# The Interaction Effect of Myopia and Time-Inconsistent Preferences on Happiness-Related Loss Aversion of Investors

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In this research the interaction effect of myopia and time-inconsistent preferences on loss aversion in happiness of investors is assessed. An experiment is held to elicit the happiness individuals perceive when presented with their performance in a hypothetical investment. The result is a counter-intuitive order of loss aversion ratios where myopic perceived loss aversion is the lowest ratio, while standard perceived loss aversion is the highest ratio. Time-inconsistent preferences in the literature have shown that investors expect more loss aversion than they perceive retrospective. Myopia should increase loss aversion by the increased frequency of evaluating performance. Much research is done on risk and return, but less on investor happiness. More precisely, interactions of effects on happiness are mostly neglected. When only smaller performance domains between -11% and 11% are used to derive loss aversion, myopic expected loss aversion is the highest ratio, while standard perceived loss aversion is the lowest ratio. Moreover, this sequence also appears when not a 0% return but 20% is used to separate gains from losses, and when only are investors examined. The findings imply that myopic loss aversion does not hold for non-investors and that the time-inconsistent preferences do not follow a one-way direction if combined with myopia.

*Loss Aversion Illusion, Myopic Loss Aversion, Time-Inconsistent Preferences, Investor Happiness, Prospect Theory, Loss Aversion*

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# 1. Introduction

Risk and return are the two most researched variables in financial literature. Since stocks were initiated, investors were united: we would like to reach the highest return with the lowest risk. As the investment universe grew the market for stocks became more efficient and excess return became hard to find. Nowadays, millions of people are directly and indirectly investing in stocks. Professional investors still try to find the best stocks with a high return and a low level of risk.

However, if we look further than just risk and return, we see a variable that is probably more important: happiness. In the end, we live our lives to be happy and not to decrease risk and increase return. Although, risk and return influence subjective well-being, they are just independent variables of a greater good.

Risk and return are two variables that are easy to measure. They can be generated using an objective method. Moreover, if people assume an efficient financial market these two variables cannot be assessed subjectively. However, there is much proof that financial markets are not efficient and one of the causes is that people value risk and return subjectively. Subjective well-being is vastly measured subjectively and differs per persons with the same risk-adjusted return.

The area of investor happiness is dedicated to broaden the insights in what drives investors to make certain decisions and what makes them glad in the end. Findings could lead to a better understanding of our emotional choices and can be used to increase the well-being of investors. Making financial choices without taking into account your future level of happiness could lead to a nice risk-adjusted return, but a lower level of happiness (Merkle, 2017) .

The upcoming literature on investor happiness shows that optimistic investors are happier with the same return as pessimistic investors. More optimistic investors create a higher sentiment, which means that more investors are optimistic about the future expected returns. This higher sentiment in the market results in a smaller error of forecasting volatility. On the other hand, a higher sentiment does increase the error in forecasting returns. Hence, optimistic investors expect a higher than rational return, but these people have a good expectation of the amount of risk (Kaplanski, Levy, Veld, & Veld-Merkoulova, 2015).

When the variables are converted, one can also see what makes investors optimistic. On average younger and female investors are less happy with a similar return than older and male investors. Another variable is the amount of influence you can have on your investment. When your own influence increases, investors want a higher return and need a higher return to be happy with their performance (Merkle, Egan, & Davies, 2015).

A different way to look at investor happiness and financial decision is more time-dependent: Do investors make the best decisions to maximize future utility? According to recent findings, investors do not (Merkle, 2019). Investors think they will exhibit from loss aversion, but this is only an illusion, which creates time-inconsistent preferences. Eventually, these preferences lead to investments that do not maximize utility.

A second variable that impacts the happiness of investors is the frequency investors look at their performance. The idea is that investors who evaluate their performance more frequently, see more losses and experience more loss aversion (Benartzi & Thaler, 1995). Hence, the same return is perceived worse for people who evaluate their performance more compared to people who evaluate their performance less. This phenomena is labeled ‘myopic loss aversion’.

Despite the upcoming psychological focus in finance, investor happiness is examined tremendously less than risk and return. This area of investor happiness looks mostly at single factors that affect subjective well-being of investors. Research that is concentrated on the interaction between variables could help to reach a more inclusive view on the systems that affect investor happiness.

This research aims to combine two variables that are time-dependent: myopic loss aversion and time-inconsistent preferences. By combining these two variables, the impact of interaction between the two on the perceived loss aversion is assessed. Henceforth, the research question of this thesis is:

*To what extent do myopic loss aversion and time-inconsistent preferences interact in affecting the happiness-related loss aversion of investors?*

By looking for an answer to this question, this research tries to disentangle the individual effects of these variables on investor happiness in a broader model. Through using an experimental setting and letting variables interact, this thesis intents to analyze the effects in a wider system of influencers on happiness. The more we know about the variables that influence our happiness and well-being, the more rational we can make our financial decisions to maximize our utility.

The research focuses on people that do not need to be investors, but are presented with an hypothetical investment decision. The experimental sample consists of mainly Dutch residents.

The thesis uses a convenience sample to elicit investor happiness of a subjective return in an experimental setting. OLS-regressions and Wald tests will be used to empirically find and answer to the research question.

# 2. Theoretical Framework

The basis for insights in investor happiness lays in behavioral economics and behavioral finance. These areas are relatively new compared to classical financial modeling, but relatively old compared to research on investors' well-being. By using features from different theories a series of hypotheses is developed to analyze the central question in this thesis.

## 2.1. Prospect Theory

The assumption that people act rational is used in many classical models in economics. However, it is proven that humans systematically act sub-optimal or even irrational. The main model that descriptively shows the systematic deviations from optimal behavior is Prospect Theory (Tversky & Kahneman, 1992). The concept of this model explains that people value payoffs non-linear and that we weigh probabilities. An important innovation is that we do not judge the utility of our total wealth, but we judge the utility based on a loss or gain compared to a reference point.

Decades ago, the idea of diminishing marginal utility and non-linearity in utility curves was already written down (Bernoulli, 1954). However, Kahneman and Tversky (1979) extended this finding to the loss domain. When a loss becomes bigger, we are relatively less affected by this additional loss. Of more interest is the fact that people are loss averse. We value losses 2 to 2.5 times as much as subsequent gains (Kahneman & Tversky, 1979). More research is conducted on this coefficient, which all confirm loss aversion, but the magnitude of it differs among the findings.

The prospect theory is now widely used to assess the decisions we make. One implication is that people are risk-seeking when there is a big probability of losing something, but also when they encounter a small probability of winning a lot. On the other hand, we are more risk-averse when there is a large probability of a gain, but also when there is a small probability of a loss (Kahneman, 2015).

## 2.2. Mental Accounting

Another thoughtful tool people use to make decisions is Mental Accounting (Thaler, 1985). Again, it acknowledges the effect of loss aversion. By categorizing our costs and benefits we get a more structured overview of where money comes from and where it goes to. Just as businesses, people use accounts or budgets to structure that which are called mental accounts (Thaler, 1990). There could be for example accounts for education, groceries, car expenses or entertainment activities.

This theory says that people need to make their financial decisions in the most optimal way. People do this by using prospect theory and then integrate or segregate financial outcomes in particular mental accounts. For example, it is rational to segregate gains. We have diminishing marginal utility, so when gains are segregated we derive more utility. Another example, when there is a small reduction of a big loss, it should also be segregated. The curve is not that steep at the end of the curve in the loss domain, and is much steeper in the beginning of the gain domain. Again, this leads to a higher utility. This optimal way of making financial decisions is called choice bracketing.

But how are we deciding if something is a loss? How do we decide what the reference point is? This is totally dependable on the mental account. Economic models predict that money is allocated to that purpose or account that yields the highest return. However, the money in mental accounts is not fungible. This idea illustrates that many people use rules-of-thumb to evaluate their consumption and income. The change in income in one account is highly correlated with the consumption in that account, but not with other mental accounts (Kahneman & Tversky, 1984). So money is sticky in our mental accounts.

This stickiness is also present in our wealth accounts. When a person's current balance account hits red values, she will probably be reluctant to take a bit of money from her pension, savings account or children's education savings. What most of us rather do, is pay a high interest and leave the current balance negative (Thaler, 1990). Naturally the magnitude of this effect differs per person. For instance, a child that has more patience will be more rational in this framework of mental accounts (Mischel, Shoda, & Peak, 1988). This shows there is at least a genetic factor that affects the magnitude of mental accounting.

Another feature of mental accounting is the difference between acquisition utility and transaction utility (Thaler, 1985). The first depends only on the value of the good compared to the cost one paid. The latter one depends on the merits of the deal. When a person buys a good for exactly the amount she is willing to pay for it, the acquisition utility is zero. If it costs the same, but it is on sale, the transaction utility will be positive. Although the amount this person pays and the value of the good are exactly the same, the utilities differ. This distinction is important with respect to loss aversion, as people only exhibit a loss compared to a certain reference point. This reference point could be the transaction utility or the acquisition utility.

## 2.3. Myopic Loss Aversion

To look at the implications of loss aversion on daily actions, research is conducted on the effect of the frequency we look at our losses (Benartzi & Thaler, 1995). The effect that occurs is called myopic loss aversion. Myopic loss aversion illustrates that the more often we look at our losses, we are less willing to take risk, and hence we become more risk averse. This increase is illustrated by a story of Samuelson (1963). He offered his colleague a bet in which he could either win $200,- or lose $100,-. The probability of both payoffs was determined by a coin flip, so both payoffs had a probability of 50%. He refused the bet, but was willing to accept it, if he could do hundreds of these bets and he did not need to watch them.

This shows loss aversion, but more importantly also myopic loss aversion. If we evaluate our loss every single time, we are more risk-averse. This effect is due to mental accounting, as we open and close an account every time we evaluate our performance. This is a famous example to illustrate the persistence of the effect of myopic loss aversion even within highly trained academics.

In finance, researchers could not find a reason for the high premium on stocks. All the calculations led to either an extreme high level of risk aversion or a large variability in consumption of investors (Shiller, 1983). The mathematically reasonable annual equity premium lays around 1%, but was observed to be 6%, which is a puzzle (Rajnish & Prescott, 1985; Larson & List, 2016). Myopic loss aversion could help explain this puzzle, because investors frequently look at their performance. This frequency increases the level of loss aversion, due to myopic loss aversion.

Benartzi and Thaler (1995) state that if investors evaluate their investments once a year, the level of risk aversion has the correct amount to solve the equity premium puzzle. Every investor has a different time frame to evaluate past returns, but most do it annually. Due to tax compliance and annually distributed reports of your asset manager, a possible valuation period of once every year is highly plausible.

## 2.4. Time-Inconsistency of Happiness in Investing

Investing is based on two main variables, risk and return. But as evaluated, other factors influence the decision-making process as well. One example is the satisfaction or happiness that investors get from their derived return (Merkle, Egan, & Davies, 2015). The authors mention that investor happiness is only seen as byproduct of consumption opportunities and that this kind of happiness is buried in utility functions which are only slightly related to actual events on the stock market. The focus of the study is on investor happiness and hence not on risk and return. By using quarterly survey data, taken from self-directed investors at Barclays Stockbrokers, they test which variables influence the level of investor happiness.

The regressions are broad, hence many variables are examined and taken into account. Two variables are the 'experienced happiness' and the 'anticipated happiness'. Both are measured by a survey question on a scale from one to seven, from 'extremely bad' to 'extremely good'. For experienced happiness, investors are asked how happy they are with the return of their portfolio in the last three months. Anticipated happiness is measured in the same way and investors were asked how happy they would be with their own expected return for the next three months.

The most interesting finding is that anticipated happiness is not correlated at all with experienced happiness for the same period (Merkle, Egan, & Davies, 2015). This makes preferences of investors inconsistent. Thus, when making an investment decision, their preferences for anticipated and experienced happiness are not aligned. This effect induces imperfect decisions that do not maximize future experienced happiness, but focus on anticipated happiness.

As people think they will evaluate their performance differently than how they actually do it, it will lead to serious imperfect decisions. Theoretically, people make rational decisions based on their unbiased expectations and stable preferences. As the preferences become unstable, the decisions made today will negatively affect investor happiness in the future.

Another important take-away is that perceived past performance is more correlated with the subjective rating of that past return. Thus, not the actual return, but the perceived return predicts investor happiness better. To come up with this measure, the authors asked participants to state the return they got during the last quarter. The actual return data is coming from their brokerage account with the bank. That perceived performance is a better predictor of happiness than actual performance contradicts standard economic theory.

## 2.5. Financial Loss Aversion Illusion

A later research of one of the same academics combines the findings about loss aversion and difference between expected and experienced happiness (Merkle, 2019). By using similar data from surveys and actual trading data from clients of Barclays, the research looks at loss aversion. Happiness is subjectively measured by asking participants how happy they are with different scenarios. This subjective rating is again generated on a scale from one to seven.

The regressions of expected portfolio return on happiness of the expected return indeed show loss aversion. Controlling for many variables, the utility curve is roughly two times as steep in the loss domain as in the gain domain. The coefficients are respectively 5.898 and 2.603. A change in expected return of 1%-point in the loss domain has an effect of 0.059 on the rating of return. The generated ratio for loss aversion is 2.27, which is derived from the coefficient in gains divided by the coefficient in losses. This ratio is consistent with existing literature and significant different from 1.

However, the effect disappears when they regress past perceived portfolio return on the subjective rating of the perceived return. Both variables, again after controlling for many variables, are extremely close to each other. The corresponding coefficients are 4.932 for losses and 4.618 for gains. The loss aversion ratio of 1.07 is hence negligible.

The tests are repeated for actual past portfolio return as independent variable. The coefficient in the loss domain is 1.727 and for the gain domain 1.809. This test even suggests a negative loss aversion ratio. However, this difference is not significant and any ratio of loss aversion below 1 is likely to come from any discrepancy between actual and perceived past performance. Therefore, people do not perceive any level of loss aversion.

Another measure for loss aversion only focuses on the small intervals close to the reference points (Köbberling & Wakker, 2005). The idea is that data within this interval will be more robust as there is more data available with a lower standard deviation. This ratio is 3.73 for expected returns, which is relatively high compared to existing literature. The ratio equals 1.04 for past portfolio return.

To conclude the paper of Merkle (2019), investors maximize anticipated utility, but this is suboptimal for experienced utility. Investors expect to suffer from loss aversion, but in the end do not perceive any loss aversion. This projection bias, together with the loss aversion illusion shows that people are biased and time-inconsistent regarding their preferences.

## 2.6. Hypotheses

This paper will try to combine the effects of the time-inconsistent preferences and myopia on the level of risk aversion. From Benartzi & Thaler (1995) we can conclude that the ratio of myopic loss aversion is bigger than the ratio for standard loss aversion, for perceived loss aversion. From Merkle (2019) we can conclude that the ratio for expected loss aversion is bigger than the ratio for perceived loss aversion. These two divisions in loss aversion create four types of loss aversion: standard perceived loss aversion; standard expected loss aversion; myopic perceived loss aversion; and myopic expected loss aversion. These four types of loss aversion are schematically shown below.

| | ***Standard Loss Aversion*** | ***Myopic Loss Aversion*** |
|---|---|---|
| ***Perceived Loss Aversion*** | Standard Perceived Loss Aversion | Myopic Perceived Loss Aversion |
| ***Expected Loss Aversion*** | Standard Expected Loss Aversion | Myopic Expected Loss Aversion |

To extent the literature within this fourfold pattern, all different ratios for loss aversion will be tested for discrepancies. The first extension will focus on the difference between myopic expected loss aversion and standard expected loss aversion. As the myopic loss aversion ratio is larger than the standard loss aversion ratio for perceived returns, this sign is also predictable for expected returns:

***Hypothesis 1:*** *The myopic expected loss aversion ratio is higher than the standard expected loss aversion ratio.*

The second extension focuses on the two types of myopic loss aversion. For standard loss aversion, the perceived loss aversion is near zero while people exhibit expected loss aversion. Hence this difference is also expected for myopic loss aversion.

***Hypothesis 2:*** *The myopic perceived loss aversion ratio is lower than the myopic expected loss aversion ratio.*

As the standard perceived loss aversion ratio is feasibly lower than the myopic perceived loss aversion (Benartzi & Thaler, 1995) and the perceived loss aversion ratio is probably lower than expected loss aversion, it will result in the following idea:

***Hypothesis 3:*** *The myopic expected loss aversion ratio is higher than the standard perceived loss aversion ratio.*

Existing studies only talk about the signal of the ratios, but the magnitude of loss aversion differs strongly among research. To test whether the effect of time-inconsistency or myopia is larger, the myopic perceived loss aversion ratio will be tested against the standard expected loss aversion. Time-inconsistency results in a total destruction of loss aversion for perceived returns, while myopic losses only enlarges the already existing losses in a standard loss aversion format. Henceforth, it is expected that the effect of time-inconsistency is bigger than myopic losses. The last hypothesis tries to distinguish this effect of time-inconsistency and myopia:

***Hypothesis 4:*** *The standard expected loss aversion ratio is higher than the myopic perceived loss aversion ratio.*

By testing these hypotheses the combined effect of time-inconsistent preferences and myopic loss aversion on investor happiness will be assessed. A schematic overview and equation of the hypotheses is given visibly to show the ratios of loss aversion:

*Standard Perceived Loss Aversion < Myopic Perceived Loss Aversion <*
*Standard Expected Loss Aversion < Myopic Expected Loss Aversion*

| | ***Standard Loss Aversion*** | ***Myopic Loss Aversion*** |
|---|---|---|
| ***Perceived Loss Aversion*** | Lowest ratio | Second lowest ratio |
| ***Expected Loss Aversion*** | Second highest ratio | Highest ratio |

# 3. Data & Methodology

To test the different types of loss aversion, data needs to be created as this type of data is not available yet. A survey has been created to set up the experiment. The full survey is shown in appendix 1.

## 3.1. Experimental Design

By using convenience sampling, people are asked to fill in the survey. To reach them, either an e-mail message is sent to them or they were asked face-to-face to join the experiment. The survey can be filled in in either English or Dutch, which makes it convenient for many people. The nationality of the respondents is mainly Dutch. All people that are sixteen years or older were included in the survey, which resulted in an N of 895. Respondents do not necessarily need to be investors, as this could show a distinction between investors and non-investors.

The very first question after respondents chose their preferred language is to choose a particular stock out of three options. The performance does not differ among the different stocks, but this method is used to create an endowment effect that people care about their chosen stock. The idea is that people give more honest answers and are more likely to finish the whole survey as they want to know their final performance.

After these questions, respondents were randomly distributed among one of the four treatments. These four treatments are treatment 1, 2, 3 and 4. Respectively they are labeled standard perceived loss aversion, standard expected loss aversion, myopic perceived loss aversion and myopic expected loss aversion:

| | ***Standard Loss Aversion*** | ***Myopic Loss Aversion*** |
|---|---|---|
| ***Perceived Loss Aversion*** | Treatment 1 | Treatment 3 |
| ***Expected Loss Aversion*** | Treatment 2 | Treatment 4 |

Next, people were shown the hypothetical (expected) return of their investment. Everyone had to evaluate a particular return for sub-periods. Dependent on the treatment, the format differed slightly.

For the two treatments about perceived loss aversion, it was made clear that the period to evaluate was in the past. Every period, a certain increase or decrease in value of their stock was presented. They were asked to evaluate this return. At the end of all periods, they stated the accumulated total perceived return, which created the variable 'perceived return'. The question that was presented was: 'How much do you think the share changed in value over the whole period of 6 years?'

Simultaneously, they evaluated the overall perceived performance of this perceived return at the end of all periods which resulted in the variable for 'subjective rating of perceived return'. The corresponding question is: 'How would you rate this change in value over the whole period of 6 years?'

People who were distributed in one of the expected loss aversion treatments were made clear that the period to evaluate was in the future. To better account for this, they were shown five scenarios of future performance for the next period. Scenarios are understandable, usable for future states and are not far from reality. An example for such scenarios is shown in figure 1. This scenario is for the first year and has an expected average return of 3%. More information about the chosen returns is explained in section 3.2.

*Figure 1: Example of Scenarios (Year 1)*

| Scenario | Likelihood of Happening | Change in value (year 1) |
|---|---|---|
| Very Bad Scenario | 20% | -19% |
| Bad Scenario | 20% | -9% |
| Intermediate Scenario | 20% | 2% |
| Good Scenario | 20% | 13% |
| Very Good Scenario | 20% | 28% |

Every period, a different combination of scenarios was presented. They were asked to evaluate this combination of scenarios. At the end of all periods, they stated the accumulated total expected return, which created the variable 'expected return'. The matching question equals: 'How much do you think the share will change in value over the whole period of 6 years?'

Simultaneously, they evaluated the overall expected performance of this perceived return at the end of all periods which resulted in the variable for 'subjective rating of expected return'. The question that was shown at the end of all periods to these respondents was: 'How would you rate this expected change in value over the whole period in the upcoming 6 years?'

The two variables 'perceived return' and 'expected return' are combined in one variable labeled 'subjective return'. Note that both these variables are not automatically the same as the actual return. The subjective perceived or expected return is a better estimator for investor happiness than the actual return (Merkle, Egan, & Davies, 2015). For this reason, the perceived and expected return are subjective returns and not the actual returns on the investment.

Moreover, 'subjective rating of perceived return' and 'subjective rating of expected return' can be combined in one variable labeled 'subjective rating of return'. For clarification, the 'subjective rating of return' is the value respondents gave to the question to estimate the return over the total period of 6 years. An overview of all the variables used in this research are presented in appendix 2.

The most important variables are yet explained, but of course there should also be a clear distinction between myopic and standard loss aversion. To cause myopic evaluation periods, the myopic loss aversion treatments show six periods of one year, while the standard loss aversion treatments only show two periods of three years. The same questions for subjective rating of return are used for myopic and standard loss aversion treatments. Table 1 shows a graphic representation of the explanation of the difference in treatments.

*Table 1: Characteristics of Treatments*

| | Standard Perceived Loss Aversion | Standard Expected Loss Aversion | Myopic Perceived Loss Aversion | Myopic Expected Loss Aversion |
|---|---|---|---|---|
| Amount of periods to evaluate | 2 (of 3 years) | 2 (of 3 years) | 6 (of 1 year) | 6 (of 1 year) |
| Presentation of return | Stated percentage | Scenarios | Stated percentage | Scenarios |
| Period to asses | Past | Future | Past | Future |
| Question about accumulated subjective return after one period | No | Yes | No | Yes |
| Question about subjective rating of return after one period | Yes | Yes | Yes | Yes |
| Question about accumulated subjective return after total period | Yes | Yes | Yes | Yes |
| Question about subjective rating of return after total period | Yes | Yes | Yes | Yes |

After the hypothetical investment, four general control questions are presented to all respondents. As this is personal information, it is not mandatory to fill in these questions. The questions refer to the variables for ‘age’, ‘gender’, ‘self-stated financial literacy’ and ‘investor’. ‘Self-stated financial literacy’ is derived from asking the question: ‘How much knowledge do you think you have of investing?’ The last variable ‘investor’ is a dummy variable to separate the whole sample in people who privately invest and people who do not invest privately.

The final variable tested in this experiment is ‘financial literacy’. The test consists of three questions on the topics of interest compounding, inflation and risk diversification. One point is given to each correct answer, so respondents could earn a maximum of three points. The test is based on research of Lusardi and Mitchell (2011a). It is now widely used to proxy financial literacy among respondents.

Lastly, to separate gains from losses, two extra interaction variables are computed to evaluate the difference in the domain of gains and losses. The variable ‘subjective return > 0%’ takes the value of the perceived or expected return when it is a positive number and 0 otherwise. The corresponding ‘subjective return < 0%’ variable’ takes the value of the perceived or expected return when it is a negative number and 0% otherwise.

It is assumed that people experience a loss when their subjective return is below zero and a gain when it takes a value above 0%. This is the most objective way as a return below 0% decreases the absolute value and a return above 0% increases the absolute value of money. However, it could be that more subjective reference points distinct losses from gains. Examples are the inflation rate, risk-free rate, or average stock market returns (Merkle, 2019).

## 3.2. Characteristics of Returns

The performances of the investments in this survey represent imaginable investments. For consistency, the average performance in all treatments is equal. The volatility among the expected loss aversion scenarios is roughly the same.

As there are six years to evaluate by people, there are also six different returns. To keep it simple, integers are used most of the time. The average return for the Dutch stock index in the last ten years lays around 8%, which can be a reference point. Another reference point is 0% as this is the point that separates losses and gains. These two returns are both used for one period. Two other returns are extreme returns, being -13% and 20%. The last two returns are a small increase and decrease in value. Respectively, these returns are 3% and -4%.

Chronologically per year, the returns are 3%, 20%, -13%, 8%, 0% and -4%. The total accumulated return after six years will be 11.49%. In the first three years the accumulated return equals 7.53% and 3.68% in the last three years. This order is chosen to diminish the effect of path dependency. Path dependency shows that people are happier with the same return when they experienced a clear gain over some consecutive periods after a clear loss over some consecutive periods instead of the reverse (Grosshans & Zeisberger, 2018). The chosen sequence does not have a clear path of consecutive losses after a consecutive gains or the reverse, but it is rather a volatile sequence.

Although the subjective total return could differ a lot among people, only a few people will perceive or expect a negative return when the actual past or predicted return is positive and vice versa. For this reason, a second survey is distributed to focus on losses instead of gains. All the returns are the same and only the signs of these returns are changed to mirror the survey with an overall gain. Due to compounded returns, the accumulated total return for this survey is -16.10%. This research focuses on the subjective perceived or experienced total return. Hence, a small difference in the total return, irrespective of the sign, does not have disadvantageous implications.

## 3.3. Limitations of the Method

Due to boundaries of this research some concessions were made. One shortcoming is that people are not incentivized through monetary outcomes in this experiment. The experiment shows a hypothetical investment opportunity and participants need to make hypothetical decisions which do not affect their real and own wealth or investment. List and Gallet (2001) analyzed 29 experimental studies in the field of economics and found a so-called 'hypothetical bias'. People make different decisions when they need to answer hypothetical or monetary incentivized decisions. The main criticism concludes that people think less about the consequences of their choices in a hypothetical setting. That is why Merkle (2019) used real investments held in the brokerage accounts of investors.

A related limitation is the fact that this hypothetical situation is used to create a period of six years. To create myopia there should be more periods. In this experiment these are hypothetical years and is far away from a six year period in a real world setting. Henceforth, myopia in the real world could have higher effect than in this experiment.

The second boundary in this research is the difficulty of this experiment. Investing comes with learning about the mechanisms of financial markets. People who are more financially illiterate will invest less in the stock market (Rooij van, Lusardi, & Alessie, 2011). This research was conducted by DNB and focused on Dutch investors. One feature to counter this shortcoming is the short financial literacy test at the end of the survey. Another attribute to control for the difficulty of the experiment is to use easy to understand stories without using technical terms for investing. However, this resulted in much text, but the most important phrases were highlighted to keep the text readable.

## 3.4. Methodology

A structured analysis will help to test the hypotheses. The first step in this process is a simple OLS-regression to have a broad view on the data. The dependent variable is the 'subjective rating of return' while the 'subjective return' is the independent variable. 'Age', 'gender', 'self-stated financial literacy', 'investor' and 'financial literacy' are used as control variables. All treatments are examined individually although they are integrated as factor variables in a single regression.

The main advantage of using OLS-regressions is the fact that coefficients are easy to interpret. A disadvantage in this context is the fact that the dependent variable 'subjective rating of return' is not perfectly continuous. This variable is quite ordinal and has 7 categories. An ordered probit model would suit the data better, but it has more assumptions and hence harder to draw conclusions.

In conclusion, as the data has many ordinal categories and the data for the subjective rating is not highly skewed, an OLS-regression will result in reasonably similar statistics. In this case, the simplicity of interpretation offsets the small statistical incorrectness. Moreover, the results in this research did not change when a probit model was used instead of an OLS model. The OLS-regressions uses baseline variables to show the differences per treatment.

The second phase takes the interaction variables 'subjective return > 0%' and 'subjective return < 0%' as independent variables instead. The coefficients tell whether people experience loss aversion, as loss aversion is defined by the ratio of the slope of the utility curve in the loss domain divided by the slope of the utility curve in the gain domain. These coefficients represent the slope in the corresponding domains. Dividing the coefficient in the loss domain by the coefficient in the gain domain will result in the loss aversion ratio, which is represented by λ. Again, this is repeated for every treatment individually as factor variables in one analysis.

To significantly check whether people exhibit loss aversion, a Wald test for equality of coefficients in the gain and loss domain is ran. This test equals testing a loss aversion ratio of 1. Comparing the ratios between the four treatments academically tests whether they differ. This comparison is also done by Wald tests for equality of the ratios. These Wald tests account for non-linearity, which is highly suitable for this dataset and aim of the research.

# 4. Results

A first impression is shown by the descriptive statistics, while the OLS-regressions and Wald tester further examine the different loss aversion ratios.

## 4.1. Descriptive Statistics

The descriptive statistics for the variables used in this research are presented in table 2. Panel A shows the measures for the control variables and displays some characteristics of the respondents. For example, many young people filled in this survey, but the distribution for male and female is rather equal. The positive skewness for age tells that the data exhibits a fat tail for older people. The average level of self-stated financial literacy ranging from 1 to 7 lays below the middle of the scale of 4. This indicates that people think they do not have much knowledge about investments. This is highlighted by the value of 4 for the $75^{th}$ percentile.

The statistics on financial literacy show the real financial knowledge of the participants in this experiment. The median amount of correct answers is 3, while only 30.2% of a sample existing of American adults gave the right answers to all three questions (Lusardi & Mitchell, 2011b). Roughly 20% of all respondents privately hold investments, which is shown by the mean and highlighted by the right-skewed distribution.

Panel B assesses the variance of distributed treatments, which is fairly equal. All four versions of the survey are filled in by roughly an equal amount of people. The first treatment about standard perceived loss aversion has an N of 232, the second treatment about standard expected loss aversion has an N of 213, the third treatment about myopic perceived loss aversion has an N of 231 and the last treatment about myopic expected loss aversion has an N of 219.

An impression about the elicited subjective values are shown in Panel C. The subjective returns have a big standard deviation for two surveys with a standardized return, which makes clear that people evaluate numerical returns differently. However this makes it better to evaluate the slope of the utility curves. The distribution of the subjective return is more centered between the values of 4 and 5 on a scale ranging from 1 to 7.

*Table 2: Descriptive Statistics*

| | N | Mean | Median | Skewness | Sd | 25q | 75q |
|---|---|---|---|---|---|---|---|
| Panel A | | | | | | | |
| Age (years) | 883 | 29 | 23 | 1.58 | 12.82 | 21 | 33 |
| Gender ( Female = 1 ) | 863 | 0.52 | 1 | -0.08 | 0.50 | 0 | 1 |
| Self-stated Financial Literacy ( 1 to 7 ) | 883 | 2.82 | 3 | -0.55 | 1.52 | 2 | 4 |
| Investor ( Yes = 1 ) | 882 | 0.20 | 0 | 1.53 | 0.40 | 0 | 0 |
| Financial Literacy ( 0 to 3 ) | 863 | 2.04 | 3 | -0.61 | 0.98 | 1 | 3 |
| Panel B | | | | | | | |
| Treatment ( 1 to 4 ) | 895 | 2.49 | 3 | -0.00 | 1.12 | 1 | 3 |
| Panel C | | | | | | | |
| Subjective return ( -100 to 100 ) | 895 | 14.31 | 11 | 0.67 | 22.16 | 5 | 23 |
| Subjective rating ( 1 to 7 ) | 895 | 4.48 | 5 | -0.52 | 1.35 | 4 | 5 |

## 4.2. Scatter Plots

Loss aversion in the whole sample is graphically presented in figure 2 in appendix 3. This appendix shows all scatter plots per treatment for the subjective return on the average subjective rating of the return. The scatter plots are separated in the gain and loss domain to have a look at the difference in coefficients per domain. The graphs present best fitted fractional-polynomial prediction plots. These graphs are just to give an insight and do not carry any statistical value as the averages of the ratings per subjective return are plotted.

The main takeaway from figure 2 is that the slope is steeper in the loss domain than in the gain domain. Hence, the resulting graph should be non-linear, which it is. Take notice that subjective returns closer to this reference point of 0% have been mentioned more than extreme returns. Hence, the dots of extreme values are more volatile, while less extreme values are more likely to be an average of many data points.

These volatile extreme ratings of return are even more pronounced in the plots per graph, as N is lower per treatment than the whole sample. For example, only the standard expected loss aversion treatments has all values for subjective return above -50%, while other exhibit some values below that point. Still loss aversion is visible, however less strong than in the total sample.

All graphs show ratios for loss aversion, but one more pronounced than the others. The loss aversion ratios are represented by a steep graph in the loss domain and a flatter graph in the gain domain. For example, the perceived standard loss aversion ratio is less obvious, while the standard expected loss aversion ratio is more obvious. One thing to mention is the decreasing returns to scale. All graphs are non-linear and follow a logarithmic shape. This corresponds to a convex shape for losses and concave a shape for gains. Unfortunately, this is beyond the scope of this thesis.

## 4.3. OLS-Regressions

The first analyses of OLS-regressions are combined in panel A of table 3. Column (1) shows the individual effect the subjective return per treatment has on the subjective rating of the return, including control variables. The second column (2) also examines the effect of the subjective return per treatment on the subjective rating, but subjective rating is split in a loss and gain domain. Column (3) adds control variables to column (2) for more robustness. In brackets the t-values are presented.

Table 3 only shows the baseline regressions. Appendix 4 shows a more detailed overview of the differences among the treatments. The same three regressions are executed as in the main model, but only the differences in coefficients of one treatment compared to the baseline treatment is presented. The baseline treatment is stated above the columns. Hence, a positive value represents a higher coefficient for the tested treatment compared to the coefficient for the baseline treatment.

Panel B of table 3 tests for the existence of loss aversion in the different analyses and treatments. The tests checks whether the coefficient in the gain and loss domain on the subjective rating are significantly not the same. The p-values of these Wald tests are shown in brackets.

Column (1) shows that the subjective return positively affects the subjective rating of return in all treatments. The value of 0.036 means that an increase of %-point of the standard perceived subjective return will lead to an average increase of 0.036 on the rating of that return. The values in appendix 4 in column (1) show that only the coefficient in the myopic perceived treatment for the subjective return is different than in treatment 1. The sign is positive, thus the coefficient is larger for myopic perceived subjective return than for standard perceived subjective return.

Once more all the different kinds of subjective return have a positive impact on the subjective rating of return, which is shown in column (2). Remember that this regression uses no control variables. However, the first idea of loss aversion appears in these regressions as the coefficients in the loss domain are notably higher than in the loss domain. In appendix 4 columns (2), (5), (8) and (11) show no significant values, meaning that at this point the coefficients in the loss domain do not differ from each other. This is equally true for the coefficients in the loss domain.

Column (3) reveals values that are close to column (2), as only control variables are added. Nevertheless, the values do change. One example is the coefficient of subjective return in the gain domain of the myopic perceived treatment. Column (7) in appendix 4 shows that this coefficient is higher than in the other treatments, which resulted in a significant difference with the corresponding value for the standard perceived and myopic expected treatment. The big difference in coefficients of subjective return on the subjective rating between the myopic perceived treatment and the standard perceived treatment is hence derived from the difference in the gain domain and not per se from the difference in the loss domain.

The ratios for loss aversion are calculated in panel B of table 3. What immediately stands out are the low p-values for the Wald-test, explaining significant loss aversion ratios for all treatments. In a descending order by the value of $\lambda$ the standard perceived rating is followed by the standard expected rating, myopic expected rating and the myopic perceived rating. It should be noted that all ratios for loss aversion are significant, independent of control variables.

Yet again, the myopic perceived loss aversion ratio changes as control variables are introduced, which is logically explained by the big difference in coefficients in the gain domain. An additional insight is focused on the coefficient of the utility curve in the gain and loss domain. The high $\lambda$ for standard perceived returns is mainly caused by flat slope of the utility curve in the gain domain and not by an extreme steep utility curve in the loss domain.

Lastly, the R-squared measures in appendix 4 highlight the suitability of these variables in the OLS-regressions. All the R-squared values lie between 0.419 and 0.468 and increase as more variables are taken into account

*Table 3: Separate OLS-Regressions on Subjective Rating of Return*

| Panel A: Linear Regression | | | |
|---|---|---|---|
| | Subjective rating of return | | |
| | (1) | (2) | (3) |
| Standard perceived subjective return | 0.036*** (10.57) | | |
| Standard expected subjective return | 0.038*** (9.72) | | |
| Myopic perceived subjective return | 0.045*** (12.96) | | |
| Myopic expected subjective return | 0.029*** (9.45) | | |
| Standard perceived subjective return < 0% | | 0.075*** (9.11) | 0.082*** (9.57) |
| Standard expected subjective return < 0% | | 0.094*** (6.65) | 0.091*** (6.58) |
| Myopic perceived subjective return < 0% | | 0.078*** (9.80) | 0.073*** (9.30) |
| Myopic expected subjective return < 0% | | 0.068*** (5.57) | 0.067*** (5.61) |
| Standard perceived subjective return > 0% | | 0.018*** (4.18) | 0.018*** (4.06) |
| Standard expected subjective return > 0% | | 0.025*** (5.84) | 0.027*** (5.87) |
| Myopic perceived subjective return > 0% | | 0.021*** (4.68) | 0.031*** (6.22) |
| Myopic expected subjective return > 0% | | 0.024*** (7.08) | 0.024*** (7.23) |
| Control Variables | Yes | No | Yes |
| N | 843 | 895 | 843 |
| **Panel B: Loss Aversion Ratio λ** | | | |
| Standard perceived λ | | 4.28*** (0.000) | 4.63*** (0.000) |
| Standard expected λ | | 3.82*** (0.000) | 3.34*** (0.000) |
| Myopic perceived λ | | 3.73*** (0.000) | 2.38*** (0.000) |
| Myopic expected λ | | 2.86*** (0.001) | 2.76*** (0.001) |

In panel A, regression (1) estimates the subjective return on the rating of return. Regression (2) estimates the subjective return split in the gain and loss domain on the rating of return without using control variables. Regression (3) adds control variables. Panel B tabulates Wald tests on the loss aversion ratios based on the coefficients in panel A. Values between brackets in panel A show T-values and p-values in panel B which are significant at **p*<.10, **p<.05, ****p*<0.01.

## 4.4. Differences in Loss Aversions Ratios

To formally test the hypotheses, Wald test for equality of ratios are used. The derived chi-squared statistics are shown in table 4. As opposed to the values in the OLS-regressions, the values in table 4 are all positive as the test statistic is a squared measure. Negative value will hence be positive. To validate the sign of the difference, the λ ratios in table 3 are used.

The value for λ for myopic expected loss aversion and standard expected loss aversion are respectively 2.38 and 3.34. This discrepancy is moderately significant with a test value of 3.11. This difference is contrary to the stated hypothesis.

For the second hypothesis the difference between the myopic perceived and myopic expected loss aversion ratio are studied. The first ratio has a value of 2.38, while the second ratio exhibits a value of 2.76. The chi-squared measure for the test for equality is insignificant, henceforth these ratios do not differ significantly.

The third prediction focused on the ratios for myopic expected loss aversion and standard perceived loss aversion. It is hypothesized that the ratio for myopic expected loss aversion is bigger than for the standard perceived loss aversion. The corresponding values for λ are 2.76 and 4.63, which clearly are two different ratios. The Wald test confirms this statement at a high significance level. However, it is a contradiction to the formulated hypothesis 3.

Lastly, the different values for loss aversion for the standard expected loss aversion and myopic perceived loss aversion ratio are tested against one another. The value for standard expected loss aversion equals 3.34 and for myopic perceived loss aversion it equals 2.38. The p-value of the non-linear Wald test is 0.20 and therefore this difference is insignificant. However, the expected sign of the difference is equal to the tested sign.

*Table 4: Wald Test Chi-Squared Statistics for Differences in λ Among Treatments*

| | Standard Perceived Loss Aversion λ | Standard Expected Loss Aversion λ | Myopic Perceived Loss Aversion λ | Myopic Expected Loss Aversion λ |
|---|---|---|---|---|
| Standard Perceived Loss Aversion λ | - | - | - | - |
| Standard Expected Loss Aversion λ | 5.71 (0.017)** | - | - | - |
| Myopic Perceived Loss Aversion λ | 8.01 (0.005)*** | 0.20 (0.651) Hypothesis 4 | - | - |
| Myopic Expected Loss Aversion λ | 9.93 (0.002)*** Hypothesis 3 | 3.11 (0.078)* Hypothesis 1 | 2.20 (0.138) Hypothesis 2 | - |

Values between brackets are p-values for Wald tests which are significant at *$p$<.10, **p<.05, ***$p$<0.01.

Two Wald test are not discussed yet. The first one examines the difference in the standard perceived loss aversion and standard expected loss aversion. Merkle (2019) found a gap between these two and labeled it financial loss aversion illusion. It defines the fact that people expect loss aversion, but do not perceive it. However, in the test in this research the sign is mirrored to the research of Merkle (2019). Loss aversion is bigger in the standard perceived treatment than in the standard expected treatment. The difference of 4.63 and 3.34 is significant at a significance level of 5%.

Benartzi and Thaler (1995) introduced the idea of myopic loss aversion for perceived returns, by testing it in an experimental setting. To solve the puzzle of high returns on the market they introduced myopia. The more you look at your returns, the higher your loss aversion. The OLS-regressions above and the Wald tests show that for this data sample, standard perceived loss aversion is almost twice as large as myopic perceived loss aversion. This magnitude contradicts the existing literature on myopic loss aversion.

In conclusion, especially the level of loss aversion for a standard and perceived setting is remarkably high. This results in findings opposing to earlier research. Moreover, the hypotheses are all rejected. The reasons are either insignificant results or the sign of the equation is significantly different from expected. This can be combined in the following schematic overview:

*Myopic Perceived Loss Aversion < Myopic Expected Loss Aversion < Standard Expected Loss Aversion < Standard Perceived Loss Aversion*

| | ***Standard Loss Aversion*** | ***Myopic Loss Aversion*** |
|---|---|---|
| ***Perceived Loss Aversion*** | Highest ratio | Lowest ratio |
| ***Expected Loss Aversion*** | Second highest ratio | Second lowest ratio |

# 5. Robustness Checks

To assess whether these relations hold when other characteristics of the data are taken into account, some robustness checks need to be completed.

## 5.1. Experience

This research uses hypothetical questions to elicit loss aversion, while Merkle (2019) used data from real investors. There is no method to change the hypothetical situation into a real world example, nevertheless there are methods to create a sample with people who have more experience in finance.

An example to create a sample with more financially sophisticated people is to only include investors in the sample. People who invest in their daily life with real money should understand consequences of their investment decisions. The idea is that people who invest privately could have a better understanding of the mechanics of the financial systems as they make financial decisions.

The data sample consists of people who invest and people who do not invest. 168 (20%) respondents filled in they invest privately. The amount is small, which could lead to misperceptions, but luckily they are fairly equally distributed among the treatments. The lowest share of investors in a treatment is 16%, while the highest is 23%. The same OLS-regression will be used to look at the characteristics of the variables for investors.

The results show that the overall subjective return significantly affects the subjective rating with a coefficient of 0.0459, which is higher than for all respondents. The loss aversion ratios $\lambda$ are 2.02 for the standard perceived treatment, 2.48 for the standard expected treatment, 2.18 for the myopic perceived treatment, and 4.53 for the myopic expected treatment. Compiling with the literature, the standard perceived loss aversion ratio is insignificantly different from 1. However, this insignificant ratio of 2.02 could be caused by the low amount of observations. All the ratios for loss aversion are shown in table 5.

This order for the value of loss aversion ratios correspond perfectly with the hypotheses. Hypothesis 1 predicts that myopic expected loss aversion is higher than standard expected loss aversion, which is met as the ratios are 4.53 and 2.48. Hypothesis 2, which states that the myopic perceived loss aversion ratio is lower than the myopic expected loss aversion ratio, is also tested positively with the values of 2.18 and 4.53. Hypothesis 3 opposed a larger ratio for myopic expected loss aversion than the standard perceived loss aversion, which is reached according to the ratios of 4.53 and 2.02. The last hypothesis that predicted a higher standard expected loss aversion ratio than the myopic perceived loss aversion ratio is also correct as the ratios are 2.48 and 2.18. However, this last difference lacks significance.

Especially, the standard loss aversion ratios differ significantly for investors compared to non-investors. The loss aversion ratios for non-investors balance out the significant difference with the whole sample. For instance the loss aversion ratio for the standard perceived treatment for non-investors equals 6.09. The myopic loss aversion ratios are closer to each other.

It can be concluded that loss aversion in mainly the standard loss aversion treatments varies between investors and non-investors. The cause may be that less financially literate people do expect a higher return, henceforth could have a higher cut-off point for gains and domains. This produces a very low coefficient for smaller gains and thus a very low coefficient for the total gains. In comparison to Merkles research (2019), this survey is filled in by many non-investors. This difference in the data could be the cause of the contradiction between the two groups.

Secondly, the self-stated level of financial knowledge could be a proxy for financial experience. The average level is 2.82 on a scale from 1 to 7, which is definitely lower than the medium value of 4. The sample is divided into two groups and as the median value is low, the cut-off point is between 3 and 4. This generates a group of people with a low level of self-stated literacy in finance and a group of people with a neutral or above level of self-stated financial literacy. However, this still leads to the lowest N of 57 in the fourth treatment. The highest N in a treatment is 83, so the results will be statistically questionable.

Similarly as to the investor split, this sample has a high coefficient for the subjective return on the rating of the return of 0.0446. When the loss aversion ratios per treatment are assessed, the following ratios occur: 7.05 for standard perceived loss aversion, 3.97 for standard expected loss aversion, 2.49 for myopic perceived loss aversion, and 2.98 for myopic expected loss aversion. An overview is shown in table 5.

Relatively, these ratios have the same distribution as the total sample, however the ratio for standard perceived loss aversion is fairly high. A reason could be the low amount of people who perceived a negative subjective return, which could lead to a small data sample in the loss domain. The result is a sample with a high standard deviation in the loss domain for this treatment.

An additional way to proxy experience in investing is the amount of correct answers on the financial literacy test. Based on validation of this financial literacy test of Lusardi and Mitchell (2011a), this test is a better proxy for financial sophistication than being an investor or self-stated financial knowledge. The scale is a four point scale, hence an option is to split the sample evenly in a group with zero or one correct answers and a group with two or three correct answers. 71% of the sample will be in the higher financial literacy group.

The coefficient for subjective return on the subjective rating is 0.045, which is comparable with the other two experience proxies. The resulting loss aversion ratios are 2.79 for the standard perceived treatment, 2.59 for the standard expected treatment, 0.87 for the myopic perceived treatment, and 3.58 for the myopic expected treatment. This is shown in table 5.

Remarkably, the 0.87 for myopic perceived loss aversion is below 1, highlighting no loss aversion at all. As suggested by Merkle (2019) any ratio below 1 does probably not carry much economic reason. It is more likely to be the result of a difference between actual and perceived return. This statement combined with the knowledge that this particular loss aversion ratio is already low when all the data was used, could be the explanation for an extremely low loss aversion ratio.

As there are extreme differences in this check, an additional test could create clarification. Only taking into account respondents who answered all questions correctly will lead to a sample with people who have the most financial knowledge. Still 350 participants fall in this group. The loss aversion ratios diverge to 2.25 for standard perceived loss aversion, 2.40 for standard expected loss aversion, 1.38 for myopic perceived loss aversion, and 4.35 for myopic expected loss aversion.

The results do not differ much, however all ratios are above 1. For people with more financial knowledge, the results are more in line with the hypotheses. It is expected that myopic loss aversion and expected loss aversion treatments will have higher ratios for loss aversion. The odd part is based on the low level of myopic perceived loss aversion. A reason could be that in the perceived treatments, it is very clear what your return was, compared to the real world. For people who understand the financial system, myopia could hence only have a small effect. Normally, they still perceive risk and volatility, while this is not the case in this experiment.

It is interesting to know whether these three different cuts represent the same group. Only 204 people did not meet any of the limits to be in a group, while 376 did not make it in any group if the financial literacy test cut lays on three correct answers. On the other hand, 96 people were part of all three groups and 66 when the stricter split for financial literacy is used.

68% of investors think they have a high level of financial knowledge, which is the same percentage of investors who have two correct answers in the financial literacy test. This decreases to 59% if the test only takes into account people with three correct answers. People who thought of themselves as average or above average on financial literacy were correct in 82% and only 56% in the stricter cut-off. These numbers show that there is some discrepancy between the groups, but the resemblance is more pronounced.

*Table 5: Loss Aversion Ratios for Different Experience Group*

| | Only Investors | High Self-Stated Literacy (≥4) | High Financial Literacy (≥2) | High Financial Literacy (=3) |
|---|---|---|---|---|
| Standard perceived λ | 2.02 | 7.05*** | 2.79*** | 2.25* |
| | (0.330) | (0.000) | (0.000) | (0.071) |
| Standard expected λ | 2.48* | 3.97*** | 2.59*** | 2.40** |
| | (0.087) | (0.004) | (0.004) | (0.017) |
| Myopic perceived λ | 2.18* | 2.49*** | 0.87 | 1.38 |
| | (0.063) | (0.009) | (0.557) | (0.272) |
| Myopic expected λ | 4.53*** | 2.98*** | 3.58*** | 4.35*** |
| | (0.002) | (0.010) | (0.001) | (0.001) |

Values between brackets are p-values and are significant at $*p<.10$, $**p<.05$, $***p<0.01$ for Wald tests

Three ways to elicit results for financially experienced people are checked. A summary is presented in table 5. Mainly people who invest, report results following the hypotheses and literature. Self-stated financial knowledge does not change the results in which rejection of the hypotheses remains. The most studied proxy for financial knowledge gives some additional insights, for example that the myopic expected treatment is indeed the treatment with the highest ratio of loss aversion. As earlier research (Merkle, 2019) was only done by examining investors, these results confirm each other.

## 5.2. Reference-Points

Loss aversion in this research is measured by the difference in steepness of the graph of subjective return on subjective rating in the loss and gain domain. The loss and gain domain are separated at the most objective point, which is a return of 0%. A lower return is defined a loss, while a higher return defines a gain. As discussed by Thaler (1985), we have two different types of utility: acquisition and transaction utility. The theory is based on the idea that people derive their utility from a subjective reference point and not per se an objective reference point. This could lead to the feeling of a loss although the return is positive, or the other way around. Other, more subjective, reference points could be better cut-offs.

Several goodness-of-fit measurements will try to show which benchmark will lead to the highest internal validity. The measures are the R-squared, F-test, AIC (Akaike, 1971) and BIC (Schwarz, 1978). A higher value for the R-squared and F-test and a lower value for the information criteria's represent a better fit of the model.

The first benchmark that will compete in the goodness-of-fit tests is the inflation rate. A positive return on your investments only results in a relative gain if you can buy more with it later on. If the inflation eats up your positive result, you did not made a gain. The average inflation in the past fifteen years for the Netherlands equals 1.5%. The six year accumulated inflation equals 9.2%.

Secondly, the average AEX return of the last fifteen years could be a benchmark for investors. The AEX is reported widely in the news and is one of the indicators for the Dutch investment environment. An accumulated return for six years equals a 12.5% return. The reasoning is that people who outperformed this benchmark perceived a relative gain, while people who underperformed this benchmark perceived a relative loss. The return on the AEX is less stable than the inflation rate and also exhibited a negative value, while the Netherlands did not perceive deflation. This makes the inflation rate a more stable benchmark, while the AEX benchmark is more time dependent.

As a third benchmark, people could have a subjective benchmark that matches their expectation. If they outperform their expectation, they perceive a gain and when they do not outperform their expectation they perceive a loss. In this research, there are two treatments that asked for expectations. If the average of these expectations is taken, the average expected return is calculated. This calculation is legitimate, because the returns are equal in all four treatments. On the other hand, this benchmark is calculated by data also used in the research itself. However, the average is used and not the personal expectation and hence a valid benchmark. This benchmark equals 20.3%.

Next, the risk-free-rate or interest rate is often taken into account as a benchmark (Merkle, 2019). This rate equals the return on the safest investment available globally. The 10-year German Government bond has been the safest investment for decades. However, this return has been decreasing for years, resulting in an abnormal return which is negative. A fifteen year average would be extremely close to zero, hence this benchmark is too close to the objective benchmark of 0%. Therefore, this benchmark is left out of the comparison.

It should be mentioned that all subjective benchmarks are positive. There is no clear reason for a negative benchmark. A persistent deflation or a stable crises in a country could lead to negative benchmarks. This is highly unlikely in western economies.

Another fact to mention is that all benchmarks are assumed to count for all participants. This is advantageous as a clear view on loss aversion can be generated, which is not possible with switching benchmarks. However, it could be that at a specific return one person asses it as a gain while another person views it as a loss. The benchmark can also not vary over time as there is no data for the subjective return for all years and all treatments. It is studied that people timely adapt their reference point (Arkers, Hirshleifer, Jiang, & Lim, 2008).

Table 6 shows the goodness-of-fit statistics for every model of the OLS-regressions with a split for the gain and loss domain and all control variables. Although the test statistics are all fairly similar, they show that a model with the average expectation as a cut-off is the model which best fits the data. This indicates that it is less assumable that people separate gains from losses at a return of 0%. It is more assumable that people base it on a reference point of roughly 20%. This finding is in contradiction to the findings in earlier research which found that the most objective split of 0% is the best (Merkle, 2015; Merkle 2019).

One reason for the contradiction to existing literature can be found in another paper of the same researcher that states that financial literacy negatively affects the risk-taking of investors (Merkle, 2017). A higher expected risk equals a higher expected return. In both this and Merkles data sample, the mean subjective return decreases as financial literacy increases. The mean subjective return for people who have zero correct answers is 23.32% while it reduces to 9.31% for respondents with three correct answers. Less financially literate people do expect a higher return, henceforth could have a higher cut-off point for gains and losses. In comparison to Merkles research (2019), this survey is filled in by many non-investors. This difference in the data could be the cause of the contradiction between the two findings.

A better model could lead to other loss aversion ratios per treatment. As the model with the average expectation is the best model, the loss aversion ratios in this model are calculated. The corresponding loss aversion ratios are 3.64 for the standard perceived treatment, 1.97 for the standard expected treatment, 2.54 for the myopic perceived treatment and 2.06 for the myopic expected treatment. The ratios are generally lower and more close to two, which is the most common loss aversion ratio. Although the model better fits the data, most of the hypotheses are not met.

To create complete clarity, the loss aversion ratios for the models with the inflation rate and AEX cut-offs are computed. The model based on inflation rate delivers a standard perceived loss aversion ratio of 4.06, a standard expected loss aversion ratio of 2.32, a myopic perceived loss aversion ratio of 2.15 and a myopic expected loss aversion ratio of 2.30. On the other hand, the model based on the AEX return generates a standard perceived loss aversion ratio of 3.53, a standard expected loss aversion ratio of 2.07, a myopic perceived loss aversion ratio of 2.23 and a myopic expected loss aversion ratio of 2.14. The values in the last three treatments are closer to each other in these two models than in the average expectations model.

*Table 6: Goodness-of-Fit Measures for Different Reference-Point Models*

| | **Zero (0%)** | **Inflation (9.2%)** | **AEX (12.5%)** | **Average Expectation (20.3%)** |
|---|---|---|---|---|
| $R^2$ | 0.468 | 0.470 | 0.482 | 0.507 |
| F-stat | 45.40 | 45.73 | 48.02 | 53.08 |
| AIC | 2380 | 2378 | 2358 | 2316 |
| BIC | 2460 | 2458 | 2438 | 2397 |

### 5.3. Diminishing Sensitivity

Up till now, every analysis is based on the assumption that the coefficients are linear. By comparing the two different coefficients in the loss and gain domain, the conclusion can be drawn that the subjective return affects the subjective rating non-linearly. Namely, the coefficients of the subjective return in the gain and loss domain differ significantly, resulting in loss aversion.

Henceforth, only the first and second dimension of the regression are documented. However, the scatter plots in appendix 3 show the existence of more dimensions in the line graphs. There is not only a kink in the reference point, but diminishing sensitivity to scale can be observed. The graph is convex in the loss domain and concave in gain domain.

Diminishing sensitivity is one of the main features of prospect theory (Tversky & Kahneman, 1992). This corresponds to a quadratic function with a quadratic value that is empirically proven to be between 0.5 and 1 (Abdellaoui, Bleichrodt, & Paraschiv, 2007). Practically this means that the same increase in return leads to a higher increase of the subjective rating when the initial performance is low compared to a high initial performance. For example, the change in happiness is bigger when a person can increase its return from 5% to 6% compared to a change from 35% to 36%.

Ideally, estimating this equation and finding the results for the quadratic value would test for diminishing sensitivity. However, this research is based on utility that is non-continuous and has scale. Adjustments to the subjective rating could solve this problem, but it will lead to arbitrary modifications. To keep the data pure, extra dimensions in the curve will be created by separating the gain domain and loss domain in two more intervals: Big Loss domain, Small Loss domain, Small Gain domain and Big Gain domain.

The cut-off point between a gain and loss is still 0%, but the cut-off between a small and big change is more subjective. One way to make the cut-off point more objective is to let the data decide. The data is not highly skewed, but it has a mean of 14%, which is clearly above 0%. Thus, more people estimated a positive than a negative return. For this reason, an objective cut-off point would be to split the loss domain at the median value for respondents who experienced a subjective loss. This maximally increases the minimal amount of data per interval. This value equals 11% above and below 0%.

The values in the OLS-regression in panel A of appendix 5 for the whole sample indeed show high coefficients for the small intervals in subjective return compared to the big intervals in subjective return. This finding is proof for the presence of diminishing sensitivity. Moreover, loss aversion for values close to zero is 4.86, while loss aversion for values farther away from zero is only 3.01. This difference is evidence for diminishing sensitivity too.

In column (2), people in the perceived treatments did experience diminishing sensitivity in subjective return. In the expected treatments however, the coefficients in the gain domain do not reveal diminishing sensitivity. These treatments enable a larger feeling of risk as respondents dealt with scenarios and no static return. If the expected subjective return was higher in the end it could generate a self-attribution bias (Feather & Simon, 1971). This bias explains that people attribute failures to bad luck, but success to their own capabilities. For financial decision-making, this bias results in higher ratings for high subjective returns if the perceived ability to affect outcomes is higher (Hoffmann & Post, 2014). This ability is higher in scenarios than in the static perceived treatment.

Panel B of appendix 5 shows all difference in loss aversion between a big and small return which confirms diminishing sensitivity, except for the standard perceived loss aversion treatment. Another thing is the extreme ratio for loss aversion for a small return in the fourth treatment of 23.65. This ratio is due to a coefficient in the gain domain close to zero. An idea for this outlier is again the self-attribution bias. As the amount of perceived own impact on the results is increased, people could think that a small increase is a relative loss and is caused by bad luck. Therefore, their rating will not be affected much.

As opposed by Köbberling and Wakker (2005), an alternative measure for loss aversion is based on the smaller intervals among the reference point. Most of the times the data in smaller domains is more flawless in these intervals. According to this measure, all loss aversion ratios follow expectations. Using this alternative definition of loss aversion, the ratios are 2.04 for standard perceived loss aversion, 10.16 for standard expected loss aversion, 3.09 for myopic perceived loss aversion and 23.65 for myopic expected loss aversion.

Hypothesis 1 predicts that myopic expected loss aversion is higher than standard expected loss aversion, which is met as the ratios are 23.65 and 10.16. Hypothesis 2, which states that the myopic perceived loss aversion ratio is lower than the myopic expected loss aversion ratio, is also tested positively with the values of 3.09 and 23.65. Hypothesis 3 opposed a larger ratio for myopic expected loss aversion than the standard perceived loss aversion, which is reached according to the ratios of 23.65 and 2.04. The last hypothesis that predicted a higher standard expected loss aversion ratio than the myopic perceived loss aversion ratio is also correct as the ratios are 10.16 and 3.09.

It can be concluded that diminishing sensitivity exists in almost all treatments. This knowledge extents the model to test the non-linearity in loss aversion. The loss aversion ratios for the small domains reveal an interesting fact. For the whole sample, the loss aversion ratios correspond to existing literature. Henceforth, mainly the divergences in the big domains cause the unexpected order of the loss aversion ratios. When an alternative method is used to derive loss aversion, the hypotheses are all accepted. This justified measure gives more insight in loss aversion by focusing on the smaller domains of returns.

The regressions shows another interesting fact which can give an explanation for the findings about the best fit of the 20% reference-point model. The coefficients for a big gain are significant but very low and the average coefficients for a small gain are higher. The average small gain coefficient is somewhat closer to the average coefficient in the total loss domain than in the big gain domain. This insight in combination with the high N in the total gain domain could hence be an explanation that the relatively high 20% cut-off model has the best fit.

## 5.4. Differences per Demographic Variable

To get a small diversification according to demographic facts, table 7 shows the loss aversion ratios of four different groups in the four different treatments. The first distinction is based on gender, while the second split is based on age. The amount of N in the total sample does not allow to distinct age in more than two groups, taking into account the four treatments. The median age is 23, but it is not a common age to a split a sample. To use a more convenient split, the age of 25 is used. Still, the statistic robustness decreases as N decreases.

Men do not have a higher loss aversion ratio in any of the four treatments. This is in accordance with recent findings (Rau, 2014). Next, according to current literature, age is positively related to loss aversion (Arora & Kumari, 2015) meanwhile table 7 shows no one-way relation between age and loss aversion among all treatments. Of course there was no distinction in different types of loss aversion in current literature. More importantly, Arora and Kumari (2015) separated age in two different groups at the age of 40 and their youngest participant was only 25 years old. All of their respondents would be in the old age group in this thesis.

This robustness check gives more background in the loss aversion ratios for people with different characteristics. It shows that the differences between people should be taken into account when sampling your respondents. For this thesis it should be noted that the age of respondents is quite low. Literature tells that age is positively related to loss aversion. As age does not has a clear effect on loss aversion in this thesis, the results will not differ if a more conventional sample with older people is used. This makes it possible to compare this thesis with other research with older respondents.

*Table 7: Loss Aversion Ratios per Demographic Variable*

| | Male | Female | Young (<25) | Old (≥25) |
|---|---|---|---|---|
| Standard perceived λ | 4.14*** | 8.27*** | 7.18*** | 4.38*** |
| | (0.000) | (0.000) | (0.000) | (0.002) |
| Standard expected λ | 3.34*** | 3.47* | 3.18*** | 3.58** |
| | (0.003) | (0.076) | (0.001) | (0.022) |
| Myopic perceived λ | 1.67* | 4.05*** | 1.62* | 4.06*** |
| | (0.092) | (0.000) | (0.054) | (0.001) |
| Myopic expected λ | 2.99** | 4.76*** | 5.64*** | 3.02*** |
| | (0.012) | (0.000) | (0.000) | (0.008) |

Values between brackets are p-values for Wald tests and are significant at *$p$<.10, **p<.05, ***$p$<0.01

## 5.5. Peak-End Rule

The idea of myopic loss aversion is that people evaluate their performance more often and therefore see more losses. More losses means more loss aversion, so myopia increases loss aversion. In the experiment this is provoked by creating multiple evaluation moments. However, it could be that it is not the frequency of evaluation periods, but rather the memorable values in those evaluation periods. More precisely, when people have to state are retrospective utility they overweigh the peak and the final experience in a pattern (Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993).

This rule was mostly examined without monetary outcomes, but it was found that also for monetary outcomes the peak-end rule exists. Although it has to be said that only if the total amount of money received is not easy to calculate the peak-end rule exists (Langer, Sarin, & Weber, 2005). The magnitude of the peak-end rule is harder to generate in investing, however Nasiry and Pepescu (2011) found that consumers generate subjective prices based on the average of the peak and latest price.

Henceforth, when the subjective ratings of the myopic treatments are regenerated as the average rating in the peak year and in the final year, the peak-end rule can be tested. The peak year in absolute values is year 2 with a return of 20%, while the last year had a return of -4%. These two subjective ratings in period 2 and 6 are used to create an average for the variable of the subjective rating of return.

The same OLS-regressions as in the main model are ran with all control variables to derive loss aversion ratios based on the peak-end rule. Hence, subjective return is regressed on the subjective rating. The value for the subjective return is the same as in the main model, but the subjective rating of return is the average value of the ratings in peak period 2 and end period 6. Again the different coefficients in in the loss and gain domain for subjective return are used to derive the loss aversion ratio. However, only for the myopic treatments a new ratio is calculated, because in the standard treatments people were not asked to give a rating every year.

The resulting ratios for myopic perceived loss aversion and myopic expected loss aversion are respectively 3.79 and 3.44. These ratios are higher than the ones for these treatments derived from the OLS-regressions with no weighted subjective rating.

To tell which of the models better fits the data, the goodness-of-fit measures R-squared, F-statistic, AIC and BIC are used. These statistics show no clear reason to prefer the main model over the peak–end model as shown in table 8. All measures for the peak-end model are higher, but a higher AIC and BIC means a lower goodness-of-fit.

This robustness check evaluated the effect of the peak-end rule on the retrospective rating of the return. A positive result for this test would mean that loss aversion in the myopic loss aversion treatments was more influenced by the performance per period than the frequency of periods. Due to inconsistent goodness-of-fit measures, it can be concluded that the peak-end rule not overshadows myopic loss aversion, but it has to be taken into consideration. There is yet no technique to completely disentangle the peak-end rule and myopic loss aversion.

*Table 8: Goodness-of-Fit Measures for Different Models*

| | **Main Model** | **Peak-End Model** |
|---|---|---|
| $R^2$ | 0.468 | 0.659 |
| F-stat | 45.40 | 99.89 |
| AIC | 2380 | 3411 |
| BIC | 2460 | 3491 |

# 6. Conclusion & Discussion

Academic research on the subjective well-being of investors in scarce, while research on risk and return in financial markets is immense. These last two variables are easier to measure and do not objectively differ among investors, while subjective well-being could differ among investors with the same risk-adjusted return. Although it is harder to measure happiness, it could be more important as people want to live a happy life. Risk and return are just influencers on our happiness.

Investigating investor happiness can develop useful knowledge about the argumentation for financial decisions by investors. The upcoming literature is expanding the area rapidly by first focusing on basic factors that affect investor happiness. On the other hand, a core path is to examine which effects our level of happiness has on financial decisions.

The research in this thesis combines two earlier tested effects, time-inconsistent preferences and myopic loss aversion, and interacts them to evaluate the effect on investor happiness. More precisely, loss aversion ratios are computed to see the individual and interaction effect of these two variables.

The results show different relative loss aversion ratios than were projected by current literature. Namely, the standard expected loss aversion ratio is bigger than the myopic expected loss aversion ratio. Furthermore, myopic perceived loss aversion does not significantly differ with myopic expected loss aversion. Thirdly, the myopic expected loss aversion ratio is significantly smaller than the standard perceived loss aversion ratio. Lastly, the standard expected loss aversion ratio is higher than the myopic perceived loss aversion ratio, however this difference is insignificant. This results in the following order of loss aversion ratios:

*Myopic Perceived Loss Aversion < Myopic Expected Loss Aversion < Standard Expected Loss Aversion < Standard Perceived Loss Aversion*

Therefore, these results do not correspond to theoretical predictions. The robustness checks examined the different features of loss aversion among the treatments, but also gave more insights in why the results do not correspond with the hypotheses. One opposed reason is diminishing sensitivity. This showed that for an alternative measure for loss aversion based on the coefficients in smaller domains are used to elicit loss aversion, the hypotheses are all accepted. This could be due to the fact that subjective returns farther away from the reference point generate more volatile answers as data points decrease in this region. Loss aversion ratios that are solely based on coefficients of subjective returns on the subjective rating close to the reference point could be more clean (Köbberling & Wakker, 2005). These loss aversion ratios based on coefficients of subjective returns on the subjective rating close to the reference point follow the relative order opposed by the hypotheses.

Other tests studied the goodness-of-fit of different models. A higher reference point close to 20%

could be a better reference point than 0%. The cause is that the coefficients for a big gain are very low and the average coefficient for a small gain is very high. The average small gain coefficient is somewhat closer to the average coefficient in the total loss domain than in the big gain domain. Hence, combining diminishing sensitivity with this high reference point would probably lead to a lower goodness-of-fit.

Moreover, the peak-end rule could have affected the given subjective rating by respondents more than myopic loss aversion. The rule states that people extremely overweigh the subjective well-being in the peak and end period. The peak-end method is simulated by using the average value of the subjective ratings in the peak and end period as the total subjective rating. Assessments show that there is no clear reason to tell whether the peak-end rule method is better than the myopic method. Though, this indicates that the given subjective rating is influenced by the returns in the peak and end year.

One of the most interesting facts can be found in the robustness checks for experience. All current literature on investor happiness was based on data from investors. As this is fully logically, this thesis retested the loss aversion ratios for investors only. The conclusions are completely in line with the current available literature. This order of loss aversion ratios is less pronounced in other splits for experience though.

To conclude, in the whole sample time-inconsistent preferences show a counter-intuitive effect on loss aversion when interacted with myopia. Moreover, myopia does not entail a one-way relation on loss aversion when combined with time-inconsistent preferences. Conversely, in different checks based on another reference-point, diminishing sensitivity or investors, the effect of time-inconsistent preferences is larger than the effect of myopia. Myopia only enlarges loss aversion, while time-inconsistent preferences almost destructs loss aversion in these checks.

Making the best investment decisions is based on maximizing utility. In financial literature, utility is calculated by using risk and return, although utility may also be derived by investor happiness. When myopia and time-inconsistent preferences alter our level of loss aversion, investors will make investment decisions that could assumable not maximize utility.

According to this thesis, people should alter their expectations about myopia and understand that the effect could be smaller than is thought. If people upfront of a decision acknowledge that their standard perceived loss aversion is relatively higher than their myopic expected loss aversion, they should take less risky investments. A large loss will eventually feel worse than expected. Moreover, it could be decreased by using myopic strategies, such as evaluating your performance more frequent. In conclusion, taking less risk and evaluating the performance more often will lead to less loss aversion and a higher level of investor happiness.

On the other hand, the results differ for investors thus also the implications. Investors will be happier in the end by taking on more risk and looking less at their performance. Myopia and expected returns cause a higher ratio of loss aversion, hence these suggestions lower loss aversion and increase investor happiness.

The equity premium was solved after decades by using myopia as an answer. However, this thesis suggests that the equity premium puzzle still exists for non-investors and in combination with time-inconsistent preferences. Myopia should not be taken too easily as the clarification for the equity premium puzzle, as it decreases in combination with time-inconsistent preferences.

Furthermore, any difference in preferences over time can easily be altered by using myopic evaluation periods. For myopic loss aversion perceived loss aversion is lower, but for standard loss aversion perceived loss aversion is higher. Thus, there is no clear one-way direction of the time-inconsistent preferences. Henceforth, the time-inconsistent preferences could be altered in direction by other factors, such as myopia.

Brokers or institutions that deliver platforms to trade stocks could use these insights in two different ways. They could either choose to help the investors and let them watch their performance less often and formulate arguments to exchange before trading and after trading a stock. This will lead to higher investor happiness on aggregate as investors will understand the positive effect of myopia and expected returns on loss aversion. By letting people practice and creating simulated experience, they will make better investment decisions (Bradburry, Hens, & Zeisberger, 2015).

These companies could also choose to maximize their own utility, which is based on commission from transactions and use the insights of this paper against investors. By sending notifications and lowering boundaries to trade there will be more trade and hence a higher profit. To make this decision is not within the scope of this paper.

Naturally, this thesis is limited to some constraints. The first two are in the method of the experiment. Respondents were not incentivized through monetary outcomes, which could lead to unrealistic findings. These hypothetical questions could deliver other data points than an experiment with real money. Although an experiment where one could lose real money is hardly done, using the brokerage accounts of investors diminishes this problem. This hypothetical situation is very far away from reality, as there is no actual time between the periods. This is problematical for creating myopia and it should take six years to replicate this in a field experiment.

Secondly, investing is not an easy practice, henceforth it resulted in much text in the experiment to explain investing. It can cause some misperceptions by respondents in which internal validity decreases. This was a concession that had to be able to do research on investing with non-investors.

Although the number of people who filled in this survey is quite high, when sample splits were introduced the amount for N decreased. Also taking into account the four treatments, some cuts have an N that is too low to academically test significance. Secondly, a perfect way to derive loss aversion is calculating the derivative in every point on the graph of subjective return on subjective rating. The low N does not allows this in this thesis.

Thirdly, the characteristics of respondents is something to take into consideration. The distribution of gender is equal, but many young inexperienced people participated in the experiment. As investors are primarily older and financially experienced people, the sample does not represent the universe of investors perfectly. The robustness checks try to decrease this discrepancy.

Last of all, happiness or subjective well-being is a variable that is extremely hard to define. Many research is done on how to elicit happiness, as it is an important but highly subjective measure. This research uses one convenient yet simple question to provoke a level of happiness, the subjective rating of the subjective return. More complicated and precise ways could alter the findings.

Further research could head in multiple directions as investor happiness is a relatively undiscovered area. Obviously, the limitations of this research could be resolved in new research by examining real investments by real investors and measuring happiness with a more sophisticated technique.

Secondly, the model in this research is a static model that does not suit any time or person dependent characteristics. People are happier with a low return in bad economic times than in good economic times (Merkle, Egan, & Davies, 2015). The amount of risk and potential loss people are willing to bear in an economic downturn would probably be different than in a good investment environment. Besides, people could differ in their cutoff point for gains and losses and a person-dependent model could solve this. A model than integrates time and person varying data will give more insights.

Lastly, it is interesting to see what the effect of these result is on perceived happiness. If a person knows the insights of this research, it could alter its preferences, which could diminish the effects found in this thesis. This research is based on an experiment that did not ask for reasons why certain answers were given. When people are confronted with their irrational behavior they often equip a self-defense mechanism caused by cognitive dissonance. Knowing more about loss aversion could lead to less loss aversion and decisions will be more close to traditional rational reasoning. This not only maximizes utility of risk-adjusted return, but also the utility of happiness. It might create a loop of effects between knowledge and happiness.

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# 8. Appendices

## Appendix 1. Survey

Below, the whole survey of his experiment is shown. In between { } features are shown that differ dependent on the choice of a respondent or the year that a person has to evaluate. The first page is shown twice to people in the standard treatments and six times to people in the myopic treatments. The black lines show page breaks. After the respondents chose a stock, they were randomly distributed to one of the treatments.

Please, select your language:

- Nederlands

- English

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Dear participant,

First of all, I would like to thank you for filling in this survey. This survey consists of a couple of questions about investing. You don't need experience nor knowledge of investing.
There is no time limit for this survey but it will not take more than five minutes to end this survey in total. The answers you give are important for my master thesis, so take all the time you need. There are no wrong answers.
At the end, some general questions will be asked. I would like to mention that all the answers you give are only being used in my master thesis and will not be spread to any other person, institution or website.

Thank you in advance

---

You will get the fictive opportunity to get a share of one company. A share gives you the right to get a part of the profits of the company. As the profit changes over time, so does the value of a stock. You will keep the share you choose during the whole survey.
There are three options, but you can only choose one. This share can decline or incline in value, so choose wisely. Choose which share of the following companies you would like to have:

There is no wrong answer

Beer Company: This German company drafts beer. The beer is brewed according to a secret family recipe. The company exports its' beer across Europe.

Wine Company: This French company makes wine. The grapes come from a vineyard that is not used before for making wine. The wine is mostly exported to the USA.

Pizza Company: This Italian company bakes pizzas. The company is trying to set up restaurants in Asia to serve their authentic pizzas there.

Of which company would like a share?

- Beer Company
- Wine Company
- Pizza Company

**Standard perceived treatment**
You chose the share of the {insert company}. Now, imagine that you received this share 6 years ago. You will keep this share from that point in time until today, so in total for 6 years. Today, you will sell the share of the {insert **company**} and receive the money.

First, you will only look at the {first/last} 3 years of this 6 six year period.

In those 3 years, the share of the ${q://QID13/ChoiceGroup/SelectedChoices}, {increased/decreased} in value with {+7,53%/+3.68%}.

On a scale from 1 to 7, how would you rate this change in value in these three years?

---

Over the total period of six years, the share of {insert company} declined or inclined in value. How much do you think the share changed in value over the whole period of 6 years?

(Answer in %)

Over the total period of six years, the share of {insert company} declined or inclined in value. How much do you think the share changed in value over the whole period of 6 years?

(Answer in %)

**Standard expected treatment**
You chose the share of the {insert company} Now, imagine that you receive this share today. You will keep this share from today until 6 years in the future, so in total for 6 years. At the end of the 6 years, you will sell the share of the {insert company} and receive the money.

First, you will look at the {first 3 years/last 3 years} of these 6 years. During these 3 years there are five possible scenarios that can occur. All the scenarios have the same likelihood of happening. This is shown below:

{Scenario}
Over the period of the {first three/last three} years, the share of {insert company} could incline or decline in value. How much do you think it will change in value over the period of the 3 years?

(Answer in %)

On a scale from 1 to 7, how would you rate this change in value in these three years?

---

Over the total period of six years, the share of {insert company} will decline or incline in value. How much do you think it will change in value over the whole period of six years?

On a scale from 1 to 7, how would you rate this expected change in value over whole period in the upcoming six years?

**Myopic perceived treatment**
You chose the share of the {insert company} Now, imagine that you received this share 6 years ago. You will keep this share from that point in time until today, so in total for 6 years. Today, you will sell the share of the {insert company} and receive the money.

First, you will only look at the {first/second/third/fourth/fifth/last} year of this 6 six year period.

In that year, the share of the {insert company} {increased/decreased} in value with {+3%/+20%/-13%/+8%/+0%/-4%}.

On a scale from 1 to 7, how would you rate this change in value in that year?

---

Over the total period of six years, the share of {insert company} declined or inclined in value. How much do you think the share changed in value over the whole period of 6 years?

(Answer in %)

On a scale from 1 to 7, how would you rate this change in value over the whole period of six years?

**Myopic expected treatment**
You chose the share of the {insert company} Now, imagine that you receive this share today. You will keep this share from today until 6 years in the future, so in total for 6 years. At the end of the 6 years, you will sell the share of the {insert company} and receive the money.

First, you will only look at the {first/second/third/fourth/fifth/last} year of these 6 years. During this year there are five possible scenarios that can occur. All the scenarios have the same likelihood of happening. This is shown below:

{Scenario}

Over the period of the {first year/second/third/fourth/fifth/last}, the share of {insert company} will incline or decline in value. How much do you think it will change in value over the {first/second/third/fourth/fifth/last} year?

(Answer in %)

On a scale from 1 to 7, how would you rate this change in value in this year?

---

Over the total period of six years, the share of {insert company} will decline or incline in value. How much do you think it will change in value over the whole upcoming period of six years?

On a scale from 1 to 7, how would you rate this expected change in value over whole period in the upcoming six years?

**General questions**
You just ended the biggest part of this survey regarding investments. Now some general questions are asked on this and the next page. This won't take long.

What is your age?

What is you gender?

- Male

- Female

- I do not want to answer this question

On a scale from 1 to 7, how much knowledge do you think you have of investing?

Do you hold any investments? Think about investing in stocks, bonds, funds, crypto-currencies, etc.(A savings-account, your pension-fund or mortgage on your home are not considered an investment in this case)

- Yes, I invest

- No, I do not invest

---

**Financial Literacy test**

Suppose you had €100,- in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

- More than €110,-
- Exactly €110,-
- Less than €110,-
- Do not know

Imagine that the interest rate on you savings account is 1% per year and the inflation is 2% per year. After 1 year, how much would you be able to buy with the money in this account?

- More than today
- Exactly the same
- Less than today
- Do not know

Please tell whether this statement is true or false. "Buying a single company's stock is usually more risky than buying an index fund."

- True
- False
- Do not know

## Appendix 2. Overview of Variables and Their Derivation

| Variable | Description | Range | Scale |
|---|---|---|---|
| Subjective rating of return | Subjective rating of perceived return: answer to the question: ‘How would you rate this change in value over the whole period of 6 years?’<br>Subjective rating of expected return: answer to the question ‘How would you rate this expected change in value over the whole period in the upcoming 6 years?’ | [ 1 ; 7 ] | 1: Extremely Bad<br>7: Extremely Good |
| Subjective return | Perceived return: answer to the question ‘How much do you think the share changed in value over the whole period of 6 years?’<br>Expected return: answer to the question ‘How much do you think the share will change in value over the whole period of 6 years?’ | [ -100% ; 100% ] | Slider |
| Subjective return > 0% | An interaction variable which is generated by multiplying the perceived/expected return with a dummy variable that has a value of 1 when the perceived/expected return is positive. | [ 0% ; 100% ] | - |
| Subjective return < 0% | An interaction variable which is generated by multiplying the perceived/expected return with a dummy variable that has a value of 1 when the perceived/expected return is negative. | [ -100% ; 0% ] | - |
| Age | Age in years of participants | [ 0 ; ∞ > | Open |
| Gender | Dummy variable which has a value of 0 for men and 1 for women. Participants could choose to not answer this question, which will results in a missing value for this participant. | [ 0 ; 1 ] | Multiple Choice |
| Self-stated financial literacy | Answer to the question ‘How much knowledge do you think you have of investing?’ | [ 1 ; 7 ] | 1: Very Less<br>7: Very Much |
| Investor | Dummy variable created based on the answer to the question ‘Do you hold any investments? Think about investing in stocks, bonds, funds, crypto-currencies, etc.’<br>0 corresponds to ‘No’ and 1 to ‘Yes’. | [ 0 ; 1 ] | Multiple Choice |
| Financial literacy | Amount of correct responses to a three question test about financial literacy | [ 0 ; 3 ] | Based on three multiple choice questions |

# Appendix 3. Scatter Plots Subjective Return on Subjective Rating of Return

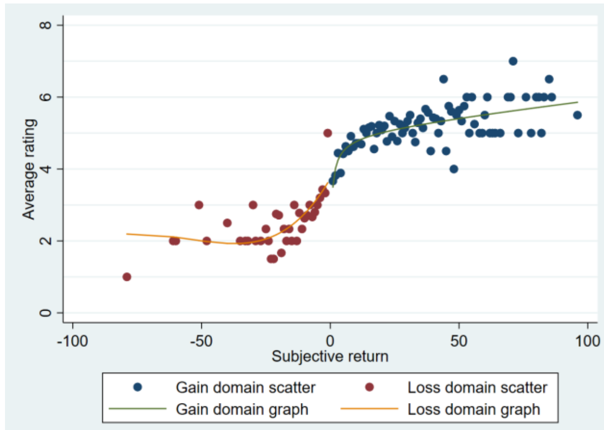


*Figure 2: Scatter Plot Whole Sample*

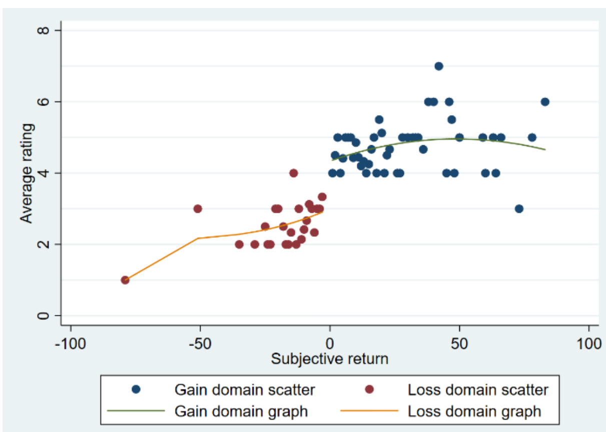


*Figure 3: Scatter Plot Standard Perceived Loss Aversion*

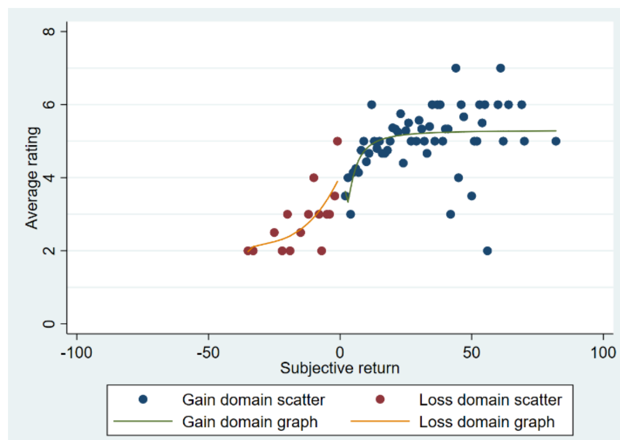


*Figure 4: Scatter Plot Standard Expected Loss Aversion*

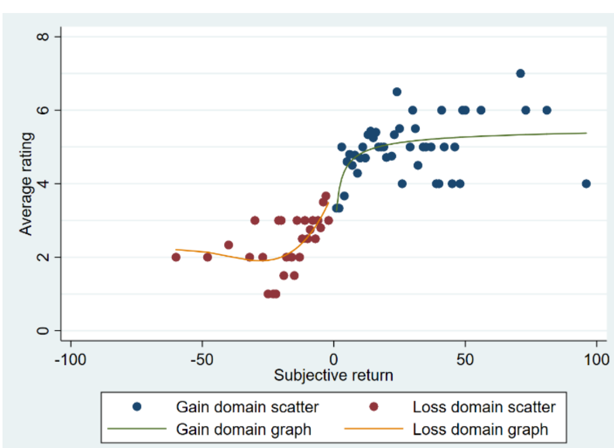


*Figure 5: Scatter Plot Myopic Perceived Loss Aversion*

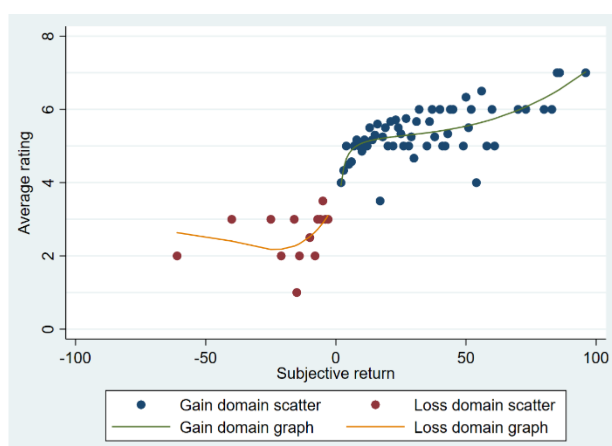


*Figure 6: Scatter Plot Myopic Expected Loss Aversion*

# Appendix 4. OLS-Regressions for differences in treatments

| | Subjective Rating of Return | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Base: Standard Perceived | | | Base: Standard Expected | | | Base: Myopic Perceived | | | Base: Myopic Expected | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Standard perceived subjective return | | | | -0.0025 | | | -0.0095** | | | 0.0063 | | |
| | | | | (-0.49) | | | (-1.97) | | | (1.38) | | |
| Standard expected subjective return | 0.0025 | | | | | | -0.0070 | | | 0.0088* | | |
| | (0.49) | | | | | | (-1.33) | | | (1.78) | | |
| Myopic perceived subjective return | 0.0095** | | | 0.0070 | | | | | | 0.0158*** | | |
| | (1.97) | | | (1.33) | | | | | | (3.39) | | |
| Myopic expected subjective return | -0.0063 | | | -0.0088* | | | -0.0158*** | | | | | |
| | (-1.38) | | | (-1.78) | | | (-3.39) | | | | | |
| Standard perceived subjective return < 0% | | | | | -0.0192 | -0.0084 | | -0.0031 | 0.0096 | | 0.0065 | 0.0155 |
| | | | | | (-1.17) | (-0.52) | | (-0.27) | (0.82) | | (0.44) | (1.05) |
| Standard expected subjective return < 0% | | 0.0192 | 0.0084 | | | | | 0.0161 | 0.0180 | | 0.0257 | 0.0239 |
| | | (1.17) | (0.52) | | | | | (0.99) | (1.13) | | (1.37) | (1.31) |
| Myopic perceived subjective return < 0% | | 0.0031 | -0.0096 | | -0.0161 | -0.0180 | | | | | 0.0096 | 0.0059 |
| | | (0.27) | (-0.82) | | (-0.99) | (-1.13) | | | | | (0.66) | (0.41) |
| Myopic expected subjective return < 0% | | -0.0065 | -0.0155 | | -0.0257 | -0.0239 | | -0.0096 | -0.0059 | | | |
| | | (-0.44) | (-1.05) | | (-1.37) | (1.31) | | (-0.66) | (-0.41) | | | |
| Standard perceived subjective return > 0% | | | | | -0.0071 | -0.0094 | | -0.0034 | 0.0128** | | -0.0064 | -0.0065 |
| | | | | | (-1.20) | (-1.49) | | (-0.56) | (-1.97) | | (-1.20) | (-1.18) |
| Standard expected subjective return > 0% | | 0.0071 | 0.0094 | | | | | 0.0037 | -0.0034 | | 0.0007 | 0.0029 |
| | | (1.20) | (1.49) | | | | | (0.61) | (-0.51) | | (0.13) | (0.51) |
| Myopic perceived subjective return > 0% | | 0.0034 | 0.0128** | | -0.0037 | 0.0034 | | | | | -0.0030 | 0.0063 |
| | | (0.56) | (1.97) | | (-0.61) | (0.51) | | | | | (-0.54) | (1.07) |
| Myopic expected subjective return > 0% | | 0.0064 | 0.0065 | | -0.0007 | -0.0029 | | 0.0030 | -0.0063 | | | |
| | | (1.20) | (1.18) | | (-0.13) | (-0.51) | | (0.54) | (-1.07) | | | |
| Constant | 3.6854 | 4.0985 | 4.1505 | 3.9418 | 4.3389 | 4.3120 | 3.8122 | 4.2366 | 4.1716 | 4.3251 | 4.5725 | 4.5566 |
| | (22.52) | (41.82) | (24.00) | (21.62) | (36.02) | (22.41) | (23.65) | (42.01) | (24.23) | (24.70) | (43.71) | (25.96) |
| Control Variables | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes |
| $R^2$ | 0.419 | 0.435 | 0.468 | 0.419 | 0.435 | 0.468 | 0.419 | 0.435 | 0.468 | 0.419 | 0.435 | 0.468 |
| N | 843 | 895 | 843 | 843 | 895 | 843 | 843 | 895 | 843 | 843 | 895 | 843 |

Regression (1) estimates the subjective return on the rating of return. Regression (2) estimates the subjective return split in the gain and loss domain on the rating of return without using control variables. Regression (3) adds control variables. Values between brackets in show T-values which are significant at *$p$<.10, **p<.05, ***$p$<0.01.

# Appendix 5. OLS-Regressions for Diminishing Sensitivity

| Panel A: Linear Regression | | |
|---|---|---|
| | Subjective rating of return | |
| | (1) | (2) |
| Standard perceived subjective return ≤ -11% | 0.061*** | 0.067*** |
| | (7.30) | (7.69) |
| Standard expected subjective return ≤ -11% | 0.098*** | 0.094*** |
| | (6.81) | (6.72) |
| Myopic perceived subjective return ≤ -11% | 0.076*** | 0.068*** |
| | (9.37) | (8.50) |
| Myopic expected subjective return ≤ -11% | 0.063*** | 0.063** |
| | (5.15) | (5.33) |
| Standard perceived subjective return < 0% & > -11% | 0.162*** | 0.171*** |
| | (6.32) | (6.62) |
| Standard expected subjective return < 0% & > -11% | 0.201*** | 0.189*** |
| | (3.98) | (3.81) |
| Myopic perceived subjective return < 0% & > -11% | 0.212*** | 0.184*** |
| | (6.85) | (5.93) |
| Myopic expected subjective return < 0% & > -11% | 0.210*** | 0.205*** |
| | (4.13) | (4.16) |
| Standard perceived subjective return > 0% & < 11% | 0.085*** | 0.084*** |
| | (3.75) | (3.74) |
| Standard expected subjective return > 0% & < 11% | 0.026 | 0.019 |
| | (0.97) | (0.70) |
| Myopic perceived subjective return > 0% & < 11% | 0.022 | 0.060*** |
| | (0.98) | (2.68) |
| Myopic expected subjective return > 0% & < 11% | 0.017 | 0.009 |
| | (0.67) | (0.34) |
| Standard perceived subjective return ≥ 11% | 0.016*** | 0.016*** |
| | (3.71) | (3.55) |
| Standard expected subjective return ≥ 11% | 0.019*** | 0.021*** |
| | (4.09) | (4.08) |
| Myopic perceived subjective return ≥ 11% | 0.016*** | 0.027*** |
| | (3.30) | (5.19) |
| Myopic expected subjective return ≥ 11% | 0.022*** | 0.022*** |
| | (5.97) | (5.98) |
| Constant | 4.05*** | 4.15*** |
| | (31.20) | (22.02) |
| Control Variables | No | Yes |
| $R^2$ | 0.481 | 0.514 |
| N | 895 | 843 |

| Panel B: Loss Aversion Ratio λ | | |
|---|---|---|
| Standard perceived λ | 1.91* | 2.04** |
| small domains | (0.060) | (0.032) |
| Standard perceived λ | 6.10*** | 4.16*** |
| big domains | (0.000) | (0.000) |
| Standard expected λ | 7.73*** | 10.16*** |
| small domains | (0.000) | (0.001) |
| Standard expected λ | 5.18*** | 4.44*** |
| big domains | (0.000) | (0.000) |
| Myopic perceived λ | 9.64*** | 3.09*** |
| small domains | (0.000) | (0.006) |
| Myopic perceived λ | 4.75*** | 2.52*** |
| big domains | (0.000) | 0.000 |
| Myopic expected λ | 12.36*** | 23.65*** |
| small domains | (0.002) | (0.001) |
| Myopic expected λ | 2.86*** | 2.91*** |
| big domains | (0.003) | (0.002) |

In panel A, regression (1) estimates the subjective return on the rating of return. Regression (2) estimates the subjective return split in the gain and loss domain on the rating of return without using control variables. Regression (3) adds control variables. Panel B tabulates Wald tests for the loss aversion ratios based on the coefficients in panel A. Values between brackets in panel A show T-values and p-values in panel B which are significant at **p*<.10, **p<.05, ****p*<0.01.