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Infographics and financial decisions: an eye-tracking experiment

Hong Phuoc (Michael) Vo
Reinier Cozijn
Peter de Goeij

DESIGN PAPER 206

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Editors
Frans Kooymans, Frans Kooymans-Text and Translation
Netspar

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Affiliations
Hong Phuoc (Michael) Vo – Tilburg University
Reinier Cozijn – Tilburg University
Peter de Goeij – Tilburg University

Abstract

The Key Investor Information Document (KIID), a communication instrument that contains infographics and tables, is mandatory for investment and insurance products that fall under UCITS. We conducted an incentive-compatible laboratory experiment using eye-tracking equipment to examine how the salience of infographics and tables can help investors in index mutual funds to minimize costs. Participants were confronted with a task to invest in various index mutual funds that track the same index. We find that net expected return graphs that visualize charges and risks reduce the amount of avoidable costs. The eye-tracking analysis shows that, when respondents make more comparisons between net expected return infographics or charges tables between different funds, avoidable costs are lower. The same holds when respondents focus more on infographics and tables. Moreover, the infographics and tables demand no extra mental efforts from investors. We recommend that the past return graph in the KIID be replaced by a net expected return graph.

Samenvatting

Het Key Investor Information Document (KIID), dat infographics en tabellen bevat om potentiële investeerders van informatie te voorzien, is verplicht voor de grote groep beleggings- en verzekeringsproducten die onder het regelgevingskader voor ICBE's vallen. In een 'incentive-compatible' survey-experiment, waarbij studenten als respondent fungeren, is met behulp van eye-tracking technologie onderzocht hoe de visualisatie van informatie hun beleggingsgedrag beïnvloedt. De respondenten werden geconfronteerd met een opdracht om te beleggen in verschillende indexfondsen. De empirische resultaten vertellen ons dat een infographic van het netto verwachte rendement dat de kosten en risico's visualiseert tot vermindering van vermijdbare kosten van de gekozen beleggingsstrategie leidt. De analyse van de oogbewegingen laat zien dat, wanneer een respondent de getoonde infographics en kostentabellen van de verschillende fondsen beter met elkaar vergelijkt, de vermijdbare kosten dan lager zijn. Dit geldt ook wanneer er meer gericht wordt op de infographics en kostentabellen, zonder dat dit een extra mentale inspanning van de respondenten vergt. Onze aanbeveling is om in het Key Investor Information Document de grafiek van het historische rendement te vervangen door een grafiek van het netto verwachte rendement.

1. Introduction

Contrary to the traditional framework of rational economic agents, the growing field of behavioral finance has shown that individuals are systematically biased when making financial decisions. This leads potentially to inefficient financial decisions, such as low participation in equity markets, less diversified portfolios, and decisions being influenced by the marketing efforts of companies and other irrelevant factors. To protect investors from such biases, academics generally propose two approaches: increasing the financial literacy of investors and enhancing the disclosure of financial information. In this paper we investigate the effectiveness of the second approach, by focusing on the mandatory Key Investor Information Document (KIID) that applies to a large number of investment and insurance products.

Academic evidence shows that decisions made by investors are not always as rational or optimal as the neoclassical framework assumes them to be. See, for example, Gruber (1996), Barber, Odean, and Zheng (2005), and Bailey, Kumar, and Ng (2011). Specifically, Kahneman and Egan (2011) argue that individuals utilize heuristics to make decisions, but that this process is vulnerable to systematic behavioral bias. Such bias is not limited to humans and may have an early-evolutionary origin (Chen, Lakshminarayanan, & Santos, 2006). This bias is most visible in the case of index mutual funds, due to the uniformity of returns when contrasted with the spread in fee level (Elton, Gruber, & Busse, 2004). Investigating why investors choose expensive index funds over cheaper ones, Choi, Laibson, and Madrian (2010) found that individuals fail to minimize fees, even after eliminating search costs and non-portfolio services. This violation of the law of one price remains one of the most puzzling phenomena in the financial world: that 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, such as by using graphical representations that convey risk information (Stone, Yates, & Parker, 1997).

Information disclosure is very important in the case of financial decisions such as portfolio choice. This is especially relevant for consumers who save for their pension in a defined contribution (DC) pension scheme and make personal investment decisions. Currently, most pension fund participants in the Netherlands have only limited freedom in their choice of investment. However, if more flexibility is allowed and offered, as planned for in the future, this research becomes very relevant for the way information and communication documents are designed. It is also relevant for the growing number of self-employed persons, who invest in 'generic' investment products such

as (index) mutual funds to save for their own pension, aside from the current legislation regarding information documents. In most cases, freedom of choice implies that the consumer or client must choose from a list of investment options, typically mutual funds. In a recent Netspar Design Paper[1], Cox and De Goeij (2020) showed that adding infographics to the mandatory Key Investor Information Document (KIID) for mutual funds leads to a significant reduction in avoidable costs incurred by a sample of student respondents, while such addition did not have an effect on a retail sample of respondents. As the student respondent sample was meant to act as a proxy for the large population of consumers who experience difficulty in making individual financial decisions, their findings indicate that infographics can help potential vulnerable investors to make better investment decisions, while not hurting the group of more experienced investors. The question that remains is why infographics have such an effect. To answer this question, this paper uses eye-tracking technology (see Liu and De Goeij, 2020) for a survey paper about using eye-tracking to better understand individual decision-making, applying an experimental setup that is similar to that used by Cox and De Goeij (2020), to investigate why adding infographics in the KIID helps reduce avoidable costs in investor choices.

Legislators and policymakers have tried to raise the level of 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" referred to as the Key Investor Information Document (KIID). These documents are compulsory for all Packaged Retail Investment and Insurance-based Products (PRIIPs). Dutch consumers, including the growing group of self-employed workers, who purchase third-pillar pension products individually, have thus already been potentially faced with the KIID since 2012. 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" (Choi et al., 2010). The standardized format is also intended to help investors to easily compare different products (European Parliament, 2014). However, the KIID in its current form is not optimal. Cox and De Goeij (2020) show that mutual fund investors who suffer from behavioral biases, when presented with standard KIID information in an experiment, invest sub-optimally and incur avoidable costs. These avoidable costs are the expenses incurred in excess of optimal investment strategy costs, which would be zero. Graphical representations of risk, return, and costs instead alleviate biases and lead to better investment decisions.

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Having established this fact, we set up a similar experiment in this study, using eye scanners to investigate the following main research question:

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

1.1 Outline of this paper

Section 2 reviews the state of the literature and establishes the theoretical foundation of the study. Section 3 describes the experimental design and the hypotheses developed. Section 4 provides an overview of the data and variables used in the study. Section 5 presents the regression results and robustness checks, and Section 6 contains conclusions.

2. Literature review

In this section we provide an overview of the relevant academic literature. Table 1 contains a summary listing of the papers and their contribution.

Table 1 – Overview of the literature and their contributions

Study	Contribution
Hortaçsu & Syverson (2004)	Dispersion of fees across mutual funds cannot be explained by differences in portfolio performance.
Choi et al. (2010)	• Dispersion of fees across mutual funds cannot be explained by differences in non-portfolio services. • Investors value irrelevant features such as past returns.
Elton et al. (2004)	Growth of high-expense funds is evidence that investors in the index mutal funds market act irrationally.
Sirri & Tufano (1998)	Factors determining fund flow include size of the fund as well as media attention.
Cronqvist (2006)	Fund flow is determined by marketing efforts.
Huang, Wei & Yan (2007)	Fund flow is affected by media attention and marketing efforts because these lower search costs.
Iyengar & Lepper (2000)	Information overload and too many investment options hurt investment decisions.
Agnew & Szykman (2005)	In case of information overload, investors gravitate towards default options.
Bertrand & Morse (2011)	Information disclosure guided by psychology reduces the amount of expensive payday borrowing, leading to lower financial charges.
Bordalo, Gennaioli & Shleifer (2012)	Decision makers, due to cognitive limitations, focus their attention on salient aspects of available options, thus overweighting probabilities associated with these salient payoffs.
Benartzi & Thaler (2001)	Due to behavioral bias and cognitive limitations, investors tend to use heuristics, such as the naive diversification strategy.
García (2013)	Financial literacy is important for investment decisions, but whether it leads to optimal decisions remains inconclusive.
Willis (2008)	Higher financial education may result in overconfidence, which nullifies the benefits of such education.
Beshears, Choi, Laibson & Madrian (2009)	While Summary Prospectus reduces time cost to investors without affecting decision quality, it does not improve portfolio choices or helps avoid errors regarding loads and charges.
Tegarden (1999)	Improving the quality of disclosed information can be done efficiently by changing the textual information to visualized graphical information.
Hutchinson, Alba & Eisenstein (2010)	• When used appropriately, visualization can increase data comprehension and likely decrease potential bias formed by prior beliefs • Visualization is detrimental to users when the visual representation is inaccurate or abused. Not properly designed graphs can exacerbate biases
Cox and De Goeij (2020)	Individual investors, who do not make optimal decisions and may be subject to behavioral bias, still benefit from graphical representation of expected return (net of fees and charges).
Knoepfle, Wang & Camerer (2009)	Use eye-tracking scan paths to observe subjects' behavior in a learning game; also argue that studying information acquisition with eye-tracking can help understand complex strategic behavior.

2.1 Index Mutual Funds

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

Two characteristics of the index mutual fund industry are prominent: the large number of funds and the considerable range of fees charged by these funds (Hortaçsu & Syverson, 2004). In theory, the law of one price dictates that two funds that track the same index should charge similar fees because the gross returns are essentially the same, other characteristics being 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 range of fees across funds. However, neither differences in portfolio performance (Hortaçsu & Syverson, 2004) nor in non-portfolio services (Choi et al., 2010; Elton et al., 2004) can justify this wide range. Although the index mutual fund industry is supposedly competitive, given the large number of market participants and the high amount and frequency of inflow and outflow, the wide range 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 charged costs which could be avoided if an optimal decision were made. These avoidable costs are the differences in fees between those of the cheapest funds and the more expensive ones. In other words, a rational investor who invests only in the cheapest fund incurs no avoidable costs. 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 several explanations why investors make sub-optimal decisions. 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 that track the same index may show different past returns. Theoretically, such information would be ignored by a rational investor. However,

there is a considerable number of investors who irrationally believe that past performance is an indication of future performance (De Bondt, 1993).

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

Finally, information overload is an important factor. Too many investment options or too much information often lead to less satisfaction and motivation (Iyengar & Lepper, 2000), which in turn influence investors to gravitate towards 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 often means funds with more media attention and marketing efforts, or they may simply diversify their wealth among available funds.

2.3 Investors' behavioral 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 that is guided by psychology reduces the amount of expensive payday borrowing, which in turn leads to lower financial charges. 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 and their attitude to risks (Vlaev, Chater, & Stewart, 2009). This might be the cause of index mutual fund investors failing to realize that funds which track the same index have an equivalent level of risks; they should thus 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 available investment options (Benartzi & Thaler, 2001). However, no diversification benefit is gained from spreading one's investment across different index mutual funds that track the same index. These investors thus make a sub-optimal decision as they fail to invest all their wealth in the cheapest fund and to minimize fees.

2.4 Improving financial decision making

While one cannot deny the importance of financial literacy in investment activity, the extent to which financial literacy leads to optimal financial decisions remains inconclusive (García, 2013). Regardless of the level of financial literacy, behavioral bias can still affect the decision-making process. Furthermore, higher financial education may result in overconfidence, which nullifies the benefits of such education (Willis, 2008). In the experiment of Choi et al. (2010), all subjects were described to be more financially educated than the average investor, yet sub-optimal decisions were not entirely avoided. Evidently, financial literacy is not the panacea for the problem in question. Another solution that is therefore also suggested is enhancing the quantity and quality 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 in sophisticated financial markets. The U.S. Securities and Exchange Commission (SEC) requires all investment companies to inform their investors by a prospectus, a statement of additional information, shareholder reports, and other documents (Eckel, Grossman, & Johnston, 2005). Realizing the need to limit the quantity of information, the SEC has allowed the use of a summary prospectus since 2007. In the European Union, the equivalent document is the KIID, which aims to promote transparency and to facilitate comparison of different financial products.

However, there are limitations to this approach. Beshears, Choi, Laibson, and Madrian (2009) find that while a summary prospectus reduces the time cost to investors without affecting decision quality, it does not improve portfolio choices or help to avoid errors regarding loads and charges. Choi et al. (2010) show that having both the summary prospectus and the full prospectus leads to better decisions, but only moderately. In summary, it can be argued that merely limiting the quantity of information is not enough to solve the sub-optimal decision issue. Further improvement of the quality of financial information is needed to help investors in making optimal decisions.

Improving the quality of disclosed information can be done efficiently by replacing textual information with visualized graphical information (Tegarden, 1999). When properly applied, visualization can increase data comprehension and decrease potential bias formed by prior beliefs (Hutchinson, Alba, & Eisenstein, 2010; Lurie & Mason, 2007). Unlike tabulated information, visualization helps users to easily gather insights, such as patterns or trends (Wainer & Velleman, 2001), and it enhances cognitive capabilities by allowing users to process information without feeling overloaded (Payne, 1982). Moreover, by summarizing data points into a coherent whole, it reduces

processing time and mental effort (Bederson & Shneiderman, 2003). In this way, visualization leads to better data comprehension, highlights important features, produces insights, and enhances cognitive capabilities, and all this with less time and effort.

On the other hand, visualization is detrimental to users when the visual representation is inaccurate or abused. Improperly 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 and De Goeij (2020) use a survey-experimental approach to show that individual investors who do not make optimal decisions or who may be subject to behavioral bias still benefit from graphical representation of expected returns (net of fees and charges). By visualizing fees as a lower starting point of net expected return, the experiment increases the awareness of fees, which is key to making optimal decisions.

2.5 Eye-tracking experiments and applications

Eye-tracking has been used by several economists to study learning, consumer choice, and deception in sender-receiver games. Knoepfle, Wang, and Camerer (2009) use eye-tracking scan paths to observe the behavior of subjects in a learning game. They argue that studying information acquisition by means of eye-tracking can help understand complex strategic behavior. 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 through 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. This study aims to fill that gap.

3. Experimental design

3.1 Data collection

To answer the research question, an experiment was conducted between May 15 and May 23, 2019 involving 73 participants, using the eye-tracking equipment (ETE) available at Tilburg University. The experiment was a laboratory-adapted version of the survey conducted by Cox and De Goeij (2020). Participants were shown the KIID of three different index mutual funds and were asked to invest their hypothetical assets of €1,000 in three index funds that tracked the same index (MSCI Europe).[2] The optimal decision in this experiment was to invest the entire amount in the cheapest fund. However, investors might use a naive diversification heuristic (Benartzi & Thaler, 2001), thereby incurring avoidable costs. The process and setup of the experiment were the same for all participants, even in trivial details such as the clothing of the researcher that was present during the experiment.

First, all participants were presented with the Introduction, which contained an overview and the purpose of the experiment. This was followed by the Guidelines and Rules: a definition of investment funds, index funds, the MSCI Europe Index, as well as details of the task, the rules, and the reward for the participants. To eliminate bankruptcy risks, participants were ensured that all funds in the experiment would never go lost during the investment period. Negative investments were not allowed. Second, participants were incentivized by two rewards: (i) a completion reward with a fixed amount of €2.50 for completing the experiment, and (ii) an investment reward, namely their final wealth (net of fees), which depended on their investment decisions. The investment reward was designed to mimic the potential payout of a real-life investment for a one-month period (the entire month of June 2019). Because of this short investment horizon and the wide spread of fees among the funds presented, the participants' investment decisions had a substantial impact on their final reward.

2 The goal of this paper is to investigate how eye-scanner technology can be used for research on information communication. For illustration purposes, this paper therefore uses a setup that is very similar to that used by Cox and De Goeij (2020). The research involved various information treatments of the KIID of different index mutual funds, to investigate why infographics and tables in the KIID help investors to make better investment decisions. This setup closely mimics the investment decision process that a self-employed individual would face when deciding what funds to invest in for personal pension savings. In future research, eye-scanner technology could also be used to investigate other forms of pension and other communications such as newsletters, pension overviews, or information shown on internet pages.

Figure 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)

All participants were required to read the Guidelines and Rules twice (both on a printed copy and 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 Eye Tracking Equipment. The model of the equipment used was SMI RED250, a head-free eye tracker with a sample rate of 250 Hz, manufactured by SMI. This 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 a photo of the ETE setup are shown in Figure 1.

While the ETE was being calibrated, participants were asked to follow with their eyes a black cross that moved around nine positions on the screen in a random order. The ETE would associate the participants' eye movements with X-Y coordinates on the screen. Before starting with the experiment, participants had to pass an eye-tracking validation test.

Finally, after passing the eye-tracking validation test, participants were randomly assigned to one of the three groups below. The group setup is similar to the one that was used by Van de Ven (2018).

- 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.*

Table 2 – 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	July 6, 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%

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

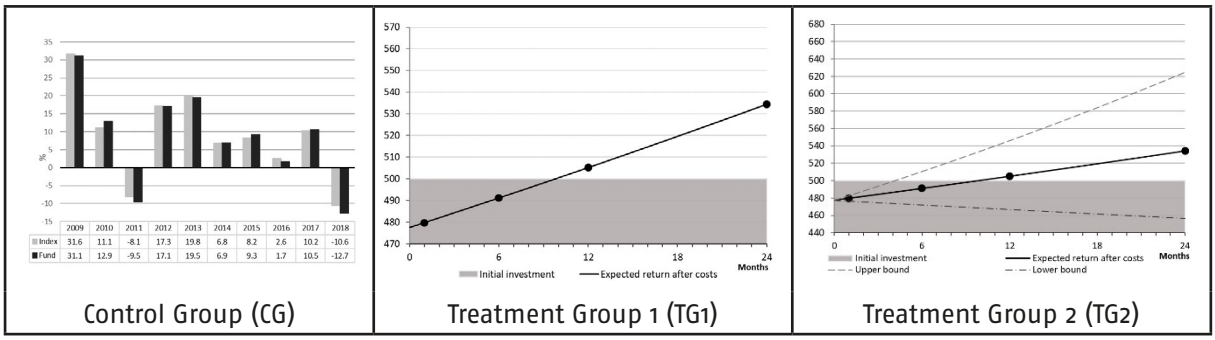
After having examined the information presented, participants were asked to allocate their assets among three MSCI Europe Index funds; these were anonymized to avoid bias on the part of participants due to prior experience with these funds. Table 2, which can be found in the Table and Figures Appendix at the end of this paper, presents general information about these funds and their fee structures.

Even though these funds track the same index and offer investors the same services (without any non-portfolio services), they still display a wide spread of fees. As such, because the risk and expected returns (before costs) are the same in all choices offered, a rational participant should immediately realize that the optimal investment strategy is to minimize cost by investing all assets in the cheapest index mutual fund. Finally, to obtain information on control variables, participants were asked 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

Of the 73 participants in the overall sample, eye-tracking data of 65 participants were successfully captured by the ETE. The analysis below captures the data of these 65 participants. Participants were randomly assigned to one of the three treatment groups by the survey platform (Qualtrics). The CG, TG1, and TG2 groups included 24, 18,

Figure 2 – Example of differences of information treatments



Control Group (CG) | Treatment Group 1 (TG1) | Treatment Group 2 (TG2)

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 was to invest all assets in this fund. See Internet Appendix 1 (which is available at the end of this paper) for a detailed copy of the experimental survey.

First, CG participants were provided with the standard information of the KIID, including the histograms and tables of past performance (see the left graph in Figure 2). Although this information may have a signaling effect about the ability of fund managers, 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 and thus have the same expected returns (gross of fees).

Second, TG1 participants were presented with the graphs that depict net expected return (demonstrated by the middle graph in Figure 2), instead of past performance. This shows how an initial investment (the gray 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 the charges of each fund. 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, but with the addition of two dotted lines that depict the lower and upper bounds of the 95% confidence interval of the expected return (the right graph in Figure 2). These bounds represent potential optimistic and pessimistic views that might occur; they are calculated such that there is a 95% chance that 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. By improving both 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 when it comes to the investment decision in this experiment.

3.3 Control variables

Because different treatment groups might display differences in participant characteristics, 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), and Previous investment experience. The existing literature has established the connection between these variables and investment decisions (Choi et al., 2010; Cox and De Goeij, 2018; Van Rooij, Lusardi, & Alessie, 2012). For more details on the wording of these questions, please refer to Appendix 1. Note that, due to the large number of variables in this study, the first words in the names of variables are capitalized to enhance the readability.

Of the demographic information obtained from the participants, Study program is particularly relevant. 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, participants were asked to answer two questions on their behavior in different risky situations: whether to accept a job switch for higher but uncertain income. The specific wording of the second question depended on the answer to the first question to further classify the participants' attitude towards risk. These two questions, adapted from the research by Barsky, Juster, Kimball, and Shapiro (1997) and Van Rooij, Lusardi, and Alessie (2011), classify each participant into one of four risk aversion levels, ranging from those who accept the risky option twice (level 1, lowest risk aversion level) to those who refuse the risky option twice (level 4, highest risk aversion level).

Cognitive capability, the capacity to absorb and process information, has also been shown to affect investment decisions directly (Korniotis & Kumar, 2011) or through risk aversion and time preferences (Benjamin, Brown, & Shapiro, 2013). To measure Cognitive capability, three questions were asked, all adapted from the Cognitive Reflection Test formulated by Frederick (2005). These questions specifically examined how participants might resist 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 (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 asked, adapted from Van Rooij et al. (2012). The first three questions focused on basic financial knowledge such as compound interest, inflation, and time value of money, while the final two questions addressed more advanced subjects, namely diversification and the relationship between bond prices and interest rate. Correct answers to all five questions are evidence that participants have a sufficient level of financial literacy in order to make good investment decisions. Furthermore, participants also self-estimated their financial literacy. This could be used as a proxy for overconfidence, which is a behavioral bias that is believed to adversely affect investment decision-making, as well documented by Kumar and Goyal (2015).

Finally, prior experience was measured through three variables: Previous investment experience, Work experience (in general), and whether the participant has Work experience in the financial sector. Similar to students of finance programs, participants with prior investment experience were more likely to be exposed to this investment problem before the experiment. It was therefore important to control for these characteristic differences.

3.4 Eye-tracking variables

Although the ETE was in operation during the entire experiment, only eye-tracking data of the investment decision were of interest; all eye-tracking data analyzed in this study began from the moment when financial information was first presented to the participants until they clicked on the "Next" button to move to the next page. The ETE captured this web page, which contained the investment decision as a stimulus image. In total, there were three stimuli in the experiment, each corresponding to one group. First, the duration of the eye-tracking data for each participant varied depending on the participant's reading, analyzing, and decision-making speeds. After the experiment, data on user actions (scrolling, clicking, keyboard input) and fixations (X-Y coordinates, duration, and pupil size) were collected.

Fixations were of primary interest to this study. The X-Y coordinates recorded the positions of each fixation on the screen with regard to the stimuli presented to the participants. Duration measured how long each fixation lasted in milliseconds. We assume that pupils are elliptic, and the pupil size of the respondent is calculated

using the recorded horizontal and vertical diameters of the pupil and and the formula for the surface of ellipse[3].

All in all, five types of eye-tracking variables were calculated for further analysis: (i) Number of fixations, (ii) Total viewing time, (iii) Focus on cheapest fund, (iv) Pupil dilation, and (v) Comparison. Number of fixations of an AOI was simply the number of fixations that 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 had difficulty extracting and understanding information (Jacob & Karn, 2003). Focus on cheapest fund was the percentage of the total viewing time that participants spent looking at the information regarding the cheapest fund. Because there were three funds in total, the baseline level for focus is 33%, which indicated that participants spend the same amount of time for each fund. Pupil dilation at any particular time is 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 is used as a proxy for mental effort (Van der Wel & Van Steenbergen, 2018). Finally, Comparison was defined as the number of times that the scan path moved from one AOI to the next within the same elements (for example, the graphs) of different funds. We refer to Appendix 2 for the stimuli and areas of interest. AOI 6 to 8 are the SRRI element; AOI 13 to 15 are the Charges table element; and AOI 20 to 22 are the graph element. For the 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 1 to 6 used eye-tracking data to answer the main research question, while Hypotheses 7 and 8 aimed to reconfirm findings of previous studies.

The first two hypotheses examined the relationship between the number of comparisons and investment decisions. Because the three funds were similar in many aspects, it was suspected that more comparisons would help participants to discern the most crucial differences and similarities between the funds and thus make the optimal decision.

3 The surface of a pupil is then calculated as $PA = \pi * \frac{Pdx}{2} * \frac{Pdy}{2}$, where Pdx is the horizontal diameter and Pdy the vertical diameter. This is the standard equation to calculate the surface of an ellipse.

Hypothesis 1: *Individuals who make more comparisons across graphical information of different alternatives (i.e. scan paths alternate across the graphs of different funds) incur lower avoidable costs than individuals who make fewer comparisons.*

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

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

Hypothesis 3: *Individuals who focus more on the Charges tables of the cheapest fund incur lower avoidable costs than individuals who focus less.*

Hypothesis 4: *Individuals who focus more on the graphs of the cheapest fund incur lower avoidable costs than individuals who focus less.*

It is important to investigate whether the net expected return graphs do demand extra mental effort from investors. If not, then the following two hypotheses would be rejected:

Hypothesis 5: *When looking at graphical representation, individuals in TG1 have a higher level of pupil dilation than individuals in CG.*

Hypothesis 6: *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 to incur lower avoidable costs, it is worthwhile checking whether this sample yields the same result.

Hypothesis 7: *Individuals in TG1 incur lower avoidable costs than individuals in CG.*

Hypothesis 8: *Individuals in TG2 incur lower avoidable costs than individuals in CG.*

The next section contains an overview of the data and how these were collected.

4. Data description and univariate analysis

4.1 Descriptive statistics

The sample consists of 65 Tilburg University students, whose eye-tracking data were successfully captured by the eye-tracking equipment (ETE). Participants were recruited through announcements via the university website, emails from faculty members, and the personal network of the experimenter, and were then randomly assigned (by the Qualtrics questionnaire software) to one of the three groups. Although the sample size is small compared to most experiments, it is sufficient for an eye-tracking study. That is because data are collected for each participant using the eye-tracking equipment. See also Table 1 in Netspar Survey Paper 57 (Liu and De Goeij, 2020), which shows that the sample size in eye-scanner experiments is very similar to that of this study.

4.1.1 Sample characteristics

From the questionnaire, sample characteristics were obtained; these are presented in Table 3. All participants were university students, with the average age across all groups just below 22 years. Almost a quarter of the total sample consisted of finance students, but they are not distributed evenly across the groups due to random assignment.

Risk aversion level is similar across the groups, with TG2 being slightly lower than the other two groups. These levels are in line with levels reported by Cox and De Goeij (2020). 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 the groups are negligible. The average self-assessed financial literacy level is almost the same across the three groups. Overall, it can be argued that risk aversion levels of the groups are homogeneous and comparable to previous studies.

Despite scoring highly on financial literacy (an average of 4.11 out of 5.00) and cognitive ability (an average of 2.00 out of 3.00), the participants were quite inexperienced with investments. On average, they disagreed with having "experience with investing in financial products", most had less than one year of work experience, and only 18% had worked in the financial sector before. This is understandable because all were students, hence this sample provides a good approximation of real-life unsophisticated investors who would consider mutual fund investments.

4.1.2 Eye-tracking data

All eye-tracking data are captured by the ETE within the period, starting from the moment when participants are first shown the stimuli to the moment when they

Table 3 – Characteristics of participants – Group average

	Group			
	CG	TG1	TG2	Full Sample
Age	21.50	22.28	21.04	21.55
Percentage male	54%	50%	65%	57%
Engaged in study	100%	100%	100%	100%
Finance student	25%	39%	9%	23%
Current or highest achieved education				
University bachelor	83%	61%	78%	75%
University master	17%	39%	22%	25%
Risk aversion level (1 to 4, higher = more risk averse)	2.58	2.50	2.30	2.46
Cognitive ability (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
Work experience (0 to 3)	1.46	1.28	1.09	1.28
% with work experience in financial sector	21%	22%	13%	18%
Observations	24	18	23	65

clicked on the "Next" button to move to the next page. Overall, there are 15 variables that captured five measurements (Comparisons, Pupil dilation, Total viewing time, Focus on cheapest fund, and Number of fixations) across three groups of elements (SRRI, Charge tables, and graphs). An overview of these variables is presented in Table 4.

First, regarding the variable Comparisons, CG and TG2 involved similar numbers, but TG1 made considerably fewer comparisons across all three elements. According to Hypotheses 1 and 2, TG1 would also have higher avoidable costs than CG and TG2 if they were all exposed to the same treatment. In Section 4, 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.

Total viewing time varies across the groups, but TG2 participants spend more time on all three elements than the other groups. TG2 also focus more on the elements

Table 4 – 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 Charge 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 Charge 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 SRRI of cheapest fund	37%	40%	44%	40%
Focus on Charges table of cheapest fund	38%	39%	42%	40%
Focus on graph of cheapest fund	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

of the cheapest fund, especially the graph with 45% of their time on average. Interestingly, CG participants focus the least on the cheapest fund 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 participants to focus more on cheapest fund graph. This may potentially help lower avoidable costs.

Finally, the variable Number of fixations is 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 participants find the graphs more important than CG or TG1 as evidenced by the higher number of fixations and the longer total viewing time.

4.2 Dependent variable: avoidable costs

After the descriptive statistics, this section presents a preliminary analysis of the data. Table 5 shows an overview of the investment decisions, with the average fees per group (entry, ongoing, total, and avoidable costs), the proportion of respondents who minimize fees (by investing all assets in the cheapest fund), and that of those who naively diversify (by investing in all three funds). Entry fees are subtracted from the investment at the start 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

Table 5 – Overview of fees and investment decisions

Group	Average entry fees (i)	Average ongoing fees (ii)	Average total fees (iii)	Average avoidable costs (iv)	% of participants who minimize fees (v)	% of participants who naively diversify (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 6 – Relative differences in avoidable costs across groups

Group	Average avoidable costs	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*

respondent, avoidable costs are the differences between minimum fees (in the case of allocating all assets to the cheapest fund) and total fees.

The fees incurred by TG1 are higher than for CG, while TG2's fees are considerably lower than those incurred by CG, mostly due to the differences in entry fees. Table 5 presents the relative differences of avoidable costs incurred per group. To see whether the differences are statistically significant, t-tests for equality of means are used. Previously, a Levene's Test for equality of variances was performed, which found no evidence of unequal variances. Although TG1 incurred 16.6% more avoidable costs than CG, while TG2 incurred 28.1% less than CG, none of the differences were statistically significant, even when the differences are very large in economic terms. However, the difference between TG1 and TG2 is statistically significant at 5% level. This can be seen as evidence supporting Hypothesis 8 while rejecting Hypothesis 7. 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. Furthermore, all groups are far from making the optimal decision of minimizing the incurred fees (only 10 eurocents if all assets are invested in the cheapest fund).

Finally, column (v) of Table 5 shows the proportion of participants who made the optimal decision. This number is lowest for TG1, while TG2 is 9 percentage points higher than CG but is still only 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%) (see Table 6). Considering that diversification offers no benefits in this case, it

is puzzling that most participants fail to optimize, but it is also not surprising as these figures are in line with previous studies.

4.3 Control variables

To control for the individual characteristics of each individual participant, control variables were captured during the experiment. These included demographic information (age, gender, study program, and education level), risk aversion level, cognitive ability, financial literacy (measured and self-assessed), investment experience, and work experience. These control variables have been shown to affect the investment decision in similar experiments (Choi et al., 2010; Cox and De Goeij, 2018). An overview of the control variables is shown in Table 7.

4.4 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 is captured by four statements, where participants are asked to state their level of agreement with these, using a five-point Likert scale, ranging from 0 ("Totally disagree") to 4 ("Totally agree"). The statements were: sufficient information on the risk levels of funds, time needed to make the decision, confidence in the decision, and comparability of different alternatives. For the exact phrasing of these statements, see the survey copy in Appendix 1. In addition, t-tests for equality of means were performed to check whether the average responses of TG1 and TG2 are different from CG.

Table 8 shows that the treatment groups agree more with "sufficient information" and "able to compare funds" than the control group, although only the latter statement of TG2 has a statistically significant difference at the 5% level. Responses for the other two statements (how much time the decision took, how confident the participants are) do not seem to differ across the three groups.

4.5 Features of information representation in the investment decision

Aside from how they perceive the decision, participants 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: TG1 participants were shown a graph indicating net expected returns, while TG2 participants were shown a graph of net expected return with upper and lower bounds. The participants rated the importance

Table 7 – Control variable overview

		Proportion in sample	Average avoidable costs	% of participants who minimize fees	% of participants who naively diversify	Number of participants
Gender	**Female**	43%	14.26	14%	64%	28
	Male	57%	12.68	27%	46%	37
Finance student	**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 ability	**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 investment 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
	1 to 5 years	35%	11.02	35%	57%	23
	More than 5 years	9%	14.65	0%	50%	6
Work 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*

Table 8 – 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*

Table 9 – Importance of features in investment decisions by participants

	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

on a five-point Likert scale ranging from 0 ("not important at all") to 5 ("very important). The results are shown in Table 9, with the ordinal ranking of each factor within one group in parentheses.

In both treatment groups, the extra feature of net expected return (bounded or unbounded) is ranked as highest in importance. This is evidence that participants use the visual representation of net expected return (which can highlight both risks and charges of the funds). Both CG and TG1 display a higher "desire to diversify" than TG2, despite TG1 and TG2 being confronted with similar representations. Next in order of importance are the charges of the funds, past performance, and risk level indicator; the responses and rankings do not differ substantially across the groups. Surprisingly, the risk level indicator is not ranked very high, indicating that participants do not concern themselves with this information. This may be explained by the fact that it is the same across the three funds (risk level 5 out of 7). Finally, the use of derivatives has, in line with expectations, the lowest ranking overall.

5. Empirical results

5.1 Avoidable costs

Avoidable Costs is a censored dependent variable with a corner value 0 in the case of respondents who minimize fees (see Figure 3 for the full histogram). As the Tobit model is theoretically preferred over Ordinary Least Square (OLS) for censored variables (Gujarati, 1995), we use this in our analyses. 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), and 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 the robustness analysis later in this paper.

Four models are estimated with the same dependent variable but different explanatory variables. Model (I) serves as the most basic model, as the benchmark, as it only uses dummy variables indicating which treatment group each observation belongs to. In Model (II), variables that capture statements of perception and the importance of each feature are added. Model (III) includes treatment group dummies and eye-tracking variables. The final and most general Model (IV) includes all variables (treatment group dummies, statements of perception, importance of each feature, and eye-tracking variables). Control variables are included in all four models.

Table 10 shows the results of these regressions. In all four models, the coefficients of TG1 are positive but not statistically different from zero. Hypothesis 7 is therefore

Figure 3 – Histogram of Avoidable costs (in euros)

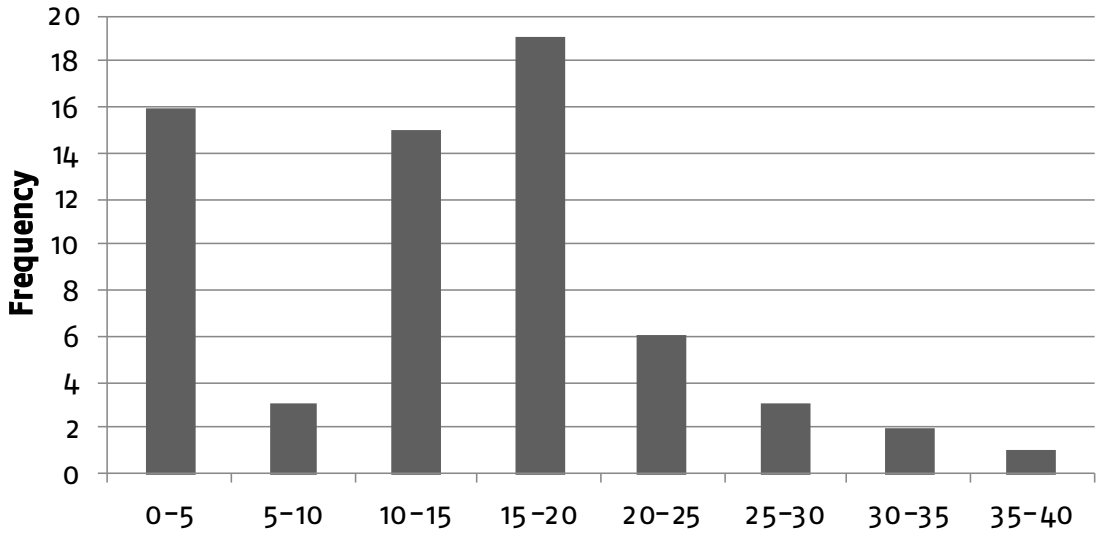


Table 10 – Effect of treatment, eye properties, perception, and features on avoidable costs

	(I) Tobit Avoidable costs	(II) Tobit Avoidable costs	(III) Tobit Avoidable costs	(IV) Tobit Avoidable costs
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 SRRI			13.88	18.36*
			(12.22)	(9.797)
Focus on cheapest fund Charges tables			-15.93	-9.282
			(16.61)	(11.82)
Focus on cheapest fund 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

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 avoidable costs and helps participants make more optimal decisions, which is consistent with Hypothesis 8. However, the treatment effect is no longer statistically significant when eye-tracking variables are added, as 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 1, where more comparisons across graphs help reduce avoidable costs. However, the variable Comparisons of Charges tables is positively related with avoidable costs, although this effect is not statistically significant. Therefore, Hypothesis 2 is inconclusive.

Similar to Comparisons, more time being focused on the cheapest fund graph decreases avoidable costs significantly, which is consistent with Hypothesis 4. The coefficient of Focus on the cheapest fund graph can be interpreted as the difference in avoidable costs between two extremes: participants who do not look at the cheapest fund graph (0%) and those who look only at that graph (100%), other circumstances being equal. In terms of standardized coefficients, one standard deviation increase in Focus on cheapest fund graph (0.168) decreases avoidable costs by 24.6% of its standard deviation (9.367). On the other hand, Focus on cheapest fund Charges tables also has negative coefficients, but they are not statistically different from zero. Therefore, Hypothesis 3 can neither be rejected nor confirmed. Overall, we suspect that Focus and Comparisons capture the effect of the information treatment on avoidable costs. In Section 5.2, these relationships will be investigated further.

When focusing on the mental efforts spent of specific information, Pupil dilation of Charges tables have positive coefficients, which are the only statistically significant variables out of three Pupil dilation variables. As expected, participants who exert more mental effort while reading Charges tables may experience difficulty understanding them. This is supported by positive coefficients of Total viewing time of Charges tables, both of which are statistically significant at 1% level in Model (IV). In standardized terms, one standard deviation increase in the Total viewing time of Charges table (15,428) raises avoidable costs by 151% of its standard deviation (9,367). It can thus be concluded that more mental effort does not necessarily lead to better decisions.

The number of fixations is proxy for the importance of the fixated information. In Model (III), the 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 for the average person, decreases avoidable costs by 19.7 eurocents (Model III) or 24.9 eurocents (Model IV). Translated to standardized terms, in Model IV, a one standard deviation increase in the Number of fixations in Charges table (67,381) cuts avoidable costs by 179% of its standard deviation (9,367). Not surprisingly, more emphasis on Charges tables help reduce fees considerably. However, it is worth noting that, while Total viewing time on Charges tables is positively correlated with Avoidable costs, the Number of fixations in Charges tables has the opposite effect. It can be inferred that with Charges tables, activities which result in a high number of short fixations, such as quickly comparing different tables, lead to lower fees. On the other hand, with graphs, a lower number of fixations with longer total viewing time leads to lower fees. This suggests an inherent difference between these types of presenting information.

The experiment made clear that two variables are statistically significant. When controlling for eye properties in Model (IV), the perception of being provided with "sufficient information" reduces avoidable costs considerably. On the contrary, participants who perceive that the investment decision "took a lot of time" incur higher fees. This may be explained by their lack of familiarity with investment materials and/or investing activity in general.

As expected, the coefficients of significant features of the variables, Fund charges and Risk level indicator are negative, while that of Desire to diversify is positive. Participants who give more attention to charges or risk level indicator should indeed incur lower avoidable costs while those who naively try to diversify incur higher fees. Based on statistical significance, the most important non-reported control variables are Previous investment experience, Self-assessed financial literacy, and Studying finance. Previous investment 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 avoidable costs, 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 is found in the average investor, resulting in a costly bias. Finally, Studying finance not surprisingly has a large negative impact on avoidable costs, lowering the amount of avoidable costs incurred substantially. To see whether finance students may have biased the findings, a robustness check in which finance students are removed from the sample is conducted next.

Table 11 – Effects of Comparisons and Focus on Avoidable costs

Dependent variable	(V) Tobit Avoidable costs	(VI) Tobit Avoidable costs	(VII) Tobit Avoidable costs	(VIII) Tobit Avoidable costs	(IX) Tobit Avoidable costs
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 SRRI			3.484	3.522	12.10
			(10.60)	(10.60)	(11.02)
Focus on cheapest fund Charges tables			−19.13	−20.49	−27.13**
			(13.48)	(14.14)	(13.40)
Focus on cheapest fund graph			−26.27***	−14.96	−40.80**
			(8.830)	(17.69)	(16.64)
Focus cheapest fund *TG1 graph				−13.64	9.431
				(21.79)	(19.18)
Focus on cheapest fund *TG2 graph				−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

5.2 Comparisons, focus and avoidable costs

In this section, the relationships between comparisons, focus, and avoidable costs are investigated using Tobit models and multiplicative dummies. Specifically, treatment group dummies are multiplied by Comparisons of graphs in Model (VI) and by Focus of cheapest fund 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 Avoidable costs. Model (IX) includes multiplicative dummies for both variables. The regression results are shown in Table 11.

Interestingly, while Model (V) does not have any statistically significant variables except for the 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. This suggests that the information treatment does not reduce fees as it prompts participants to make more comparisons.

On the other hand, Model (VII) shows that the treatment for TG1 leads to higher fees, and Focus on the cheapest fund graph decreases fees significantly (at 1% level). When multiplicative dummies are added in Model (VIII), the coefficients of Focus on cheapest fund graphs and its multiplicative dummies are negative, 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. Contrary to Table 10, in the final Model (IX), Comparisons and Focus on cheapest fund Charges table reduce fees significantly at 5% confidence level. This is evidence supporting Hypotheses 2 and 3, which found no conclusive effects in Table 10.

5.3 Pupil dilation

The final model examines the relationship between information treatments and mental efforts, which is proxied by Pupil dilation of graphs. The OLS estimation results are shown in Table 12. TG2 participants may have spent greater mental efforts than TG1 due to having more abstract elements: the lower and upper bounds of expected return, and hence the positive coefficient contrary to the negative coefficient of TG1. However, as expected, neither is statistically significant, rejecting Hypotheses 5 and 6.

Table 12 – Effects of Treatment on Pupil Dilation of Graphs

Dependent variable	(X) OLS 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 Robustness checks

5.4.1 Avoidable costs

As mentioned previously, OLS regression is used to check the robustness of the Tobit models. Although the coefficients become smaller in absolute value terms, most remain statistically significant and the directions of the effects are preserved. Overall,

the robustness check with OLS confirms previous findings in Section 5.1 above. A second robustness check is the model estimated using Tobit on a sample that excludes the 15 finance students from the sample. Models (I) to (III) largely confirm 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 persons without any finance practice may have difficulty understanding the Charges tables, leading to higher fees incurred. Without financial education, greater mental efforts may not lead to a more optimal outcome, as demonstrated by the insignificance of all Pupil dilation variables.

5.4.2 Comparison, focus, and avoidable costs

Compared to Table 10, most of the previous results remain valid, except for Comparisons of Charges tables, which is no longer statistically different from zero. This casts doubt on Hypothesis 2. However, Focus on cheapest fund Charges table is still significant at 10% level. A second robustness check is the model estimated using Tobit, with finance students removed from the sample; this 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 Charges tables, which are no longer statistically significant. Furthermore, coefficients of the former variable are positive. Therefore, Hypotheses 2 and 3 remain inconclusive.

5.4.3 Pupil dilation

When removing finance students form the sample, we find that the coefficients for TG1 and TG2 have increased in absolute terms but remain statistically insignificant. Therefore, the previous findings that reject Hypotheses 5 and 6 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.

5.5 Summary of the empirical findings

Based on our empirical analyses, we conclude that most hypotheses can either be conclusively confirmed or rejected. Summarizing, we find that more comparisons across different graphs help participants reduce avoidable costs, although this may not always help them understand the implied risk levels of the funds. On the other

hand, extra comparisons between the Charges tables, which is key information to the optimal decision and not presented in graphical form, do not lead to lower incurred fees. An infographic that might help in this regard is the net expected return graphs with confidence bounds (TG2), which clearly visualize risks, charges, and expected return. Finally, we also have shown that the information treatment does not demand extra mental effort from investors. Nevertheless, it should be noted that graphical treatment is no panacea; investors still need financial knowledge and to exert mental effort to reach the optimal outcome.

6. Conclusion

Index mutual funds are an important element in the financial markets and an essential investment vehicle in the portfolios of many investors. Despite current policies that require adequate information disclosure by the providers of these products, the investment decisions of consumers are seldom optimal. So there is room for improvement regarding disclosure policy as well as the decision-making process. As mentioned above, this is increasingly important for the pension industry as well. Currently, this is especially relevant for consumers who personally invest for their pension. If pensions funds that currently have a DB scheme transfer in the future to a DC scheme that allows participants to make their own investment decisions, then our findings become quite relevant for the way information and communication documents are designed. Aside from the current legislation regarding information documents, it is also relevant for the growing number of self-employed workers, who invest in 'generic' products such as (index) mutual funds to save for their retirement.

The existing literature proposes two solutions for this issue: increasing financial literacy and enhancing information disclosure. This paper focuses 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?*" Using eye-tracking technology, an experiment was conducted to gather data from 65 participants who were asked to make a specific investment decision. The data reveal many findings about how the information treatment and behavior of participants relate to the optimality of the decisions.

Participants who are presented with graphs of net expected returns (with confidence bounds) make noticeably better decisions than those presented with past returns, as per current regulations. This implies that the current way that information is communicated can be improved with simple changes by policymakers. Even with a relatively small sample, this result is significant and robust to different versions of the models and sample. Moreover, the graphs of net expected returns do not require extra mental efforts by the investors. Considering the simplicity of this graphical representation, with almost no downside, it is recommended that the graphs be adopted as soon as possible. It is evident that replacing theoretically irrelevant information, such as past performance, by a graphical representation of future outcome of the investment, such as net expected return, helps individuals make better investment decisions, and this is not confined to index mutual funds. Because index mutual funds that track 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 applies to index mutual funds and other investment products.

Whether the information treatment helps reduce fees through more comparisons across graphs or more focus on the cheapest funds remains inconclusive, but the eye-tracking data reveal that more comparisons across graphs or more focus on the cheapest funds reduces avoidable costs. Therefore, other implementations which promote such behavior should also be considered. Without focusing on the KIID, this may include information websites that allow 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 stand to benefit the most.

Nevertheless, the importance of financial education cannot be denied. In our sample of respondents, finance students had significantly lower avoidable costs, also when taking into account other control 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, owing to logistical constraints. Therefore, there may not be enough statistical power to conclusively test all hypotheses. Furthermore, the entire sample consisted of Tilburg University students and is therefore not fully representative of the population of current or future investors, thus limiting the generalizability of the results. On the other hand, it can be argued that our sample reflects inexperienced investors, who may be making their first investments.

In addition, the experiment only includes index mutual funds with a clear definition of entry charges, exit charges, and annual expenses. It would be worthwhile to investigate different financial instruments, such as individual retirement investment schemes. In addition, it would certainly be interesting to investigate other communication means, such as the Uniform Pension Statement, using eye-scanner technology. Moreover, data captured by the eye-tracking equipment also reveal certain beneficial behaviors which can be associated with optimal decisions, namely comparison of graphical elements of different alternatives, and focus on the most optimal option. Therefore, future representation of financial information should try to stimulate these behaviors.

In conclusion, graphical representation of financial information, specifically net expected return graphs that visualize charges and risks, can reduce the amount of avoidable costs incurred by individual investors of index mutual funds, while demanding no extra mental effort. Therefore, it is recommended that the current past return graph in the Key Investor Information Document of investment products be replaced by a net expected return graph.

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INTERNET APPENDIX

Appendix 1: Experiment questionnaire

I. Investment decision

The bottom part of this page is the same for all three groups.

Survey Completion
0% 100%

TILBURG UNIVERSITY

OBJECTIVES AND INVESTMENT STRATEGY OF THE FUNDS

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.

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.

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.

RISK AND REWARD PROFILE

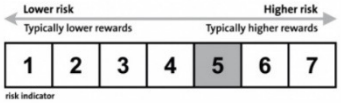
The indicators below are based on historical data and may not be reliable indicators of the future risk profile of the Funds. The risk categories shown are not guaranteed and may change over time. The lowest category does not mean risk free.

Index fund A

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.

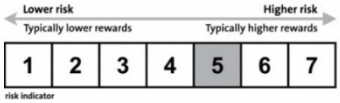
Index fund B



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.

Index fund C



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.

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

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%

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

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%

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

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%

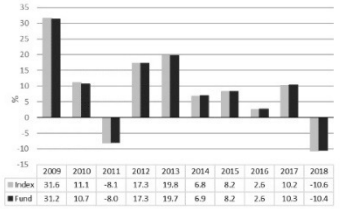
The ongoing charges are based on the expenses in the period of 12 months which ended on the 31st of December.

This is the rest of the investment decision shown to the Control Group.

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

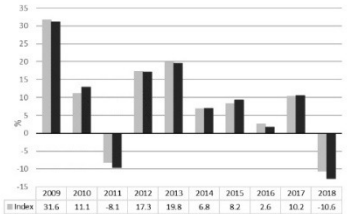


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Index	31.6	11.1	-8.1	17.3	19.8	6.8	8.2	2.6	10.2	-10.6
Fund	31.2	10.7	-8.0	17.3	19.7	6.9	8.2	2.6	10.3	-10.4

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)

Index fund B

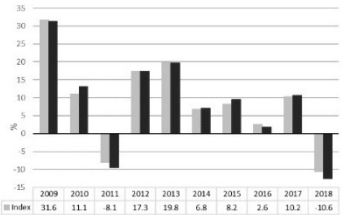


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Index	31.6	11.1	-8.1	17.3	19.8	6.8	8.2	2.6	10.2	-10.6
Fund	31.1	12.9	-9.5	17.1	19.5	6.9	9.3	1.7	10.5	-12.7

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

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	31.3	13.1	-9.4	17.3	19.7	7.0	9.5	1.8	10.7	-12.5

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?

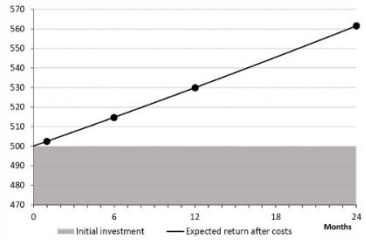
Fund A	€ 0
Fund B	€ 0
Fund C	€ 0
Total	€ 0

Next

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

EXPECTED RETURN AFTER COSTS

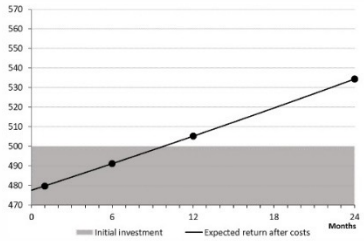
Index funds A



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.

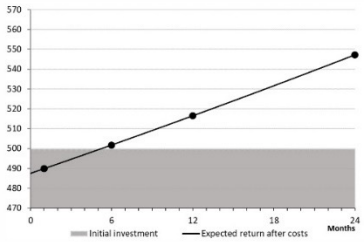
Index fund B



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

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 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?

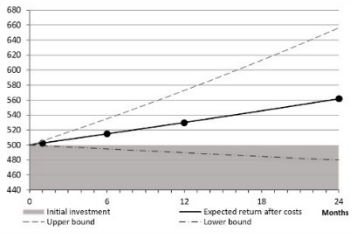
Fund A	€ 0
Fund B	€ 0
Fund C	€ 0
Total	€ 0

Next

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

EXPECTED RETURN AFTER COSTS

Index funds A

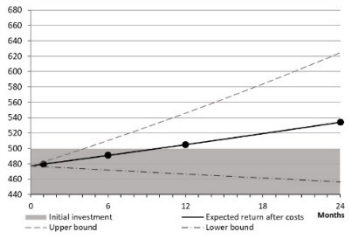


This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

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.

Index fund B

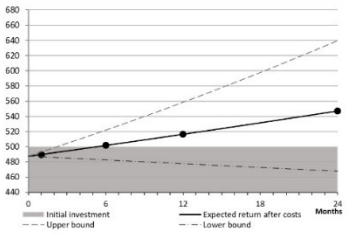


This graph shows the growth of the expected return of the fund after subtracting all the costs charged by fund. It is based on the 20-year average return of the MSCI Europe Index for a period of 24 months.

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.

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.

The investment decision

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

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

Next

II. Decision questions

The 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	○	○	○	○	○	○	○
Index fund B	○	○	○	○	○	○	○
Index fund C	○	○	○	○	○	○	○

"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
○	○	○	○	○

"The investment decision took a lot of time"

Totally disagree	Disagree	Neutral	Agree	Totally agree
○	○	○	○	○

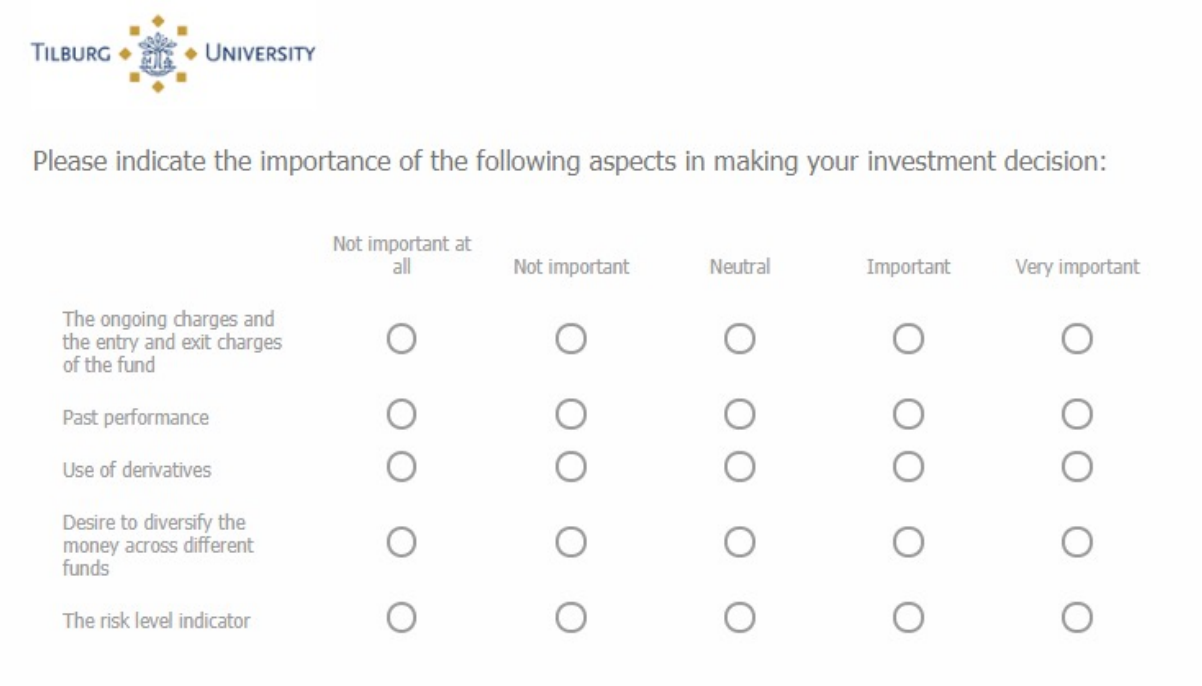
"I'm confident that I made the right investment decision"

Totally disagree	Disagree	Neutral	Agree	Totally agree
○	○	○	○	○

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

Totally disagree	Disagree	Neutral	Agree	Totally agree
○	○	○	○	○

The part below is only for the Control Group.



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 Treatment Group 1.

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	○	○	○	○	○

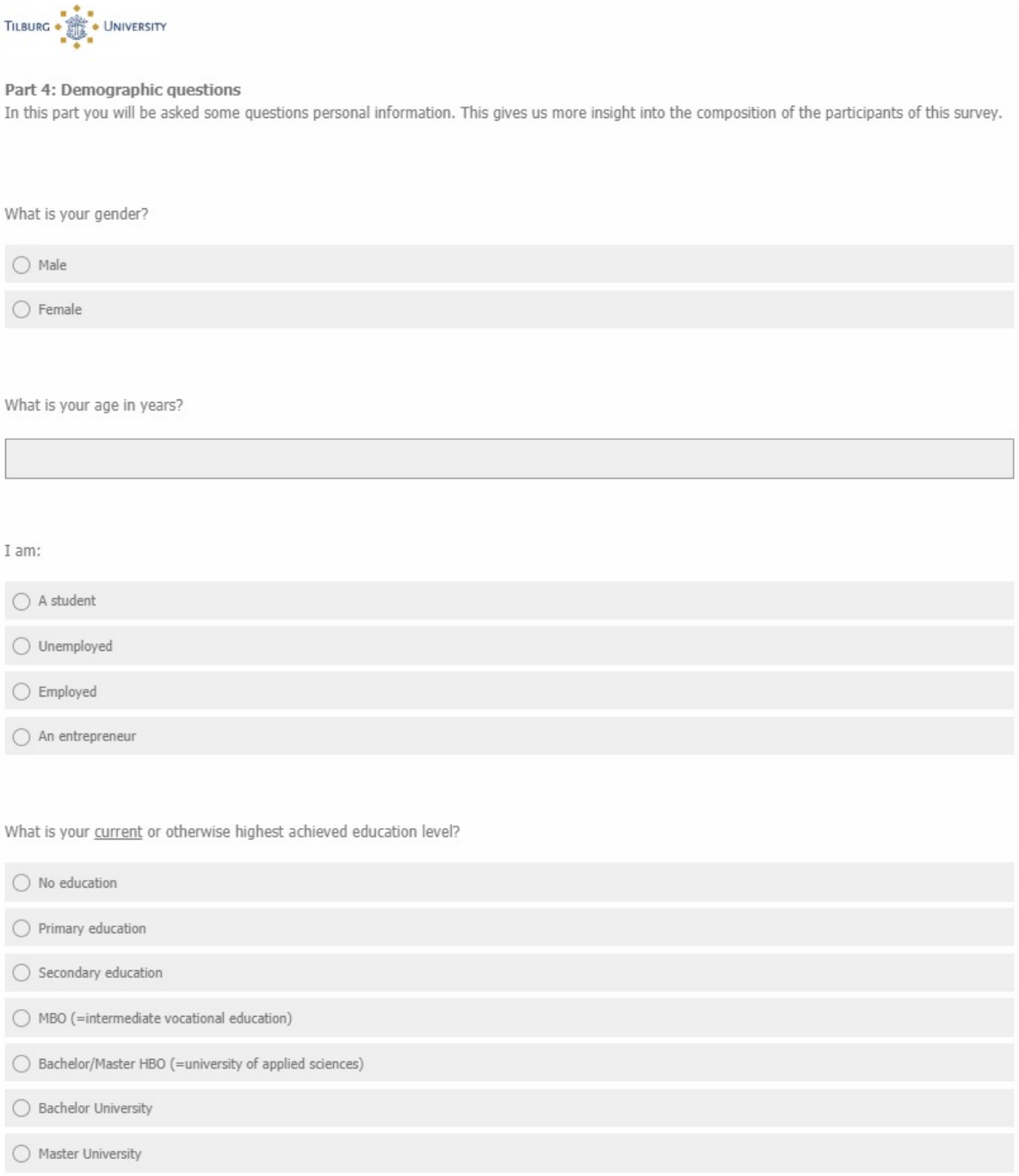
The part below is only for Treatment Group 2.

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

The part below is for all three groups.



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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?

I am:

- ◯ A student
- ◯ Unemployed
- ◯ Employed
- ◯ An entrepreneur

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

The 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 the first version of Question 2 (if the participant chooses "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 the second version of Question 2 (if the 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

The 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

The 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 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 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 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
○	○	○	○	○	○	○

VII. Investment experience and end of questionnaire

The 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:

[ ]

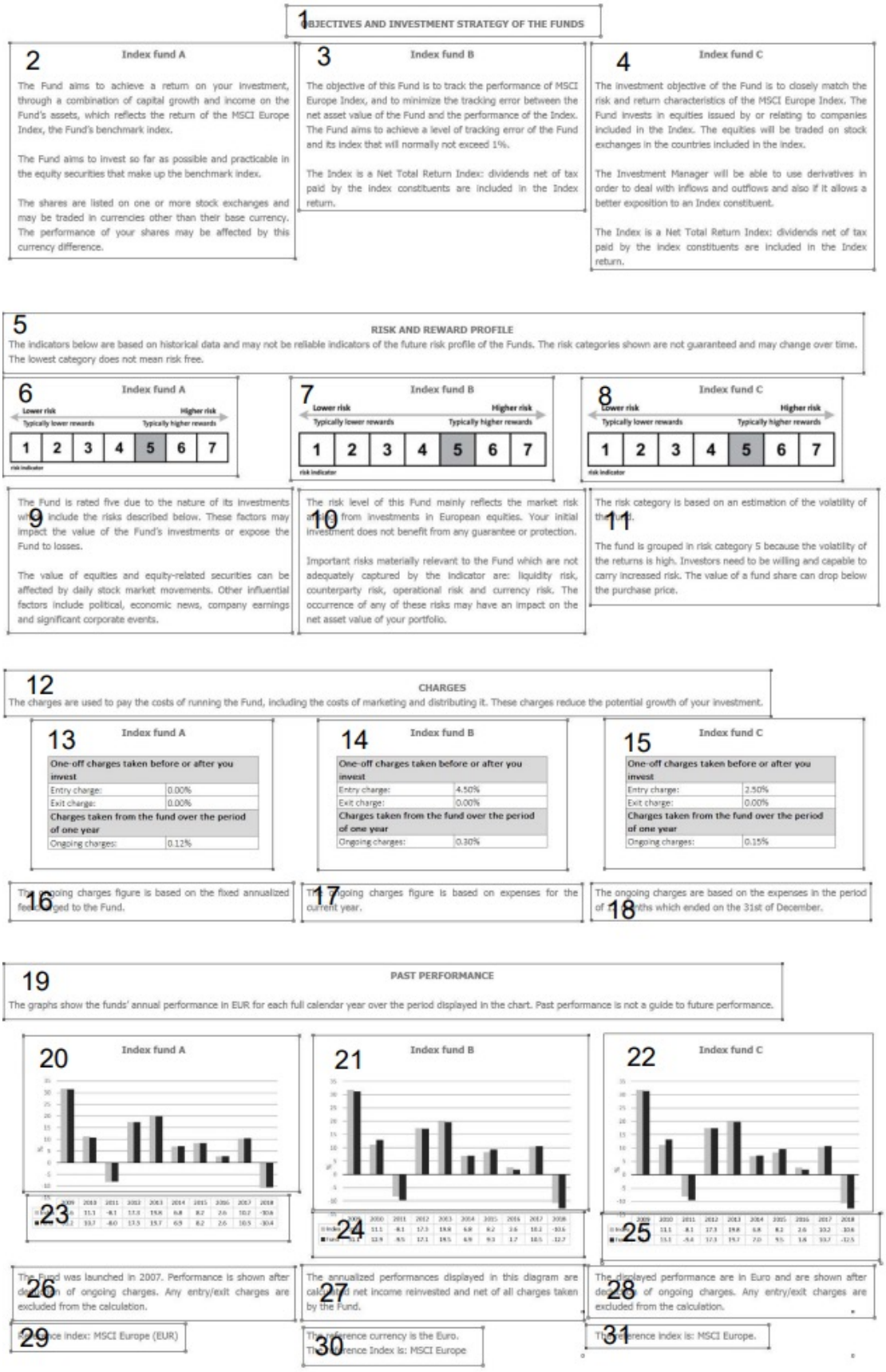
- ○ No

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

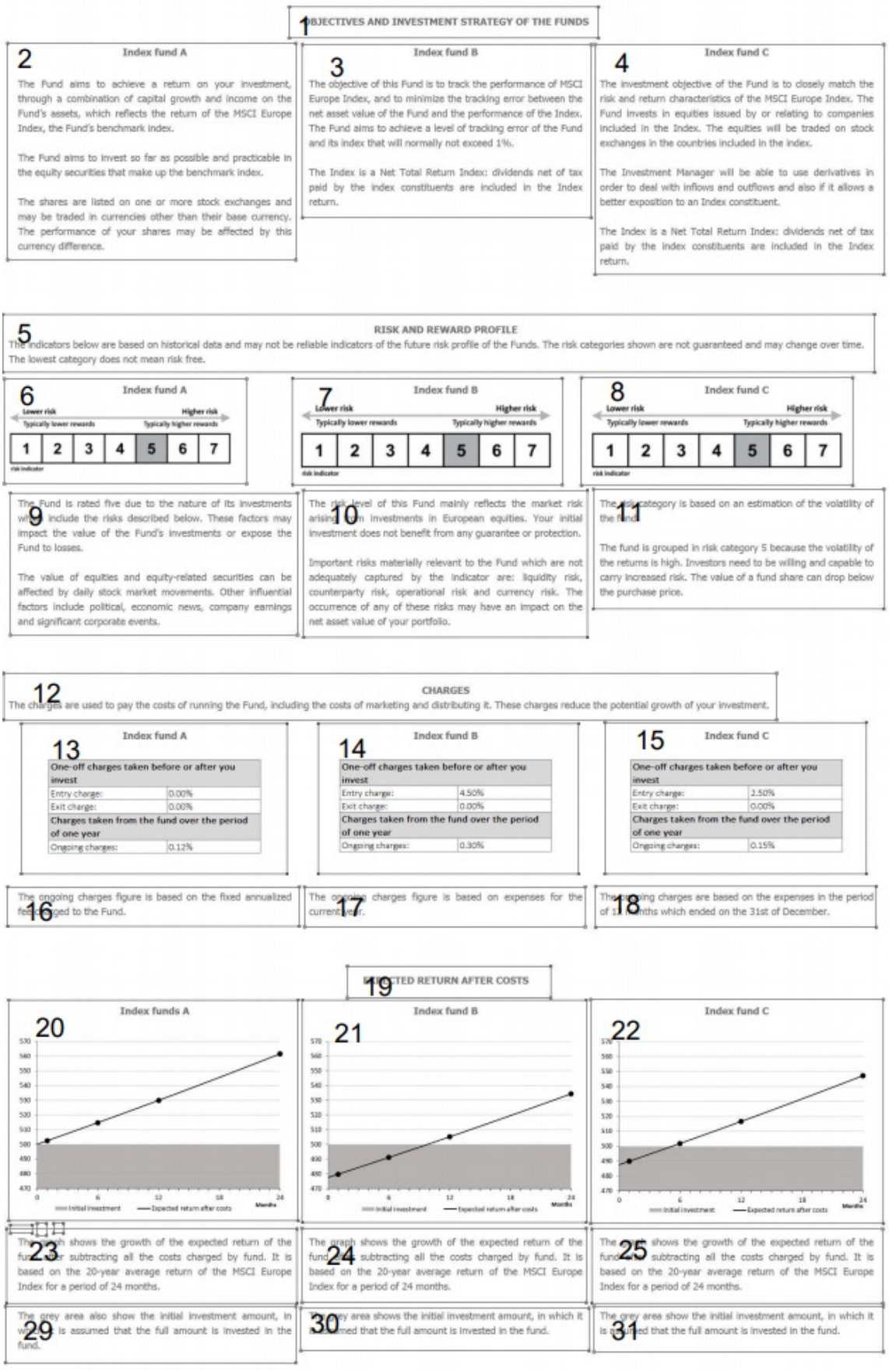
- ○ Yes
- ○ No

Appendix 2: Stimuli and areas of interest

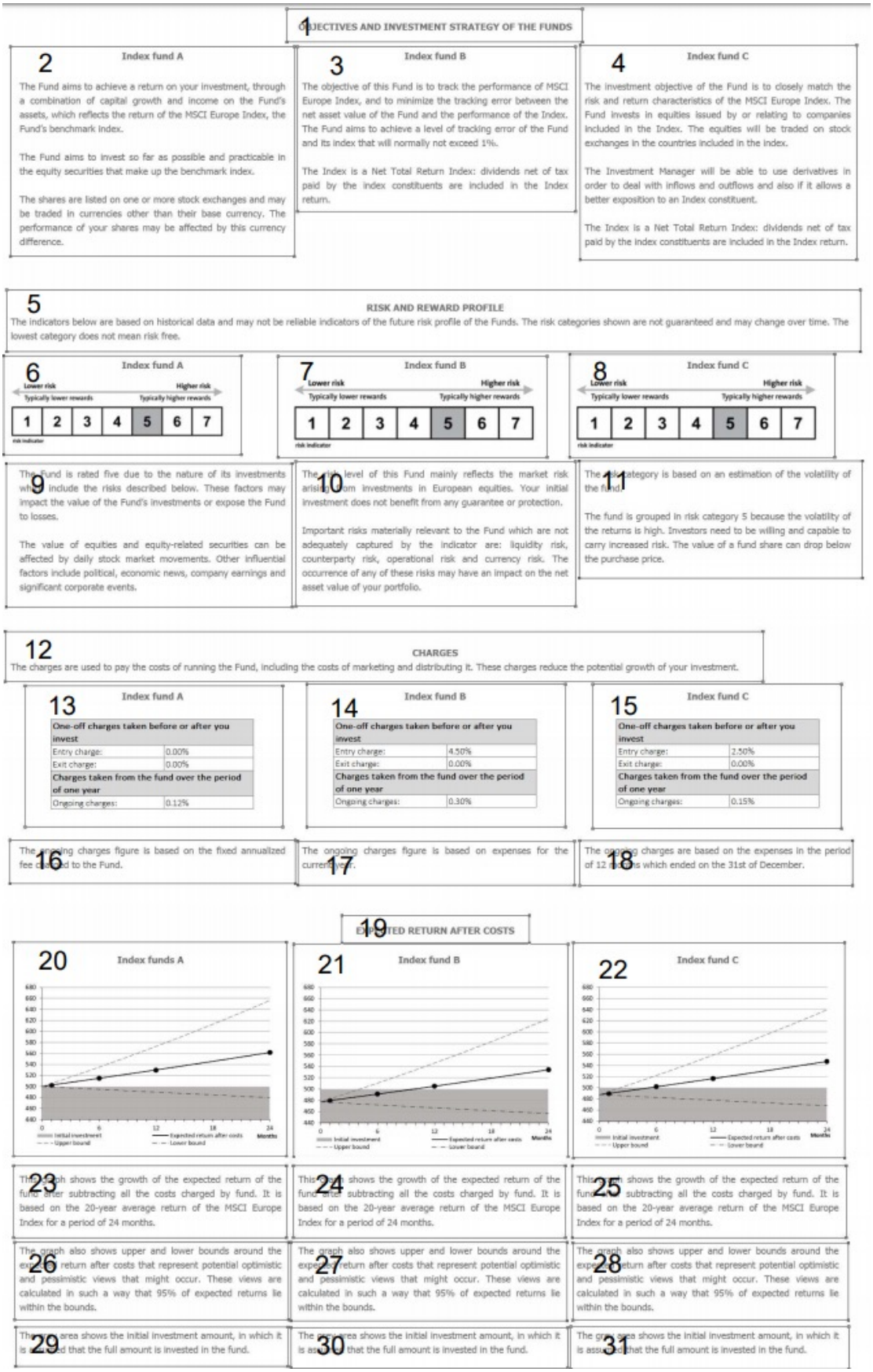
Stimulus 1 (CG)



Stimulus 2 (TG1)



Stimulus 3 (TG2)

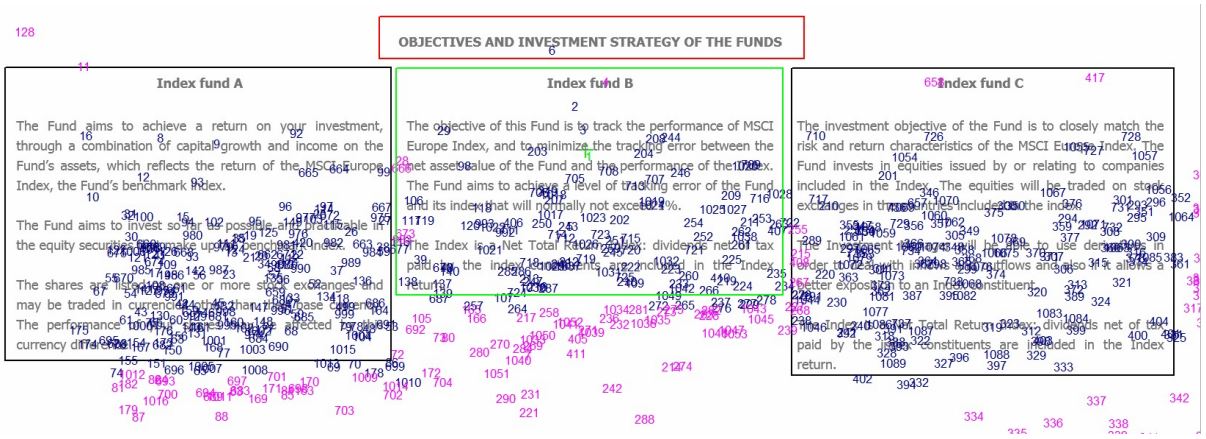


Appendix 3: Example of linear re-shift adjustments in eye-tracking data

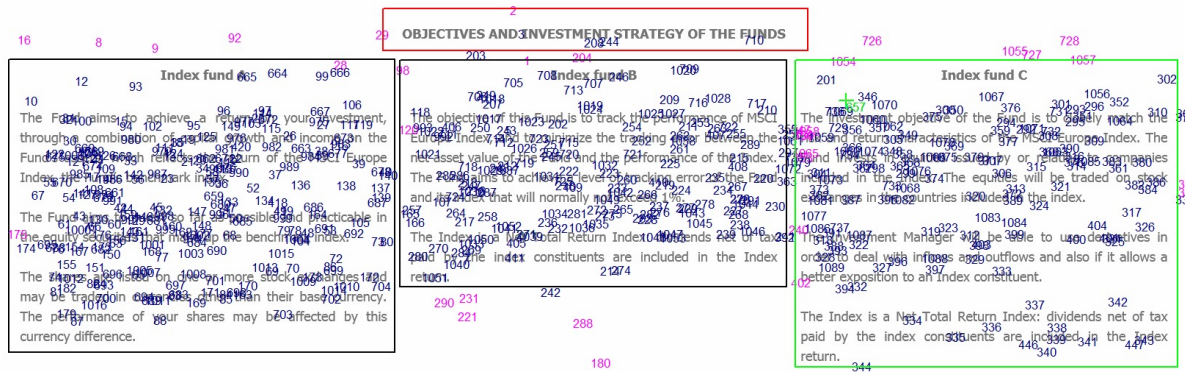
Following the collection of primary data, the data underwent manual reassignment of fixations. Using the stimuli marked with areas of interest (AOI), only fixations falling within the bounds of these AOI were included in the analysis (see Appendix 2 for a full copy of stimuli and their AOI). However, some fixations which belonged to an AOI fell just outside of its boundaries, while other fixations that did not belong to that AOI did fall within the boundaries. This is why a few fixations are manually reassigned.

During this reassignment process, in some cases all fixations were linearly shifted in a certain direction, most likely because participants had shifted their bodies during the experiment. For these cases, a linear re-shift adjustment was implemented so that the data could be interpreted. 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; these were removed from the sample.

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

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