The Value of Financial Knowledge

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Preliminary draft - Please don't cite or circulate

This version: February 15, 2023

Abstract

This paper explores individuals' willingness to pay for financial education as well as the effectiveness of financial education on financial decision-making. We provide participants in an experimental setting the option to purchase an educational treatment directly linked to an incentivized portfolio allocation task. We measure the subjective value that participants place on the financial education by eliciting their willingness to pay for it, as well as the objective value that the intervention has for participants by measuring the treatment effect on the incentivized portfolio allocation task. To that end, we develop two novel measures of a Pareto improvement of portfolio efficiency and a preference-independent measure of welfare. We find that participants with higher levels of revealed financial literacy have a higher willingness to pay for financial education, while participants with higher self-reported financial knowledge want to pay less for the intervention. The educational intervention increases people's portfolio heterogeneity, and it also boosts the likelihood of improving portfolio efficiency by almost 20 percentage points. We further show that participants with higher levels of revealed cognitive ability and numeracy benefit more from the treatment, compared to participants with lower scores. On average, participants' willingness to pay for the educational intervention was not aligned with their benefit from financial education.

JEL classification: G11, G41, G53

Keywords: Financial Education, Financial Literacy, Portfolio Efficiency

*Corresponding author. We would like to thank Bertrand Achou, David Boisclair, Claudio Daminato, Hans-Martin von Gaudecker, Franca Glenzer, Christian Kubitza, Christian Waibel and seminar participants at ETH Zurich for helpful comments and suggestions, and Alexa Samuel and Yong Yu for valuable research assistance. Further, we thank the Wharton School of the University of Pennsylvania as well as the Retirement and Savings Institute at HEC Montréal for generous research funding.

1 Introduction

Individuals exhibit surprisingly low levels of financial literacy, even in developed nations. For instance, many people in the U.S. and Europe do not understand interest rate compounding and risk diversification (Lusardi and Mitchell, 2011b, 2014), or mutual fund expenses (Choi et al., 2009). Such financial illiteracy becomes highly relevant in the context of retirement planning, since less financially literate individuals accumulate and manage wealth less effectively (Hilgert et al., 2003; van Rooij et al., 2011) and often fail to plan for retirement (Lusardi and Mitchell, 2007).

The evidence is mixed on the effectiveness of financial education programs as well as on the effectiveness of financial advice.[1] For example, Bluethgen et al. (2008) and Hackethal et al. (2012) find that financial advice improves household portfolio choice. In contrast, Bhattacharya et al. (2012) observe that investors rarely follow financial advice to improve their portfolio efficiency. Those authors also emphasize that investors who need financial advice most are least likely to obtain it - even when it is free. This is confirmed by Hung and Yoong (2013) who show that only one-third of people elect to receive information when offered financial advice for free in an experimental setting. The latter study also reported that financial advice tends to change behavior only when it was solicited.

Our project investigates individuals' willingness to receive and pay for financial education. We also explore whether individuals improve their financial decision-making and/or financial knowledge when they acquire financial education, and whether consumers who benefit most from financial education are also willing to pay more for it. We do so using an incentivized experiment on a representative sample of Canadian households conducted with the online survey organization AskingCanadians.

In the experiment, we first ask subjects to allocate endowments across three different hypothetical assets that differ in expected return and volatility. After observing participants' investment decisions, we inform respondents that they will face the same allocation exercise again later in the survey and that their final payouts will depend on the actual performance of these assets, so the decision is incentivized. We then provide participants with an opportunity to acquire financial knowledge with respect to the financial decision they just made and will make again. We elicit participants' willingness to pay for the interventions using the method suggested by Becker et al. (1964). That is, we incentivize

[1] See for instance Martin (2007), Agarwal et al. (2011), and (Kaiser et al., 2022) for reviews of the effectiveness of financial education programs, and Hackethal and Inderst (2013) for a review of the effectiveness of financial advice.

subjects to report their true willingness to pay for financial knowledge by linking their decisions to the actual payouts received on completing the survey.[2]

This setting enables us to study the determinants of individuals' willingness to pay for financial knowledge. For example, we examine whether financial knowledge is more valuable to the least educated or individuals who are likely to benefit most from it. In a theoretical setting, Lusardi et al. (2017) argue that peoples' willingness to pay for financial knowledge equals the marginal benefit of the associated information. This marginal benefit is likely to depend on peoples' expectations regarding how the information will change their financial decisions. Therefore, we also elicit subjects' assessment of the marginal benefit of knowledge and shed light on its determinants across individuals.

Our treatment provides an explanation of portfolio diversification and we describe the concept of risk-adjusted portfolio returns, after which we ask subjects to again allocate an endowment across the three different assets. This second portfolio allocation decision is incentivized: that is, the return on the second portfolio allocation task drives the final payouts received upon survey completion. We observe investment decisions before and after the exogenous increase in subjects' financial knowledge. For this purpose, we form one treatment group and two control groups. The treatment group receives educational treatment with explanations of portfolio diversification and risk-adjusted portfolio returns. The first control group includes individuals who were offered the financial knowledge treatment but who (randomly) did not receive it. The second control group consists of individuals not offered any treatment. This allows us to measure the effect of the acquisition of financial knowledge. Thus our setup also contributes to an understanding of the impact of financial knowledge on financial decision-making with a clear causal estimation method. Further, we can relate subjects' willingness to pay for financial knowledge to its effectiveness. By measuring participants' performance with respect to portfolio efficiency and observing participants' expectations about their performance, we can causally identify subjects' mistakes and infer whether individuals demand a discount or are willing to pay a premium for knowledge relative to their improvement (treatment effect).

While previous studies have documented low levels of financial knowledge, our analysis develops a better understanding of why financial knowledge is as low as it is. Thus our findings will have important implications for those seeking to enhance individuals'

[2]In order to elicit respondents' true willingness to pay for the treatment, we must "sell" the treatment to the participants. In other settings, this would create a selection effect. In our framework, the treatment is randomly assigned, given the respondent's willingness to pay. In fact, we can observe the selection, since we observe participants' willingness to pay as well as the randomly generated price, which determines whether the treatment is purchased.

financial knowledge – in particular, to improve retirement planning decisions. In view of Hung and Yoong (2013)'s result that advice tends to change behavior only when solicited, it is of utmost importance to design policies that incentivize individuals to increase their financial knowledge so their saving and investment choices become more efficient. Accordingly, our study is the first to conduct an incentivized experiment eliciting peoples' willingness to pay for financial education and its determinants. Moreover, while a large number of studies examines the impact of financial education on decision-making, these are typically not incentivized and may be subject to omitted variable bias which can undermine causal interpretation of their findings (Lusardi and Mitchell, 2014). Our study sheds light on the reasons driving individuals to acquire financial education as well as on determinants of its effectiveness for financial decision-making.

We find that almost one quarter of participants did not wish to receive the educational treatment, even when it was provided free of charge. Stated willingness to pay for the treatment was mainly driven by participants' expectations about their ability to transform the financial information from the intervention into a higher return. In addition, a higher level of revealed sophistication such as financial literacy increased the willingness to receive the educational treatment, while high self-reported financial knowledge decreased the willingness to pay for it.

The treatment intervention increased heterogeneity in portfolio allocations, indicating that it encouraged participants to customize their portfolios *vis a vis* standard allocations. For example, the educational treatment substantially reduces participants' propensity to spread the entire endowment equally across all three funds, by around 50 percentage points. To further analyze whether financial education in our experimental setting improved participants' financial decisions, we developed two novel measures: A measure of Pareto improvement of portfolio efficiency and a measure of preference-independent welfare improvements. We showed that our treatment increased peoples' likelihood of achieving this type of efficiency and welfare improvements by almost 20, and 3 percentage points, respectively. With these results, we highlight the importance of measuring improvements in portfolio allocations in a well-defined theoretical way and we contribute to the literature arguing that financial education can have a positive effect on financial behavior (e.g. Kaiser et al., 2022). Our heterogeneity analyses shows that participants with higher levels of revealed cognitive ability and numeracy scores benefited more from the treatment than did participants with lower scores. Participants with characteristics that are driving a higher willingness to pay for the educational intervention were not necessarily benefiting more from the treatment than those with a lower willingness to pay

for financial education. This finding could be driven by the observation that, on average, participants did not assess their ability to apply the treatment very well.

2 Related Literature

Our project is related to two strands of literature. One explores individuals' willingness to acquire financial knowledge or financial advice.[3] A second focuses on the effectiveness of financial education programs and financial advice.[4] Lusardi et al. (2011, 2017) provide a theoretical framework to endogenize financial knowledge, building and calibrating a multi-period stochastic life cycle model in which consumers choose between investing in financial knowledge or consumption. In their framework, financial knowledge gave people access to higher expected returns on more sophisticated investment technologies. One prediction was that the optimal investment in financial knowledge (measured in money and time) should equal the marginal benefit of the associated information. To test this in the present setting, we relate peoples' monetary investment in financial education to their recorded willingness to pay for additional financial education. Our study elicits subjects' assessment of the marginal benefit of knowledge and sheds light on its determinants in the cross-section. We find that the subjective marginal benefit of an investment in financial education depends on peoples' expectations regarding how the information would change their financial decisions. Further, we confirm that individuals who were willing to pay more for the educational intervention had higher expectations about the treatment effect. Yet, they did not achieve a higher benefit from the treatment, on average. Another prediction from the Lusardi et al. (2011, 2017) model is that the optimal level of financial knowledge over the life cycle differed by educational group. This is due to relatively low retirement benefit accruals for high earners, leading to a hump-shaped labor income profile for the best educated, and also a need for private wealth accumulation. An important implication is that better-educated consumers have higher gains from investing in financial knowledge, but it is less useful for less well educated consumers to invest in financial knowledge, given the costs and the assurance of their retirement consumption via transfer programs. Since our experiment recorded educational levels, as well as self-reported and

[3]See for example (Hung and Yoong, 2013; Jappelli and Padula, 2013; Lusardi and Mitchell, 2014; Kim et al., 2016; Hsu, 2016; Lusardi et al., 2011, 2017).

[4]See for example (Bernheim et al., 2001; Bernheim and Garrett, 2003; Duflo and Saez, 2003; Clark and d'Ambrosio, 2009; Hastings and Tejeda-Ashton, 2008; Cole et al., 2014; Choi et al., 2009; Hastings and Mitchell, 2011; Bhattacharya et al., 2012; Behrman et al., 2012; Hung and Yoong, 2013; Heinberg et al., 2014; Lusardi and Mitchell, 2014; Ambuehl et al., 2017; Clark et al., 2017; Lusardi et al., 2020; Kaiser et al., 2022).

revealed sophistication, we are also able to test whether peoples' willingness to pay for financial knowledge in our experimental framework corresponds to the knowledge pattern under this third, very important, prediction. In our experiment, we confirm that participants with higher levels of financial literacy were willing to pay more for the financial education. Yet, on average, they did not benefit more from receiving the treatment.

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Two studies closely related to ours with respect to the experimental design - albeit framed in the context of financial advice rather than financial education - are by Bhattacharya et al. (2012) and Hung and Yoong (2013). The former employed a field study that asked whether unbiased financial advice was attractive to selected customers of a large German brokerage firm offered impartial advice on their portfolios. This advice comprised general financial knowledge, such as an explanation of volatility, mean-variance efficiency, and the Sharpe ratio, and it also listed the trades necessary to realize a recommended portfolio identified by a mean-variance optimizer (Markowitz, 1952). Results showed that investors who most needed financial advice - identified as the less financially sophisticated, measured by past portfolio performance - were least likely to obtain it; also, the small share of investors which did obtain financial advice rarely followed it and did not improve their portfolios' efficiency. Nevertheless, these findings may be driven by selection effects, since respondents were a select group of high-value brokerage customers having at least three trades over a 12-month period. Further, among the targeted group, customers self-selected into receiving financial advice. By contrast, in our experimental setting, we confirm that participants with low financial literacy (who may need financial education most) were more likely to reject the intervention. If measure sophistication by past portfolio performance, we find no association between sophistication and the willingness to pay for financial education. In contrast to Bhattacharya et al. (2012)'s results, participants in our experimental setting improved their portfolio efficiency after receiving the educational treatment.

Hung and Yoong (2013) employed two complementary observational and experimental analyses to explore the impact of financial advice on investment decisions. Focusing on the defined contribution pension participants in the American Life Panel (ALP), the authors found little evidence of improved pension asset allocations attributable to financial advice. Due to problems of reverse causality and selection in the ALP, the authors additionally implemented an unincentivized experiment in which participants faced a portfolio allocation exercise. The authors found that unsolicited (solicited) advice had no (an) effect on investment behavior. In one of the respondent groups, the *affirmative decision* group,

subjects could choose whether to receive financial advice and only those who wished to receive it, did so. Individuals who chose advice in in this group performed better than those provided advice by default. The authors stressed that opportunity costs of time, trust, and individual preferences for self-reliance could have driven demand for advice. Finally, the authors found that respondents with low financial literacy chose financial advice more often.

Our analysis differs from Hung and Yoong (2013) in several ways. In their framework, financial advice had no effect when it was unsolicited. One explanation for this result could be that their subjects could not assess how much the advice might alter the experiment's outcome. In our setting, we control for this by asking individuals for their expectations about the informativeness of the treatment, whether they expected to be able to apply the received information to their investment decision, and by how much they thought their return would increase. Quantifying peoples' willingness to pay for financial education permits us to explore the link between individuals' willingness to pay for the treatment and their expectations about its effectiveness, as well as the link between individuals' willingness to pay for the treatment and its actual effectiveness. Further, we directly quantify the mistakes that subjects make by measuring preference-independent improvements in portfolio efficiency, while the portfolio composition chosen in Hung and Yoong (2013) highly depended on subjects' characteristics. Instead of providing statements about portfolio composition, we instead offer respondents an easy rationale for investing sensibly. We thus test whether subjects learned from the information and applied it later on. Finally, the decisions we observe in our experiment are incentivized.

3 Experiment

We implemented our experiment in Fall 2021 using the online panel of *Asking Canadians*, a Canadian survey organization. Of the pool of respondents age 25 to 80, 2005 subjects were randomly selected. Participants were paid in rewards from their choice of major retailers from a list provided at the very end of the experiment.[5]

Our instrument was composed of two modules. In the first, we collected extensive information about respondents' backgrounds and preferences, while the second module was devoted to the investment experiment.

[5]Retailers included but were not limited to Aeroplan (Air Canada), the department store Hudson's Bay, Petro-Canada, and VIA Rail.

3.1 Survey Module

The first module requested participant information on basic demographics and financials (balance sheet and income). We also elicited preferences in three domains using procedures developed in the literature: risk aversion (Holt and Laury, 2002), time preferences (Frederick et al., 2002) and ambiguity aversion (Dimmock et al., 2016). In order to elicit subjects' *cognitive ability* and *numeracy*, we employed the cognitive reflection test introduced by Frederick (2005) and the Berlin numeracy test introduced by Cokely et al. (2012). To record subjects' *financial literacy*, we calculated a financial literacy score based on the Big Three questions designed by Lusardi and Mitchell (2008, 2011a). Details appear in the Appendix C.

The experimental module consisted of three tasks: an initial portfolio allocation decision, a willingness-to-pay elicitation for financial knowledge, and a follow-up portfolio allocation decision. The willingness-to-pay elicitation was used to determine who received financial education as a treatment.

3.2 Experimental Module

Next, we provide details on each of these tasks and the assignment mechanism to treatments. A summary of the experimental timeline appears in Appendix B.

3.2.1 Task 1: Initial Portfolio Decision "Allocation Task 1"

Subjects received a hypothetical endowment of $ 30 to allocate across three funds. For each, we presented information about its expected 5-year returns (μ) and respective volatility (σ).[6] Further, we provided some explanation on how these parameters can be interpreted and we illustrated the probabilities of different realizations of 5-year returns for each fund. The full allocation exercise appears in Section 4 of the questionnaire in Appendix C After subjects decided on their allocations, we asked for their subjective beliefs about the expected return for the total portfolio. Asking participants to state their beliefs about their expected return allows us to quantify their misperception of their financial performance, and to relate this to their willingness to pay for financial education as well as its efficacy.

[6] We choose simple $\mu - \sigma$ illustration of assets, since most people are not confronted with investing in index funds during their lifetime but they have to take other financial decisions that most often can be characterized by their expected return and their volatility.

3.2.2 Task 2: The Willingness to Pay Elicitation

After subjects allocated their first endowment, they received a second endowment of the same amount ($ 30). Subjects were told that they could use this endowment to purchase some form of educational treatment that could help them perform better in a second allocation task, in which they would invest the remaining amount of this second endowment. To elicit individuals' willingness to pay for financial education, we used a Becker-DeGroot-Marschak (BDM) mechanism (Becker et al., 1964), a standard incentive-compatible method. Subjects had to state the maximum amount of their endowment that they were willing to pay for the treatment, in a given interval of $ [0-5]. A random number generator then determined the actual purchase price within this interval; if that price was below the respondent's elicited willingness to pay, the subject received the treatment (at the price generated by the random number generator), otherwise he or she did not.

We also randomly assigned participants to each of two treatment arms: one group to whom no treatment was offered (control arm, "treatment 1"); and a second group offered the financial education, namely the explanation of portfolio diversification and risk-adjusted returns (knowledge arm, "treatment 2"). For the knowledge treatment arm, the BDM instrument was used to determine who received the treatment. Therefore, as a result of the BDM random assignment (conditional on willingness-to-pay), one group within the treatment arm received treatment while two groups did not (one in the treatment arm and the control arm). Two remarks are in order regarding this setup.

First, the information given to subjects about each treatment arm before their willingness to pay elicitation is important. For the knowledge arm, we told participants that they could acquire additional information that might help them make better financial decisions and could possibly increase their return in the next portfolio allocation task. The exact wording appears in Appendix C.

Second, our rationale for including a control arm is as follows: Individuals who wished to purchase financial knowledge but were not selected to receive it might have exhibited a different motivation when facing the second financial decision versus the first, e.g., they might have felt disappointed or deceived.[7] The same might be true for individuals who did not wish to purchase financial knowledge but were selected to receive it. To control for such potential changes in motivation and to isolate learning effects from the first decision, we included the control arm that was never offered any treatment.

[7] We partially mitigate this by framing, i.e. avoiding language such as: "Unfortunately, you were not selected for the treatment".

3.2.3 Task 3: Follow-up Portfolio Decision ("Allocation Task 2")

After the treatment, we again asked all subjects (independently of whether they received the treatment) to allocate their endowment across the three funds from Allocation Task 1. At this step, subjects' endowments corresponded to what they received for making their previous financial allocation decision ($ 30), minus the price they paid for the treatment (if they received it). This way, the endowment in the second financial decision (Allocation Task 2) was random by the draw of the random number generator, conditional on assignment to treatment. Again, subjects had to allocate their full (remaining) endowment across the three assets in the $\mu - \sigma$ representation used in Task 1.

3.3 The Treatment

Next we discuss the financial knowledge we provided to subjects regarding two important concepts related to financial decision-making: portfolio diversification, and risk-adjusted portfolio returns. The intervention consisted of several screens displayed to participants, where the first defined the process of portfolio allocation and then discussed the value of diversification. To that end, we illustrate a hypothetical investment opportunity consisting of three different funds that have the same expected return and standard deviation (referred to as *variability*). The treatment illustrated verbally and graphically that a portfolio's standard deviation decreases when an endowment is spread equally across those three funds, relative to investing everything in a single fund, while the expected return is unchanged. We then related this decrease in variability to the term *diversification*.

In the next step, the intervention focused on the concept of high risk-adjusted returns. To that end, we introduced a second hypothetical investment opportunity consisting of three funds with different expected returns and standard deviations. The instructions suggested that the subject first build a portfolio by spreading the endowment equally across the three funds, and then discussed how one could increase the portfolio's expected return while keeping the standard deviation unchanged. To achieve this, we suggested that subjects calculate risk-adjusted returns of each fund by dividing its expected return by its standard deviation, and then by allocating more money to funds with higher risk-adjusted returns (see Appendix C).

4 Portfolio choice: Task 1

A total of 2,005 participants completed our survey.[8] Table 1 reports demographics, financial information, measures of financial sophistication, and preferences for the 1,993 respondents in our study sample. These respondents were on average 53 years old, 44.5% of respondents in our sample were female, 65.4% were married, and 61.2% had children. Half the sample (51.6%) had a Bachelor's degree or higher. The respondents in our sample earned an average of $ 84,113 in annual household income (18.9% refused to disclose this information) and they held an average of $ 248,562 in financial wealth (in RRSPs, TFSAs, individual stocks, defined contribution plans and other accounts).

A total of 26.8% of respondents held domestic stocks and 19.1% held individual stocks in various plans or accounts such as RRSPs and TFSAs. A minority of respondents had traded stocks or other financial instruments themselves (36.3%), implying that stock market experience was likely low for a majority of respondents. Only 8.3% of respondents reported having high knowledge of the stock market, and 2.5% very high knowledge.

Only 12.9% (5%) of respondents in our sample assessed their overall financial knowledge as high (very high). Fewer than 30% of respondents had studied economics or finance in high school. In addition to self-reported measures of sophistication, we use three different scores to measure individuals' objective sophistication levels. We define `Financial Literacy Score` as the sum of correct answers to the big three questions designed to measure financial literacy (Lusardi and Mitchell, 2008, 2011a), `Cognitive Ability Score` as the sum of correct answers to the cognitive reflection test by Frederick (2005) to measure cognitive ability, and `Numeracy Score` as the sum of correct answers to the three-question Berlin numeracy test by Cokely et al. (2012). Overall, this sample of respondents scored relatively well on financial literacy, inasmuch as 66.13% of respondents answered all of the three questions correctly. The average score on cognitive skills was lower (0.966 out of 3, on average). Finally, the average numeracy score was also low, 0.554 out of 3.

In terms of preferences, we measured risk aversion using a Holt and Laury (2002) multiple price list. By determining the point at which respondents switched the risky lottery, we obtain a measure of their risk aversion. A substantial fraction, 20.4% switched at the last choice (9), reflective of high risk aversion, while the median was closer to 5. We also measured the degree of peoples' patience using the Frederick et al. (2002) scale. There proved to be considerable heterogeneity in time preferences in our sample. Finally,

[8] We dropped 12 respondents who refused to disclose their gender as we used this as a control variable in all regressions.

we measured ambiguity aversion as in Dimmock et al. (2016) as the difference between the matching probability reported by the respondent and 0.5, expressed in percent. Overall, our respondents were relatively ambiguity averse.

In Task 1, all respondents were asked to choose their portfolio allocations using the three fund options. Let i denote a respondent, and k an investment option. Each investment option is characterized by an expected return μ_k and a standard deviation of returns σ_k. Let $w_{1,i,k}$ be the weight put by respondent i in Task 1 for investment option k. Given the absence of correlation across investment options (by construction), the expected return and variance of the portfolio selected are given by:

$$\mu_{1,i} = \sum_k w_{1,i,k}\mu_k, \quad \sigma^2_{1,i} = \sum_k w^2_{1,i,k}\sigma_k - \mu^2_{1,i} \tag{1}$$

Next, we measure performance and potentially sub-optimal choices. Knowing whether someone picks a high expected return vs. a low expected return portfolio cannot elucidate a normative claim, since a risk averse person might find it optimal to choose a portfolio with lower risk (and lower return). To make progress, we consider the efficient frontier as the set of weights which provides the highest expected return for a given level of risk (or vice-versa). A respondent picking a portfolio below the frontier would be making a sub-optimal choice, since she could increase her return for a given level of risk leading to greater welfare (assuming her utility function is increasing in wealth). Alternatively, she could decrease her portfolio risk holding expected return constant, leading to greater welfare for any concave utility function or level of risk aversion.

To measure respondents' degree of sub-optimal choices, we start by measuring the Sharpe ratio of a given portfolio in Task 1, $S_{1,i} = \mu_{1,i}/\sigma_{1,i}$. Taking σ_i as given, we denote $\{w^*_{1,k}\}_{k=1,2,3}$ as the weights that maximize the portfolio's expected return. These are the weights that would bring the respondent to the efficient frontier for a given level of risk. Let $S^*_{\mu,i}$ be the Sharpe ratio for those weights. Then the relative mean return loss is defined as $RML_{1,i} = 1 - \frac{S_{1,i}}{S^*\mu,i}$, which measures the relative vertical distance between a portfolio allocation and the point on the efficient frontier in the mean-variance space. We can also compute the point on the efficient frontier that minimizes the standard deviation for a given expected return (the horizontal distance in the mean-variance space). This yields the relative difference in risk between the efficient frontier and what the respondent selected. Let $S^*_{\sigma,i}$ be the Sharpe ratio that minimizes the standard deviation for a given level of expected return. Then the relative return loss for the standard deviation is $RSL_{1,i} = 1 - \frac{S_{1,i}}{S^*\sigma,i}$.

Table 1: Demographics and Characteristics of Respondents

	N	mean	sd	median
Demographics				
Female		0.445	0.497	0
Age		52.950	14.128	54
Married or common-law		0.654	0.476	1
Has children		0.612	0.487	1
Number of household members		2.125	1.168	2
Region				
Quebec		0.216	0.412	0
Ontario		0.381	0.486	0
British Columbia		0.147	0.354	0
Prairies		0.197	0.398	0
Maritimes		0.059	0.235	0
Education				
College or some university		0.347	0.476	0
Bachelor degree or more		0.516	0.500	1
Financials				
ln(Household income) (imputed; ln of '000 $)		4.035	1.975	4.605
Household income missing		0.189	0.392	0
Financial wealth ('000 $)		248.562	488.995	50
Ownership of individual stocks		0.191	0.393	0
Ownership of domestic stocks		0.268	0.443	0
Sophistication				
Financial Literacy Score		2.513	0.776	3
Cognitive Ability Score		0.966	1.056	1
Numeracy Score		0.554	0.859	0
Financial knowledge: high (self-reported)		0.129	0.336	0
Financial knowledge: very high (self-reported)		0.050	0.218	0
Stock market knowledge: high (self-reported)		0.083	0.276	0
Stock market knowledge: very high (self-reported)		0.025	0.156	0
Has traded stocks		0.363	0.481	0
Has studied economics [or finance in high school]		0.298	0.457	0
Preferences				
Risk averse: 2		0.013	0.113	0
Risk averse: 3		0.047	0.212	0
Risk averse: 4		0.180	0.384	0
Risk averse: 5		0.218	0.413	0
Risk averse: 6		0.140	0.347	0
Risk averse: 7		0.090	0.287	0
Risk averse: 8		0.052	0.222	0
Risk averse: 9		0.204	0.403	0
Impatient: 2		0.607	0.489	1
Impatient: 3		0.135	0.342	0
Impatient: 4		0.037	0.189	0
Ambiguity averse		7.903	20.080	3
N	1993			

Note: This table presents summary statistics of the control variables. For continuous variables, we show mean and standard deviation. For binary variables we show the share. `Household income missing` =1 if respondents refused to provide information on their household income, and zero otherwise. We report the log of annual household income and impute the sample's minimum positive income for any reported zeros. We further impute missing values of this variable with the sample's mean income. `Financial wealth` is the sum of wealth held in RRSPs, TFSAs, defined contribution plans, and other accounts. `Financial Literacy Score` is the sum of correct answers to three questions measuring financial literacy (Lusardi and Mitchell, 2008, 2011a), `Cognitive Ability Score` is the sum of correct answers to the three question cognitive reflection test (Frederick, 2005), and `Numeracy Score` is the sum of correct answers to the 3 question Berlin numeracy test (Cokely et al., 2012). The dummy variables for risk aversion indicate at which choice in the multiple price list respondents switched to the riskier lottery. A higher switching point suggests higher risk aversion.

We report in Table 2 summary statistics on respondents' performance on their first investment task. Here we see that the average expected return is 31.7% and it ranges from 18.9% to 44.4%. There is also considerable variation in $\sigma_{1,i}$, with a mean of 26.06% and a range of 7.4% to 50.2%. The relative mean loss $RML_{1,i}$ averages 3.88%, again with a large range from 0 to 33.1%. The relative standard deviation loss, $RSL_{1,i}$, is larger, 7.63%, on average, again with a large range. We also compute the fraction of respondents who put equal weights on each of the three investment funds. We find that close to a quarter of respondents (24.4%) made that selection. The relatively large frequency of this 1/K behavior has been reported previously (Thaler et al., 2001). We also report the frequency of respondents who invested their entire endowment in the fund with the highest return. This behavior, which we label as *return chasing*, characterized one out of 10 respondents (10.8%). Overall, we identify considerable heterogeneity in portfolio allocations and considerable scope for improvement in respondents' portfolios.

Table 2: Performance in Allocation Task 1

	N	mean	sd	min	median	max
Mean_1		31.679	6.498	18.9	30.264	44.4
$\text{Standard Deviation}_1$		26.056	11.480	7.410	21.605	50.2
Sharpe Ratio_1		1.374	0.412	0.682	1.401	2.704
RML_1		3.883	5.861	0	1.375	33.086
RSL_1		7.628	11.473	0	3.365	59.852
$1/\text{K}_1$		0.244	0.430	0	0	1
Return Chasing_1		0.108	0.310	0	0	1
N	1993					

Note: This table presents summary statistics of the performance variables generated by Allocation Task 1. For continuous variables, we show the mean and standard deviation. For binary variables we show the share. $\texttt{1/K}_1$ is equal to one if respondents spread their endowments equally over all assets, and zero otherwise. $\texttt{Return chasing}_1$ is equal to one if respondents invested their entire endowment in the fund with the highest expected return, and zero otherwise.

Figure 1 shows the portfolio allocations in the mean vs. standard deviation plane. The size of each point (bubble) is indicative of the number of respondents with a particular allocation. Although one can clearly trace out the efficient frontier from these allocations, a considerable portion of the sample falls below the frontier.

We next investigate how to explain some of the heterogeneity observed in Task 1. To this end, we run a set of regressions for different outcome variables using a vector of respondent characteristics as controls. Table 3 reports the results.

Performance measures $(\mu_{1,i}, \sigma_{1,i}, S_{1,i})$ indicate that higher-income respondents were more likely to elect lower return and slightly lower risk portfolios. While there is a negative association with education and wealth, these effects are not statistically signifi-

Table 3: Regressions of Factors Associated with Performance in Allocation Task 1

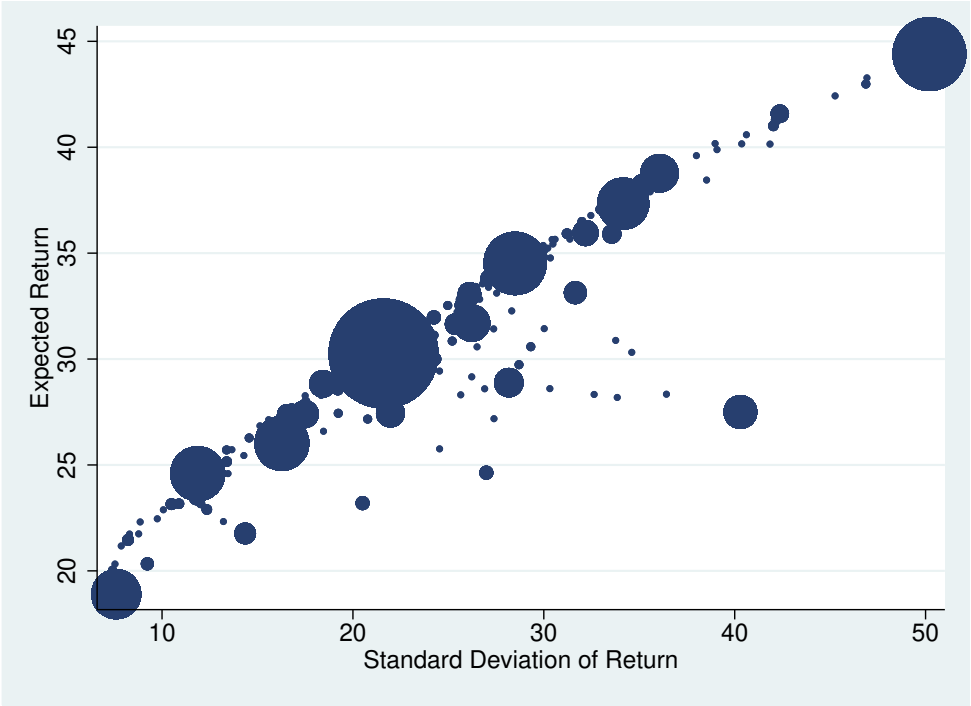
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Mean_1	Standard Deviation_1	Sharpe Ratio_1	RML_1	RSL_1	$1/\text{K}_1$	Return Chasing_1
Female	0.002	0.332	0.014	0.359	0.286	-0.022	0.026
	(0.311)	(0.552)	(0.020)	(0.284)	(0.558)	(0.020)	(0.015)
College or some university	-0.218	0.023	0.002	0.530	0.979	-0.059*	-0.005
	(0.462)	(0.821)	(0.029)	(0.423)	(0.830)	(0.028)	(0.022)
Bachelor degree or more	-0.781	-0.575	0.039	1.097**	1.631*	-0.034	0.004
	(0.463)	(0.822)	(0.029)	(0.423)	(0.830)	(0.028)	(0.022)
ln(Household income)	-0.178*	-0.224	0.008	0.139*	0.227	-0.005	-0.006
	(0.075)	(0.133)	(0.005)	(0.068)	(0.134)	(0.005)	(0.003)
Household income missing	0.235	0.027	-0.004	-0.584	-0.925	0.047*	0.009
	(0.391)	(0.694)	(0.025)	(0.357)	(0.701)	(0.023)	(0.019)
Financial wealth	-0.001	-0.001	0.000*	0.000	0.000	-0.000	-0.000
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Financial Literacy Score	0.006	0.163	0.001	0.229	0.484	-0.065***	-0.001
	(0.217)	(0.385)	(0.014)	(0.198)	(0.389)	(0.012)	(0.010)
Cognitive Ability Score	-0.570***	-0.909**	0.042***	0.136	0.102	-0.006	-0.001
	(0.171)	(0.303)	(0.011)	(0.156)	(0.307)	(0.011)	(0.008)
Numeracy Score	-0.324	-0.606	0.027*	-0.046	-0.074	-0.021	-0.000
	(0.201)	(0.357)	(0.013)	(0.184)	(0.361)	(0.014)	(0.010)
Financial knowledge: high	0.684	1.334	-0.003	0.010	-0.564	-0.053	0.053*
	(0.523)	(0.928)	(0.033)	(0.478)	(0.938)	(0.037)	(0.023)
Financial knowledge: very high	0.525	1.041	-0.047	0.098	0.210	-0.023	0.004
	(0.837)	(1.487)	(0.053)	(0.766)	(1.503)	(0.056)	(0.041)
St. market knowledge: high	-0.033	0.313	-0.012	0.544	0.993	0.002	0.004
	(0.648)	(1.150)	(0.041)	(0.592)	(1.162)	(0.047)	(0.029)
St. market knowledge: very high	0.462	-0.171	0.022	-1.533	-3.101	0.020	0.009
	(1.130)	(2.007)	(0.072)	(1.033)	(2.027)	(0.078)	(0.052)
Has traded stocks	0.712*	1.243*	-0.010	-0.161	-0.559	-0.052*	0.045**
	(0.346)	(0.615)	(0.022)	(0.317)	(0.621)	(0.023)	(0.016)
Has studied economics	0.011	0.237	-0.024	0.365	0.843	-0.003	-0.011
	(0.328)	(0.582)	(0.021)	(0.300)	(0.588)	(0.022)	(0.016)
_cons	34.083***	27.873***	1.299***	0.203	0.935		
	(1.172)	(2.081)	(0.074)	(1.071)	(2.102)		
Mean	31.679	26.056	1.374	3.883	7.628	0.244	0.108
N	1993	1993	1993	1993	1993	1993	1993
r2	0.055	0.045	0.054	0.029	0.024		
chi2						177.675	54.232

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Columns 1-5 report OLS coefficient estimates. Columns 6-7 report marginal effects from Logit regressions. In all regressions, we also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as ambiguity aversion and patience.

Figure 1: Mu-Sigma Combinations in the Allocation Task 1



Note: This figure illustrates all combinations of expected return and standard deviation of return achieved by respondents in Allocation Task 1. The size of the markers indicates the frequency by which the respective combination occurred.

cant. Turning to measures of knowledge and cognition, respondents with higher cognition scores selected less risky allocations (with lower expected returns), yet those allocations had higher Sharpe ratios. We also find that those with higher numeracy scores obtained better Sharpe ratios. Those with experience trading stocks were more likely to pick riskier portfolios (with higher expected returns). Also preference measured did predict portfolio allocations: the more risk averse tended to select less risky portfolios (not reported in Table 3).

Turning to measures of sub-optimal choice, we find that the better educated were more likely to have larger relative return losses, both in terms of expected returns and risk. This result is consistent with Calvet et al. (2007) who also showed that the more highly educated tended to suffer larger return losses. One interpretation is that more educated individuals might be more exposed to risk and therefore more exposed to return loss. Yet his cannot explain our results here, as we showed that the better educated tended to select less risky portfolios. Interestingly, return losses are seen across the entire sample, as few respondent characteristics help differentiate people more versus less likely to suffer from these losses. In terms of heuristics, those scoring higher on the financial literacy index were less likely to use the 1/N rule when picking their portfolios. Interestingly, those who

thought they were very financially knowledgeable were more likely to be return chasers and invest their endowments entirely in the investment option with the highest return. Those who had experience trading stocks were also more likely to be return chasers.

5 Willingness to Pay for Financial Education

Next, we turn to an examination of how much respondents are willing to pay to obtain financial education in our experiment. We randomized the offer of financial education across respondents: around 80% received the treatment offer (N=1,592), while the remaining 20% (N=401) form a random control group for later evaluating the natural progression of respondents in repeated investment tasks. Unless indicated otherwise, we restrict our subsequent analyses in this section to the sample that received the treatment offer. Respondents were next told that they could obtain knowledge which might increase their return in a second investment task. They had a new initial endowment of 30 dollars and were allowed to pay up to 5 dollars for this education. The amount paid for financial education, if chosen to receive it, was deducted from their initial endowment before they participated in the second investment task. Hence, there was a real opportunity cost to receiving financial education.

As Table 4 reports, 24.5% of respondents offered the treatment elected not to receive it, even if they had to pay nothing for it. For those who did agree to pay, the average willingness to pay was 2.909 (median of 3)[9]. Overall, the average willingness to pay was 2.196 (with WTP = 0 for those participants who rejected the treatment). Fewer than 4.9% of respondents reported a zero willingness to pay. Moreover, respondents were not particularly confident they could apply the knowledge gained in this exercise. Some 46.2% of respondents offered the treatment thought that they would be able to apply the knowledge received while 19.3% reported that they did not know whether this would be the case. 46.7% of respondents thought that their return in investment Task 2 would be higher than in the first Task if they received the treatment, while 26.9% reported that they did not know whether this would be the case.

To understand what factors influenced respondents' willingness to pay for the financial education treatment, we next explore the determinants of participants' decisions to reject the treatment even if it were offered at no cost (extensive margin), as well as the factors shaping how much participants were willing to pay for the intervention (intensive margin).

[9]Figure A2 in the Appendix reports the distribution of the stated willingness to pay (conditional on being offered and not rejecting the treatment).

Table 4: Descriptive Statistics on Willingness to Pay for Treatment and Expectations about Treatment

	N	mean	sd	median
Received treatment	1592	0.431	0.495	0
Reject treatment	1592	0.245	0.430	0
Willingness to pay	1592	2.196	1.816	2.5
Willingness to pay (>= 0)	1202	2.909	1.514	3
Ability to apply treatment: yes	1592	0.462	0.499	0
Ability to apply treatment: dk	1592	0.193	0.395	0
Exp. higher return in task 2: yes	1592	0.467	0.499	0
Exp. higher return in task 2: dk	1592	0.269	0.444	0

Note: `Reject treatment` is a dummy variable equal to one if the respondent indicated that she did not want to receive the treatment in any case. `Willingness to pay` takes the value of 0 if the respondent indicated that she did not want to receive the treatment in any case, otherwise it takes the value stated by the respondent as her willingness to pay for the treatment. `Willingness to pay (>= 0)` indicates the respondent's stated willingness to pay for the treatment if she did elect to receive the treatment.

The marginal effects on the extensive margin (from a Logit regression) appear in Column 1 of Table 5; estimated coefficients on the intensive margin appear in Column 2. Column 3 combines both margins with a dependent variable defined as 0 if the participant rejected the treatment, and as the willingness to pay if the participant provided a WTP.

There was a real opportunity cost of purchasing the educational intervention in our setting, as the amount paid for the treatment was deducted from the endowment for the second allocation task, and the return from the second allocation task was paid to the participants. Therefore, participants had to trade-off their willingness to pay against the expected benefit from the treatment. We find that participants rationally based their demand for financial education on their expectations about whether they would be able to apply the knowledge conveyed in the treatment, and whether the knowledge was anticipated to boost their return in the second allocation task. Participants who expected to be able to apply the information in the treatment were 6.7 percentage points less likely to refuse the treatment, and they were willing to pay more for it than those participants who did not think that they could apply the information. Analogously, participants who expected to obtain a higher return in the second allocation task, if they received the treatment were 12.9 percentage points less likely to refuse the treatment and were also willing to pay more than their counterparts.[10] Interestingly, participants with high levels

[10]Note that participants with a stated willingness to pay of zero still had a chance to receive the treatment, when the random price generated equaled zero. For participants who did not expect any benefit from the treatment, it could therefore have been rational to reject the treatment rather than stating a zero willingness to pay. A higher probability of rejecting the treatment, even if it offered at no cost, likely reflected peoples' opportunity cost of time associated with receiving the treatment. Kim et al. (2016) showed in a theoretical setting that acquiring financial knowledge can be sub-optimal for certain individuals, given opportunity costs of time.

Table 5: Regression Estimates of Factors Associated with Willingness to Pay for Educational Treatment

	(1) Reject treatment		(2) Willingness to pay (>= 0)		(3) Willingness to pay	
Ability to apply treatment: yes	-0.067**	(0.025)	0.399***	(0.111)	0.508***	(0.110)
Ability to apply treatment: dk	0.045	(0.026)	0.091	(0.149)	-0.083	(0.133)
Exp. higher return in task 2: yes	-0.129***	(0.026)	0.338**	(0.119)	0.588***	(0.117)
Exp. higher return in task 2: dk	0.017	(0.025)	0.056	(0.142)	-0.072	(0.129)
Female	-0.029	(0.020)	0.073	(0.094)	0.138	(0.091)
College or some university	0.042	(0.030)	-0.112	(0.142)	-0.187	(0.135)
Bachelor degree or more	0.059	(0.030)	-0.221	(0.141)	-0.307*	(0.135)
ln(Household income)	0.020**	(0.006)	-0.017	(0.021)	-0.060**	(0.022)
Household income missing	0.128***	(0.022)	-0.154	(0.140)	-0.573***	(0.117)
Financial wealth	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Financial Literacy Score	-0.045***	(0.013)	-0.029	(0.073)	0.150*	(0.063)
Cognitive Ability Score	0.017	(0.011)	0.046	(0.051)	0.012	(0.050)
Numeracy Score	-0.055***	(0.015)	-0.066	(0.058)	0.061	(0.059)
Financial knowledge: high	0.010	(0.037)	-0.499**	(0.154)	-0.446**	(0.153)
Financial knowledge: very high	0.038	(0.051)	-0.519*	(0.247)	-0.482*	(0.236)
St. market knowledge: high	-0.000	(0.046)	-0.109	(0.194)	-0.107	(0.192)
St. market knowledge: very high	0.054	(0.071)	-0.141	(0.354)	-0.250	(0.336)
Has traded stocks	-0.047*	(0.024)	0.008	(0.100)	0.141	(0.100)
Has studied economics	0.016	(0.022)	0.149	(0.099)	0.090	(0.096)
Mean_1	-0.069	(0.045)	-0.001	(0.180)	0.114	(0.180)
$\text{Standard Deviation}_1$	0.035	(0.022)	-0.002	(0.090)	-0.055	(0.089)
Sharpe Ratio_1	-0.067	(0.150)	-0.151	(0.619)	0.066	(0.611)
RML_1	-0.037	(0.021)	0.040	(0.084)	-0.024	(0.086)
RSL_1	0.005	(0.005)	0.004	(0.020)	-0.004	(0.020)
$1/\text{K}_1$	0.083**	(0.030)	-0.165	(0.144)	-0.392**	(0.136)
Return Chasing_1	0.102	(0.081)	-0.105	(0.350)	-0.434	(0.343)
_cons			3.112	(4.379)	-1.096	(4.373)
Mean	0.245		2.909		2.196	
N	1592		1202		1592	
chi2	426.906					
r2			0.080		0.200	

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: `Reject treatment` is a dummy variable that is equal to one if respondents indicated that they did not want to receive the treatment in any case. `Willingness to pay` takes the value of 0 if they indicated that they did not want to receive the treatment in any case, otherwise it takes the value which the respondent stated as their willingness to pay for the treatment. `Willingness to pay (>= 0)` indicates the respondents' stated willingness to pay for the treatment if they did not select the option not to receive the treatment in any case. Column 1 reports marginal effects from a Logit regression. Columns 2-3 report OLS coefficient estimates. All columns also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience. Furthermore, we control for the response "don't know" to the questions on whether the respondent thinks she will be able to apply the financial information provided to her investment decision in Allocation Task 2, later in this survey, and to the question whether the respondent expects her total return from Allocation Task 2 to be higher than the total return from Allocation Task 1, if she acquired additional financial information.

of revealed sophistication - measured by their financial literacy and numeracy scores - were less likely to reject the educational treatment,[11] while self-reported financial knowledge was negatively related with participant willingness to pay for the intervention.

Interestingly, higher household income and greater formal education were associated with a lower willingness to pay, while participants who had experience trading stocks were 4.7 percentage points less likely to reject the educational intervention.

Participants who spread their endowment equally across all funds in the first allocation task were 8.3 percentage points more likely to reject the treatment, and they were also less willing to pay for the intervention, compared to others. Beyond this, we find no evidence that participants' performance in the allocation Task 1 affected their willingness to receive the educational intervention that might improve their performance in allocation Task 2.[12] The market revelation mechanism introduced by Becker et al. (1964) allows us to elicit participants' willingness to pay for the intervention, on the condition that respondents needed to understand the mechanism sufficiently well for this to work.[13] To this end, during the experiment, participants were provided with information on the mechanism and provided examples. Furthermore we implemented a control question to test whether participants had understood the process. As a robustness check, we split the sample into one group of participants who responded correctly to this control question (54.15%), and another with those who did not respond correctly (45.85%). We repeat our analyses on the determinants of willingness to pay on these samples, and though we lose power when we split the sample, our results still hold qualitatively for both sub-samples. Results appear in Table A2 in the Appendix. This suggests that although many participants may have not fully understood the BDM mechanism, they still reported their true willingness to pay by responding to the question, how much they would be willing to pay, without thinking about the mechanism. Therefore, their misunderstanding of the mechanism does not introduce a sizable measurement error to our willingness to pay measure.

As noted above, one important driver of respondents' willingness to pay is their perception of the benefits expected from the intervention. That is, respondents would be willing to pay more for the intervention if they expected to be able to apply the new information to allocation Task 2, and if they expected the return from the second task to

[11]Note that these results hold even though we controlled for participants' expectations about their ability to apply the knowledge conveyed in the treatment.

[12]Since some of the performance measures in the first allocation task are correlated, we also run our analyses with each individual performance measure without including the others. The results of these regressions do not differ qualitatively from the results presented in Table 5.

[13]Note that even if participants did not understand the mechanism, they may still have stated their true willingness to pay based on intuition, but we cannot test if this was the case.

be higher than the return earned on allocation Task 1. While we do not observe how individuals formed their expectations, we can explore the relationship between respondents' socio-demographic characteristics, cognitive ability, and their performance in allocation Task 1 with their expectations about the benefits of the intervention.

Results in Table 6 show that women were less confident than men in their ability to apply the new knowledge, and they also indicated that they did not know whether they had this ability. Financial literacy was positively related to the perceived ability to apply the treatment information and to yield a higher return in allocation Task 2, conditional on receiving the treatment. Interestingly, self-reported financial knowledge only had a positive statistically significant association with the ability to apply the treatment. Participants who had traded stocks in the past were 7.4 percentage points more confident that they could transform the information acquired into a higher return in allocation Task 2 (relative to the returns earned in allocation Task 1). Respondents who had studied economics and finance in high school were, respectively, 7.5 percentage points and 6 percentage points more likely to believe that they could apply the information and that it would lead to a higher return. Finally, the performance in allocation Task 1 was associated with participants' beliefs about whether the treatment would help them achieve a higher return in allocation Task 2. Respondents with a higher mean, Sharpe ratio, or relative mean loss in allocation Task 1 were less likely to respond "Don't know" to the question about whether they believed that their return in Task 2 would be higher if they received the treatment. Respondents with a higher standard deviation in Task1 were more likely to respond "Don't know" to this question.[14]

To elicit respondents' true willingness to pay for the intervention, we associate the likelihood to receive the treatment intervention to the willingness to pay via the mechanism presented by Becker et al. (1964). As a result, the treatment was not allocated randomly across all participants. Let d_i equal one if the respondent is selected to receive the treatment. Let w_i be the willingness to pay. The probability of being assigned to treatment is

$$\Pr(d_i = 1|w_i) = w_i/w_{\max} \tag{2}$$

where $w_{\max}$ is the maximum price that can be paid for the intervention (5). Let $y_{i,0}$ be some potential outcome in task 2 if the respondent did not get the treatment and $y_{i,1}$

[14]Since some of the performance measures in the first allocation task were correlated, we also re-ran our analyses on each individual performance measure separately, excluding the others. These results do not differ qualitatively from those appearing in Table 6.

Table 6: Regressions Estimates of Factors Associated with Respondents' Expectations about Treatment

	(1) Ability to apply treatment:	(2) Ability to apply treatment:	(3) Exp. higher return in task 2: yes	(4) Exp. higher return in task 2: dk
Female	yes-0.078**	dk 0.049*	-0.027	0.024
	(0.025)	(0.020)	(0.025)	(0.022)
College or some university	0.051	-0.027	0.036	-0.026
	(0.038)	(0.028)	(0.038)	(0.032)
Bachelor degree or higher	0.051	-0.043	0.038	-0.059
	(0.038)	(0.029)	(0.038)	(0.032)
ln(Household income)	0.010	0.007	0.006	0.022**
	(0.006)	(0.006)	(0.006)	(0.007)
Household income missing	-0.181***	0.128***	-0.136***	0.130***
	(0.032)	(0.022)	(0.032)	(0.025)
Financial wealth	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Financial Literacy Score	0.071***	-0.036**	0.065***	-0.058***
	(0.018)	(0.013)	(0.018)	(0.014)
Cognitive Ability Score	0.007	0.007	0.023	0.001
	(0.013)	(0.012)	(0.014)	(0.013)
Numeracy Score	0.046**	-0.024	0.041*	-0.008
	(0.016)	(0.015)	(0.016)	(0.015)
Financial knowledge: high	0.176***	-0.020	0.067	-0.070
	(0.043)	(0.039)	(0.043)	(0.043)
Financial knowledge: very high	0.015	-0.061	-0.040	-0.106
	(0.065)	(0.063)	(0.066)	(0.067)
St. market knowledge: high	-0.104	0.005	-0.103	0.040
	(0.054)	(0.049)	(0.054)	(0.054)
St. market knowledge: very high	-0.094	0.011	-0.110	0.146
	(0.092)	(0.089)	(0.094)	(0.087)
Has traded stocks	0.030	-0.039	0.074**	-0.070**
	(0.027)	(0.024)	(0.027)	(0.026)
Has studied economics	0.075**	-0.076**	0.060*	-0.047
	(0.026)	(0.023)	(0.026)	(0.025)
Mean_1	0.022	-0.005	0.082	-0.131**
	(0.049)	(0.042)	(0.050)	(0.048)
$\text{Standard Deviation}_1$	-0.005	-0.008	-0.038	0.058*
	(0.025)	(0.021)	(0.025)	(0.023)
Sharpe Ratio_1	0.183	-0.231	0.195	-0.336*
	(0.168)	(0.147)	(0.170)	(0.164)
RML_1	-0.009	0.008	0.014	-0.043*
	(0.023)	(0.020)	(0.024)	(0.021)
RSL_1	0.011	-0.005	0.011*	-0.005
	(0.005)	(0.005)	(0.005)	(0.005)
$1/\text{K}_1$	-0.029	-0.032	-0.073	0.024
	(0.038)	(0.031)	(0.038)	(0.033)
Return Chasing_1	-0.102	0.148	-0.145	0.179
	(0.094)	(0.085)	(0.094)	(0.091)
Mean	0.462	0.193	0.467	0.269
N	1592	1592	1592	1592
chi2	272.890	164.537	256.316	219.204

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table reports marginal effects from Logit regressions. All regressions also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience.

if he received it. We can only observe $y_i = d_i y_{i,1} + (1 - d_i) y_{i,0}$ which implies a missing data problem, so the missing at random assumption:

$$y_{i,0}, y_{i,1} \perp d_i$$

is unlikely to hold. Those who were willing to pay more for financial education are likely to be subjects who expected to gain more from it ($y_{i,1} > y_{i,0}$). Hence, a simple comparison of outcomes between the treated and untreated groups will not deliver an estimate of the average effect of the treatment. Define $\Delta_i = y_{i,1} - y_{i,0}$. Then,

$$E(\Delta_i) \neq E(y_i | d_i = 1) - E(y_i | d_i = 0) \tag{3}$$

But conditional on willingness to pay, the treatment was assigned randomly. Each respondent with the same willingness to pay had the same probability of being selected in the treatment. Specifically, the missing at random assumption is given by:

$$y_{i,0}, y_{i,1} \perp d_i | w_i \tag{4}$$

In the next section, we estimate the treatment effect of our educational intervention using this missing at random assumption. Accordingly, we must first confirm that the treatment allocation was random, conditional on respondents' willingness to pay. If this is the case, controlling for willingness to pay in our subsequent analyses allows us to control for selection effects when estimating the treatment effect.

To implement this test, we check whether assignment to treatment was independent of respondent characteristics X_i, which may include Task 1 outcomes, conditional on the willingness to pay:

$$d_i \perp X_i | w_i \tag{5}$$

We test this using a conditional independence test with the null hypothesis $E(d_i | w_i, Z_i) = E(d_i | w_i)$. Table 7 presents marginal effects from Logit regressions of the binary variable equal to 1 if a participant received the treatment, and 0 otherwise. In column 1, we do not include willingness to pay as an explanatory variable for treatment allocation. The results suggest that treatment allocation is not random when we do not control for willingness to pay. In column 2, however, we include willingness to pay as an explanatory variable; now the overall test statistic for the joint hypothesis that all coefficients (except the co-

efficient for willingness to pay) in column 2 are zero provides a test of randomness. The respective p-value is 0.5219. Therefore, the results in column 2 confirm that controlling for willingness to pay is sufficient to maintain the missing at random assumption.

Table 7: Factors Associated with Treatment Assignment Conditional on Willingness to Pay: Is WTP sufficient to confirm the missing at random assumption?

	(1)		(2)	
	Received treatment		Received treatment	
Willingness to pay			0.154***	(0.002)
Female	0.010	(0.026)	-0.006	(0.018)
College or some university	-0.057	(0.039)	-0.030	(0.026)
Bachelor degree or higher	-0.080*	(0.039)	-0.031	(0.026)
ln(Household income)	-0.014*	(0.006)	-0.006	(0.004)
Household income missing	-0.105**	(0.034)	0.049	(0.025)
Financial wealth	0.000	(0.000)	-0.000	(0.000)
Financial Literacy Score	0.063***	(0.019)	0.019	(0.014)
Cognitive Ability Score	0.015	(0.014)	0.005	(0.009)
Numeracy Score	0.009	(0.017)	-0.007	(0.011)
Financial knowledge: high	-0.083	(0.044)	-0.020	(0.029)
Financial knowledge: very high	-0.095	(0.069)	0.009	(0.046)
St. market knowledge: high	-0.119*	(0.056)	-0.079*	(0.037)
St. market knowledge: very high	-0.056	(0.096)	0.005	(0.066)
Has traded stocks	0.072**	(0.028)	0.033	(0.019)
Has studied economics	0.030	(0.027)	-0.008	(0.019)
Mean_1	0.098	(0.052)	0.053	(0.034)
$\text{Standard Deviation}_1$	-0.052*	(0.026)	-0.031	(0.017)
Sharpe Ratio_1	-0.008	(0.173)	-0.061	(0.118)
RML_1	0.033	(0.025)	0.021	(0.016)
RSL_1	0.000	(0.006)	-0.001	(0.004)
$1/\text{K}_1$	-0.118**	(0.039)	-0.038	(0.026)
Return Chasing_1	-0.085	(0.097)	0.027	(0.067)
Mean	0.431		0.431	
N	1592		1592	
chi2	150.397		1154.095	

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table reports marginal effects from Logit regressions. In both models we also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience. The overall test statistic for the joint hypothesis that all coefficients (except the coefficient for willingness to pay) in column 2 are zero provides a test of randomness. The respective p-value is 0.5219.

6 Portfolio Choice: Task 2

In this section, we present the results from the second allocation task that participants had to solve after being offered or receiving the treatment. To analyze the effect of our treatment on respondents' portfolio allocations, we define two indicators of portfolio improvement based on a comparison of their performance in the first and the second allocation tasks. To measure Sharpe Ratio improvement, we define Δ Sharpe Ratio = Sharpe Ratio$_2$/Sharpe Ratio$_1$ - 1. For participants in Task 1 who spread their endowments equally across all assets, and for those who invested everything in the fund with the highest mean return, we define a dummy variable equal to 1 if they changed their allocation in Task 2. That is, Δ 1/K = 1-1/K$_2$ if 1/K$_1$==1,[15] and Δ Return chasing = 1-Return chasing$_2$ if Return chasing$_1$==1. Further, we compute the absolute difference between the relative mean losses in two allocation tasks, as well as the absolute difference between the relative standard deviation losses in both tasks. That is, Δ RML = RML$_2$ - RML$_1$ and Δ RSL = RSL$_2$ - RSL$_1$.

In terms of efficiency, getting closer to the efficient frontier along either dimension can be classified as an improved outcome, so we construct an indicator that is equal to 1 if either RML or RSL improved. Formally, we define an efficiency improvement as:

$$\Delta E_i = \mathbb{I}(\Delta_{i,RML} < 0)\mathbb{I}(\Delta_{i,RSL} \leq 0) + \mathbb{I}(\Delta_{i,RML} \leq 0)\mathbb{I}(\Delta_{i,RSL} < 0) \tag{6}$$

Without taking into account respondents' degree of risk aversion, a portfolio efficiency improvement would not necessarily mean an improvement in utility; to get at this, a more restrictive definition is required. Since individuals may optimally trade off their RML against their RSL, depending on their risk preferences, a preference-independent welfare

[15] Note that the endowment for the second allocation task is random for participants who purchase the treatment, since the random price for the treatment will be deducted from the initial endowment of \$30. Therefore, for some endowments, it was not possible to split them equally across three funds and a participant aiming to split her endowment equally would end up allocating \$ 0.01 more or less to any of the three funds. In order to avoid overestimating our treatment effect on Δ 1/K (since by construction this could only be the case for treated participants), we define the variables 1/K$_2$ to be equal to 1, if the absolute difference between the percentages allocated into either fund is not greater than 0.01 percentage points. Doing so, Δ 1/K is equal to 0 for 8 participants who could by construction not split their endowment in Task 2 equally across all funds and for whom it would take the value 1 (that is they would be considered as having moved away from the strategy to split their endowment equally across all funds) if we would define 1/K$_2$ to be equal to 1 if participants split their endowment across all three funds with equal percentages. In Task 1, when all participants have a hypothetical endowment of \$30, the variable 1/K$_1$ describes a uniform allocation funds for the same number of participants, irrespective of whether it is defined to equal 1 if participants split their endowment across all three funds with equal percentages or whether it is defined to equal 1 if the absolute difference between the percentages allocated into either fund is not greater than 0.01 percentage points.

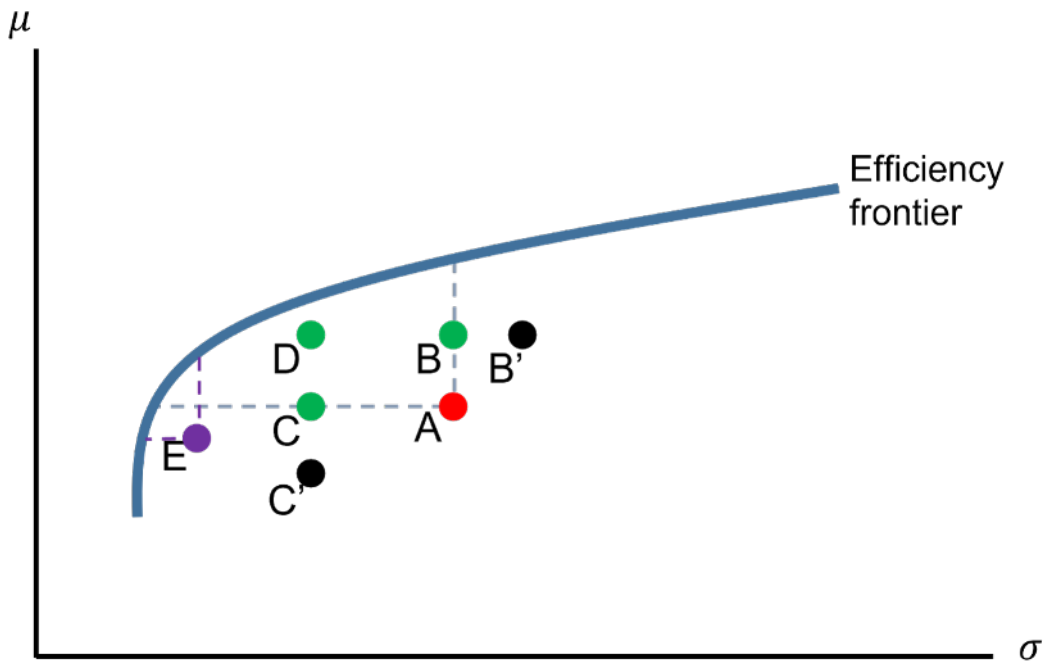
improvement can only be defined if both the vertical and the horizontal distance to the efficiency frontier decrease from allocation Task 1 to Task 2, or if one of them decreased while the other stayed constant. To measure this welfare improvement independent of preferences, we define a new measure:

$$\Delta W_i = \mathbb{I}(\Delta\mu_i > 0)\mathbb{I}(\Delta\sigma_i \leq 0) + \mathbb{I}(\Delta\mu_i \geq 0)\mathbb{I}(\Delta\sigma_i < 0), \tag{7}$$

where $\mathbb{I}(\cdot)$ equals one if the argument is true, and zero if not. Hence, ΔW equals 1 if there was an improvement along one dimension, without the other one deteriorating; it is zero otherwise. Figure 2 illustrates the rationale for this welfare improvement measure in the μ-σ space. For a given portfolio A, a reallocation of funds that decreased the RML can result in a portfolio B that keeps the RSL constant, or in portfolio B' which increases the RSL. Analogously, a reallocation of funds that decreased the RSL can result in a portfolio C that keeps the RML constant, or in a portfolio C' which increases the RML. Only a reallocation of funds that decreased the RML or the RSL while keeping the other constant results in an efficiency improvement. These cases are illustrated by portfolios B, C, D, and E. Within this set of improved allocations, only a reallocation of funds that shifted the initial portfolio A into the section restricted by the initial portfolios' RML and RSL (e.g., portfolios B, C, or D) results in a welfare improvement, independent of the participant's risk preferences. This preference-independent measure allows to captures the (directional) effect of the treatment on utility.

Table 8 presents summary statistics of portfolio performance measures in Task 2. Both the average expected return and the average standard deviation of participants' portfolios are now slightly lower (mean_2=31.458 and $\text{standard deviation}_2$=25.327) compared to in allocation Task 1 (mean_1=31.679 and $\text{standard deviation}_1$=26.056). Combining these measures in the Sharpe ratio context shows that participants improved their performance between allocation tasks, as the average Sharpe ratio increased (Sharpe Ratio_1=1.374 and Sharpe Ratio_2=1.384). Of 395 participants who previously had spread their endowment equally across all three funds in the allocation Task 1, 50.9% changed their allocation in the second task. Of 165 participants who had put all their money in a single fund, 47.3% adjusted this behavior after being offered or receiving the treatment. Both of our portfolio efficiency measures, the vertical distance to the efficiency frontier (RML) and the horizontal distance to the efficiency frontier (RSL), are smaller, on average, in the second allocation task, relative to the first. Finally, Table 8 shows that 34.2 % of our participants

Figure 2: Illustration of the efficiency improvement measure Δ E and welfare measure Δ W



improved their portfolio efficiency by decreasing their RML without increasing the RSL, by decreasing their RSL without increasing the RML, or by decreasing both. 3.5% of all participants achieved a preference-independent welfare improvement.

To illustrate how portfolio allocations moved in the μ-σ space, Figure 3 contrasts all combinations of expected returns and standard deviation of returns achieved by respondents (who were offered the treatment) in allocation Tasks 1 and 2. Portfolios in the first task are displayed as blue dots and portfolios in the second tasks are shown as red circles. Again, the size of the markers indicates the frequency by which the respective combination occurred. Figure 3a illustrates the portfolio allocations for participants who were offered the treatment but did not receive it. The figure shows that most participants who did not receive the treatment did not change their portfolio allocation between the two tasks. Figure 3b displays the portfolio allocations of treated participants. The most striking observation for this group is that many of the larger portfolio allocation bubbles in Task 1 (indicating allocations chosen by many participants) are much larger than the bubbles on the same allocation in Task 2. In this illustration, portfolio allocations in Task 1 are mainly characterized by few large bubbles, while portfolio allocations in Task 2 are mainly characterized by many small bubbles. This indicates that, of those participants who received the treatment, very few selected the same allocation both times; that is, portfolios were more heterogeneous in the second task (after the treatment) compared

Table 8: Performance in Allocation Task 2

	N	mean	sd	min	median	max
Mean_2	1592	31.458	6.036	18.9	30.264	44.4
$\text{Standard Deviation}_2$	1592	25.327	10.577	7.410	22.337	50.2
Sharpe Ratio_2	1592	1.384	0.390	0.682	1.346	2.721
RML_2	1592	3.468	5.142	0	1.375	33.086
RSL_2	1592	7.072	10.292	0	3.365	59.852
$1/\text{K}_2$	1592	0.173	0.379	0	0	1
Return chasing_2	1592	0.077	0.266	0	0	1
Δ Sharpe Ratio	1592	0.039	0.276	-0.726	0	2.644
Δ RML	1592	-0.410	5.966	-33.086	0	31.711
Δ RSL	1592	-0.517	11.876	-59.852	0	57.051
Δ 1/K	395	0.489	0.501	0	0	1
Δ Return chasing	165	0.473	0.501	0	0	1
Δ E	1592	0.342	0.474	0	0	1
Δ W	1592	0.035	0.184	0	0	1

Note: The performance improvement measures are defined as follows: Δ Sharpe Ratio = $\text{Sharpe Ratio}_2/\text{Sharpe Ratio}_1$ - 1; Δ RML = RML_2 - RML_1; Δ RSL = RSL_2 - RSL_1; Δ 1/K = 1-$1/\text{K}_2$ if $1/\text{K}_1$==1; Δ Return chasing = 1-Return chasing_2 if Return chasing_1==1; Δ E = 1 if (Δ RML $<$ 0 & Δ RSL $\leq$ 0) or (Δ RSL $<$ 0 & Δ RML $\leq$ 0)

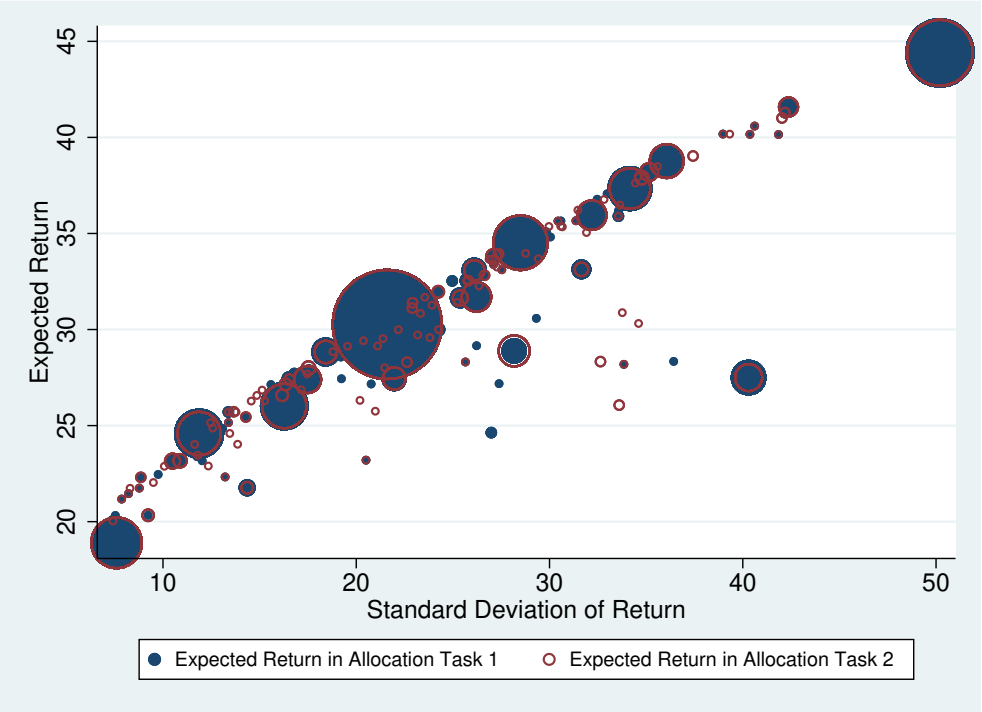
to the first. This suggests that, after having received the treatment, participants customized their allocations more and choose less *standard* allocations. A Logit regression of a dummy variable equal to 1 if a participant who was offered the treatment did not change her allocation between the first and the second tasks suggests that this increase in heterogeneity was in fact mainly driven by the acquisition of knowledge under our treatment. Table A1 in the Appendix shows that receiving the treatment had an economically substantial and statistically significant effect on the propensity to adjust the portfolio allocation in Task 2.

To estimate the effect of the treatment, recall the missing at random assumption, $d_i \perp X_i | w_i$. The most straightforward way of exploiting this assumption is in a regression framework. Specifically, we regress the difference in outcomes from Task 2 versus 1 on the willingness to pay, which is effectively the propensity score. We also control for other factors as well to improve the efficiency of the estimator. Specifically, we use

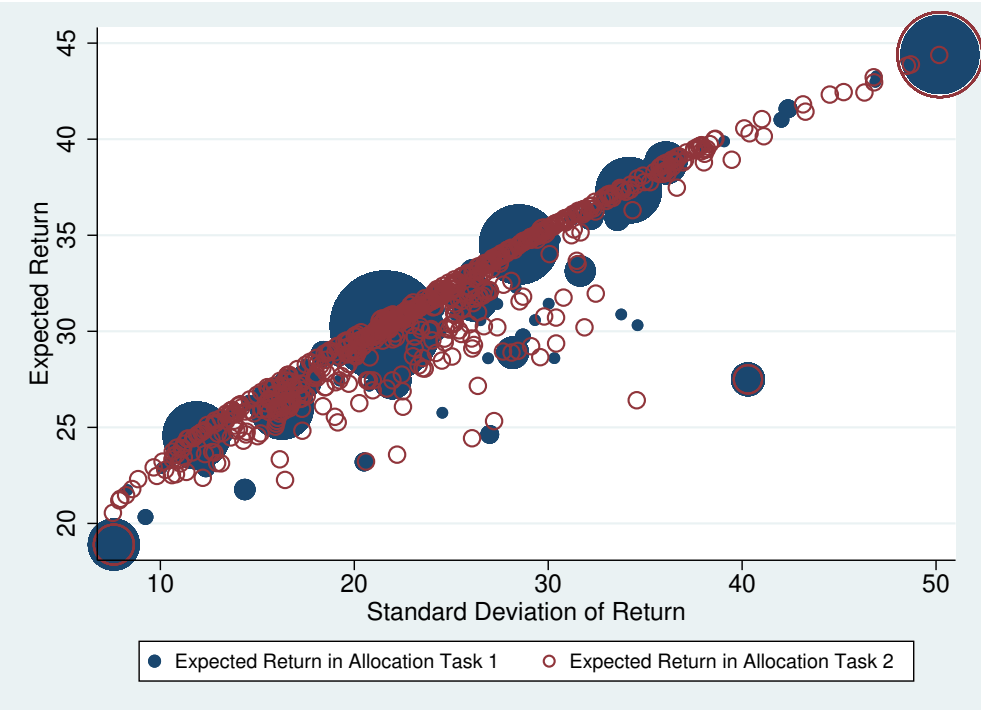
$$y_i = \alpha d_i + \eta w_i + X_i \beta + \varepsilon_i, \tag{8}$$

where y_i is an outcome measured in change between Tasks 2 and 1, X_i is a set of controls, and ε_i is an error term. The estimated effect of the treatment is given by α. We have also explored including non-linear controls for w_i with no change in the results. Hence, we keep this more parsimonious specification.

Figure 3: Comparison of Mu-Sigma Combinations in Allocation Tasks 1 and 2



(a) Participants who were offered the treatment but did not receive it



(b) Participants who received the treatment

Note: This figure illustrates all combinations of expected return and standard deviation of return achieved by respondents in Allocation Task 1 and 2. The size of the markers indicates the frequency of the respective combination.

Table 9 reports the average treatment effect on our measures of portfolio improvement. Columns 1-3 report OLS coefficient estimates and columns 4-6 report marginal effects from Logit regressions. While individually we find no statistically significant effects of the treatment on improved Sharpe ratios, RMLs, or RSLs, we do find that the treatment led to an increase of 19.6 percentage points in the propensity to achieve an efficiency improvement (i.e., a lower RML with constant RSL, a lower RSL with constant RML, or both a lower RML and a RSL). That is, the treatment had a substantial beneficial effect on portfolio efficiency, measured by the proximity to the efficiency frontier. While the definition of a preference-independent welfare improvement is much more restrictive, we still find a treatment effect of around 3 percentage points on this measure. That is, financial education increased the likelihood that participants' improved their welfare independent of their preferences by 3 percentage points. Further, we also find that individuals who initially spread their endowments equally across all assets, as well as those who invested everything in the fund with the highest expected return, were respectively 49.6 percentage points and 27.1 percentage points more likely to change this behavior, when they received the educational intervention compared to those who did not receive it.[16]

In order to understand whether the educational treatment enhanced participants' financial knowledge, we also asked them to respond to a few questions at the end of the survey related to the treatment, in particular, to return chasing, risk-adjusted returns, and spreading all of one's money equally across the available funds. The full wording can be found in Appendix C. Table 10 presents summary statistics of dummy variables equal to 1 if a participant responded correctly to each of these questions. Further, the variable *Treatment Score* is defined as the sum of correct answers to those three questions. Here we see that 72.7% , 82.6%, and 78.1% of the participants responded correctly to the individual questions. The average score in the sample of participants who received the treatment offer was 2.33 (out of 3).

We analyze the average treatment effect on the propensity to respond correctly to those questions and on the overall *Treatment Score*. Table 11 shows that the educational

[16]Note that for estimating the average treatment effect on the treated, it should not matter whether participants correctly understood the BDM process, since we control for willingness to pay in order to eliminate selection effects and selection was based on stated willingness to pay, irrespective of whether this reflected participants' *true* willingness to pay. Nevertheless, we also investigated a robustness check based on the response to the BDM control question; results appear in Tables A3 and A4 in the Appendix. The treatment effect on efficiency improvements was similar for both subgroups, though splitting the sample by answers to the BDM control questions as well as those who allocated their endowments equally across all assets in Task 1, versus those who invested everything into highest expected return asset, resulted in sub-samples too small to estimate regressions of Δ 1/K and Δ Return chasing.

Table 9: Regression Estimates of Factors Associated with a Change in Performance between Allocation Tasks

	(1) Δ Sharpe Ratio	(2) Δ RML	(3) Δ RSL	(4) Δ 1/K	(5) Δ Return chasing	(6) Δ E	(7) Δ W
Received treatment	-0.007	-0.842	-1.101	0.496***	0.271*	0.196***	0.029*
	(0.021)	(0.456)	(0.910)	(0.059)	(0.115)	(0.032)	(0.014)
Willingness to pay	-0.001	0.102	0.291	0.007	0.036	0.018	-0.003
	(0.007)	(0.150)	(0.298)	(0.022)	(0.035)	(0.011)	(0.005)
Reject treatment	-0.061**	0.119	0.394	-0.045	0.002	-0.003	-0.032
	(0.023)	(0.507)	(1.011)	(0.061)	(0.109)	(0.041)	(0.021)
Female	0.014	-0.132	-0.275	-0.026	0.127	-0.028	0.015
	(0.015)	(0.326)	(0.651)	(0.040)	(0.074)	(0.025)	(0.010)
College or some university	0.020	-0.263	-0.563	0.109	0.165	0.026	0.024
	(0.022)	(0.488)	(0.973)	(0.05)	(0.116)	(0.037)	(0.020)
Bachelor degree or higher	0.031	-0.496	-0.872	0.126*	0.065	0.021	0.040*
	(0.022)	(0.487)	(0.971)	(0.064)	(0.120)	(0.037)	(0.020)
ln(Household income)	0.005	-0.106	-0.203	0.003	-0.019	0.000	0.005
	(0.004)	(0.079)	(0.157)	(0.009)	(0.015)	(0.006)	(0.004)
Household income missing	-0.030	0.196	0.204	0.016	0.018	0.013	0.000
	(0.020)	(0.425)	(0.848)	(0.051)	(0.101)	(0.033)	(0.014)
Financial wealth	-0.000*	0.000	0.000	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Financial Literacy Score	-0.000	0.145	0.237	0.035	-0.016	0.015	0.002
	(0.011)	(0.229)	(0.457)	(0.025)	(0.054)	(0.018)	(0.009)
Cognitive Ability Score	-0.003	-0.362*	-0.708*	-0.006	0.025	0.016	0.002
	(0.008)	(0.179)	(0.357)	(0.026)	(0.044)	(0.013)	(0.006)
Numeracy Score	-0.006	0.024	0.142	-0.005	-0.050	-0.001	-0.001
	(0.010)	(0.212)	(0.422)	(0.035)	(0.056)	(0.016)	(0.007)
Financial knowledge: high	-0.009	-0.455	-0.552	-0.019	0.042	0.001	-0.030
	(0.025)	(0.551)	(1.099)	(0.079)	(0.127)	(0.041)	(0.023)
Financial knowledge: very high	0.003	-0.280	-1.151	0.113	2.710	0.031	0.020
	(0.039)	(0.854)	(1.704)	(0.109)	(338.797)	(0.064)	(0.026)
St. market knowledge: high	0.015	0.306	0.821	-0.196	0.115	0.010	-0.010
	(0.032)	(0.695)	(1.386)	(0.100)	(0.155)	(0.052)	(0.026)
St. market knowledge: very high	0.032	1.021	1.849	-0.066	-2.476	-0.059	0.000
	(0.056)	(1.214)	(2.422)	(0.209)	(338.797)	(0.093)	(.)
Has traded stocks	0.006	0.334	0.835	0.088	0.025	0.010	-0.009
	(0.017)	(0.360)	(0.718)	(0.051)	(0.084)	(0.027)	(0.012)
Has studied economics	-0.018	-0.486	-1.095	0.048	-0.125	-0.005	0.012
	(0.016)	(0.345)	(0.689)	(0.047)	(0.091)	(0.026)	(0.011)
_cons	-0.021	-0.209	-0.894				
	(0.060)	(1.294)	(2.581)				
Mean	0.039	-0.410	-0.517	0.489	0.473	0.342	0.035
N	1592	1592	1592	395	163	1592	1592
r2	0.027	0.024	0.019				
chi2				213.890	68.560	168.536	55.810

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Columns 1-3 report OLS coefficient estimates, while Columns 4-6 report marginal effects from Logit regressions. In all regressions, we also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience.

Table 10: Performance Questions about Treatment

	N	mean	sd	min	median	max
Treatment Score		2.334	0.786	0	3	3
Q: Return chasing		0.727	0.445	0	1	1
Q: Risk-adjusted returns		0.826	0.379	0	1	1
Q: 1/K		0.781	0.414	0	1	1
N	1592					

Table 11: Regression Estimates of Factors Associated with Performance on Questions about Treatment

	(1)		(2)		(3)		(4)	
	Treatment Score		Q: Return chasing		Q: Risk-adjusted returns		Q: 1/K	
Received treatment	0.161**	(0.054)	0.146***	(0.032)	0.008	(0.030)	0.011	(0.031)
Willingness to pay	-0.011	(0.018)	-0.016	(0.011)	0.011	(0.010)	-0.002	(0.010)
Reject treatment	-0.090	(0.060)	0.009	(0.035)	-0.055	(0.029)	-0.009	(0.032)
Female	0.119**	(0.038)	0.064**	(0.023)	0.011	(0.019)	0.046*	(0.021)
College or some university	-0.008	(0.057)	0.014	(0.033)	-0.014	(0.028)	-0.020	(0.030)
Bachelor degree or higher	0.004	(0.057)	0.019	(0.034)	-0.004	(0.029)	-0.017	(0.031)
ln(Household income)	0.036***	(0.009)	0.012*	(0.005)	0.011*	(0.004)	0.009*	(0.005)
Household income missing	-0.046	(0.050)	0.030	(0.030)	-0.048*	(0.023)	-0.015	(0.026)
Financial wealth	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Financial Literacy Score	0.207***	(0.027)	0.074***	(0.015)	0.022	(0.012)	0.058***	(0.013)
Cognitive Ability Score	0.058**	(0.021)	0.036**	(0.013)	-0.000	(0.011)	0.027*	(0.012)
Numeracy Score	0.062*	(0.025)	0.015	(0.016)	0.020	(0.014)	0.049**	(0.017)
Financial knowledge: high	0.055	(0.065)	0.036	(0.041)	0.018	(0.036)	0.003	(0.037)
Financial knowledge: very high	-0.059	(0.100)	0.009	(0.061)	-0.024	(0.048)	-0.032	(0.054)
St. market knowledge: high	-0.018	(0.082)	0.014	(0.051)	-0.043	(0.043)	0.011	(0.048)
St. market knowledge: very high	0.144	(0.143)	0.154	(0.102)	-0.057	(0.069)	0.034	(0.083)
Has traded stocks	-0.051	(0.042)	-0.066**	(0.025)	0.013	(0.023)	0.012	(0.024)
Has studied economics	-0.043	(0.041)	0.015	(0.025)	-0.014	(0.021)	-0.042	(0.022)
Mean_1	-0.092	(0.076)	-0.074	(0.050)	-0.001	(0.044)	-0.023	(0.051)
$\text{Standard Deviation}_1$	0.052	(0.038)	0.035	(0.026)	0.004	(0.022)	0.016	(0.026)
Sharpe Ratio_1	0.155	(0.260)	-0.034	(0.161)	0.111	(0.141)	0.145	(0.152)
RML_1	-0.052	(0.036)	-0.038	(0.025)	-0.006	(0.021)	-0.016	(0.025)
RSL_1	0.013	(0.008)	0.006	(0.006)	0.004	(0.005)	0.007	(0.006)
$1/\text{K}_1$	-0.133*	(0.058)	-0.032	(0.035)	-0.045	(0.028)	-0.029	(0.031)
Return Chasing_1	0.013	(0.146)	0.041	(0.086)	-0.010	(0.077)	-0.026	(0.080)
_cons	2.801							
	(1.856)							
Mean	2.334		0.727		0.826		0.781	
N	1592		1592		1592		1592	
r2	0.227							
chi2			173.175		174.774		214.015	

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Column 1 reports OLS coefficient estimates, while Columns 2-4 report marginal effects from Logit regressions. All regressions also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience.

intervention had a positive effect on the treatment score. Yet the treatment effect on the individual questions was only statistically significant for the question about whether one would always earn the highest return when investing everything into the fund with the highest expected return.

7 Heterogeneous Effects

Above we analyzed the determinants of willingness to pay for the educational treatment as well as the effect of our intervention on participants' portfolio efficiency. Next we delve into an evaluation of which population sub-group benefited most from such financial education, and whether these individuals were also those who were more likely to demand it. After exploring these questions, we then evaluate whether individuals' expectations about their ability to apply the information gleaned matched their treatment effect.

Who benefits most from the treatment? In a theoretical framework, Lusardi et al. (2017) predicted that better-educated consumers would gain more from investing in financial knowledge, while their less-educated counterparts might not benefit as much from investing in financial knowledge. This arises mainly because of the progressive structure of Social Security benefits, providing low earners much higher benefits than high earners, relatively speaking. To explore this conjecture, Table 12 reports the treatment effect with respect to efficiency improvements in the allocation tasks for a series of group pairs, testing for the difference in treatment effects across groups. Groups are formed to compare efficiency improvements resulting from the treatment between participants with higher formal education and lower formal education, between participants with scores above the mean and below the mean for financial literacy, cognitive ability, and numeracy as well as between participants with high self-reported financial / stock-market knowledge and low self-reported financial / stock-market knowledge. We find that the efficiency improvement resulting from the treatment was significantly higher for participants having higher revealed scores for cognitive ability and numeracy, compared to participants with lower revealed scores. We detect no significant differences in the treatment effect on efficiency when we compare respondents according to their highest degree of education, their financial literacy scores, their self-reported financial knowledge, or self reported stock market knowledge. This implies that participants with high prior knowledge do not benefit more from our treatment than their counterparts (partially because they may already know some of the information conveyed in the treatment), whereas individuals with higher abil-

ity have a significantly higher gain from receiving financial education than individuals with lower ability.

Are those who (could) benefit more from the treatment willing to pay more for it? In the context of unbiased financial advice on portfolio allocation that also included information on efficiency measures and diversification, Bhattacharya et al. (2012) reported that individuals who most needed the advice were least likely to obtain it.[17] To evaluate whether this also applies in our context, we next examine whether the least sophisticated individuals as well as those who elected less efficient portfolios were also more likely to reject the educational treatment and indicate they would pay less for it. Further, we also examine whether, people who were less (more) willing to pay for financial education were also less (more) likely to achieve greater portfolio efficiency, as measured by Δ E, as a result of the treatment. Table 5, discussed above, showed that participants with higher financial literacy (or numeracy) score were less likely to reject the treatment. This result is in line with Bhattacharya et al. (2012)'s findings. However we find no statistically significant results for the effect of these scores on peoples' willingness to pay levels. We find no association between participants' willingness to pay for the treatment and the distance of participants' portfolio to the efficiency frontier, i.e. peoples' potential for improvement as measured by the RML_1 and the RSL_1. To explore whether participants who were less (more) willing to pay for financial education also had a lower (higher) treatment effect with respect to efficiency improvements, we compare the results in Table 12 to the determinants of willingness to pay for financial education presented in Table 5. Participants with higher formal education, a financial literacy score, or high self-reported stock market knowledge are do not have a significantly different willingness to pay than their counterparts, nor do they benefit more or less from the treatment. For the other groups, we do not find a match of willingness to pay for and benefit from financial education relative to their counterparts. Participants with a higher cognitive ability or numeracy score were not willing to pay more for the treatment (Table 5), although their treatment effect was significantly higher than the treatment effect of participants with lower cognitive ability or numeracy scores. Reversely, participants with higher self-reported financial knowledge had a lower willingness to pay for the treatment, yet their benefit from it was not significantly smaller than for participants with lower self-reported financial knowledge. In sum, these findings suggest that individual's willingness

[17] Bhattacharya et al. (2012) identified individuals who most needed the advice as the less financially sophisticated, as measured by their past portfolio performance.

Table 12: Difference in Treatment Effect on Δ E between participants with higher (subjective and revealed) sophistication and ability and participants with lower (subjective and revealed) sophistication and ability) (t-test)

	N (=1,592)	Treatment Effect Δ E	Diff.
Bachelor degree or higher == 0	768	0.193***	
Bachelor degree or higher == 1	824	0.242***	-0.049
Below Mean Financial Literacy Score	530	0.190**	
Above Mean Financial Literacy Score	1,062	0.232***	-0.042
Below Mean Cognitive Ability Score	728	0.078	
Above Mean Cognitive Ability Score	864	0.323***	-0.245***
Below Mean Numeracy Score	1,025	0.151**	
Above Mean Numeracy Score	567	0.309***	-0.158*
Financial Knowledge (very) high == 0	1,312	0.216***	
Financial Knowledge (very) high == 1	218	0.180*	0.036
Stock Market Knowledge (very) high == 0	1,427	0.207***	
Stock Market Knowledge (very) high == 1	165	0.320***	-0.113
Ability to apply treatment == 0	857	0.168**	
Ability to apply treatment == 1	735	0.260***	-0.092

Note: This table presents coefficients of linear probability models that regress our measure for portfolio efficiency improvements on our standard set of covariates (identical to the ones used in Table 9) for a series of subgroup pairs. Further, this table presents test statistics for the difference between the coefficients for the treatment dummies across subgroups. The dummy variable *Below Mean Financial Literacy Score* is equal to 1 if the participant's financial literacy score is smaller than the mean of all treated participants, i.e. smaller than 2.64723, and 0 otherwise. Analogously, *Above Mean Financial Literacy Score* is equal to 1 if the participant has responded correctly to all 3 financial literacy questions. The dummy variable *Below Mean Cognitive Ability Score* is equal to 1 if the participant's cognitive ability score is smaller than the mean of all treated participants, i.e. smaller than 1.071429, and 0 otherwise. Analogously, *Above Mean Cognitive Ability Score* is equal to 1 if the participant has responded correctly to 2 ore more cognitive ability questions. The dummy variable *Below Mean Numeracy Score* is equal to 1 if the participant's cognitive ability score is smaller than the mean of all treated participants, i.e. smaller than 0.6180758, and 0 otherwise. Analogously, *Above Mean Numeracy Score* is equal to 1 if the participant has responded correctly to any of the numeracy questions. The dummy *Ability to apply treatment* is equal to 1 if the participant responds "yes" or "probably" to to the question "Do you think you will be able to apply the financial information provided to your investment decision in Allocation Task 2, later in this survey?" and 0 otherwise. ***, **, and * represent significance at the 0.1, 1 and 5 percent level, respectively.

to pay for financial education is not necessarily aligned with their potential benefit from receiving it.

The role of confidence Participants would need an accurate understanding of their own abilities if they were to align their willingness to pay for financial education with their expected benefit from such treatment. Accordingly, we next evaluate whether treated participants correctly estimated their own ability to apply the knowledge conveyed in the educational intervention. The last two rows in Table 12 compare the treatment effects on efficiency improvements between participants who claimed that they could apply the information gained, and individuals who did not believe that they could apply the information (the latter group included those responding "don't know" or "refuse to answer").[18] Although the treatment effect on efficiency for the group of individuals who believe that they can apply the information is higher than for their counterparts, the difference is not statistically significant. In sum, we conclude that participants did not have realistic beliefs about their ability to process financial information, which may contribute to the explanation why their willingness to pay for financial education is not aligned with their benefit from it.

8 Conclusion

In this paper, we evaluate an online experiment in which participants were asked to perform a portfolio allocation task both before and after they were offered the opportunity to purchase an educational treatment related to their allocation decisions. We elicited participants' true willingness to pay for the treatment intervention via the Becker et al. (1964) mechanism. Purchasing the treatment intervention had real monetary implications, as the price for the intervention was deducted from the endowment that participants received for the incentivized second allocation task. Hence, participants had to trade off the potential increase in portfolio efficiency and related monetary benefit they could gain from taking financial education, against the price they were willing to pay for it. We use this experiment to explore the determinants of peoples' willingness to pay for financial education (the subjective value that participants placed on financial knowledge), as well as the change in performance resulting from the treatment (the objective gain resulting from receiving financial knowledge).

[18]Note that our question "Do you think you will be able to apply the financial information provided to your investment decision in Allocation Task 2, later in this survey?" was asked before participants received the treatment.

We find that almost one quarter of participants did not wish to receive the educational treatment, even when it was provided free of charge. Peoples' stated willingness to pay for the treatment was mainly driven by participants' expectations about whether they felt able to transform the new financial information into a higher return. In addition, people who were objectively more sophisticated, that is, more financially literate, were more willing to receive the financial education, while those feeling themselves very confident regarding finances were less willingness to pay for education.

The treatment intervention increased heterogeneity in portfolio allocations, indicating that it encouraged people to customize their portfolios differently from standard allocations. For example, the educational treatment substantially reduced participants' propensity to spread their endowments equally across all funds (by around 50 percentage points). We find that financial education did not have a significant effect on changes in the Sharpe ratio, relative mean loss, or relative sigma loss. To further analyze whether financial education in our experimental setting improved participants' financial decisions, we developed two novel measures: A measure of Pareto improvement of portfolio efficiency and a measure of preference-independent welfare improvements. We showed that our treatment increased peoples' likelihood of achieving this type of efficiency and welfare improvements by almost 20, and 3 percentage points, respectively. With these results, we highlight the importance of measuring improvements in portfolio allocations in a well-defined theoretical way and we contribute to the literature arguing that financial education can have a positive effect on financial behavior (e.g. Kaiser et al., 2022). In our heterogeneity analyses, we show that participants with higher levels of revealed cognitive ability and numeracy scores benefited more from the treatment than did participants with lower scores. On average, participants with characteristics that are driving a higher willingness to pay for the educational intervention were not necessarily benefiting more from the treatment than those with a lower willingness to pay for financial education. This finding could be driven by the observation that, on average, participants did not assess their ability to apply the treatment very well.

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A Additional Tables

Table A1: Regression Estimates of Factors Associated with Keeping the Allocation Unchanged between the First and the Second Allocation Task

	(1)	
	Allocation Unchanged	
Received Treatment	-0.484***	(0.032)
Willingness to Pay	-0.011	(0.008)
Female	0.014	(0.021)
College or some university	-0.024	(0.032)
Bachelor degree or higher	-0.029	(0.032)
ln(Household income)	-0.002	(0.005)
Household income missing	0.017	(0.026)
Financial wealth	0.000	(0.000)
Financial Literacy Score	-0.030*	(0.014)
Cognitive Ability Score	0.033**	(0.011)
Numeracy Score	-0.001	(0.014)
Financial knowledge: high	-0.008	(0.035)
Financial knowledge: very high	-0.041	(0.054)
St. market knowledge: high	0.052	(0.043)
St. market knowledge: very high	0.095	(0.078)
Has traded stocks	-0.058*	(0.024)
Has studied economics	0.016	(0.022)
Risk aversion: 2	-0.003	(0.105)
Risk aversion: 3	-0.123	(0.063)
Risk aversion: 4	-0.121*	(0.048)
Risk aversion: 5	-0.091*	(0.046)
Risk aversion: 6	-0.096*	(0.049)
Risk aversion: 7	-0.098	(0.054)
Risk aversion: 8	-0.091	(0.060)
Risk aversion: 9	-0.026	(0.047)
Amiguity Averse	0.001*	(0.000)
Mean	0.323	
N	1592	
chi2	600.450	

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table reports marginal effects from a Logit regression of a dummy variable that is equal to one if the participant has not changed their allocation between the first and the second allocation task for all participants who where offered the treatment. We also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience.

Table A2: Regression Estimates of Factors Associated with Willingness to Pay by Response to BDM Control Question

	(1) Reject treatment for BDM=1	(2) Willingness to pay (>= 0) for BDM=1	(3) Willingness to pay for BDM=1	(4) Reject treatment for BDM=0	(5) Willingness to pay (>= 0) for BDM=0	(6) Willingness to pay for BDM=0
Ability to apply treatment: yes	-0.073**	0.361**	0.528***	-0.024	0.537**	0.475**
	(0.028)	(0.139)	(0.146)	(0.042)	(0.191)	(0.169)
Ability to apply treatment: dk	0.019	0.373*	0.251	0.095*	-0.354	-0.357
	(0.030)	(0.188)	(0.191)	(0.043)	(0.255)	(0.186)
Expected higher return in task 2: yes	-0.074*	0.083	0.271	-0.149***	0.604**	0.780***
	(0.029)	(0.148)	(0.155)	(0.044)	(0.204)	(0.180)
Expected higher return in task 2: dk	0.013	-0.219	-0.258	0.021	0.458	0.170
	(0.029)	(0.180)	(0.186)	(0.040)	(0.237)	(0.179)
Female	-0.039	0.167	0.247*	-0.009	-0.054	0.003
	(0.023)	(0.114)	(0.121)	(0.034)	(0.174)	(0.138)
College or some university	0.000	-0.145	-0.121	0.081	-0.016	-0.204
	(0.035)	(0.181)	(0.191)	(0.047)	(0.238)	(0.191)
Bachelor degree or higher	0.028	-0.270	-0.288	0.107*	-0.147	-0.315
	(0.035)	(0.180)	(0.190)	(0.048)	(0.239)	(0.193)
ln(Household income)	0.005	-0.034	-0.044	0.035***	-0.007	-0.081*
	(0.006)	(0.026)	(0.028)	(0.010)	(0.037)	(0.035)
Household income missing	0.062*	0.008	-0.325	0.167***	-0.377	-0.661***
	(0.026)	(0.174)	(0.171)	(0.036)	(0.242)	(0.163)
Financial wealth	-0.000*	0.000	0.000	-0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial Literacy Score	-0.020	-0.058	0.058	-0.048*	-0.043	0.102
	(0.016)	(0.099)	(0.099)	(0.020)	(0.117)	(0.085)
Cognitive Ability Score	0.011	0.059	0.033	0.031	0.047	-0.052
	(0.012)	(0.061)	(0.063)	(0.019)	(0.097)	(0.079)
Numeracy Score	-0.041*	-0.097	-0.003	-0.054*	0.012	0.155
	(0.016)	(0.065)	(0.071)	(0.027)	(0.118)	(0.103)
Financial knowledge: high	0.035	-0.466**	-0.549**	-0.007	-0.654*	-0.481
	(0.037)	(0.179)	(0.189)	(0.065)	(0.294)	(0.259)
Financial knowledge: very high	0.077	-0.850**	-0.968**	0.076	0.033	-0.256
	(0.050)	(0.293)	(0.305)	(0.094)	(0.468)	(0.380)
St. market knowledge: high	0.019	0.231	0.175	-0.106	-0.550	-0.203
	(0.047)	(0.232)	(0.245)	(0.082)	(0.365)	(0.309)
St. market knowledge: very high	-0.011	0.192	0.243	0.041	-0.072	-0.299
	(0.085)	(0.418)	(0.449)	(0.121)	(0.691)	(0.515)
Has traded stocks	0.002	-0.009	0.003	-0.099*	0.023	0.269
	(0.026)	(0.120)	(0.129)	(0.039)	(0.181)	(0.155)
Has studied economics	0.000	0.171	0.161	0.035	0.122	0.015
	(0.024)	(0.115)	(0.122)	(0.038)	(0.194)	(0.154)
Mean_1	-0.171**	0.003	0.285	0.009	-0.123	-0.090
	(0.052)	(0.206)	(0.218)	(0.081)	(0.366)	(0.314)
$\text{Standard Deviation}_1$	0.088***	-0.013	-0.157	-0.005	0.076	0.051
	(0.025)	(0.103)	(0.108)	(0.041)	(0.186)	(0.158)
Sharpe Ratio_1	-0.215	-0.173	0.160	0.088	-0.208	-0.473
	(0.161)	(0.696)	(0.736)	(0.276)	(1.278)	(1.071)
RML_1	-0.082***	-0.024	0.114	-0.005	-0.058	-0.011
	(0.023)	(0.096)	(0.101)	(0.039)	(0.183)	(0.153)
RSL_1	0.006	0.008	-0.005	0.004	-0.004	-0.020
	(0.005)	(0.023)	(0.024)	(0.009)	(0.044)	(0.036)
$1/\text{K}_1$	0.018	-0.130	-0.209	0.119*	-0.032	-0.402
	(0.033)	(0.178)	(0.185)	(0.052)	(0.258)	(0.209)
Return Chasing_1	0.013	0.237	0.113	0.191	-0.545	-0.790
	(0.079)	(0.400)	(0.419)	(0.153)	(0.719)	(0.600)
_cons		3.028	-4.026		5.731	3.867
		(5.008)	(5.322)		(8.730)	(7.521)
Mean	0.126	3.023	2.644	0.386	2.717	1.668
N	862	754	862	730	448	730
chi2	149.149			244.222		
r2		0.087	0.135		0.167	0.244

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Columns 1 and 4 report marginal effects from Logit regressions. Columns 2, 3, 5, and 6 report OLS coefficient estimates. In all regressions, we also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience.

Table A3: Regression Estimates of Factors Associated with Change in Performance between Allocation Tasks by Response to BDM Control Question

	(1) Δ Sharpe Ratio for BDM=1	(2) Δ Sharpe Ratio for BDM=0	(3) Δ RML for BDM=1	(4) Δ RML for BDM=0	(5) Δ RSL for BDM=1	(6) Δ RSL for BDM=0
Received Treatment	-0.000	-0.027	-1.235*	-0.232	-1.867	0.051
	(0.025)	(0.039)	(0.572)	(0.797)	(1.130)	(1.609)
Willingness to pay	-0.003	0.005	0.206	-0.085	0.487	-0.058
	(0.009)	(0.012)	(0.200)	(0.240)	(0.395)	(0.484)
Reject treatment	-0.077*	-0.052	0.127	0.132	0.174	0.665
	(0.036)	(0.034)	(0.820)	(0.685)	(1.621)	(1.383)
Female	0.004	0.016	-0.005	-0.064	0.055	-0.320
	(0.020)	(0.024)	(0.463)	(0.479)	(0.915)	(0.966)
College or some university	0.001	0.035	0.383	-0.788	1.015	-1.843
	(0.032)	(0.033)	(0.732)	(0.666)	(1.446)	(1.345)
Bachelor degree or higher	0.027	0.024	0.141	-1.116	1.012	-2.684*
	(0.032)	(0.033)	(0.726)	(0.670)	(1.435)	(1.353)
ln(Household income)	0.003	0.009	-0.058	-0.200	-0.145	-0.332
	(0.005)	(0.006)	(0.107)	(0.122)	(0.210)	(0.247)
Household income missing	-0.047	-0.022	0.782	-0.185	1.523	-0.712
	(0.029)	(0.028)	(0.658)	(0.571)	(1.300)	(1.152)
Financial wealth	-0.000*	-0.000	-0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Financial Literacy Score	-0.004	0.005	-0.086	0.358	-0.318	0.750
	(0.016)	(0.015)	(0.379)	(0.296)	(0.749)	(0.598)
Cognitive Ability Score	0.001	-0.006	-0.423	-0.255	-0.779	-0.595
	(0.010)	(0.014)	(0.241)	(0.276)	(0.477)	(0.558)
Numeracy Score	-0.012	0.008	0.058	-0.027	0.139	0.155
	(0.012)	(0.018)	(0.272)	(0.358)	(0.537)	(0.722)
Financial knowledge: high	0.005	-0.019	-0.425	-0.441	-0.401	-0.891
	(0.031)	(0.044)	(0.719)	(0.901)	(1.420)	(1.819)
Financial knowledge: very high	0.033	-0.042	-0.535	-0.171	-1.505	-1.217
	(0.051)	(0.065)	(1.165)	(1.323)	(2.302)	(2.672)
St. market knowledge: high	0.009	0.014	0.451	0.239	0.917	1.072
	(0.041)	(0.053)	(0.945)	(1.082)	(1.866)	(2.185)
St. market knowledge: very high	0.064	-0.015	1.904	-0.127	3.186	0.084
	(0.074)	(0.088)	(1.715)	(1.781)	(3.388)	(3.597)
Has traded stocks	-0.022	0.042	0.263	0.409	0.821	0.844
	(0.021)	(0.027)	(0.494)	(0.541)	(0.975)	(1.093)
Has studied economics	0.001	-0.039	-0.442	-0.643	-1.078	-1.389
	(0.020)	(0.026)	(0.464)	(0.536)	(0.917)	(1.083)
_cons	0.018	-0.081	-0.819	0.900	-1.813	0.895
	(0.085)	(0.089)	(1.959)	(1.811)	(3.869)	(3.658)
Mean	0.035	0.045	-0.455	-0.358	-0.461	-0.584
N	862	730	862	730	862	730
r2	0.030	0.061	0.046	0.035	0.040	0.035

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table compares regression results of performance measures Δ Sharpe Ratio, Δ RML, and Δ RSL between participants who responded correctly to the BDM control question and those who did not. In all regressions, we also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience.

Table A4: Regression Estimates of Factors Associated with Change in Performance between Allocation Tasks by Response to BDM Control Question

	(1)		(2)	
	Δ E for BDM=1		Δ E for BDM=0	
Received Treatment	0.214***	(0.039)	0.172**	(0.056)
Willingness to pay	0.031*	(0.014)	0.009	(0.017)
Reject treatment	0.020	(0.068)	-0.051	(0.053)
Female	-0.047	(0.034)	-0.013	(0.036)
College or some university	-0.030	(0.053)	0.090	(0.050)
Bachelor degree or higher	0.008	(0.053)	0.047	(0.051)
ln(Household income)	-0.004	(0.008)	0.005	(0.009)
Household income missing	-0.029	(0.050)	0.032	(0.044)
Financial wealth	0.000	(0.000)	-0.000	(0.000)
Financial Literacy Score	0.059*	(0.029)	-0.006	(0.023)
Cognitive Ability Score	0.009	(0.018)	0.022	(0.020)
Numeracy Score	0.012	(0.019)	-0.037	(0.027)
Financial knowledge: high	-0.021	(0.053)	0.036	(0.066)
Financial knowledge: very high	-0.079	(0.089)	0.182	(0.096)
St. market knowledge: high	0.021	(0.068)	-0.044	(0.083)
St. market knowledge: very high	0.016	(0.126)	-0.160	(0.153)
Has traded stocks	0.010	(0.035)	0.007	(0.040)
Has studied economics	-0.027	(0.034)	0.035	(0.040)
Mean	0.361		0.319	
N	862		730	
chi2	130.359		84.500	

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table compares marginal effects from Logit regressions of Δ welfare between participants who responded correctly to the BDM control question and those who did not. In all regressions, we also control for region, ownership of individual stocks, ownership of domestic stocks, marital status, children, number of HH members, age, and preferences, such as risk aversion, ambiguity aversion, and patience.

B Additional Figures

Figure A1: Experimental Timeline

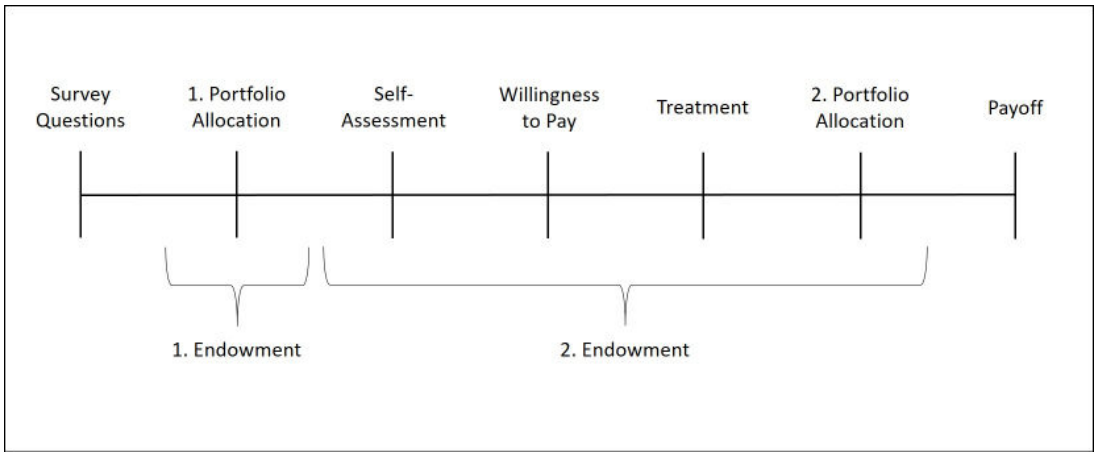
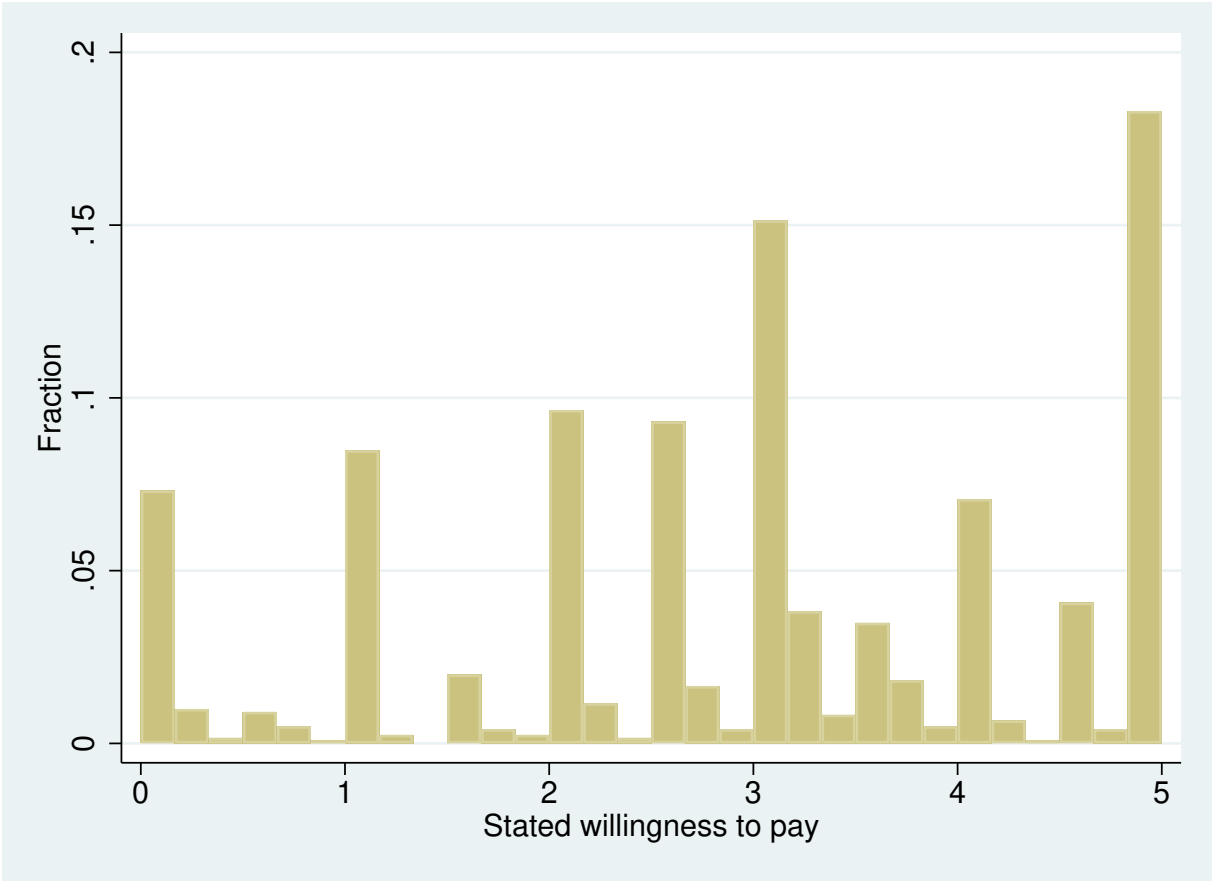


Figure A2: Distribution of Willingness to Pay



C Survey Instrument