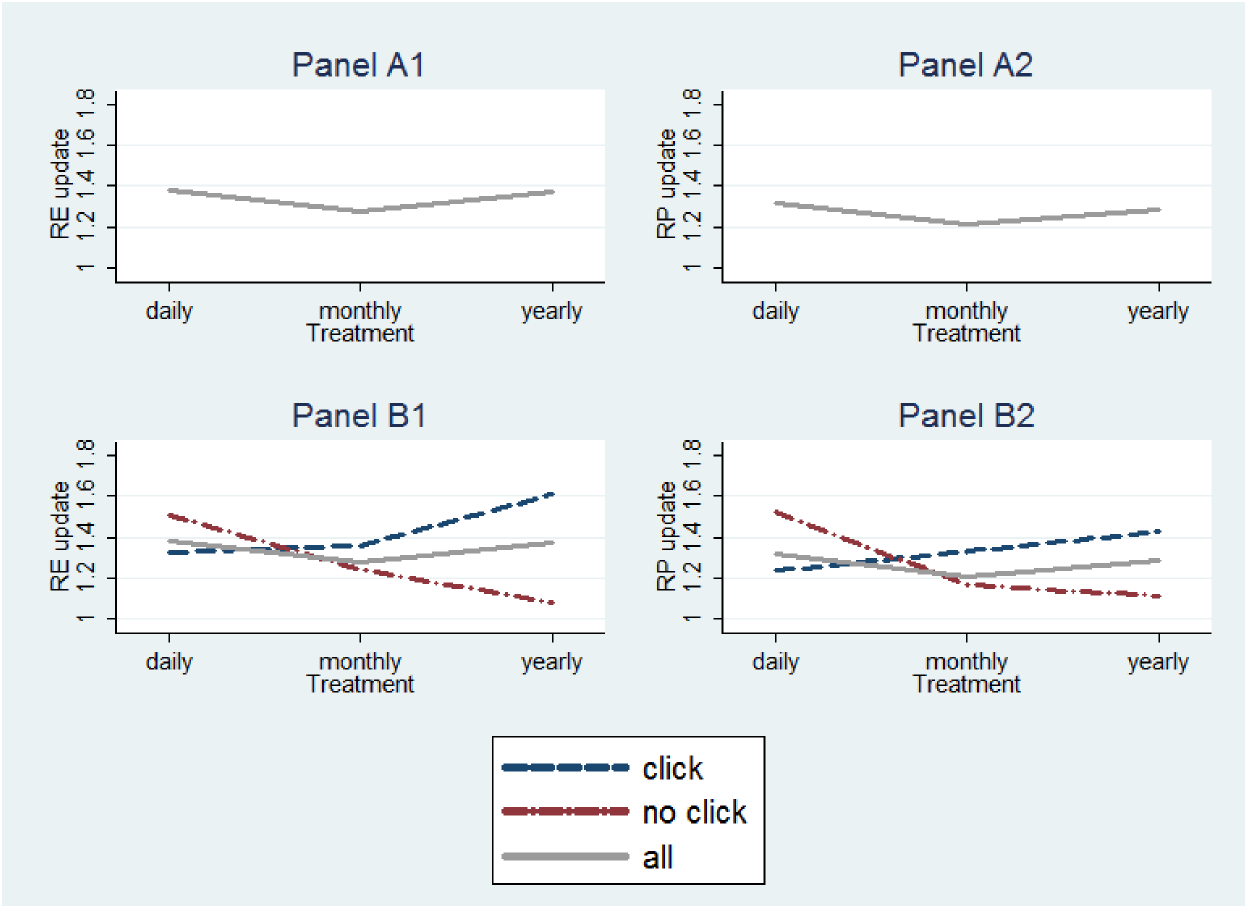


Figure 2 Return Expectations and Risk perceptions by Clicking Behavior for Treatment Groups



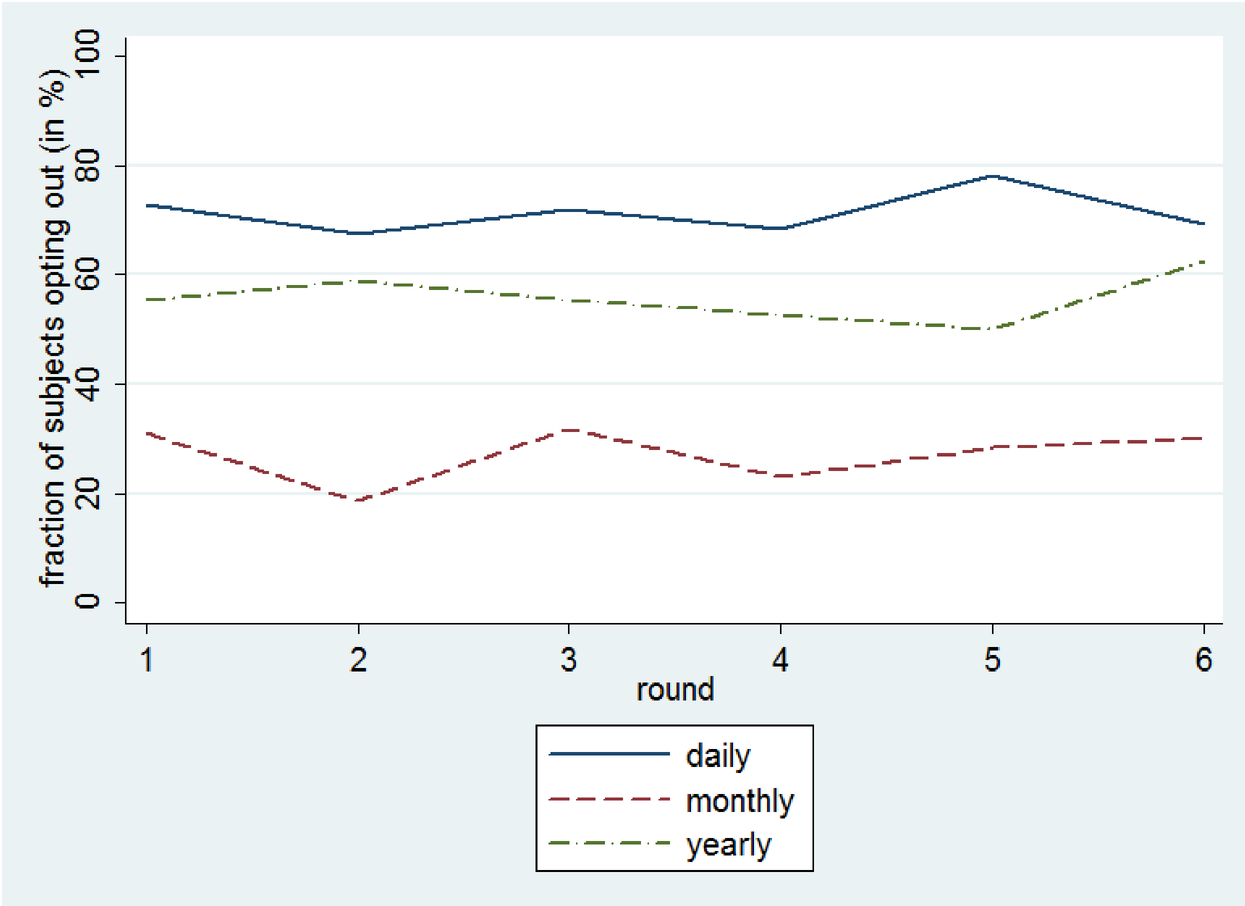
Notes: This figure presents subjects' beliefs over the six experimental rounds. The left panel presents mean return expectations and the right panel shows mean risk perception. "Click" and "no click" refers to subjects who did or did not opt out of the default information horizon, respectively. Returns shown for each treatment in each round are summarized on the right-hand scale.

Figure 3 Belief Updating Across Treatments



Notes: This figure presents subjects' belief updating based on the three treatment groups. The graphs on the left summarize updates in return expectations ("RE"), whereas the graphs on the right show updates in risk perceptions ("RP"). Updates are calculated as the absolute difference between expressed beliefs and their counterpart from the previous evaluation round, leaving the figure to be an average of five individual assessments of belief updating. The three lines correspond to the group of all subjects as well as splitting them up based on whether they decided to opt out of the default in any given round ("click") or not ("no click").

Figure 4 Opting Out of the Default Information Horizon over Evaluation Rounds



Notes: This figure presents subjects' opting out behavior based on the three treatment groups over the six experimental rounds. "Daily", "monthly", and "yearly" correspond to the default information horizon.