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The effect of saliency of graphical information on investment decisions

an eye-tracking experiment

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NETSPAR

The effect of saliency of graphical information on investment decisions: an eye-tracking experiment

Master Thesis

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1. Introduction

1.1 Academic motivation

In contrast to the traditional framework of rational economic agents, the growing sub-field of behavioural finance has shown that individual investors can be systematically biased, which leads to a range of inefficient finance decisions, such as under-participation in equity markets, under-diversified portfolios, or decisions influenced by funds' marketing efforts and other irrelevant factors. In order to protect investors from such biases, there are two approaches proposed by academia so far: increasing investors' financial literacy and enhancing financial information disclosure. This study adopts the second approach.

There is academic evidence that decisions made by financial investors are not always rational or optimal as the neoclassical framework assumes them to be, such as Gruber (1996); Barber, Odean, and Zheng (2005); Bailey, Kumar, and Ng (2011). Specifically, Kahneman and Egan (2011) argue that individuals utilize heuristics to make decisions and this process is vulnerable to systematic behavioural biases. These biases are not limited to humans and may have an early-evolutionary origin (Chen, Lakshminarayanan, & Santos, 2006). Found even in the financial markets, which have long been assumed to be mostly efficient, these biases are most visible in the case of index mutual funds due to the uniformity of returns in contrast to the dispersion in fees (Elton, Gruber, & Busse, 2004). Investigating the reasons why investors choose expensive index funds over cheaper ones, Choi, Laibson, and Madrian (2010) find that individuals fail to minimize fees, even after eliminating search costs (which matter to some extent) and non-portfolio services (which is rejected as a potential reason for choosing expensive funds). This violation of the law of one price remains one of the most puzzling phenomena in the financial markets: investors choose expensive index funds (the dominated option) over cheaper ones that offer the same expected returns (the dominating option). Although the puzzle has yet to be solved, this problem can be assuaged by improving information disclosure, one of which is to use graphical representations that convey risk information (Stone, Yates, & Parker, 1997). Following Cox, De Goeij, and Van Campenhout (2018), this study examines how graphical representation of key information can be used to improve the presently sub-optimal decisions of the average investors.

Specifically, an eye-tracking experiment is conducted to examine how salient graphical information can help investors make optimal investment decisions. The novelty of this experiment is the utilization of eye-tracking equipment (ETE) to study the eye movement of participants. This allows gathering data on which information the participants look at on the

screen, both when gathering information and when making investment decisions. Moreover, the pupil dilation level can also be studied as a proxy for mental effort (van der Wel & van Steenbergen, 2018), which will allow us to investigate whether graphical representation demands extra mental efforts from investors. Although eye-tracking experiments have been conducted widely in marketing (Wedel, 2013), they are not yet popular among economists.

1.2 Research question

Legislators and policy makers have been trying to improve the transparency in financial markets by requiring the disclosure of information about investment products in investor-friendly forms. In Europe, this disclosure typically takes the form of a prospectus, which in most cases is a long and technical document, and a two-page "fact-sheet", called Key Investor Information Document (KIID); these documents are compulsory for all Packaged Retail Investment and Insurance-based Products (PRIIPs). The main objective of the KIID is "to help investors understand the nature and key risks of the fund in order to make a more informed investment decision" ("Key investor information document," n. d.). The standardized format also aims to help investors easily compare different products (European Parliament, 2014). However, the KIID in its current format is unlikely to achieve its objective. Cox et al. (2018) show that when mutual fund investors suffer from behavioural biases and being presented with standard KIID information in an experiment, they invest sub-optimally by incurring preventable fees. On the other hand, having graphical representations of risk, returns, and costs alleviates biases and improves their investment decisions. Having established that fact, this study replicates and improves on this experiment in order to answer the following main research question:

"How does salient graphical information help investors make more optimal investment decisions?"

To answer this question, a lab experiment is conducted. The next chapter, Chapter 2, reviews the state of literature and establishes the theoretical foundation of the study. Chapter 3 describes the experimental design and developed hypotheses. Chapter 4 provides an overview of the data and variables used in the study. Chapter 5 presents the results of regression models and robustness checks. Chapter 6 discusses recommendation of the study. Finally, Chapter 7 concludes the study.

2. Literature review

2.1 Index mutual funds

First offered in the 1970s, index mutual funds have grown to become important investment vehicles, especially suited for unsophisticated investors due to the hands-off nature and allegedly lower costs. In the United States as of year-end 2018, 497 index mutual funds have 3.3 trillion U.S. dollars of assets under management, which accounts for 18% of assets in long-term funds; net inflow of these funds in 2018 is 156 billion U.S. dollars and 36% of households that owned mutual funds invest in index mutual funds (ICI, 2019). These facts establish the importance of index mutual funds in the financial markets.

There are two prominent characteristics of the index mutual fund industry: the large number of funds and the considerable dispersion of fees charged by these funds (Hortaçsu & Syverson, 2004). In theory, the law of one price dictates that two funds tracking the same index should charge similar fees because the gross returns are essentially the same, holding other characteristics constant. In practice, there are idiosyncratic differences among index funds, such as non-portfolio services or index replication techniques, which may result in different tracking errors. A few studies have tried to explain this dispersion of fees across funds. However, neither differences in portfolio performance (Hortaçsu & Syverson, 2004) nor non-portfolio services (Choi et al., 2010; Elton et al., 2004) can explain this dispersion. Although the index mutual fund industry is supposedly competitive given the large number of market participants and the high amount/frequency of inflow and outflow, the dispersion of fees persists, even with the growing popularity of other substitutes, such as exchange-traded funds (ETFs). As a result, investors in more expensive index mutual funds are being charged preventable fees, which they could avoid if an optimal decision were to be made. These preventable fees are the differences in fees between fees of the cheapest funds and more expensive ones. In other words, a rational investor who invests only in the cheapest fund incurs no preventable fees. This sub-optimal financial decision and the growth of these high-expense funds (Elton et al., 2004) are evidence that investors in the index mutual funds market act irrationally.

2.2 The sub-optimal financial decision

There are a few explanations for the sub-optimal decision made by investors. First, investors may value normatively irrelevant features, such as past returns (Choi et al., 2010). Because different inception dates can affect the calculation of past performance, funds tracking the same index may have different past returns. Theoretically, such information would be

ignored by the rational investors. However, there are a considerable number of investors who irrationally believe that past performance indicates future performance (De Bondt, 1993).

Second, other factors determining fund flow include size of the fund's complex as well as media attention (Sirri & Tufano, 1998), and funds' marketing efforts (Cronqvist, 2006). These factors lower search costs, which consequently impact fund flows (Huang, Wei, & Yan, 2007). According to Choi et al. (2010), the sub-optimal decision persists even after eliminating search costs, and they suggest that financial illiteracy may explain this finding.

Finally, information overload is also an important factor. Too many investment options or too much information presented often lead to less satisfaction and motivation (Iyengar & Lepper, 2000), which influence investors to gravitate towards the default options (Agnew & Szykman, 2005). Instead of spending more time and effort trying to figure out the optimal decision to minimize fees, investors may opt for "the path of least resistance", which are often funds with more media attention and marketing efforts, or simply diversify their wealth among available funds.

2.3   Investors' behavioural biases, cognitive limitations, and heuristics

The assumption in the traditional framework is that economic agents are rational and consider all available information in the decision-making process. Recent research has shown that this may not be the case. Bertrand and Morse (2011) find that information disclosure guided by cognitive biases significantly affect decisions of payday borrowing. Bordalo, Gennaioli, and Shleifer (2012) propose a model where decision makers, due to cognitive limitations, focus their attention on salient aspects of available options, thus overweighting probabilities associated with these salient payoffs. Additionally, a possible cause of sub-optimal financial decisions is the potential discrepancy between investors' understanding of risks, their attitude to risks, and their financial decisions (Vlaev, Chater, & Stewart, 2009). This might be the case of index mutual funds investors failing to realize that funds which track the same index have equivalent level of risks, thus, should have equivalent fees.

Due to these biases and cognitive limitations, investors tend to utilize heuristics, such as the naive diversification strategy in which the initial wealth is split evenly between all the available investment options (Benartzi & Thaler, 2001). However, there is no diversification benefit to be gained from spreading one's investment across different index mutual funds tracking the same index, and these investors make the sub-optimal decision by failing to invest all their wealth in the cheapest fund and minimize fees.

2.4 Improving financial decision making

Thus far, there are two approaches proposed by academic literature to improve financial decision making: (1) increase investors' financial literacy, and (2) improving financial information disclosure.

2.4.1 Increase financial literacy

While one cannot deny the importance of financial literacy in investing, the extent to which financial literacy leads to optimal financial decisions remains inconclusive (García, 2013). Regardless of the level of financial literacy, behavioural biases can still affect the decision-making process. Furthermore, higher financial education may result in overconfidence, which nullifies the benefits of more financial education (Willis, 2008). In the experiment of Choi et al. (2010), all subjects were described to be more financially educated than the typical investors, yet sub-optimal decisions were not entirely avoided. Evidently, financial literacy is not the panacea for the problem in question, and other solutions are also suggested, namely enhancing the quantity and quality of disclosed information.

2.4.2 Quantity of disclosed information

Since investors are cognitively limited, limiting the quantity of financial information may lead to better decisions (Nisbett, Zukier, & Lemley, 1981). In practice, this has been widely implemented by developed financial markets. The U.S. Securities and Exchange Commission (SEC) require all investment companies to inform their investors by Prospectus, Statement of Additional Information, Shareholder Reports, and other documents ("Information Available to Investment Company Shareholders," 2010). Realizing the need to limit information quantity, the SEC has allowed the use of Summary Prospectus since 2007. In the European Union, the equivalent document is the KIID, which aims to promote transparency and facilitate comparisons between different financial products.

However, there are certain limitations to this approach. Beshears, Choi, Laibson, and Madrian (2009) find that while Summary Prospectus reduces time cost to investors without affecting decision quality, it does not improve portfolio choices or helps to avoid errors regarding loads and charges. In an experiment setting, Choi et al. (2010) show that having both the summary prospectus and the prospectus improves the decisions, albeit only modestly.

In summary, it can be argued that limiting the information quantity alone is not enough to solve the sub-optimal decision issue. Further improvement on the quality of financial information is needed to help investors reach the optimal decisions.

2.4.3 Quality of disclosed information and graphical representation

Improving the quality of disclosed information can be done efficiently by changing the textual information to visualized graphical information (Tegarden, 1999). If used appropriately, visualization can increase data comprehension and likely decrease potential bias formed by prior beliefs (Hutchinson, Alba, & Eisenstein, 2010; Lurie & Mason, 2007). Unlike tabulated information, visualization helps users gather insights, such as patterns or trends, easily (Wainer & Velleman, 2001), and enhances cognitive capabilities by allowing users to process information without overloading them (Payne, 1982). Moreover, by summarizing many data points into a coherent whole, it reduces processing time and mental effort (Bederson & Shneiderman, 2003). Thus, increasing data comprehension, altering saliency of important features, delivering insights, enhancing cognitive capabilities, reducing time and effort are believed to be benefits of visualization.

On the other hand, visualization is detrimental to users when the visual representation is inaccurate or abused. Not properly designed graphs can exacerbate biases (Hutchinson et al., 2010) or encourage erroneous comparisons (Lurie & Mason, 2007). Therefore, the use of visual graphical representation is beneficial only when the representation is implemented correctly and understood properly by graph viewers.

Regarding the use of visualizations to present financial information, Cox et al. (2018) use a survey-experimental approach to show that individual investors, who do not make optimal decisions and may be subject to behavioural biases, benefit from graphical representation of expected return (net of fees and charges). By visualizing fees as a lower starting point of net expected return, the experiment increases the saliency of fees, which is key to making the optimal decision.

2.5 Eye-tracking experiments and applications

Eye-tracking has been used by a small number of economists to study learning, consumer choice, and deception in sender-receiver games. Knoepfle, Wang, and Camerer (2009) use eye-tracking scan paths to observe subjects' behaviour in a learning game and argue that studying information acquisition with eye-tracking can help understand complex strategic behaviour. Wang, Spezio, and Camerer (2010) use "pupil dilation to understand truth telling and deception in sender-receiver games". Reutskaja, Nagel, Camerer, and Rangel (2011) use eye-tracking to study consumer choice and search dynamics by an experiment similar to a consumer's supermarket choice problem (choosing among many alternatives with time constraints). Aside

from these studies, research in economics with eye-tracking has been scarce, especially in finance literature. This study aims to fill that gap.

3. Experimental design

3.1 Data collection

To answer the research question, an experiment was conducted using the eye-tracking equipment (ETE) at Tilburg University from 15th May 2019 to 23rd May 2019 with 73 participants. Designed to see how graphical representation of financial information affects investment decision, this experiment was a laboratory-adapted version of the survey done by Cox et al. (2018). Participants were asked to invest all their hypothetical wealth of €1,000 in three Index funds that tracked the same index (MSCI Europe). The optimal decision was to invest all wealth in the cheapest fund. However, investors might use a naive diversification heuristic (Benartzi & Thaler, 2001), which incurred preventable fees. The process and setting of the experiment were the same for all participants, even in trivial details such as the experimenter's outfits.

First, all participants were presented with the "Introduction" containing an overview and the purpose of the experiment, then the "Guidelines and Rules": definition of investment funds, index funds, the MSCI Europe Index, as well as details of the task, rules, and their reward. To eliminate bankruptcy risks, participants were ensured that all funds in the experiment would never go bankrupt during the investment period. Negative investments were not allowed.

Second, participants were incentivized by two rewards: (i) the completion reward was a fixed amount of €2.50 for completing the experiment, and (ii) the investment reward was their final wealth (net of fees), which depended on their investment decisions. The investment reward was designed to mimic the potential payout of real-life investment for a one-month period (from 1st June 2019 to 30th June 2019). Because of this short investment horizon and the wide dispersion of fees among presented funds, participants' investment decisions had a substantial impact on their final reward.

All participants were required to read the "Guidelines and Rules" twice (once on a printed copy and once on the computer screen) to make sure they thoroughly understood the rules. After all potential questions and doubts (if any) were resolved, the participants were calibrated with the ETE. The model of equipment was SMI RED250, a head-free eye tracker with a sample rate of 250 Hz. Manufactured by SMI, it was attached beneath a 22" monitor and emitted infrared light, which was absorbed by the pupils, allowing it to track the position and size of the participants' pupils. Specifications and photo of the ETE can be found in Figure 3.1.

Figure 3.1 Specification and photo of the ETE

Screen-based Eye Tracker	
Model	RED250
Sample rate	250 Hz
Accuracy	0.4°
Head movement	40 cm x 20 cm
Operating distance	60 - 80 cm
Screen size	Integrated with 22" monitor
Connection type	USB

Source: Manufacturer's website (www.smivision.com)

During the calibration of the ETE, participants were asked to use their eyes to follow a black cross moving around nine positions on the screen in a random order. The ETE would associate participants' eye movement with X-Y coordinates on the screen. In order to begin the experiment, participants had to pass an eye-tracking validation test. Finally, passing participants were randomly assigned to one of the three groups below:

Control Group (CG): Participants were presented with standard KIID information.

Treatment Group 1 (TG1): Participants were presented with KIID information with graphs of historical returns replaced by graphs of net expected return.

Treatment Group 2 (TG2): Participants were presented with KIID information with graphs of historical returns replaced by graphs of net expected return with 95% confidence bounds.

All three groups were presented with the same information about objectives and investment strategies of the funds, risk and reward profile, and charges. The difference among groups was limited to the last section where CG was presented with a bar graph of past performance, while TG1 with a line graph of expected return after costs, and TG2 with a line graph of expected return after costs plus lower and upper bounds of 95% confidence interval. These differences are discussed thoroughly in Section 3.2.

After examining the information presented, participants were asked to allocate their wealth among three MSCI Europe Index funds, which were anonymized to avoid biasing

participants with prior experience associated with these funds. Table 3.1 below presents general information of these funds and their fee structures.

Table 3.1 Funds' characteristics

| Fund	A	B	C
Official name	iShares MSCI Europe UCITS ETF (Dist)	AMUNDI INDEX MSCI EUROPE - AE	AMUNDI INDEX MSCI EUROPE - IE
ISIN code	IE00B1YZSC51	LU0389811885	LU0389911539
Inception date	06 July 2007	2009	2009
Benchmark	MSCI Europe	MSCI Europe	MSCI Europe
Entry fees	0.00%	4.50%	2.50%
Exit fees	0.00%	0.00%	0.00%
Ongoing fees	0.12%	0.30%	0.15%

Even though these funds track the same index and offer the same services to investors (without any non-portfolio services), there is still a wide dispersion of fees among them. Thus, it should be obvious to the rational participants that the optimal investment strategy is to minimize cost by investing all their wealth in the cheapest fund.

Finally, to obtain information on control variables, participants were asked questions about their demographics background, risk aversion level, cognitive skills, financial literacy, and investing experience. These control variables are discussed thoroughly in Section 3.3.

3.2   Differences between Treatment Groups and Control Group

Out of 73 participants in the total sample, eye-tracking data of 65 participants were successfully captured by the ETE. Randomly assigned to one of the three groups by the survey platform (Qualtrics), CG, TG1, and TG2 have 24, 18, and 23 participants respectively. All groups were presented with the same information on objectives and investment strategy, risk and reward profile, and charges of the investment options. The different treatments were administered to the final part only. For all groups, the first fund (A) was always the cheapest and the optimal choice is to invest all wealth into this fund. Please refer to Appendix 1 for a detailed copy of the experimental survey.

Figure 3.2 Example of differences of information treatments

| Control Group (CG) | Treatment Group 1 (TG1) | Treatment Group 2 (TG2) |
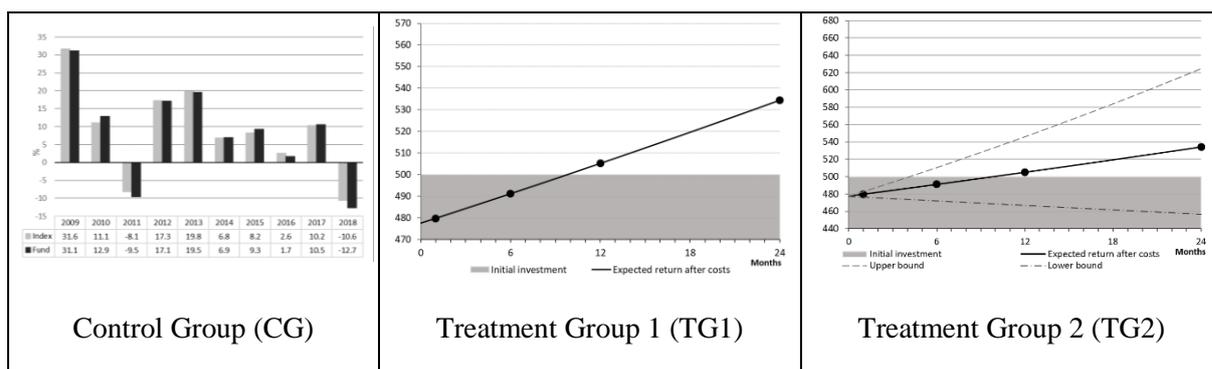
First, CG participants are provided with the standard information of the KIID, including the histograms and tables of past performance (please see the left graph in Figure 3.1). Although this information may have the signalling effect about fund managers' ability, it is less relevant in this experiment because (1) the three funds in question are all passive funds and (2) they track the same index, thus, have the same expected returns (gross of fees).

Secondly, TG1 participants are presented with the graphs depicting net expected return (demonstrated by the middle graph in Figure 3.1), instead of past performance. This shows how an investment of €500 (the grey area) would grow at the expected return rate (the 20-year average monthly return of the MSCI Europe Index) after all fees are subtracted based on each fund's charges. By taking charges into account and improving the information quality, the treatment for TG1 was relevant to the investment decision because the optimal decision in this case is to minimize costs.

Finally, the graphs of TG2 are similar to those of TG1, with the addition of two dotted lines depicting the lower and upper bounds of the 95% confidence interval of the expected return (please refer to the right graph in Figure 3.1). These bounds represent potential optimistic and pessimistic views that might occur and are calculated so that there is 95% chance that the future realized returns lie within these bounds. Because all three funds have the same distribution for expected return, the spread of the lower and upper bounds are the same for all of them. By both improving the information quality (showing charges on the graphs) and quantity (showing that the three funds have the same return distribution and risks), the treatment for TG2 is even more relevant than that for TG1 in regard to the investment decision in this experiment.

3.3   Control variables

Because there might be differences in participant characteristics between different treatment groups, the following control variables were taken into account: demographic variables (Age, Gender, Employment status, Study program, Education level), Risk aversion level, Cognitive capability, Financial literacy (measured and self-assessed), Previous investing experience. Existing literature have established the connection between these variables to investment decisions (Choi et al., 2010; Cox et al., 2018; Van Rooij, Lusardi, & Alessie, 2012). For more details on the wording of these questions, please refer to Appendix 1. It should be noted that due to the large number of variables in this study, the first words in variables' names are capitalized for the purpose of readability.

Specifically, out of the demographic information obtained from the participants, Study program is particularly important. Participants studying for a Master of Science in Finance degree may have been exposed to similar kinds of questions in their curriculum prior to the experiment and are more likely to make the optimal decision.

To estimate Risk aversion level, each participant answered two questions on their behaviour in different risky situations: whether to accept a job switch for larger but uncertain income. The specific wording of the second question depended on the answer of the first question to further classify participants' attitude towards risk. Adapted from the research of Barsky, Juster, Kimball, and Shapiro (1997) and Van Rooij, Lusardi, and Alessie (2011), these two questions classify each participants into one of four risk aversion levels, ranging from those who accept the risky option twice (lowest risk aversion level, level 1) to those who refuse the risky option twice (highest risk aversion level, level 4).

Cognitive capability, the capacity of absorbing and processing information, has also been shown to affect investment decision directly (Korniotis & Kumar, 2011) or through risk aversion and time preferences (Benjamin, Brown, & Shapiro, 2013). To measure Cognitive capability, three questions were adapted from the Cognitive Reflection Test formulated by Frederick (2005). Specifically, these questions examined how participants might resist the impulsive responses and engage their logical thinking ability. With only three questions, this test only takes up a few minutes, yet its predictive power matches or surpasses that of more elaborate tests, which may take up to 3.5 hours to finish (Frederick, 2005).

Another factor which has been widely linked to investment decision making is the level of financial literacy (Bernheim, Garrett, & Maki, 2001; Cole & Shastry, 2009). To assess Financial literacy level, five questions were adapted from Van Rooij et al. (2012) with the first

three questions focusing on basic financial knowledge such as compounding interest, inflation, and time value of money, while the final two questions are more advanced: diversification, and relationship between bond prices and interest rate. Correct answers on all these five questions show that participants have a sufficient level of financial literacy in order to make good investment decisions. Furthermore, participants also self-estimated their own financial literacy. This could be used as a proxy for overconfidence, which is a behavioural bias believed to adversely affect investment decision-making as well documented in Kumar and Goyal (2015).

Finally, prior experience was measured through three variables: Previous investing experience, Work experience (in general), and whether participant have Work experience in financial sector. Not unlike students of finance programs, participants with prior investing experience were more likely to be exposed to this investment problem before the experiment. Therefore, it was important to control for these characteristic differences.

3.4 Eye-tracking variables

Although the ETE was in operation for the total duration of the experiment, only eye-tracking data of the investment decision were of interest; all eye-tracking data analysed in this study began from the moment financial information was presented to the participants until they clicked on the "Next" button to move to the next page. The ETE captured this web page containing the investment decision as a stimulus image. In total, there were three stimuli in the experiment; each corresponded to one group. The duration of the eye-tracking data for each participant varied depending on his/her reading, analysing, and decision-making speed. After the experiment, data on user actions (scrolling, clicking, keyboard inputting) and fixations (X-Y coordinates, duration, and pupil size) were collected.

Fixations were of primary interest to this study. X-Y coordinates recorded the positions of each fixations on the screen with regards to the stimuli presented to the participants. Duration measured how long each fixation lasted in milliseconds. Finally, pupil size were the diameters of the pupil in two axes, Pdx and Pdy. By assuming the pupils were elliptic, the area of the pupil (PA) was calculated with the following formula:

$$PA = \pi * \frac{Pdx}{2} * \frac{Pdy}{2}$$

After primary data collection, the data underwent the manual reassignment of fixations. With the stimuli marked with areas of interest (AOI), only fixations falling within the bounds of these AOI were included in the analysis (see Appendix 2 for a full copy of stimuli and their AOI). However, there were fixations which belonged to an AOI but fell just outside of its

boundaries, or vice versa, fixations that did not belong to that AOI but fell within the boundaries. That was why a few fixations had to be interpreted and manually reassigned. During reassignment, in some cases, all fixations were linearly shifted in a certain direction, most likely because participants had shifted their bodies during the experiment. With these cases, a linear re-shift adjustment was implemented for the data to be interpretable. See Appendix 3 for an example of a linear re-shift adjustment. During the manual reassignment phase, three cases of uninterpretable data and five cases where the ETE failed to capture data were detected and removed from the sample.

After manual reassignment, five types of eye-tracking variables were calculated for further analysis: Number of fixations, Total viewing time, Focus on cheapest fund, Pupil dilation, and Comparison. Number of fixations of an AOI was simply the number of fixations fell within an AOI, reflecting the importance of the information in the AOI (Fitts, Jones, & Milton, 1950). Total viewing time was the total sum of duration of all fixations within an AOI. Longer viewing time might indicate that participants have difficulty extracting and understanding information (Jacob & Karn, 2003). Focus on cheapest fund was the percentage of total viewing time participants spent looking at the cheapest fund's information. Because there were three funds in total, the baseline level for focus is 33%, which indicated that the participants spend equal time for each fund. Pupil dilation at any particular time was defined as the difference between the baseline pupil area (the average pupil area of the first 30 fixations) and the pupil area at that time. This could be used as a proxy for mental effort (van der Wel & van Steenbergen, 2018). Finally, Comparison was defined as how many times the scan path moved from one AOI to the next within the same elements (for example, the graphs) of different funds. AOI 6 to 8 were the SRRI element, AOI 13 to 15 were the Charges table element, and AOI 20 to 22 were the graph element. For CG, the graphs also included AOI 23 to 25 (the past return tables). With five types of variables for each of the three elements, there were 15 eye-tracking variables in total for further analysis.

3.5 Hypotheses

To see how graphical representation of financial information assists investors in making investment decisions, the following hypotheses were constructed. Hypotheses 1a to 6b and 9a to 10b used eye-tracking data to answer the main research question while Hypotheses 7a to 8b aimed to reconfirm findings of previous studies.

The first three hypotheses examined the relationship between the number of comparisons and investment decision. Because the three funds were similar in many aspects, it was suspected

that more comparisons helped participants discern the most crucial differences and similarities between the funds to make the optimal decision.

Hypothesis 1a: Individuals who make more comparisons across graphical information of different alternatives (ie. scan paths alternate across the graphs of different funds) incur lower preventable fees than individuals who make fewer comparisons.

Hypothesis 1b: Individuals who make more comparisons across graphical information of different alternatives (ie. scan paths alternate across the graphs of different funds) have a lower standard deviation of risk assessment than individuals who make fewer comparisons.

Hypothesis 2: Individuals who make more comparisons across Charges tables of different alternatives incur lower preventable fees than individuals who make fewer comparisons.

Hypothesis 3: Individuals who make more comparisons across graphical risk indicators (SRRI) of different alternatives have lower standard deviation of risk assessment than individuals who make fewer comparisons.

On the other hand, it may be the case that when presented with many alternatives, investors spending more time examining the information of the cheapest fund than other funds make more optimal decisions.

Hypothesis 4a: Individuals who focus more on the Charges tables of cheapest fund incur lower preventable fees than individuals who focus less.

Hypothesis 4b: Individuals who focus more on the graphs of cheapest fund incur lower preventable fees than individuals who focus less.

Since individuals may be behaviourally biased, exerting more mental effort may not lead to a lower amount of preventable fees. If it is the case, the following hypothesis would be rejected:

Hypothesis 5: Individuals with high pupil dilation level when looking at graphical information incur lower preventable fees than individuals with lower pupil dilation level.

To convince legislators to implement the net expected return graphs, it is worthwhile to show that these graphs do not demand extra mental effort from investors. If it is the case, the following two hypotheses would be rejected:

Hypothesis 6a: When looking at graphical representation, individuals in TG1 have a higher level of pupil dilation than individuals in CG.

Hypothesis 6b: When looking at graphical representation, individuals in TG2 have a higher level of pupil dilation than individuals in CG.

Since previous work has established that net expected return graphs help investors incur lower preventable fees, it is worthwhile to check if this sample yields the same result.

Hypothesis 7a: Individuals in TG1 incur lower preventable fees than individuals in CG.

Hypothesis 7b: Individuals in TG1 have lower standard deviation of risk assessment than individuals in CG.

Hypothesis 8a: Individuals in TG2 incur lower preventable fees than individuals in CG.

Hypothesis 8b: Individuals in TG2 have lower standard deviation of risk assessment than individuals in CG.

Finally, to see how these graphs can help investors reduce preventable fees, by prompting investors to make more comparisons, or to focus on graphs of the most optimal fund, or perhaps both, the hypotheses below are formulated:

Hypothesis 9a: The negative effect on preventable fees of comparisons of graphs is larger for individuals in TG1 than individuals in CG.

Hypothesis 9b: The negative effect on preventable fees of comparisons of graphs is larger for individuals in TG2 than individuals in CG.

Hypothesis 10a: The negative effect on preventable fees of focusing on graphs of the cheapest fund is larger for individuals in TG1 than individuals in CG.

Hypothesis 10b: The negative effect on preventable fees of focusing on graphs of the cheapest fund is larger for individuals in TG2 than individuals in CG.

4. Data overview

4.1 Descriptive statistics

The sample consisted of 65 Tilburg University students whose eye-tracking data was successfully captured by the ETE. Participants were recruited through Blackboard announcements, email from faculty members, and personal network of the experimenter, then randomly assigned (by the questionnaire software- Qualtrics) to one of the three groups. Although the sample size is small compared to previous studies on the same topic, it is sufficient for an eye-tracking study, which normally consists of 40 participants for the total sample.

4.1.1 Sample characteristics

From the questionnaire, sample characteristics were obtained and presented in Table 4.1 below. Since all participants were university students, the average age across all groups was just below 22 years. Almost a quarter of the total sample were finance students, but they are not distributed evenly across groups due to random assignment. Regarding current or highest achieved education level, there seemed to some misunderstanding among the participants. Some bachelor students mistakenly ticked on secondary education (which could not be the case because Tilburg University did not offer secondary education). Additionally, there were participants claiming to be Master students while answering the study program question, which was open-ended, and mistakenly ticked on "Bachelor University" in the education level question. In the analyses, these misunderstandings were corrected.

Risk aversion level is similar across groups with TG2 being slightly lower than the other two groups. These levels are in line with levels reported by Cox et al. (2018). For cognitive capability, CG performs the best while TG1 scores the lowest. On the other hand, TG1 has the highest financial literacy score, but the differences across groups are negligible. The average self-assessed financial literacy level is almost the same across three groups. Overall, it can be argued that risk aversion levels of the groups are homogenous and comparable to previous studies.

Despite scoring highly on financial literacy (an average of 4.11 out of 5.00) and cognitive capability (an average of 2.00 out of 3.00), participants seem to be quite inexperienced. On average, they disagree with having "experience with investing in financial products", most have less than 1 year of working experience, and only 18% have worked in the financial sector before. It is understandable because all of them are students, hence this sample provides a good approximation of real-life unsophisticated investors considering mutual fund investments.

Finally, to justify the use of these control variables based on the data, OLS regressions without a constant (not reported) were conducted with each of these control variables as dependent variables and dummy variables of CG, TG1, and TG2 as independent variables. Subsequent F-tests in all the regressions reject at 1% level the null hypotheses of these characteristics being the same across different groups. Therefore, these variables should be used to control for characteristics differences of participants.

Table 4.1 Participants' characteristics – Group average

	Group			
	CG	**TG1**	**TG2**	**Full Samle**
Age	21.50	22.28	21.04	21.55
Percentage Male	54%	50%	65%	57%
% studying	100%	100%	100%	100%
% of finance student	25%	39%	9%	23%
Current or highest achieved education				
Bachelor University	83%	61%	78%	75%
Master University	17%	39%	22%	25%
Risk aversion level (1 to 4, higher = more risk averse)	2.58	2.50	2.30	2.46
Cognitive capability (0 to 3, higher = better)	2.17	1.78	2.00	2.00
Financial literacy level (0 to 5, higher = better)	4.00	4.28	4.09	4.11
Self-assessed financial literacy level (0 to 5, higher = better)	3.13	3.22	3.22	3.18
Previous investing experience (-2 to +2, 0=neutral)	-0.46	-0.78	-0.61	-0.60
Working experience (0 to 3)	1.46	1.28	1.09	1.28
% has working experience in financial sector	0.21	0.22	0.13	0.18
Observations	24	18	23	65

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4.1.2 Eye-tracking data

All eye-tracking data are captured by the ETE within the period starting from when participants are first shown the stimuli to the moment they click on "Next" button to move to the next page. Overall, there are 15 variables capturing five measurements (Comparisons, Pupil dilation, Total viewing time, Focus on cheapest fund, and Number of fixations) across three groups of elements (SRRI, Charges tables, and graphs). An overview of these variables is presented in Table 4.2.

First, regarding Comparisons, CG and TG2 have similar figures but TG1 make considerably fewer comparisons across all three elements. According to Hypotheses 1a, 1b, 2, and 3, TG1 would also have higher preventable fees and standard deviation of risk assessment than CG and TG2 if they were all exposed to the same treatment. In Chapter 5, these hypotheses are tested rigorously with regression models.

Surprisingly, Pupil dilation is negative for all groups on average. This suggests that instead of dilating, the pupils constrict when extracting information from the elements compared to the baseline pupil area. However, the relative difference of Pupil dilation across three elements can still serve as a proxy for mental effort, higher Pupil dilation (less negative number) means higher mental effort.

The Total viewing time varies across groups but TG2 spends more time on all three elements than the other groups. TG2 also focus more on the cheapest fund's elements, especially the graph with 45% of their time on average. Interestingly, CG focuses the least on cheapest fund's graph, allocating only 19% of their time on this while TG1 is near the baseline focus with 36%. It seems that the treatments for TG1 and TG2 helped participant focus more on the cheapest fund's graph. This may potentially help lower preventable fees.

Finally, Number of fixations are fairly similar across all three groups, except for Number of fixations in graphs. This is within expectations because the graphs are where the information treatment is applied. On average, TG2 finds the graphs more important than CG or TG1 because of the higher number of fixations and longer total viewing time.

Table 4.2 Overview of eye-tracking data - Group average

	Group			
	CG	**TG1**	**TG2**	**Full Sample**
Comparisons of SRRI	13.71	11.44	13.30	12.94
Comparisons of Charges tables	22.21	18.50	22.83	21.40
Comparisons of graphs	44.17	34.33	44.52	41.57
Pupil dilation of SRRI	-6.19	-3.61	-8.53	-6.30
Pupil dilation of Charges tables	-12.17	-12.13	-7.97	-10.67
Pupil dilation of graphs	-3.59	-5.45	-3.14	-3.95
Total viewing time of SRRI (seconds)	10.70	10.82	12.79	11.47
Total viewing time of Charges tables (seconds)	22.94	22.83	27.87	24.65
Total viewing time of graphs (seconds)	39.67	32.13	51.55	41.79
Focus on cheapest fund's SRRI	37%	40%	44%	40%
Focus on cheapest fund's Charges table	38%	39%	42%	40%
Focus on cheapest fund's graph	19%	36%	45%	33%
Number of fixations in SRRI	58.92	54.67	59.65	58.00
Number of fixations in Charges tables	114.83	107.72	114.52	112.75
Number of fixations in graphs	161.21	149.33	205.61	173.63
Observations	24	18	23	65

4.2   Differences in preventable fees

After descriptive statistics, the next section presents preliminary analysis of the data. Table 4.3 shows an overview of the investment decisions with the average fees per group (entry, ongoing, total, and preventable fees), the proportion of respondents who minimize fees (invest all wealth in the cheapest fund), and that of those who naively diversify (invest in all three funds). Entry fees are subtracted from the investment in the beginning of the investment period (June 2019) while ongoing fees are proportional to the invested assets at the end of this period. Because none of the three funds have exit fees, total fees are the sums of entry and ongoing fees. For each respondent, preventable fees are the differences between the minimum fees (in the case of allocating all wealth to the cheapest funds) and the total fees. The fees incurred by TG1 is higher than CG while TG2's fees are considerably lower than CG's, mostly due to the differences in entry fees. As can be seen, all groups are far from making the optimal decision of minimizing the incurred fees (only 0.10 euro if all wealth is invested in the cheapest fund).

Column (v) of Table 4.3 shows the proportion of participants who made the optimal decision. This number is lowest for TG1 while TG2 is 9 percentage point higher than CG but remains just 30%. On the other hand, in column (vi), the percentage of those who naively diversified is the highest in CG (67%) and lowest in TG2 (39%). Considering how diversification offers no benefits in this case, it is puzzling that most of the participants fail to optimize, but also not surprising since these figures are in line with previous studies.

Table 4.3. Overview of fees and investment decisions

Group	Average entry fees (i)	Average ongoing fees (ii)	Average total fees (iii)	Average preventable fees (iv)	% participant minimizing fees (v)	% participant naively diversifying (vi)
CG	13.99	0.14	14.12	14.02	21%	67%
TG1	16.66	0.14	16.80	16.70	11%	56%
TG2	10.05	0.13	10.18	10.08	30%	39%

Table 4.4 below presents the relative differences of preventable fees incurred per group. To see if the differences are statistically significant, t-tests for equality of means are used. Previously, a Levene's Test for equality of variances was performed and found no evidence of unequal variances. Although TG1 incurred 16.6 percent more preventable fees than CG and TG2 did 28.1 percent less than CG, none of the differences were statistically significant, even when the differences are, economically speaking, very large. However, the difference between TG1 and TG2 is statistically significant at 5% level. This can be seen as evidence supporting

Hypothesis 8a while rejecting Hypothesis 7a. Nevertheless, since these tests cannot account for characteristic differences among participants, which were captured by control variables, more robust analysis is conducted in Section 5.1.

Table 4.4 Relative differences in preventable fees across groups

Group	Average preventable fees	CG	TG1
CG	14.02	-	-
TG1	16.70	19.1%	-
TG2	10.08	-28.1%	-39.7%**

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level*

4.3 Differences in perception of risk

Besides preventable fees, there is another important part of the investment decision: participants' perception of risks. In this experiment, all three funds share the same level of risks but for investment decisions in reality, it is of course not the case. With thousands of possible investment options to choose from, it is imperative that investors can discern the correct level of risks from the available financial information.

Participants in the whole sample were provided with risk level indicators, as per standards of KIID. All three investment options were rated 5 out of 7 on the risk scale as regulated by European laws. In addition, the information treatment in TG2 included expected return's upper and lower bounds, which indicates the level of risks. Because the risks are the same for three funds, how much these bounds spread from the expected return is also the same. Immediately after the decision, participants were asked to specify each fund's level of risk. Table 4.5 reports the average perceived risk level per fund for each group, as well as the standard deviation of this rating, which was calculated per participant. Lower standard deviation suggests that participants perceived correctly that all funds are equally risky. In the last column, the proportion of participants who had a standard deviation of zero are also reported. Finally, to check for significant difference between CG and the treatment groups, t-tests for equality of means, assuming unequal variance, were conducted. Only the difference of Risk level standard deviation between CG and TG2 was found to be statistically significant at 5% level.

Table 4.5 Overview of perceived risk level and standard deviation

Group	Fund A's average risk level	Fund B's average risk level	Fund C's average risk level	All fund's average risk level	Risk level standard deviation	% participant perceiving risk level correctly
CG	4.75	4.96	5.00	4.90	0.16	88%
TG1	4.78	5.06	5.11	4.98	0.36	78%
TG2	4.48	4.87	4.74	4.70	0.66**	57%

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level*

As can be seen in Table 4.5, TG2 perceives risk level of all three funds as lower than CG and TG1; however, those differences are not statistically significant. However, TG2 has a significantly higher Risk level standard deviation compared to CG, which suggests that the past performance graphs in CG being roughly the same across the three funds may have helped participants understand risk level better. However, before rejecting Hypotheses 7b and 8b, more robust analysis is conducted in Section 5.3.

4.4 Control variables

To control for individual characteristics of each participant, control variables were captured during the experiment. They included demographic information (age, gender, study program, and education level), risk aversion level, cognitive capability, financial literacy (measured, and self-assessed), investing and work experience. Table 4.6 shows the average preventable fees, the proportion of participants minimizing fees or naively diversifying in groups defined by these control variables.

T-tests for equality of means were used to test if the difference in preventable fees is statistically significant for different groups. For control variables with more than two groups, the two furthest groups were used (for example, "Risk aversion level 1" and "Risk aversion level 4"). Perhaps due to the small sample size of some of the groups, the t-tests find the only control variables with statistically significant differences across groups is related to education. Specifically, the difference between finance and non-finance students is statistically significant at 5% level. Finance students incurred 46% less fees than the rest of the sample. Furthermore, Master students also pay 35% less fees than Bachelor students, and this difference is statistically significant at 10% level.

Regarding individual characteristics, none of them display a statistically significant difference across groups. However, aside from groups with too few participants, these variables display expected relationship with preventable fees. First, risk aversion does not seem to factor

in the investment decision because all three funds are equally risky. Second, preventable fees unsurprisingly decrease when cognitive capability increases, except for cognitive level 0 with only 7 participants. Third, high financial literacy levels also seem to decrease preventable fees if small groups with one or two participants are ignored. On the other hand, self-assessed financial literacy does not seem to affect the average fees but the likelihood of making the optimal decision markedly rises (from 0 percent to 40 percent going from the lowest to highest ranking).

Finally, investing and working experiences seem to be important as well. Overall, participants with previous investing experience incur lower fees and are more likely to minimize fees. Although the difference in fees between the highest ("Completely agree") and lowest group ("Completely disagree") is not significant, perhaps because the highest group is too small in size (three participants), the difference between the next highest ("Agree) and the lowest is statistically significant at 10% level. Furthermore, while longer working experience does not seem to assist in this investment decision, participants who used to work in financial sector incur lower fees and are more likely to make the optimal decision.

Throughout this study, referring to control variables includes all variables in Table 4.6, unless stated otherwise.

Table 4.6 Control variable overview

		Proportion in sample	Average preventable fees	% participant minimizing fees	% participant naively diversifying	Number of participants
Gender	**Female**	43%	14.26	14%	64%	28
	Male	57%	12.68	27%	46%	37
Study finance	**No**	77%	14.96	14%	62%	50
	Yes	23%	8.06**	47%	27%	15
Education level	**Bachelor**	75%	14.64	16%	61%	49
	Master	25%	9.46*	38%	31%	16
Risk aversion level	**1**	9%	8.35	33%	33%	6
	2	49%	12.72	28%	50%	32
	3	28%	16.91	6%	67%	18
	4	14%	11.88	22%	56%	9
Cognitive capability	**0**	11%	12.24	29%	43%	7
	1	22%	15.86	21%	57%	14
	2	25%	13.95	13%	50%	16
	3	43%	12.06	25%	57%	28
Financial literacy level	**0**	2%	7.02	0%	100%	1
	1	0%	-	-	-	0
	2	3%	8.27	50%	50%	2
	3	20%	16.65	8%	62%	13
	4	32%	14.63	24%	62%	21
	5	43%	11.48	25%	43%	28
Self-assessed financial literacy level	**Very low**	2%	18.79	0%	100%	1
	Low	2%	37.10	0%	0%	1
	Below average	14%	15.43	11%	78%	9
	Above average	51%	12.35	21%	55%	33
	High	25%	12.82	25%	44%	16
	Very high	8%	12.23	40%	40%	5
Previous investing experience	**Completely disagree**	35%	15.83	13%	61%	23
	Disagree	22%	13.98	21%	71%	14
	Neutral	15%	14.33	20%	60%	10
	Agree	23%	9.53	33%	33%	15
	Completely agree	5%	7.51	33%	0%	3
Working experience	**None**	26%	15.18	12%	59%	17
	Less than 1 year	29%	14.17	21%	47%	19
	Between 1 and 5 years	35%	11.02	35%	57%	23
	More than 5 years	9%	14.65	0%	50%	6
Working experience in finance	**No**	82%	13.98	19%	57%	53
	Yes	18%	10.64	33%	42%	12

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level*

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4.5   Perception and experience of participants in the investment decision

Besides improving the outcome of the decision, the information treatment also may have enhanced the perceived experience of participants about the decision-making process. This was captured by four statements that participants can agree or disagree with using a five-point Likert scale, ranging from 0 ("Totally disagree") to 4 ("Totally agree"). The statements were: sufficient information on funds' risk levels, time consumption of the decision, confidence in the decision, comparability of different alternatives. For the exact phrasing of these statements, please refer to the survey copy in Appendix 1. Furthermore, t-tests for equality of means were performed to check if TG1 and TG2's average responses are different from CG.

From Table 4.7, it can be seen that treatment groups agree more with "sufficient information" and "able to compare funds" than the control group although only the TG2's latter statement has a statistically significant difference at 5% level. Responses for other two statements, how much time the decision took and how confident the participants are, do not seem to differ across the three groups.

Table 4.7 Statements of perception and experience about the investment decision

Group	Sufficient information	Took a lot of time	Confident about decision	Able to compare funds
CG	2.08	1.75	2.21	2.04
TG1	2.39	1.72	2.11	2.33
TG2	2.39	1.70	2.26	2.61**

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level*

4.6   Features of information representation in the investment decision

Aside from how participants perceive the decision, they were also asked how important each feature of the provided KIID is to their decisions. The basic features were: (i) fund charges, (ii) past performance, (iii) use of derivatives, (iv) desire to diversify the money across different funds, and (v) risk level indicator. Each treatment group had one extra feature; while TG1 had figure of net expected return, TG2 had figure of net expected return with upper and lower bounds. The participants rated the importance on a five-point Likert scale ranging from 0 ("not important at all") to 5 ("very important). The results are shown in Table 4.8 with the ordinal ranking of each factor within one group in parentheses.

In both treatment groups, the extra feature of net expected return (with or without bounds) is ranked the highest importance. This is evidence that participants make use of the visual representation of net expected return (which is able to highlight both risks and charges

of the funds). Interestingly, both CG and TG1 display a high "desire to diversify" in contrast to TG2, despite TG1 and TG2's being presented with similar representations. This "desire" may be the cause of why TG1 underperforms in this experiment. Next in line of importance are the charges of the funds, past performance, and risk level indicator; the responses and rankings do not differ substantially across groups. Curiously, that risk level indicator is not ranked very highly indicates that participants do not concern themselves with this information because it is the same across three funds (risk level 5 out of 7). Finally, the use of derivatives expectedly has the lowest rankings overall.

Table 4.8 Features' importance in participants' investment decisions

|	CG	TG1	TG2
Fund charges	2.96 (2)	3.00 (3)	3.09 (3)
Past performance	2.75 (3)	2.78 (5)	3.17 (2)
Use of derivatives	1.83 (5)	2.17 (6)	2.04 (6)
Desire to diversify	3.08 (1)	3.28 (2)	2.96 (4)
Risk level indicator	2.54 (4)	2.78 (4)	2.74 (5)
Figure of net expected return	-	3.50 (1)	-
Figure of net expected return with upper and lower bounds	-	-	3.48 (1)
Sample size	24	18	23

Ordinal ranking in parentheses

5. Multivariate analysis

5.1 Preventable fees

5.1.1 Regression models

Because the dependent variable, Preventable fees, has a corner value at 0 in the case of respondents minimizing fees (see Figure 5.1 for the full histogram), a Tobit regression model is used. Developed by Tobin (1958), Tobit model is theoretically recommended over Ordinary Least Square (OLS) for censored variables (Gujarati, 1995). It has been widely applied in finance for censored variables such as corporate dividends (Nizar Al-Malkawi, 2007; Singhania & Gupta, 2012), R&D expenditures (Czarnitzki & Hottenrott, 2011; Müller & Zimmermann, 2009), or cost of consumer credit (Disney & Gathergood, 2013). A common approach is to use both Tobit and OLS because when the number of censored observations is low, OLS may offer more benefits (Wilson & Tisdell, 2002). Therefore, an OLS model is also used as a robustness check in Section 5.1.2.

Figure 5.1 Histogram of Preventable fees
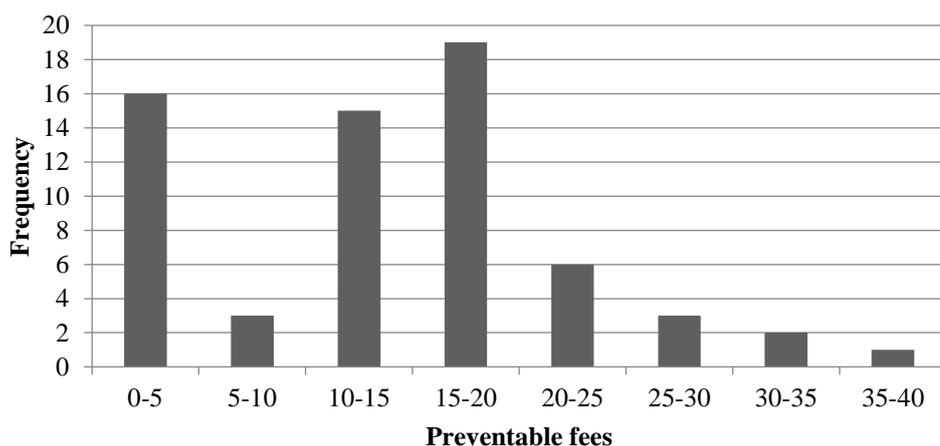
Four models are estimated with the same dependent variable (Preventable fees) but different explanatory variables. Model (I) only uses dummy variables indicating which treatment group each observation belongs to. In Model (II), variables capturing statements of perception and the importance of each feature are added. Model (III) has treatment group dummies and eye-tracking variables. The final and most general Model (IV) includes all aforementioned variables (treatment group dummies, statements of perception, importance of each feature, and eye-tracking variables). Control variables are included in all four models.

Table 5.1 shows the results of these regressions. In all four models, the coefficients of TG1 are positive but not statistically different from zero. Therefore, Hypothesis 7a is rejected. Although this is not in line with previous findings, note that in this case, the sample is much

smaller, which would result in more imprecise estimates. On the other hand, coefficients of TG2 are negative in all four models and statistically significant at 5% level in Model (I) and (II). This suggests that the treatment for TG2 (net expected return with bounds) lowers the incurred preventable fees and helps participants make more optimal decisions, which is consistent with Hypothesis 8a. However, the effect is no longer statistically significant when eye-tracking variables are added in Model (III) and (IV), implying that eye-tracking variables have additional exploratory power.

Regarding the first of the eye-tracking variables, Comparisons across different alternatives, the coefficients of Comparisons of graphs is negative and statistically significant at 1% level in Model (III). This is consistent with Hypothesis 1a where more comparisons across graphs help reduce preventable fees. However, Comparisons of Charges tables is positively related with preventable fees although this effect is not statistically significant. Therefore, Hypothesis 2 is still inconclusive.

Similar to Comparisons, more time focused on cheapest fund's graph decreases Preventable fees significantly, which is consistent with Hypothesis 4b. The coefficient of Focus on cheapest fund's graph can be interpreted as the difference in Preventable fees between two extremes: participants who do not look at the cheapest fund's graph (0%) and those who look only at that graph (100%), ceteris paribus. In terms of standardized coefficients, one standard deviation increase in Focus on cheapest fund's graph (0.168) decrease Preventable fees by 24.6% of its standard deviation (9.367). On the other hand, Focus on Charges tables of the cheapest fund also has negative coefficients, but they are not statistically different from zero. Therefore, Hypothesis 4a can neither be rejected nor confirmed. Overall, it is suspected that Focus and Comparisons have captured the effect of the information treatment on preventable fees. In Section 5.2, these relationships will be investigated further.

About mental efforts spent of specific information, Pupil dilation of Charges tables have positive coefficients, which are the only statistically significant variable out of three Pupil dilation variables. As expected, participants who exert more mental efforts while reading Charges tables may have difficulty understanding them, which is supported by positive coefficients of Total viewing time of Charges tables, both of which is statistically significant at 1% level in Model (IV). In standardized terms, one standard deviation increase in Total viewing time of Charges table (15.428) raises Preventable fees by 151% of its standard deviation (9.367). Therefore, it can be concluded that more mental effort does not lead to better decisions, rejecting Hypothesis 5.

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The number of fixations is proxy for the importance of the fixated information. In Model (III), Number of fixations in Charges tables and graphs both have statistically significant coefficients with opposite signs. One more fixation on Charges table, which usually lasts for a quarter of a second on an average human, decreases Preventable fees by 19.7 cents (Model III) or 24.9 cents (Model IV). Translated to standardized terms, in Model IV, one standard deviation increase in Number of fixations in Charges table (67.381) cuts Preventable fees by 179% of its standard deviation (9.367). Unsurprisingly, more emphasis on Charges tables help reduce fees considerably. However, it is interesting that while Total viewing time on Charges tables is positively correlated with Preventable fees, Number of fixations in Charges tables have the opposite effect. It can be inferred that with Charges tables, activities which result in a high quantity of short fixations, such as quickly comparing between different tables, reduce fees. On the other hand, with graphs, a lower number of fixations with longer total viewing time decrease fees. This suggests an inherent difference between these types of information representation.

Regarding the experience during the experiment, two variables are statistically significant. When controlling for eye properties in Model (IV), the perception of being provided with "sufficient information" reduces preventable fees considerably. In contrast, participants perceiving that the investment decision "took a lot of time" incur higher fees, which may be explained by their unfamiliarity with investment materials and/or investing in general.

As expected of the significant feature variables' coefficients, Fund charges and Risk level indicator are negative while Desire to diversify are positive. Participants placing more attention to charges or risk level indicator should indeed have lower amount of preventable fees while those (naively) trying to diversify incur more fees.

Judged by the statistical significance, the most important control variables (not reported) are Previous investing experience, Self-assessed financial literacy, and Studying finance. Previous investing experience lowers fees to a small extent and is no longer distinguishable from zero as more variables are added to the models. Interestingly, higher self-assessed financial literacy leads to significantly higher preventable fees, which is consistent with the explanation that participants may overestimate their own ability (and are punished by incurring higher fees). This is indication that overconfidence does exist in the average investor and is a costly bias. Finally, Studying finance understandably has a large negative impact on preventable fees, lowering the amount of preventable fees incurred substantially. To see if finance students may have biased the findings in the next section on robustness check, a robustness check with finance students removed from the sample is conducted in Section 5.1.2.

Table 5.1 Effect of treatment, eye properties, perception, and features on preventable fees

Dependent variable	(I) Tobit Preventable fees	(II) Tobit Preventable fees	(III) Tobit Preventable fees	(IV) Tobit Preventable fees
Treatment Group 1	4.616	4.040	4.579	4.715
	(2.998)	(2.483)	(3.782)	(3.076)
Treatment Group 2	-6.910**	-4.687**	-6.542	-4.589
	(2.782)	(1.992)	(3.981)	(3.258)
Comparisons of SRRI			-0.266	-0.534*
			(0.380)	(0.289)
Comparisons of Charges tables			0.142	0.162
			(0.146)	(0.133)
Comparisons of graphs			-0.253***	-0.0686
			(0.0888)	(0.0887)
Pupil dilation of SRRI			0.145	0.0546
			(0.181)	(0.126)
Pupil dilation of Charges tables			0.317**	0.230***
			(0.119)	(0.0820)
Pupil dilation of graphs			-0.320	-0.178
			(0.213)	(0.147)
Total viewing time of SRRI			-0.532	-0.740
			(0.701)	(0.601)
Total viewing time of Charges tables			0.545*	0.922***
			(0.297)	(0.260)
Total viewing time of graphs			-0.113	-0.241**
			(0.112)	(0.0985)
Focus on cheapest fund's SRRI			13.88	18.36*
			(12.22)	(9.797)
Focus on cheapest fund's Charges tables			-15.93	-9.282
			(16.61)	(11.82)
Focus on cheapest fund's graph			-23.48**	-13.69*
			(8.978)	(7.508)
Number of fixations in SRRI			0.226	0.252*
			(0.163)	(0.131)
Number of fixations in Charges tables			-0.197**	-0.249***
			(0.0907)	(0.0808)
Number of fixations in graphs			0.0890*	0.0531
			(0.0445)	(0.0374)
Sufficient information		-1.351		-3.110**
		(1.460)		(1.354)
Took a lot of time		2.875**		2.642**
		(1.222)		(1.019)
Confident about decision		-2.128		-0.883
		(1.823)		(1.411)
Able to compare funds		-0.501		-0.540
		(1.403)		(1.367)
Fund charges		-3.502**		-3.898**
		(1.570)		(1.553)
Past performance		-0.367		0.798
		(1.279)		(1.148)
Use of derivatives		0.274		-0.807
		(1.097)		(1.122)
Desire to diversify		4.656***		4.968***
		(1.310)		(1.230)
Risk level indicator		-1.987*		-1.170
		(1.055)		(0.950)
Constant	8.194	11.60	21.74**	16.23
	(8.929)	(11.45)	(9.462)	(11.80)
Observations	65	65	65	65
Sample	Full sample	Full sample	Full sample	Full sample
Control variables	Yes	Yes	Yes	Yes
Pseudo R-squared	0.0644	0.1557	0.1259	0.2212

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level*

Robust standard errors in parentheses

5.1.2 *Robustness check*

As mentioned previously, OLS regression is also used to check robustness of the Tobit models. In Table 5.2, although the coefficients become smaller in absolute value, most of them remain statistically significant and the directions of the effects are preserved. Most importantly, information treatment for TG2 still reduces Preventable fees at 5% significance level in Model (I) and (II). Most of the other significant effects displayed by the Tobit model are confirmed by the OLS model, including Comparisons of graphs, Pupil dilation of Charges tables, Total viewing time of Charges tables, Focus on cheapest fund's graph, Number of fixations in Charges tables, Took a lot of time, Fund charges, and Desire to diversify. Overall, the robustness check with OLS confirms previous findings in Section 5.1.1.

The second robustness check in Table 5.3 is the model estimated using Tobit on a sample excluding the 15 finance students from the sample. Model (I) to (III) largely confirms the signs of previous coefficients, with some losing or gaining statistical significance. The dummies for TG2 are still negative and statistically significant in the first two models. In Model (II), statements about perception and features agree with those in the original Tobit model. On the other hand, in Model (III), the coefficients of Comparison of Charges tables and Total viewing time of Charges tables are now statistically significant while none of the Pupil dilation variables are. It can be inferred that a sample completely untrained in the finance practice may have difficulty understanding the Charges tables, which increases the incurred fees. Without financial education, exerting more mental efforts may not lead to a more optimal outcome, as demonstrated by the insignificance of all Pupil dilation variables. Finally, regarding Model (IV), a large shift occurs with dummies for TG1 and TG2 while other coefficients maintain their signs. However, this result may not be valid due to having too many exploratory variables (35 variables, including control variables) and a smaller sample (50 observations after excluding finance students). Therefore, Model (IV) of the robustness check in Table 5.3 is for reference purpose only.

Table 5.2 Robustness check – Preventable fees - OLS

	(I) OLS	(II) OLS	(III) OLS	(IV) OLS
Dedependent variable	**Preventable fees**	**Preventable fees**	**Preventable fees**	**Preventable fees**
Treatment Group 1	3.480	2.914	4.325	4.804
	(2.658)	(2.574)	(3.871)	(3.695)
Treatment Group 2	-6.135**	-4.386**	-5.244	-1.957
	(2.306)	(1.918)	(4.056)	(3.858)
Comparisons of SRRI			-0.243	-0.362
			(0.405)	(0.396)
Comparisons of Charges tables			0.160	0.127
			(0.149)	(0.156)
Comparisons of graphs			-0.182**	-0.0440
			(0.0865)	(0.129)
Pupil dilation of SRRI			0.0726	0.000230
			(0.175)	(0.169)
Pupil dilation of Charges tables			0.274**	0.172*
			(0.122)	(0.101)
Pupil dilation of graphs			-0.196	-0.0315
			(0.212)	(0.185)
Total viewing time of SRRI			-0.459	-0.300
			(0.711)	(0.769)
Total viewing time of Charges tables			0.442	0.517*
			(0.297)	(0.254)
Total viewing time of graphs			-0.104	-0.187
			(0.114)	(0.114)
Focus on cheapest fund's SRRI			10.26	7.823
			(11.79)	(11.44)
Focus on cheapest fund's Charges tables			-16.15	-9.524
			(15.20)	(12.10)
Focus on cheapest fund's graph			-19.24**	-14.17
			(8.744)	(8.600)
Number of fixations in SRRI			0.196	0.148
			(0.168)	(0.170)
Number of fixations in Charges tables			-0.156*	-0.132
			(0.0893)	(0.0785)
Number of fixations in graphs			0.0627	0.0245
			(0.0435)	(0.0467)
Sufficient information		-0.957		-2.104
		(1.315)		(1.582)
Took a lot of time		2.378*		2.017
		(1.192)		(1.304)
Confident about decision		-1.876		-0.981
		(1.818)		(1.884)
Able to compare funds		-0.195		-0.792
		(1.325)		(1.555)
Fund charges		-3.205*		-3.543*
		(1.591)		(1.916)
Past performance		-0.228		0.922
		(1.256)		(1.369)
Use of derivatives		0.129		-0.693
		(1.062)		(1.441)
Desire to diversify		2.524**		2.127
		(1.128)		(1.373)
Risk level indicator		-1.803		-1.110
		(1.092)		(1.231)
Constant	10.27	17.26	21.35**	26.04*
	(8.306)	(10.99)	(9.797)	(14.27)
Observations	65	65	65	65
Sample	Full sample	Full sample	Full sample	Full sample
Control variables	Yes	Yes	Yes	Yes
R-squared	0.338	0.616	0.634	0.774

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level*

Robust standard errors in parentheses

Table 5.3 Robustness check – Preventable fees – Finance students removed

Dependent variable	(I) Tobit Preventable fees	(II) Tobit Preventable fees	(III) Tobit Preventable fees	(IV) Tobit Preventable fees
Treatment Group 1	2.845	4.969*	3.832	7.861**
	(3.025)	(2.843)	(4.648)	(3.431)
Treatment Group 2	-7.866***	-5.084***	-4.926	0.517
	(2.652)	(1.556)	(5.553)	(3.917)
Comparisons of SRRI			-0.310	-0.465
			(0.427)	(0.298)
Comparisons of Charges tables			0.465**	0.808***
			(0.186)	(0.210)
Comparisons of graphs			0.0590	0.286*
			(0.127)	(0.140)
Pupil dilation of SRRI			0.0552	0.0716
			(0.208)	(0.131)
Pupil dilation of Charges tables			0.144	-0.0781
			(0.146)	(0.141)
Pupil dilation of graphs			0.0617	0.287
			(0.244)	(0.195)
Total viewing time of SRRI			-0.143	0.470
			(0.817)	(0.592)
Total viewing time of Charges tables			0.671*	0.923***
			(0.355)	(0.267)
Total viewing time of graphs			-0.123	-0.239*
			(0.142)	(0.120)
Focus on cheapest fund's SRRI			2.700	9.135
			(16.13)	(11.99)
Focus on cheapest fund's Charges tables			-6.955	-3.944
			(19.42)	(9.136)
Focus on cheapest fund's graph			-25.25**	-11.38
			(9.419)	(10.72)
Number of fixations in SRRI			0.107	-0.0316
			(0.216)	(0.140)
Number of fixations in Charges tables			-0.192*	-0.231**
			(0.103)	(0.0798)
Number of fixations in graphs			0.00824	-0.0552
			(0.0708)	(0.0511)
Sufficient information		-1.400		-4.754**
		(1.665)		(1.625)
Took a lot of time		3.916***		0.796
		(1.078)		(1.047)
Confident about decision		-1.073		0.757
		(1.824)		(1.447)
Able to compare funds		1.148		0.448
		(1.414)		(1.981)
Fund charges		-2.825*		-6.565***
		(1.658)		(2.071)
Past performance		-1.694		-0.530
		(1.468)		(1.131)
Use of derivatives		-0.333		-2.699***
		(0.975)		(0.882)
Desire to diversify		3.231**		2.295
		(1.549)		(1.416)
Risk level indicator		-3.160**		0.263
		(1.290)		(1.479)
Constant	7.222	8.350	26.75*	31.65**
	(9.118)	(11.01)	(13.61)	(11.46)
Observations	50	50	50	50
Sample	No finance students	No finance students	No finance students	No finance students
Control variables	Yes	Yes	Yes	Yes
Pseudo R-squared	0.0509	0.1556	0.1261	0.2611

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level

Robust standard errors in parentheses

5.2 Comparisons, focus, and preventable fees

5.2.1 Regression models

In this section, the relationships between comparisons, focus, and preventable fees are investigated using Tobit models and multiplicative dummies. Specifically, treatment group dummies are multiplied with Comparisons of graphs in Model (VI) and with Focus of cheapest fund's graph in Model (VIII). Because the treatment is only administered to the graphs of the KIID, this allows for different effects of different treatment on Preventable fees. The final Model (IX) includes multiplicative dummies for both variables. The regression results are shown in Table 5.4.

Table 5.4 Effects of Comparisons and Focus on Preventable fees

	(V) Tobit	(VI) Tobit	(VII) Tobit	(VIII) Tobit	(IX) Tobit
Dependent variable	Preventable fees	Preventable fees	Preventable fees	Preventable fees	Preventable fees
Treatment Group 1	4.809	-8.167	8.112***	11.04*	-2.003
	(3.122)	(6.384)	(2.699)	(6.456)	(9.186)
Treatment Group 2	-6.829**	-17.54**	-0.00532	4.202	-12.77
	(2.632)	(6.641)	(3.119)	(8.618)	(11.31)
Comparisons of SRRI	0.315	0.175			0.234
	(0.243)	(0.250)			(0.216)
Comparisons of Charges tables	-0.104	-0.123			-0.194**
	(0.112)	(0.107)			(0.0828)
Comparisons of graphs	-0.0244	-0.159**			-0.235***
	(0.0537)	(0.0663)			(0.0547)
Comparisons of graphs *TG1		0.322**			0.182
		(0.128)			(0.111)
Comparisons of graphs *TG2		0.255**			0.308***
		(0.121)			(0.112)
Focus on cheapest fund's SRRI			3.484	3.522	12.10
			(10.60)	(10.60)	(11.02)
Focus on cheapest fund's Charges tables			-19.13	-20.49	-27.13**
			(13.48)	(14.14)	(13.40)
Focus on cheapest fund's graph			-26.27***	-14.96	-40.80**
			(8.830)	(17.69)	(16.64)
Focus on cheapest fund's graph *TG1				-13.64	9.431
				(21.79)	(19.18)
Focus on cheapest fund's graph *TG2				-15.81	6.397
				(24.97)	(23.47)
Constant	4.872	10.78	21.78**	21.34**	27.97***
	(8.858)	(10.15)	(10.22)	(10.45)	(8.750)
Observations	65	65	65	65	65
Sample	Full sample	Full sample	Full sample	Full sample	Full sample
Control variables	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.0680	0.0846	0.0930	0.0940	0.1298

**** Significant at 1% level, ** significant at 5% level, * significant at 10% level*
Robust standard errors in parentheses

Interestingly, while Model (V) does not have any statistically significant variables except for TG2 dummy, Model (VI) reveals that Comparisons of graphs reduces fees for the base group (CG) but this effect is negated for TG1 and TG2. Evidently, this suggests that the information

treatment does not reduce fees by prompting participants to make more comparisons, rejecting Hypotheses 9a and 9b.

On the other hand, Model (VII) shows that the treatment for TG1 increases fees and Focus on cheapest fund's graph decreases fees significantly (at 1% level). When multiplicative dummies are added in Model (VIII), the coefficients of Focus on cheapest fund's graphs and its multiplicative dummies are negative as predicted by Hypotheses 10a and 10b but none of them are statistically significant. Furthermore, in Model (IX), the coefficients of these multiplicative dummies change sides to positive although they are still not significant. Therefore, Hypotheses 10a and 10b can neither be rejected nor confirmed.

Contrary to Table 5.1, in the final Model (IX), Comparisons and Focus on cheapest fund's Charges table reduce fees significantly at 5% confidence level. This is evidence supporting Hypotheses 2 and 4a, which found no conclusive effects in Table 5.1.

5.2.2   Robustness check

Similar to Section 5.1, two robustness checks are conducted for Section 5.2. The first one is OLS regression, whose results can be found in Table 5.5. Compared to Table 5.4, most of the previous results remain valid, except for Comparisons of Charges tables, which is no longer statistically different from zero. This cast doubt on Hypothesis 2. However, Focus on cheapest fund's Charges table is still significant at 10% level.

The second robustness check in Table 5.6 is a Tobit model with finance students removed from the sample and yields results similar to the first check. Almost all earlier relationships maintain their signs and significance, except for Comparisons of Charges tables and Focus on cheapest fund's Charges tables, which are no longer statistically significance. Furthermore, coefficients of the former variable are positive. Therefore, Hypothesis 2 and 4a remain inconclusive.

Table 5.5 Robustness check - Focus, comparisons, and preventable fees - OLS

Dependent variable	(V) OLS Preventable fees	(VI) OLS Preventable fees	(VII) OLS Preventable fees	(VIII) OLS Preventable fees	(IX) OLS Preventable fees
Treatment Group 1	3.802	-7.612	6.492***	8.852	-4.570
	(2.866)	(6.016)	(2.373)	(5.551)	(9.366)
Treatment Group 2	-6.156***	-14.59**	-0.596	1.239	-13.40
	(2.231)	(5.531)	(2.890)	(7.039)	(10.62)
Comparisons of SRRI	0.256	0.137			0.191
	(0.214)	(0.230)			(0.210)
Comparisons of Charges tables	-0.0327	-0.0524			-0.107
	(0.0829)	(0.0854)			(0.0746)
Comparisons of graphs	-0.0262	-0.136**			-0.206***
	(0.0505)	(0.0590)			(0.0545)
Comparisons of graphs *TG1		0.291**			0.188
		(0.128)			(0.122)
Comparisons of graphs *TG2		0.204**			0.237**
		(0.0993)			(0.100)
Focus on cheapest fund's SRRI			3.163	3.266	6.900
			(9.102)	(9.332)	(10.06)
Focus on cheapest fund's Charges tables			-19.40	-19.79	-23.61*
			(11.67)	(12.17)	(12.90)
Focus on cheapest fund's graph			-20.37***	-13.44	-36.83**
			(7.171)	(14.58)	(15.77)
Focus on cheapest fund's graph *TG1				-9.786	14.91
				(17.94)	(18.73)
Focus on cheapest fund's graph *TG2				-7.944	15.30
				(19.82)	(21.25)
Constant	7.083	11.04	22.43**	21.65**	26.84***
	(8.192)	(9.364)	(9.274)	(9.991)	(8.753)
Observations	65	65	65	65	65
Sample	Full sample	Full sample	Full sample	Full sample	Full sample
Control variables	Yes	Yes	Yes	Yes	Yes
R-squared	0.350	0.430	0.470	0.472	0.580

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level

Robust standard errors in parentheses

Table 5.6 Robustness check - Focus, comparisons, and preventable fees – Finance students removed

Dependent variable	(V) Tobit Preventable fees	(VI) Tobit Preventable fees	(VII) Tobit Preventable fees	(VIII) Tobit Preventable fees	(IX) Tobit Preventable fees
Treatment Group 1	3.508	-11.73	4.599	6.269	-25.34
	(2.842)	(7.921)	(2.792)	(8.000)	(16.18)
Treatment Group 2	-7.737***	-21.51***	0.234	4.930	-19.91*
	(2.637)	(7.420)	(3.142)	(8.576)	(11.09)
Comparisons of SRRI	0.226	-0.0406			-0.0469
	(0.248)	(0.272)			(0.202)
Comparisons of Charges tables	0.179	0.0548			0.0449
	(0.182)	(0.170)			(0.104)
Comparisons of graphs	-0.00678	-0.152**			-0.228***
	(0.0554)	(0.0711)			(0.0543)
Comparisons of graphs *TG1		0.344**			0.332**
		(0.145)			(0.141)
Comparisons of graphs *TG2		0.317**			0.365***
		(0.135)			(0.108)
Focus on cheapest fund's SRRI			5.516	4.877	11.49
			(11.57)	(11.33)	(11.54)
Focus on cheapest fund's Charges tables			-21.20	-23.57	-20.93
			(14.30)	(15.93)	(14.06)
Focus on cheapest fund's graph			-33.41***	-22.60	-50.27**
			(9.576)	(19.54)	(19.03)
Focus on cheapest fund's graph *TG1				-8.874	52.42
				(26.83)	(35.00)
Focus on cheapest fund's graph *TG2				-16.26	17.76
				(25.98)	(24.28)
Constant	0.239	13.74	26.36**	26.97**	30.32***
	(9.877)	(11.97)	(11.30)	(11.27)	(9.913)
Observations	50	50	50	50	50
Sample	No finance students	No finance students	No finance students	No finance students	No finance students
Control variables	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.0578	0.0801	0.0952	0.0963	0.1277

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level*

Robust standard errors in parentheses

5.3 Perceived risk level standard deviation

5.3.1 Regression models

To investigate if the explanatory variables' effects on Risk level standard deviation, four Tobit models are used because more than 73% of observations (48 out of 65) have their standard deviation equal to zero (when participants perceive the same level of risk across three funds). Therefore, the variation in of the independent variable, Risk level standard deviation, is limited to the variation of 17 observations. Please refer to Figure 5.2 for the histogram of this variable. High standard deviation implies an incorrect perception of risk level because all three funds have the same risk level. Besides control variables, Model (X) include only treatment group dummies, Model (XI) adds Comparisons variables, Model (XII) has explanatory variables of features' importance and perceived experience, and Model (XIII) include all aforementioned variables. Table 5.7 reports the results of these regressions.

Figure 5.2 Histogram of Risk level standard deviation
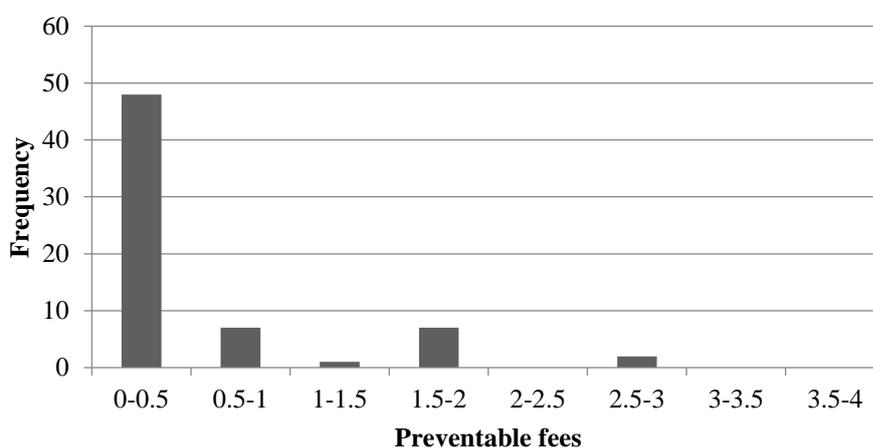
First, while coefficients of TG1 are not statistically significant in all models, those of TG2 are positive and statistically significant in three out of four models. When features' importance and perceived experience are added in Model (XII), this effect becomes statistically insignificant. Instead, the variation in standard deviation can be explained by participants' perception of the decision (Able to compare funds) or features' importance (Use of derivatives, Desire to diversify, and Risk level indicator). The information treatments introduced to TG1 and TG2 either do not affect or increase standard deviation of risk assessment, which rejects Hypothesis 7b and 8b.

Second, coefficients of Comparisons of SRRI are positive and statistically significant at 1% level in Model (XIII). At first sight, it is puzzling that more comparisons across SRRI result in incorrect assessments of the funds' risk levels. However, it can also be interpreted that

participants having difficulty understanding the risk levels of the funds and thus must make more comparisons before proceeding. Nevertheless, Hypothesis 3 is rejected.

Finally, Comparisons of graphs' coefficients are negative but not statistically significant. Therefore, Hypothesis 1b cannot be confirmed. Surprisingly, Comparisons of Charges tables have negative and statistically significant coefficients, suggesting that extra comparisons of Charges tables help participants understand risk levels better. To explain this relationship, further research into investors' understanding of risk is needed.

Table 5.7 Effect of treatment, comparisons, perception, and features on standard deviation of perceived risk level

Dependent variable	(X) Tobit Standard deviation	(XI) Tobit Standard deviation	(XII) Tobit Standard deviation	(XIII) Tobit Standard deviation
Treatment Group 1	1.140	1.330	0.283	-0.284
	(0.775)	(0.919)	(0.692)	(0.920)
Treatment Group 2	1.697**	1.951**	0.480	1.104*
	(0.721)	(0.741)	(0.670)	(0.594)
Comparisons of SRRI		0.112		0.317***
		(0.0933)		(0.0902)
Comparisons of Charges tables		-0.0704*		-0.271***
		(0.0408)		(0.0644)
Comparisons of graphs		-0.000613		-0.00552
		(0.0169)		(0.0164)
Sufficient information			-0.554*	-0.686
			(0.329)	(0.441)
Took a lot of time			-0.00531	0.883***
			(0.247)	(0.307)
Confident about decision			0.118	0.113
			(0.337)	(0.246)
Able to compare funds			0.839**	0.679*
			(0.385)	(0.402)
Fund charges			-0.0501	0.345
			(0.299)	(0.318)
Past performance			-0.385	-0.00745
			(0.311)	(0.323)
Use of derivatives			0.754***	1.541***
			(0.259)	(0.386)
Desire to diversify			0.727**	1.625***
			(0.316)	(0.390)
Risk level indicator			0.691**	0.973***
			(0.326)	(0.300)
Constant	-5.005**	-6.662**	-7.245***	-20.74***
	(2.410)	(3.036)	(2.153)	(4.892)
Observations	65	65	65	65
Sample	Full sample	Full sample	Full sample	Full sample
Control variables	Yes	Yes	Yes	Yes
Pseudo R-squared	0.2398	0.2556	0.4219	0.5394

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level
Robust standard errors in parentheses

5.3.2 Robustness check

The robustness check for Model (X) to (XIII) is conducted with 15 finance students removed from the sample and its results are reported in Table 5.8. Because the majority of the observations (73%) has standard deviation of risk level at the lower limit of zero, OLS estimation may produce biased coefficients.

Overall, the robustness check agrees with previous models, except for a few points. When excluding finance students, the coefficient of Comparison of graphs is negative and statistically significant at 5% level in Model (XIII). While Hypothesis 1b cannot be confirmed previously, now there is supporting evidence within the non-finance-student sample.

Table 5.8 Robustness check – Standard deviation – Finance students removed

	(X) Tobit	(XI) Tobit	(XII) Tobit	(XIII) Tobit
Dependent variable	**Standard deviation**	**Standard deviation**	**Standard deviation**	**Standard deviation**
Treatment Group 1	0.909	1.621*	0.149	3.097*
	(0.902)	(0.918)	(0.818)	(1.705)
Treatment Group 2	1.713**	2.147***	0.593	4.019**
	(0.674)	(0.733)	(0.667)	(1.770)
Comparisons of SRRI		0.162		0.963***
		(0.104)		(0.344)
Comparisons of Charges tables		-0.0674		-0.517***
		(0.0466)		(0.173)
Comparisons of graphs		-0.0100		-0.123**
		(0.0166)		(0.0469)
Sufficient information			-0.577	-1.509**
			(0.401)	(0.707)
Took a lot of time			0.0150	2.405**
			(0.211)	(1.084)
Confident about decision			-0.00556	1.773*
			(0.328)	(1.013)
Able to compare funds			0.668*	-0.109
			(0.378)	(0.432)
Fund charges			0.00671	-0.279
			(0.270)	(0.561)
Past performance			-0.515*	0.685
			(0.285)	(0.487)
Use of derivatives			0.618**	2.698***
			(0.290)	(0.602)
Desire to diversify			0.841**	3.180***
			(0.355)	(0.972)
Risk level indicator			0.694*	4.057*
			(0.373)	(2.048)
Constant	-4.879**	-7.988**	-6.773***	-56.58**
	(2.295)	(3.259)	(1.994)	(24.03)
Observations	50	50	50	50
Sample	No finance students	No finance students	No finance students	No finance students
Control variables	Yes	Yes	Yes	Yes
Pseudo R-squared	0.1820	0.2124	0.3892	0.5743

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level.

Robust standard errors in parentheses

5.4 Pupil dilation

5.4.1 Regression model

    The final model examines the relationship between information treatments and mental efforts, which is proxied by Pupil dilation of graphs, using an OLS estimator. The result is shown in Table 5.9. Participants of TG2 may have extended more mental efforts than TG1 due to having more abstract elements: the lower bounds and upper bounds of expected return, and hence the positive coefficient in contrast to the negative coefficient of TG1. However, as expected, both of them are not statistically significant, rejecting Hypotheses 6a and 6b.

Table 5.9 Effects of treatment on Pupil dilation of graphs

	(XIV) OLS
Dependent variable	**Pupil dilation of graphs**
Treatment Group 1	-2.126
	(5.409)
Treatment Group 2	0.711
	(5.162)
Constant	-1.710
	(16.84)
Observations	65
Sample	Full sample
Control variables	Yes
R-squared	0.061

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level.

Standard errors in parentheses

5.4.2 Robustness check

    First, Breusch-Pagan test for heteroskedasticity (not reported) found no evidence of heteroskedasticity in Model (XIV) of Table 5.9. Moreover, using robust standard errors does not change the statistical significance of any coefficients.

    As can be seen in Table 5.10, another robustness check removes finance students from the sample and found that the coefficients for TG1 and TG2 have increased in absolute terms but remain statistically insignificant. Therefore, the previous findings rejecting Hypothesis 6a and 6b remain valid: when fixating on graphical representation, individuals in TG1 and TG2 do not have a higher level of pupil dilation than those in CG.

Table 5.10 Robustness check – Pupil dilation of graphs – Finance students removed

Dependent variable	(XIV) OLS Pupil dilation of graphs
Treatment Group 1	-2.342
	(7.644)
Treatment Group 2	2.449
	(6.189)
Constant	-11.89
	(20.19)
Observations	50
Sample	No finance students
Control variables	Yes
R-squared	0.082

*** Significant at 1% level, ** significant at 5% level, * significant at 10% level.*

Standard errors in parentheses

5.5   Findings summary

After 14 regression models on three dependent variables, most of the hypotheses can be conclusively confirmed or rejected. More comparisons across different graphs help participants reduce preventable fees although it may not always help them understand the implied risk levels of the funds. On the other hand, extra comparisons on Charges table, which is one of the key information to the optimal decision but not represented graphically, do not decrease the incurred fees. This can be achieved by the net expected return graphs with bounds (TG2), which visualizes risks, charges, and expected return in a clear manner. It has also been shown that the information treatment does not demand extra mental efforts from investors. Nevertheless, it should be noted that the graphical treatment is no panacea; investors still need financial knowledge and mental efforts to reach the optimal outcome.

Contrary to expectations, the treatments do not help participants discern the correct risk levels of the funds. Neither do more comparisons across the graphical risk indicator (SRRI). Surprisingly, more comparisons across the Charges tables do. This is a promising direction for future eye-tracking research on the representation of financial information and how investors perceive risks.

6. Recommendation

Using an experimental approach, this thesis highlights how the quality of financial information in KIID and similar financial documents can be improved for the benefits of the investors. It is evident that replacing theoretically irrelevant information, such as past performance, by graphical representation of future outcome of the investment, such as net expected return, helps individuals make better investing decisions, and its use is not limited to only index mutual funds. Because index mutual funds tracking the same index have similar risks and returns, they are similar to commodities, which is useful in this experimental setting. However, the graphical treatment itself is applicable to index mutual funds and other investment products.

Even though the treatment cannot completely eliminate preventable fees, it is moderately effective and simple to implement. Therefore, regulators should consider applying the graphical representation on financial documents for investment products. Specifically, the KIID should be one of the first documents to be revised to use the net expected return graph with lower and upper bounds, which is proven to reduce preventable fees incurred while demanding no extra mental efforts from investors.

Furthermore, although whether the information treatment helps reduce fees through more comparisons across graphs or more focus on the cheapest funds remain inconclusive, eye-tracking data reveal that more comparisons across graphs or more focus on the cheapest funds reduce preventable fees. Therefore, other implementations which promote these behaviours should also be considered, for instance, websites allowing for easier graphical comparison of financial products. It is important to design these solutions to be as user-friendly as possible because untrained or inexperienced investors are the ones who stand to benefit the most.

Nevertheless, the importance of financial education cannot be denied. Simply being a finance student significantly reduces preventable fees, even after controlling for all other applicable variables. However, investors should regularly re-examine their financial knowledge in order to avoid overconfidence.

Despite the efforts put into this study, it is not without flaws. First, the sample size is limited due to logistical constraints. Therefore, there may not be enough statistical power to conclusively reject or confirm all hypotheses. Furthermore, the entire sample was Tilburg University students and is not fully representative of the population of current or future investors, which limit the generalizability of the results. On the other hand, it can be argued that the sample reflects inexperienced investors who may be making their first investments.

In addition, the experiment only includes index mutual funds with clear definition of entry charges, exit charges, and annual expenses. This calls into question how the results can be generalized to other financial products with different cost structures, such as funds with expense ratios (zero loads). However, it should be noted that the graphical information treatment itself has no properties limiting its applicability to any particular investment products.

Finally, although the KIID in the experiment were based on actual index mutual funds, how the three KIID were presented side-by-side is not close to how investors are presented with this information in reality. Rarely is information of all available alternatives spread out neatly across the table for investors to compare and make decisions. Therefore, it may be worthwhile for future studies to present the funds more realistically; for example, three funds' KIID are presented sequentially in randomized order.

7. Conclusion

Index mutual funds have been an important part of the financial markets and an essential investment vehicle in many investors' portfolios. However, it seems that the decisions regarding these funds have not been made optimally, especially those made by inexperienced individuals. Despite the existing policies requiring adequate information disclosure from the providers of these products, the investment decisions fail to reach their optimal outcome. Therefore, there is room for improvement regarding current policies as well as the decision-making process.

Existing literature proposed two solutions for this issue: increasing financial literacy and enhancing information disclosure. This thesis focused on the second approach, using a laboratory experiment to answer this research question: *"How does salient graphical information help investors make more optimal investment decisions?"*

With eye-tracking technology, an experiment was conducted and successfully obtained data from 65 participants. Analysing these data reveals many findings about how the information treatment and behaviours of participants relate to the optimality of the decisions.

Participants presented with graphs of net expected returns (with bounds) make noticeably better decisions than those presented with past returns as per current regulations. This implies that the current situation of investment decision is far from optimal, but it can be greatly improved by simple efforts from policy makers. Even from a relatively small sample, this result is significant and robust to different modifications of the models and sample. Moreover, the graphs of net expected returns do not require extra mental efforts from the investors. Considering the simplicity of this graphical representation with almost no downside, it is recommended that the graphs are adopted as soon as possible, starting from index mutual funds.

Furthermore, data captured by the eye-tracking equipment also reveal certain beneficial behaviours which can be associated with optimal decisions, namely comparing graphical elements of different alternative and focusing on the most optimal option. Therefore, future representation of financial information should try to promote these behaviours.

Besides the effect on preventable fees, the graphical representation does not seem to have a beneficial effect on participants' understanding of risk. However, the result suggests a few unexpected relationships between the eye-tracking variables the standard deviation of perceived risk levels. This may a worthwhile direction for future research.

In conclusion, graphical representation of financial information, specifically net expected return graphs visualizing charges and risks, can reduce the amount of preventable fees incurred by individual investors of index mutual funds while demanding no extra mental efforts. Therefore, it is recommended that the current past return graph should be replaced by the net expected return graph in the Key Investor Information Document of investment products, especially index mutual funds for the benefits of the investors.

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Tables and figures

Appendix

Appendix 1: Experiment questionnaire

I.   Investment decision

The below part in this page is the same for all three groups.

Survey Completion

0%   100%

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OBJECTIVES AND INVESTMENT STRATEGY OF THE FUNDS

Index fund A	Index fund B	Index fund C
The Fund aims to achieve a return on your investment, through a combination of capital growth and income on the Fund's assets, which reflects the return of the MSCI Europe Index, the Fund's benchmark index.	The objective of this Fund is to track the performance of MSCI Europe Index, and to minimize the tracking error between the net asset value of the Fund and the performance of the Index. The Fund aims to achieve a level of tracking error of the Fund and its index that will normally not exceed 1%.	The investment objective of the Fund is to closely match the risk and return characteristics of the MSCI Europe Index. The Fund invests in equities issued by or relating to companies included in the Index. The equities will be traded on stock exchanges in the countries included in the index.
The Fund aims to invest so far as possible and practicable in the equity securities that make up the benchmark index.	The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.	The Investment Manager will be able to use derivatives in order to deal with inflows and outflows and also if it allows a better exposition to an Index constituent.
The shares are listed on one or more stock exchanges and may be traded in currencies other than their base currency. The performance of your shares may be affected by this currency difference.		The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.

RISK AND REWARD PROFILE

The indicators below are based on historical data and may not be reliable indicators of the future risk profile of the Funds. The risk categories shown are not guaranteed and may change over time. The lowest category does not mean risk free.

Index fund A	Index fund B	Index fund C
Lower risk — Higher risk	Lower risk — Higher risk	Lower risk — Higher risk
Typically lower rewards / Typically higher rewards	Typically lower rewards / Typically higher rewards	Typically lower rewards / Typically higher rewards
1 2 3 4 **5** 6 7 (risk indicator)	1 2 3 4 **5** 6 7 (risk indicator)	1 2 3 4 **5** 6 7 (risk indicator)
The Fund is rated five due to the nature of its investments which include the risks described below. These factors may impact the value of the Fund's investments or expose the Fund to losses.	The risk level of this Fund mainly reflects the market risk arising from investments in European equities. Your initial investment does not benefit from any guarantee or protection.	The risk category is based on an estimation of the volatility of the fund.
The value of equities and equity-related securities can be affected by daily stock market movements. Other influential factors include political, economic news, company earnings and significant corporate events.	Important risks materially relevant to the Fund which are not adequately captured by the indicator are: liquidity risk, counterparty risk, operational risk and currency risk. The occurrence of any of these risks may have an impact on the net asset value of your portfolio.	The fund is grouped in risk category 5 because the volatility of the returns is high. Investors need to be willing and capable to carry increased risk. The value of a fund share can drop below the purchase price.

CHARGES

The charges are used to pay the costs of running the Fund, including the costs of marketing and distributing it. These charges reduce the potential growth of your investment.

Index fund A	Index fund B	Index fund C

Index fund A

One-off charges taken before or after you invest	
Entry charge:	0.00%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.12%

Index fund B

One-off charges taken before or after you invest	
Entry charge:	4.50%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.30%

Index fund C

One-off charges taken before or after you invest	
Entry charge:	2.50%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.15%

The ongoing charges figure is based on the fixed annualized fee charged to the Fund.	The ongoing charges figure is based on expenses for the current year.	The ongoing charges are based on the expenses in the period of 12 months which ended on the 31st of December.

This is the rest of the investment decision shown to the <u>Control Group</u>.

PAST PERFORMANCE

The graphs show the funds' annual performance in EUR for each full calendar year over the period displayed in the chart. Past performance is not a guide to future performance.
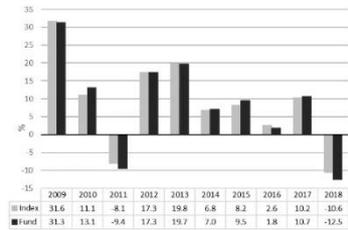
Index fund A	Index fund B	Index fund C
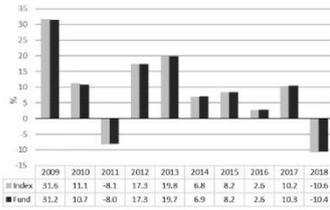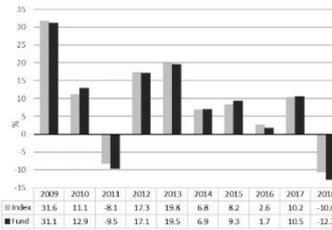
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Index	31.6	11.1	-8.1	17.3	19.8	6.8	8.2	2.6	10.2	-10.6
Fund	31.2	10.7	-8.0	17.3	19.7	6.9	8.2	2.6	10.3	-10.4

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Index	31.6	11.1	-8.1	17.3	19.8	6.8	8.2	2.6	10.2	-10.6
Fund	31.1	12.9	-9.5	17.1	19.5	6.9	9.3	1.7	10.5	-12.7

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Index	31.6	11.1	-8.1	17.3	19.8	6.8	8.2	2.6	10.2	-10.6
Fund	31.3	13.1	-9.4	17.3	19.7	7.0	9.5	1.8	10.7	-12.5

The Fund was launched in 2007. Performance is shown after deduction of ongoing charges. Any entry/exit charges are excluded from the calculation.

Reference index: MSCI Europe (EUR)

The annualized performances displayed in this diagram are calculated net income reinvested and net of all charges taken by the Fund.

The reference currency is the Euro.
The reference Index is: MSCI Europe

The displayed performance are in Euro and are shown after deduction of ongoing charges. Any entry/exit charges are excluded from the calculation.

The reference index is: MSCI Europe.

The investment decision
In which fund(s) do you invest your €1000?

Fund A	€	0
Fund B	€	0
Fund C	€	0
Total	€	0

[Next]

58

This is the rest of the investment decision shown to the Treatment Group 1.

EXPECTED RETURN AFTER COSTS
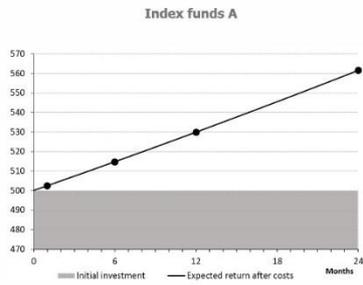
| Index funds A | Index fund B | Index fund C |

The graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

The graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

The graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

The grey area also show the initial investment amount, in which it is assumed that the full amount is invested in the fund.

The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.

The grey area show the initial investment amount, in which it is assumed that the full amount is invested in the fund.

The investment decision

In which fund(s) do you invest your €1000?

Fund A	€ 0
Fund B	€ 0
Fund C	€ 0
Total	€ 0

Next

This is the rest of the investment decision shown to the Treatment Group 2.

EXPECTED RETURN AFTER COSTS

Index funds A	Index fund B	Index fund C

This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

The graph also shows upper and lower bounds around the expected return after costs that represent potential optimistic and pessimistic views that might occur. These views are calculated in such a way that 95% of expected returns lie within the bounds.

The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.

This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

The graph also shows upper and lower bounds around the expected return after costs that represent potential optimistic and pessimistic views that might occur. These views are calculated in such a way that 95% of expected returns lie within the bounds.

The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.

This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

The graph also shows upper and lower bounds around the expected return after costs that represent potential optimistic and pessimistic views that might occur. These views are calculated in such a way that 95% of expected returns lie within the bounds.

The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.

The investment decision
In which fund(s) do you invest your €1000?

Fund A	€ 0
Fund B	€ 0
Fund C	€ 0
Total	€ 0

Next

60

II.   Decision questions

This part below is for all three groups.

What is the level of risk of the three index funds?

	Risk level 1	Risk level 2	Risk level 3	Risk level 4	Risk level 5	Risk level 6	Risk level 7
Index fund A	O	O	O	O	O	O	O
Index fund B	O	O	O	O	O	O	O
Index fund C	O	O	O	O	O	O	O

"I was presented with sufficient information to make a good estimation of the **level of risk** of the three index funds"

Totally disagree	Disagree	Neutral	Agree	Totally agree
O	O	O	O	O

"The investment decision took a lot of time"

Totally disagree	Disagree	Neutral	Agree	Totally agree
O	O	O	O	O

"I'm confident that I made the right investment decision"

Totally disagree	Disagree	Neutral	Agree	Totally agree
O	O	O	O	O

"I was able to compare the three funds properly based on the information provided"

Totally disagree	Disagree	Neutral	Agree	Totally agree
O	O	O	O	O

This part below is only for the Control Group.

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Please indicate the importance of the following aspects in making your investment decision:

	Not important at all	Not important	Neutral	Important	Very important
The ongoing charges and the entry and exit charges of the fund	○	○	○	○	○
Past performance	○	○	○	○	○
Use of derivatives	○	○	○	○	○
Desire to diversify the money across different funds	○	○	○	○	○
The risk level indicator	○	○	○	○	○

This part below is only for the Treatment Group 1.

TILBURG ✦ UNIVERSITY

Please indicate the importance of the following aspects in making your investment decision:

	Not important at all	Not important	Neutral	Important	Very important
The ongoing charges and the entry and exit charges of the fund	○	○	○	○	○
Past performance	○	○	○	○	○
Use of derivatives	○	○	○	○	○
Desire to diversify the money across different funds	○	○	○	○	○
The risk level indicator	○	○	○	○	○
The figure of net expected returns	○	○	○	○	○

This part below is only for the <u>Treatment Group 2</u>.

TILBURG ◆ UNIVERSITY

Please indicate the importance of the following aspects in making your investment decision:

	Not important at all	Not important	Neutral	Important	Very important
The ongoing charges and the entry and exit charges of the fund	○	○	○	○	○
Past performance	○	○	○	○	○
Use of derivatives	○	○	○	○	○
Desire to diversify the money across different funds	○	○	○	○	○
The risk level indicator	○	○	○	○	○
The figure of net expected returns with upper and lower bounds	○	○	○	○	○

III. Demographic questions

This part below is for all three groups.

TILBURG ✦ UNIVERSITY

Part 4: Demographic questions
In this part you will be asked some questions personal information. This gives us more insight into the composition of the participants of this survey.

What is your gender?

○ Male

○ Female

What is your age in years?

What is your current or otherwise highest achieved education level?

○ No education

○ Primary education

○ Secondary education

○ MBO (=intermediate vocational education)

○ Bachelor/Master HBO (=university of applied sciences)

○ Bachelor University

○ Master University

IV. Risk aversion questions

This part below is for all three groups.

Question 1
Suppose that you are the sole income provider for your family. You have a good job which enables you to always provide sufficient income for your family.

Now you are offered a new equivalent job. However, there is a **50% chance** that the salary of the new job:

- is **double** your current income.

or

- decreases your current income with **one-third**.

Would you accept the job?

- ○ Yes
- ○ No
- ○ I don't know
- ○ I don't want to answer

Below is first version of Question 2 (if participant choose "Yes" in Question 1).

Question 2
Suppose that you are the sole income provider for your family. You have a good job which enables you to always provide sufficient income for your family.

Now you are offered a new equivalent job. However, there is a **50% chance** that the salary of the new job:

- is **double** your current income.

or

- is **half** your current income.

Would you accept the job?

- ○ Yes
- ○ No
- ○ I don't know
- ○ I don't want to answer

Below is second version of Question 2 (if participant does not choose "Yes" in Question 1).

Question 2

Suppose that you are the sole income provider for your family. You have a good job which enables you to always provide sufficient income for your family.

Now you are offered a new equivalent job. However, there is a **50% chance** that the salary of the new job:

- is **double** your current income.

or

- decreases your current income with **one-fifth**.

Would you accept the job?

○ Yes

○ No

○ I don't know

○ I don't want to answer

V. Risk aversion questions

This part below is for all three groups.

Question 1

A book and a pen together cost €1.10. The book costs € 1.00 more than the pen. What is the price of the pen in **cents**?

Question 2

A portion of a lake is covered with a bunch of water lilies. The water lilies double in size every day, and it takes 48 days for the water lilies to cover the entire lake. How many **days** will it take to cover half the lake with water lilies?

Question 3

If it takes five machines five minutes to make five products. How many **minutes** does it take 100 machines to make 100 products?

VI.   Financial literacy questions

This part below is for all three groups.

Question 1

Suppose you have **€100** in a savings account. The interest rate is **2%** per year. How much euro will be in the savings account after five years? (Assume that you leave the money in the savings account for these five years)

○ More than 110 euro

○ Exactly 110 euro

○ Less than 110 euro

○ I don't know

Question 3

Suppose that Tom inherits **€10,000** today. At the moment, we know with certainty that Jerry will also inherit **€10.000** exactly 3 years from now. Which of the two is richer because of the inheritance? Assume a normal state of the economy.

○ Tom

○ Jerry

○ Tom and Jerry are equally rich

○ I don't know

Question 2

Suppose that the interest rate on your savings account is **2%** per year. The inflation rate is **3%** per year. After one year, would you be able to buy more, less or exactly the same as today with the money on your savings account.

○ More than today

○ Exactly the same as today

○ Less than today

○ I don't know

Question 4

Consider the following proposition:

"In general, an investment in an individual company's stock is less risky than an investment in a fund with stocks of multiple companies"

○ True

○ False

○ I don't know

Question 5

What happens to the prices of bonds if the interest rate declines?

○ The prices of bonds fall

○ The prices of bonds rise

○ The prices of bonds will stay the same

○ I don't know

Financial literacy varies among persons. What is your estimation of your own financial literacy?

Very low	Low	Below average	Above average	High	Very high	I don't know
○	○	○	○	○	○	○

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VII. Investing experience and end of questionnaire

This part below is for all three groups.

"I have experience with investing in financial products like stocks, bonds, and investment funds."

Completely disagree	Disagree	Neutral	Agree	Completely agree
○	○	○	○	○

How many years of work experience do you have (including full-time jobs and internships)?

○ None

○ Less than 1 year

○ Between 1 and 5 years

○ More than 5 years

Do you have work experience in the financial sector?

○ Yes

○ No

Dear participant,

Thanks for participating! Below there are two concluding questions on the potential payout of your reward and the use of your answers.

Would you like to be paid your investment reward over the period of **01-06-2019 to 30-06-2019?**

○ Yes. Please transfer my reward to the following bank account:

○ No

May other researchers use your answers for future research? Your answers will be treated anonymously.

○ Yes

○ No

Appendix 2: Stimuli and areas of interest

I. Stimulus 1 (CG)

1 OBJECTIVES AND INVESTMENT STRATEGY OF THE FUNDS

2 Index fund A

The Fund aims to achieve a return on your investment, through a combination of capital growth and income on the Fund's assets, which reflects the return of the MSCI Europe Index, the Fund's benchmark index.

The Fund aims to invest so far as possible and practicable in the equity securities that make up the benchmark index.

The shares are listed on one or more stock exchanges and may be traded in currencies other than their base currency. The performance of your shares may be affected by this currency difference.

3 Index fund B

The objective of this Fund is to track the performance of MSCI Europe Index, and to minimize the tracking error between the net asset value of the Fund and the performance of the Index. The Fund aims to achieve a level of tracking error of the Fund and its index that will normally not exceed 1%.

The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.

4 Index fund C

The investment objective of the Fund is to closely match the risk and return characteristics of the MSCI Europe Index. The Fund invests in equities issued by or relating to companies included in the Index. The equities will be traded on stock exchanges in the countries included in the index.

The Investment Manager will be able to use derivatives in order to deal with inflows and outflows and also if it allows a better exposition to an Index constituent.

The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.

5 RISK AND REWARD PROFILE

The indicators below are based on historical data and may not be reliable indicators of the future risk profile of the Funds. The risk categories shown are not guaranteed and may change over time. The lowest category does not mean risk free.

6 Index fund A

Lower risk — Higher risk
Typically lower rewards — Typically higher rewards

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

risk indicator

7 Index fund B

Lower risk — Higher risk
Typically lower rewards — Typically higher rewards

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

risk indicator

8 Index fund C

Lower risk — Higher risk
Typically lower rewards — Typically higher rewards

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

risk indicator

9 The Fund is rated five due to the nature of its investments which include the risks described below. These factors may impact the value of the Fund's investments or expose the Fund to losses.

The value of equities and equity-related securities can be affected by daily stock market movements. Other influential factors include political, economic news, company earnings and significant corporate events.

10 The risk level of this Fund mainly reflects the market risk arising from investments in European equities. Your initial investment does not benefit from any guarantee or protection.

Important risks materially relevant to the Fund which are not adequately captured by the indicator are: liquidity risk, counterparty risk, operational risk and currency risk. The occurrence of any of these risks may have an impact on the net asset value of your portfolio.

11 The risk category is based on an estimation of the volatility of the fund.

The fund is grouped in risk category 5 because the volatility of the returns is high. Investors need to be willing and capable to carry increased risk. The value of a fund share can drop below the purchase price.

12 CHARGES

The charges are used to pay the costs of running the Fund, including the costs of marketing and distributing it. These charges reduce the potential growth of your investment.

13 Index fund A

One-off charges taken before or after you invest	
Entry charge:	0.00%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.12%

14 Index fund B

One-off charges taken before or after you invest	
Entry charge:	4.50%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.30%

15 Index fund C

One-off charges taken before or after you invest	
Entry charge:	2.50%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.15%

16 The ongoing charges figure is based on the fixed annualized fees charged to the Fund.

17 The ongoing charges figure is based on expenses for the current year.

18 The ongoing charges are based on the expenses in the period of months which ended on the 31st of December.

19 PAST PERFORMANCE

The graphs show the funds' annual performance in EUR for each full calendar year over the period displayed in the chart. Past performance is not a guide to future performance.

20 Index fund A

21 Index fund B

22 Index fund C

23

24

25

26 The Fund was launched in 2007. Performance is shown after deduction of ongoing charges. Any entry/exit charges are excluded from the calculation.

27 The annualized performances displayed in this diagram are calculated net income reinvested and net of all charges taken by the Fund.

28 The displayed performance are in Euro and are shown after deduction of ongoing charges. Any entry/exit charges are excluded from the calculation.

29 Reference index: MSCI Europe (EUR)

30 The reference currency is the Euro. The reference Index is: MSCI Europe

31 The reference index is: MSCI Europe.

II. Stimulus 2 (TG1)

1 OBJECTIVES AND INVESTMENT STRATEGY OF THE FUNDS

2 Index fund A	**3** Index fund B	**4** Index fund C
The Fund aims to achieve a return on your investment, through a combination of capital growth and income on the Fund's assets, which reflects the return of the MSCI Europe Index, the Fund's benchmark index. The Fund aims to invest so far as possible and practicable in the equity securities that make up the benchmark index. The shares are listed on one or more stock exchanges and may be traded in currencies other than their base currency. The performance of your shares may be affected by this currency difference.	The objective of this Fund is to track the performance of MSCI Europe Index, and to minimize the tracking error between the net asset value of the Fund and the performance of the Index. The Fund aims to achieve a level of tracking error of the Fund and its index that will normally not exceed 1%. The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.	The investment objective of the Fund is to closely match the risk and return characteristics of the MSCI Europe Index. The Fund invests in equities issued by or relating to companies included in the Index. The equities will be traded on stock exchanges in the countries included in the index. The Investment Manager will be able to use derivatives in order to deal with inflows and outflows and also if it allows a better exposition to an Index constituent. The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.

5 RISK AND REWARD PROFILE

The indicators below are based on historical data and may not be reliable indicators of the future risk profile of the Funds. The risk categories shown are not guaranteed and may change over time. The lowest category does not mean risk free.

6 Index fund A	**7** Index fund B	**8** Index fund C
Lower risk — Higher risk Typically lower rewards — Typically higher rewards 1 2 3 4 **5** 6 7 risk indicator	Lower risk — Higher risk Typically lower rewards — Typically higher rewards 1 2 3 4 **5** 6 7 risk indicator	Lower risk — Higher risk Typically lower rewards — Typically higher rewards 1 2 3 4 **5** 6 7 risk indicator
9 The Fund is rated five due to the nature of its investments which include the risks described below. These factors may impact the value of the Fund's investments or expose the Fund to losses. The value of equities and equity-related securities can be affected by daily stock market movements. Other influential factors include political, economic news, company earnings and significant corporate events.	**10** The risk level of this Fund mainly reflects the market risk arising from investments in European equities. Your initial investment does not benefit from any guarantee or protection. Important risks materially relevant to the Fund which are not adequately captured by the indicator are: liquidity risk, counterparty risk, operational risk and currency risk. The occurrence of any of these risks may have an impact on the net asset value of your portfolio.	**11** The risk category is based on an estimation of the volatility of the fund. The fund is grouped in risk category 5 because the volatility of the returns is high. Investors need to be willing and capable to carry increased risk. The value of a fund share can drop below the purchase price.

12 CHARGES

The charges are used to pay the costs of running the Fund, including the costs of marketing and distributing it. These charges reduce the potential growth of your investment.

13 Index fund A		**14** Index fund B		**15** Index fund C	
One-off charges taken before or after you invest		One-off charges taken before or after you invest		One-off charges taken before or after you invest	
Entry charge:	0.00%	Entry charge:	4.50%	Entry charge:	2.50%
Exit charge:	0.00%	Exit charge:	0.00%	Exit charge:	0.00%
Charges taken from the fund over the period of one year		Charges taken from the fund over the period of one year		Charges taken from the fund over the period of one year	
Ongoing charges:	0.12%	Ongoing charges:	0.30%	Ongoing charges:	0.15%

16 The ongoing charges figure is based on the fixed annualized fee charged to the Fund.	**17** The ongoing charges figure is based on expenses for the current year.	**18** The ongoing charges are based on the expenses in the period of 12 months which ended on the 31st of December.

19 EXPECTED RETURN AFTER COSTS

| Index funds A	Index fund B	Index fund C
20	**21**	**22**
— Initial investment — Expected return after costs — Months	— Initial investment — Expected return after costs — Months	— Initial investment — Expected return after costs — Months
23 The graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.	**24** The graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.	**25** The graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.
29 The grey area also show the initial investment amount, in which is assumed that the full amount is invested in the fund.	**30** The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.	**31** The grey area show the initial investment amount, in which it is assumed that the full amount is invested in the fund.

III. Stimulus 3 (TG2)

1 OBJECTIVES AND INVESTMENT STRATEGY OF THE FUNDS

2 Index fund A

The Fund aims to achieve a return on your investment, through a combination of capital growth and income on the Fund's assets, which reflects the return of the MSCI Europe Index, the Fund's benchmark index.

The Fund aims to invest so far as possible and practicable in the equity securities that make up the benchmark index.

The shares are listed on one or more stock exchanges and may be traded in currencies other than their base currency. The performance of your shares may be affected by this currency difference.

3 Index fund B

The objective of this Fund is to track the performance of MSCI Europe Index, and to minimize the tracking error between the net asset value of the Fund and the performance of the Index. The Fund aims to achieve a level of tracking error of the Fund and its index that will normally not exceed 1%.

The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.

4 Index fund C

The investment objective of the Fund is to closely match the risk and return characteristics of the MSCI Europe Index. The Fund invests in equities issued by or relating to companies included in the Index. The equities will be traded on stock exchanges in the countries included in the Index.

The Investment Manager will be able to use derivatives in order to deal with inflows and outflows and also if it allows a better exposition to an Index constituent.

The Index is a Net Total Return Index: dividends net of tax paid by the index constituents are included in the Index return.

5 RISK AND REWARD PROFILE

The indicators below are based on historical data and may not be reliable indicators of the future risk profile of the Funds. The risk categories shown are not guaranteed and may change over time. The lowest category does not mean risk free.

6 Index fund A

Lower risk — Typically lower rewards / Higher risk — Typically higher rewards

1	2	3	4	5	6	7

risk indicator

7 Index fund B

Lower risk — Typically lower rewards / Higher risk — Typically higher rewards

1	2	3	4	5	6	7

risk indicator

8 Index fund C

Lower risk — Typically lower rewards / Higher risk — Typically higher rewards

1	2	3	4	5	6	7

risk indicator

9 The Fund is rated five due to the nature of its investments which include the risks described below. These factors may impact the value of the Fund's investments or expose the Fund to losses.

The value of equities and equity-related securities can be affected by daily stock market movements. Other influential factors include political, economic news, company earnings and significant corporate events.

10 The risk level of this Fund mainly reflects the market risk arising from investments in European equities. Your initial investment does not benefit from any guarantee or protection.

Important risks materially relevant to the Fund which are not adequately captured by the indicator are: liquidity risk, counterparty risk, operational risk and currency risk. The occurrence of any of these risks may have an impact on the net asset value of your portfolio.

11 The risk category is based on an estimation of the volatility of the fund.

The fund is grouped in risk category 5 because the volatility of the returns is high. Investors need to be willing and capable to carry increased risk. The value of a fund share can drop below the purchase price.

12 CHARGES

The charges are used to pay the costs of running the Fund, including the costs of marketing and distributing it. These charges reduce the potential growth of your investment.

13 Index fund A

One-off charges taken before or after you invest	
Entry charge:	0.00%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.12%

14 Index fund B

One-off charges taken before or after you invest	
Entry charge:	4.50%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.30%

15 Index fund C

One-off charges taken before or after you invest	
Entry charge:	2.50%
Exit charge:	0.00%
Charges taken from the fund over the period of one year	
Ongoing charges:	0.15%

16 The ongoing charges figure is based on the fixed annualized fee charged to the Fund.

17 The ongoing charges figure is based on expenses for the current year.

18 The ongoing charges are based on the expenses in the period of 12 months which ended on the 31st of December.

19 EXPECTED RETURN AFTER COSTS

20 Index funds A

21 Index fund B

22 Index fund C

23 This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

24 This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

25 This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

26 The graph also shows upper and lower bounds around the expected return after costs that represent potential optimistic and pessimistic views that might occur. These views are calculated in such a way that 95% of expected returns lie within the bounds.

27 The graph also shows upper and lower bounds around the expected return after costs that represent potential optimistic and pessimistic views that might occur. These views are calculated in such a way that 95% of expected returns lie within the bounds.

28 The graph also shows upper and lower bounds around the expected return after costs that represent potential optimistic and pessimistic views that might occur. These views are calculated in such a way that 95% of expected returns lie within the bounds.

29 The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.

30 The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.

31 The grey area shows the initial investment amount, in which it is assumed that the full amount is invested in the fund.

Appendix 3: Example of linear re-shift adjustments in eye-tracking data

Before linear re-shift adjustment
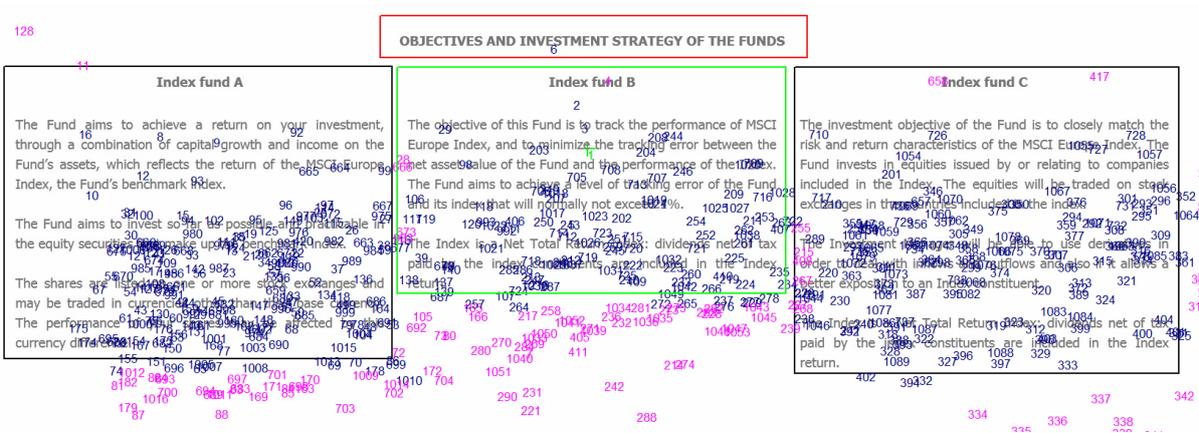
After linear re-shift adjustment
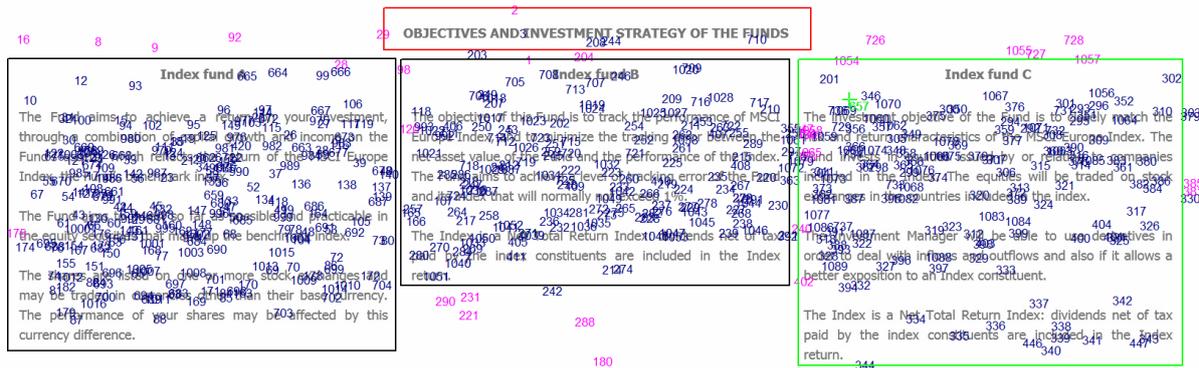
Legend:

- Pink number: fixations not assigned to any AOI
- Blue number: fixations assigned to a specific AOI