Interest to Reinvest
Individuals’ use of numerical information for investment decisions
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Abstract
The general aim of this thesis is to contribute to the understanding of how numerical information, such as asset values and interest rates, influences inexperienced investors in their investment decisions. In relation to this, I have investigated the participants’ own understanding of what information they rely on for their own decisions. I have also investigated how their willingness to wait for greater rewards is related to their investment decisions. Importantly, I have distinguished between average behavior (group behavior) and individual behavior in an attempt to better describe how different information is important for different individual investors.

On the group level the only reliable predictor of investment size was whether there was a gain or a loss during the period before the investment. However, how large the gain or loss was had no, or very limited, influence on investment size. When looking at each investor’s individual decisions, it was revealed that a substantial number of participants actually did rely on information other than only the gain/loss information, for example, the interest rates of forecasted developments of the different investment prospects. Furthermore, a substantial number of participants relied heavily on one of the cues; at least 50% of their investments were explained by the cue relied upon.

Interestingly, very few participants’ investments were influenced by their own judgments of future asset outcomes. Furthermore, the participants’ willingness to invest in funds with guaranteed gains was used as a proxy for time preference (willingness to wait for greater rewards instead of accepting lesser rewards in the present). Time preference was relevant for investments but it did not relate to judged asset outcomes. This indicates that people may be more influenced by their future-oriented preferences rather than by their future-oriented beliefs (judgments).

To conclude, these findings suggest that people use a preference-driven simplified strategy for investments and that these strategies differ substantially between individuals. This corroborates the idea about heuristic thinking, meaning that people simplify their decisions in a way that can deviate from normative value-maximizing behavior. For practical application, it is important to note the variety of strategies among individuals. This variety suggests that there is no “one size fits all” solution regarding instructions that can be given to inexperienced investors. The participants’ very limited insight into what information they relied upon is reason for researchers and advisors to understand the individuality in strategies in greater depth.

Keywords: decision making, investments, interest rate, asset accumulation, information processing, gains, losses.

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INTEREST TO REINVEST

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To my good friends!
Abstract

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Svensk sammanfattning

Tänk dig att du börjat fundera över ditt långsiktiga sparande. Urvalet av sparandetyper är mångfalt men fondsparande kan ändå uppenbara sig som relativt lättbegripligt. Ofta kan man hitta fondutvecklingar i form av procen-
tuelle förändringar i värde över tid. Men hur mycket är egentligen SEK 10 000 värt om 10 år om man får 10 % avkastning varje år?

Nu kanske du är klok nog att inte förlita dig på din egen uppskattning av värdet utan istället väljer att se till det utbud av fonder som finns och hur deras utveckling sett ut tidigare. Alternativt kanske du rådfrågar någon om hur utvecklingen av olika fonder förväntas att se ut den kommande tiden.

Den här avhandlingen behandlar just denna typ av frågeställning. Vilken information använder sig folk av när de ska besluta hur mycket de vill inv e-
ster i olika fonder? Inom psykologisk forskning är det vanligt att man ser till medelvärden beräknade på en grupp individer som ett mått på hur folk tänker och beter sig. En viktig del av den här avhandlingen är att den går närmre individen i analyserna och illustrerar hur väldigt olika folk kan bete sig även om de blir presenterade med exakt samma information. Även indivi-
ders egen förståelse av vilken information de själva ser som viktig för sina egna beslut har undersöks. Dess värre tycks denna insikt vara ytterst be-
gränsad hos många.

Vidare går avhandlingen in på hur vi kan påverkas av att antingen tänka oss att vi ska göra vår fondinsats som en summa pengar eller som en pro-
centuell andel av det vi redan har. Även preferensen för att vänta på att en summa pengar hinner växa till sig har undersöfts. Med andra ord, om man föredrar en mindre summa pengar nu jämfört med en större summa pengar flera år framåt i tiden.

Utöver dessa specifika frågeställningar erbjuder avhandlingen även en in-
blick i hur ekonomer en gång i tiden utgick från att vi människor är ration-
ella varelser. Enligt detta antagande agerar människor alltid rationellt gäl-
lande maximerande av värde och de agerar endast i egenintresse. Detta har dock visat sig inte stämma särskilt väl över huvud taget. Därför diskuteras även hur resultaten från avhandlingens studier kan bidra med idéer kring ekonomisk rådgivning.
First and foremost I want to thank my supervisor Ola Svenson for teaching me so many valuable tools to handle academic life. He was the first person ever to help me believe I actually could accomplish something worth mentioning. This is priceless to me! He has put through with my unwavering stubbornness in an impressive fashion. Even in times when I refused to change my mind because of a strong conviction in my line of thinking, he still stood by my side regardless of heated debates that dragged along for unreasonable amounts of time. Thank you Ola for being a supportive friend and an important part of my accomplishments!

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Now I will turn to my good friends that I have got to know during my time at the department.

Tina Sundelin, I don’t know what to write without having to explain myself exactly what I mean by whatever I’ve written, which now is this. I have never met someone with the same desire for clear definitions as I have, and you may beat me. This fact is just awesome!... And by awesome I mean… (to be continued in another thesis).

Anders Sand, I’ve always enjoyed your provocative style of questioning (even when you try to mask it). It is always a challenge and a great deal of fun having an argument with you. Also, I admire your conviction about how science should be conducted!
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List of studies


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Introduction

Imagine that you have SEK 10 000 saved in a fund. Each year your assets will increase by an additional 15%. How much will that fund be worth in 10 years? Imagine further, halfway through those 10 years your banker asks you if you want to keep your money in that fund for the remainder of the 10 years or if you would like to withdraw some of it. The assets could keep growing as before, but they could as well start to decline at an annual 15% rate during the next investment period. This is the kind of problem addressed in this thesis.

Traditional economists make assumptions about human cognition and motivation to create comprehensive models that can predict different markets and other economical outcomes. However, understanding how people think and act regarding this type of problem is useful for several other reasons. The aim of this thesis is to describe different types of cognition and strategies involved in this type of decision. The benefit of this is, hopefully, a better understanding of the investment decisions process and following implications. I will distinguish between average behaviors, that is, what the group tends to do, and individual behaviors, that is, what different people do. This is important because individuals can behave very differently in the same situation. Thus, I will attempt to illustrate how average behavior can be different from individual behavior. In fact, the average behavior is not a behavior; it is only an outcome of several different behaviors. The distinction between average and individual behavior is useful for all kinds of psychological research where the actual behaviors or cognitions of humans are of interest.

Averages are useful in predicting group results, for example, market trends and outcomes. In the world of economists the aggregate savings and borrowing behavior of households affects the macro economy (Ranyard & Ferreira, 2017). The macro economy consists of individuals involved in micro economies, and they are complementary halves of the same discipline. Individual behaviors affect the macro economy, which in turn affects individual behaviors (Lea, Tarpy, & Webley, 1987). However, as noted by Barber and Odean (2013), the great variation among individual investors is masked by the average performance of the collective group. For decision research purposes, the more nuanced approach in this thesis is an attempt to add knowledge about how different individuals use information differently. In the end, this may help individuals better understand their decisions. Fur-
thermore, it may help investment advisors to consider different ways of presenting information, depending on the person being advised.

It is a complex task to decide how to allocate assets for the future, and most people have to manage their assets by themselves. Predicting the stock market and deciding when to sell and buy stocks, funds, bonds, and so forth is difficult, and even professional investors often rely on their intuitions rather than formalized predictions (Hedesström, 2017). Individual investors who manage their own assets are usually less experienced than professional investors. Therefore, it is reasonable to assume that for individual investors it is a very difficult task to invest efficiently and to maximize gains as well as minimize losses. Even in situations where a satisfying goal is lower, or different, than the maximum outcome value, it can be difficult for the individual investor to meet the goals and expectations of their investment endeavors. Furthermore, if capital margins are scarce, it is of even greater importance to understand the implications of one’s own decisions and what those decisions are based on.

Expected value

In traditional economic theory a common concept is expected value (EV). EV refers to the sum of each outcome that can occur multiplied by its chance of occurring. For example, imagine that you toss a coin; if it turns up heads, then you will win SEK 200, if it turns up tails you will lose SEK 100. Assuming that it is a fair coin, with 50% chance for heads and tails, respectively, then the expected value of tossing the coin is SEK $200 \times 0.5 - SEK 100 \times 0.5 = SEK 50$. In other words, if you toss this coin an infinite number of times you will on average gain SEK 50 per coin toss. EV can be calculated by the following equation:

$$ EV = V_1 \times P_1 + ... + V_n \times P_n \quad (1) $$

The variable $V_i$ denotes the value of the first outcome that can occur and $P_i$ denotes the probability of outcome $V_i$. Hence, each outcome is multiplied by its respective probability and the resulting products are summed for the $n$ number of outcomes that can occur.

Expected value is an example of a normative model, that is, a model that assumes a correct decision or outcome from some point of view. In economics the norm is often value maximization, usually described mathematically within a specified context. However, people often do not act according to normative models, as described in more detail later. Therefore, there is a need for descriptive models that describe actual behavior. There are also prescriptive models that describe what should be done, or how results may
be improved. A prescriptive model builds upon normative definitions or assumptions because these are the goal state. However, in contrast to the normative models, the prescriptive models consider the behavior or outcome predicted by descriptive models so that after implementation of the prescriptions from the model the predicted outcomes will be closer to the normative goal state (Bell, Raiffa, & Tversky, 1988).

**Homo economicus**

Classical economists and neoclassical economists often assume the idea of the economic man, also known as *homo economicus*. *Homo economicus* acts to maximize wealth with only self-interest in mind. *Homo economicus* is even assumed to have the cognitive capacity required to understand and carry out rational choices (Doucouliagos, 1994). Maximization of wealth can be either in the form of monetary value or in the form of utility. Utility is the pleasure, or pain, received from a product or some form of asset, and it is calculated in the same way as expected value. It should be noted that when there is an objective value (e.g., money), assuming that humans are rational, the value and utility will be the same.

Behavioral decision theory originates from the von Neumann-Morgenstern utility theorem that used axioms of rational behavior. Utility can be described as the pleasure- and pain-giving properties of an object. Early utility maximization theory assumed that people have the goal of maximizing the pleasure (positive utility) and minimizing the pain (negative utility). This leads people to seek maximum utility from their decisions (Edwards, 1954). Expected utility theory includes maximizing both value and utility and can be seen as a gold standard of economic behavior (Thaler, 2016). However, in 1947 von Neumann and Morgenstern pointed out that one of the greatest difficulties for economic theory is to properly describe the assumptions of human motivation. Furthermore, these authors suggest that assumptions that are made should be experimentally tested (Von Neumann & Morgenstern, 2007), that is, they should not remain assumptions indefinitely.

As early as 1738 Bernoulli started to theorize that, even if the price of a product is the same for all potential buyers, the utility of that product is not the same for everyone. By addressing this issue, he made a distinction between objective value and utility, that is, subjective value (Bernoulli, 1954). These were early thoughts about utility differing between individuals, which creates difficulties for normative theories. However, even if the utility differs between individuals, the utility for an individual can be substituted for objective value in expected utility calculations for that individual.

That subjective utilities differ between individuals is an important part of the understanding of decision-making. Another important part of this un-
standing is the human limitations in processing capacity of numbers and facts. Even if all people were to value something the same and had the intention of maximizing value, they would not all be able to maximize value within the given context. This can be explained by the idea of bounded rationality, which in short means that we are not capable of being maximizers, whether we like it or not. Humans are affected by factors that economists often assume to be irrelevant, supposedly irrelevant factors (SIFs) (Thaler, 2016). The idea of bounded rationality is a cornerstone in the field of economic psychology and behavioral economics. This will be the topic of the following section.

**Bounded rationality**

In 1956, John Cohen and Mark Hansel pioneered the work on subjective understanding of probabilities with their book *Risk and Gambling: A Study of Subjective Probability*. These authors noted that three hundred years earlier mathematicians Chevalier de Méré and Blaise Pascal started the work on what would become the theory of probability. However, Cohen and Hansel also noted that (at that time) the world of subjective probability was largely unexplored. Subjective probability refers to the perceptions, choices, predictions, and decisions individuals have when they make conclusions about uncertain events. Thus, conclusions derived with subjective probabilities are made with imperfect knowledge (Cohen & Hansel, 1956). Since the work of Cohen and Hansel, subjective probabilities have been investigated to a great extent, and it is clear that they are not the same as mathematical probabilities, which are calculated normatively.

Simon (1957) introduced the term *bounded rationality*, the idea that because of context and cognitive limitations we cannot act according to objective or normative rationality. In other words, people do not possess the capacities of homo economicus. Furthermore, bounded rationality proponents criticize the idea of homo economicus on the grounds that people strive to satisfy their needs rather than maximize every opportunity for gains (Doucouliagos, 1994).

The idea of bounded rationality has implications for our daily lives. We need to simplify complex problems so that we do not get stuck at every single decision that seems to be of any importance. Simplifying problems saves time, but it may also come at an unwanted expense. Here we will go back to the introductory example. The SEK 10 000 that accumulated at an annual 15% rate for 10 years would be worth SEK 40 455.58 at the end of the 10th year. The average person, however, would only judge them to be worth around SEK 25 000 (Gonzalez & Svenson, 2014; Gonzalez, 2017). Hence, thinking about investment-related information without doing formal calculations can lead to an erroneous perception of potential gains and losses.
There are analysts who use formal statistical analyses to make predictions and forecasts professionally. However, people often make judgments without the help of formal calculations and therefore act as “intuitive statisticians” (Peterson & Beach, 1967; Slovic, 1972). In the beginning of the 1970s Amos Tversky and Daniel Kahneman started what would become the heuristic and bias tradition. They described heuristics as mental shortcuts that are used when making judgments under uncertainty. Heuristics are very effective because they are economical in time and effort, but in some situations they lead to systematic and predictable errors, called biases (Kahneman & Tversky, 1972; Tversky & Kahneman, 1974). In the context of mutual funds and the stock market this is important, because knowledge about how they work has been found to be notably low (Lusardi & Mitchell, 2011).

To summarize, people tend to lack understanding, simplify complex information, and sometimes focus on information that is not even relevant to the problem at hand. Therefore, it is useful to investigate how people make use of the information in investment settings that often contains a lot of complex information.

**Behavioral economics**

It can be argued that the field of behavioral economics started with the creation of prospect theory (Kahneman & Tversky, 1979). Kahneman and Tversky described how we judge and decide according to subjective values of utility. This was formalized in their prospect theory. The value function of the subjective utility in prospect theory is not linear. Instead, value increase and decrease is greatest close to a reference point (often the present state) and declines the further away from the reference point we get (Figure 1).

![Figure 1: Illustration of prospect theory.](image-url)
For example, an increase of wealth from $100 to $110 is perceived as
greater than an increase from $1000 to $1010, when in reality the increase is
$10 in both cases. Furthermore, losses are seen as greater in value compared
to equal gains. For example, the pain of losing $10 is greater than the plea-
sure of gaining $10. Prospect theory was later developed into cumulative
prospect theory, which includes overweighting of small probabilities for
extreme events (Tversky & Kahneman, 1992). I will, however, not go into
further detail of probability judgment per se; it is outside the scope of this
thesis.

Sometimes, distinctions between behavioral economics and economic
psychology, based on different assumptions within the two fields, are made.
However, not all researchers find it useful to separate the two, and the line
between the two fields is becoming more blurred (Ranyard & Ferreira,
2017). In the end, the fundamental idea is that economic decision-making
research should point out what Thaler calls supposedly irrelevant factors
(Thaler, 2016). In other words, factors that traditional economics treats as
irrelevant are more relevant than assumed and need to be investigated. This
thesis investigates how people can behave economically, but it also investi-
gates the psychology behind economic decisions. Therefore, I see no need to
distinguish between the labels economic psychology and behavioral eco-
nomics, at least, not regarding the topic of this thesis. Hence, these two terms
are interchangeable from here on.

In behavioral economics beliefs and preferences are relevant in several
ways (Thaler, 2016). To clarify the two terms, a belief is a person’s thoughts
and/or perceptions about the facts of a specific question or state of the world.
A preference is what a person would like the most from available choices at
a specific point in time. Asking people for judgments is a way of measuring
beliefs, because judgments are statements about the result from specific con-
ditions. In other words, judgments are explicit outcome predictions (or
guesses) based on a combination of information and beliefs. In this thesis I
will discuss two types of beliefs. One type of belief is about the future in the
form of judgments of future asset outcomes. The other type of belief is about
one’s own behavior and cognitions. I will also treat preferences in terms of
the amount of capital assets a person is willing to risk for a chance of gaining
greater capital and the time preference for rewards. In other words, the aim
in this thesis is to increase understanding and knowledge about how beliefs
and preferences about assets and investments are relevant for long-term in-
vestment decisions.
Aims

With this thesis I aim to contribute to the understanding of how we think about, and act with, our assets when there are asset accumulations and uncertainty involved. To achieve this, the empirical studies of this thesis specifically investigated how numerical information influences investment decisions. Two types of information were involved. The first type was objectively generated as part of the experimental manipulations. The second type was subjectively generated; this means that the participants themselves made judgments about future values without formal calculations, that is, beliefs about accumulated value. The objective and subjective information constitutes a basis for beliefs about outcomes. In addition to beliefs, one study also measured preferences for saving. The following variables were used to investigate how investments can be influenced in different ways.

**Objective information**

1) Interest rates
   a. Historical interest rate (prior fund performance)
   b. Forecasted interest rate (predicted future fund performance)

2) The difference between making investments as a proportion of available assets (a percentage) or as an amount of assets (SEK)

**Subjective information**

3) Judgments of future asset accumulation

**Preference**

4) The willingness to wait for greater rewards, known as time preference

I also aim to make a distinction between average and individual behavior. Average behavior is useful for making predictions about general outcomes. Individual behavior is useful in understanding cognition in different investors. Therefore, the latter is important to include when the aim is to understand how beliefs and preferences can influence investment decisions. Also investigated was how the participants understood their own investment strategies.
Beliefs and preferences about future outcomes

Beliefs and preferences are important to understand in relation to economic behavior. The beliefs and preferences that people have are the reason that they do not act as the homo economicus of neoclassical economists. In the following I will describe judgments of accumulated value. In this thesis these judgments act as a measure of belief about how much assets will be worth in the future. I will also describe time preference; this is a preference for either having a smaller amount of assets now or waiting for a greater amount of assets in the future. There is a clear distinction between the two because the first is beliefs about the objective world, while the second is a preference about what a person subjectively would like to receive from that world. Perhaps obviously, both concepts have a clear connection to investments of all sorts.

Judgment of accumulated value

Judgment refers to a human approximation made about an outcome of a specific situation where the knowledge about the outcome is in some respect incomplete. A judgment can stay implicit within the person judging, but in experimental settings judgments can be explicitly stated by that person. This way, judgments act as a measure of belief about the outcome. It should be noted that there may be several beliefs about different facts that together result in the judgments made. Regarding judgments of how value changes over time, it should be noted that there are different types of value accumulations that can be judged, for example, judging a product’s value 5 years ago or 10 years into the future for products with an annual price increase of 7% (Benzion, Shachmurove, & Yagil, 2004). Note that this type of exponential growth and decline can be found outside the world of economics, for example, the increase of pollution in the air or bacterial growth, and so forth. The commonly found underestimation of accumulating numerical increases has been found for different presentation formats, for example, mathematical expressions ($a^n$) (Mullet & Cheminat, 1995) and numerical series or graphs (Timmers & Wagenaar, 1977). The effect is robust and persists even with economic incentives to judge accurately (Christandl & Fetchenhauer, 2009).
Judgments of asset accumulations have been found to have a positive relationship with borrowing and savings behavior, portfolio choice, and estimated net worth (Stango & Zinman, 2009). Importantly, it has been found that people in general have difficulties judging asset accumulations, and great accumulations are greatly underestimated (Benzion et al., 2004; Gonzalez, 2017; Gonzalez & Svenson, 2014; Timmers & Wagenaar, 1977; Wagenaar & Sagaria, 1975).

For growth, the correct calculation of accumulated value is described by equation (2) where $V_t$ denotes the accumulated assets after $t$ number of periods, $V_0$ denotes the assets before any growth has taken place ($t = 0$), and $g$ denotes the proportional growth for each time unit $t$. The equation applies when $V_0 > 0$, $g > 0$, and $t > 0$.

$$V_t = V_0 (1 + g)^t \quad (2)$$

The equation for decline (3) is identical to the equation for growth, except that the proportion of decline for each time unit $t$ is subtracted from 1 instead of added to it.

$$V_t = V_0 (1 - g)^t \quad (3)$$

It is important to note that for each time unit of growth the growth rate will be greater than for the previous time unit, while for each time unit of decline the decline will be smaller. For example, if you have SEK 100 and increase that capital by 50% you will have SEK 150; if you gain an additional 50% you will have SEK 225. That means that the gain from the first increase was SEK 50, and for the second increase, SEK 75. If you, on the other hand, lost 50%, you would have SEK 50, and if you then again lost 50% you would have SEK 25. This means that you would have lost first SEK 50 and then an additional SEK 25. Therefore, to recover a loss of 50% you need a consecutive gain of 100%, and this can for many non-expert investors be hard to understand (Newall, 2016).

As mentioned earlier, people often act as intuitive statisticians (Peterson & Beach, 1967; Slovic, 1972) and make judgments without carrying out formal calculations. However, people do not always make decisions that correspond to their judgments (Slovic, 1975; Slovic, Griffin, & Tversky, 1990; Slovic & Lichtenstein, 1983). Therefore, in this thesis I have investigated to what extent individual investors’ own judgments of asset accumulations are related to their own investment decisions.
Time preference

When it comes to the utility of assets people tend to vary in their patience. Some people would rather spend today and have less in the future, while others prefer to reduce their consumption now for greater wealth later (Becker & Mulligan, 1997). The idea of time preference dates back to Fisher (1930), who suggested that people borrow capital at an interest rate because of their time preference. Hence, interest rates stem from the concept of time preference.

A real world example of time preference is spending your salary immediately on expensive dinners and clothing as soon as it enters your bank account, or saving it in an interest-bearing account for later but greater consumption. You may even take out a loan to achieve earlier consumption, which, because of loan interest rates, will in the future cost more than if you wait until you have earned sufficient money.

The time preference of a person is often measured with an intertemporal choice task. It is common in intertemporal choice research to ask participants to choose between an option that is smaller but received sooner and an option that is larger but received later (Read & Scholten, 2017). Time preference is suggested to result from the self-control of an individual. This is a product of a conflict within the individual between the farsighted planner and the myopic (i.e., shortsighted) doer (Thaler & Shefrin, 1981). A high time preference means that a person has a greater preference to receive rewards sooner than a person with low time preference. In other words, a high-time-preference person discounts future rewards or costs more than a low-time-preference person.

How people will choose in inter-temporal choice tasks has been modeled in several different ways. One way the time preference, also known as discounting over time, has been modeled is by hyperbolic discounting (Loewenstein & Prelec, 1992; Loewenstein & Thaler, 1989). This means that the further into the future value will be received, the less it will be worth, but the decline in value diminishes over time. The discount function is a mathematical way of modeling the time preference and leads to a concave function. The hyperbolic model has been questioned. Read (2001) suggested that the discounting of value over time is rather sub-additive than hyperbolic. This means that when the choice between a reward now or later is divided into several shorter time intervals the discounting will be less, that is, the decision maker will be less impatient for a greater reward in the future. Time preference has also been explained by a simple heuristic model (ITCH) relying on basic psychological principles that do not assume an underlying discount function. Instead, the ITCH model suggests that time preference is based on reference points and simple arithmetic comparisons (Marzilli Ericson, White, Laibson, & Cohen, 2015).
Time preference is relevant in many forms of savings because the present self has to give up consumption to benefit the future self. However, because of the risk involved in some types of savings and investments there is not always a guaranteed gain to be expected, and the time preference is therefore not a clear determinant of investment decisions. Furthermore, judgments of asset accumulations concern judgments of future assets. Therefore, I have investigated the relationship between asset judgments and time preference and how these two constructs may affect investment decisions, as illustrated in Figure 2.

Discount rates tend to vary from one domain to another (Gattig & Hendrickx, 2007). Hence, it can be assumed that different measures of time preference will have different accuracy when predicting the time preference within different domains or contexts. In other words, different discount functions may apply, depending on context and measure. One aim in this thesis was to understand to what extent time preference is important, specifically for investment decisions. Therefore, I have not used the classical intertemporal choice task. Instead, I used what can be assumed as a more ecologically valid measure of time preference for the current problem formulation, investments. The measure used was investment size in risk-free savings accounts, where any amount of the available assets could be saved. This was
thought to best reflect the amount of assets a person would like to have at the present moment compared to the amount set aside for the future, when the assets will have grown into a greater amount.
Investment behavior

People simplify their investment decisions in different ways and have different, but more or less consistent, strategies. For example, it is common for investors to invest based on trends, either buying on a positive trend and selling on a negative trend, the momentum trader, or vice versa, the contrarian trader (Jonsson, Söderberg, & Wilhelmsson, 2017b). Usually investors stick to the same investment strategy (Goetzmann & Massa, 2002; Grinblatt & Keloharju, 2000).

It is important to note that within different groups of investors there is heterogeneity in the strategies used. In part this heterogeneity has been attributed to demographic variables such as income and profession as well as other variables such as financial literacy (Dhar & Zhu, 2006). Interestingly, financial literacy has been questioned as a predictor for how well a person invests (Fernandes, Lynch, & Netemeyer, 2014). It has also been found that even professional investors use different strategies, some behave as momentum investors and others as contrarians (Morrin et al., 2002).

Greater wealth has been found to correlate with greater well-being and reduced economic stress (Headey & Wooden, 2004). Prospect theory, however, suggests that the subjective value increases at a lower rate the more wealth that is accumulated (Tversky & Kahneman, 1992), described by the concave gain function (see Figure 1). Hence, the utility of each unit of money decreases for every unit gained, as long as spending does not occur. This means that although it is good to save for a secure economic future, maximizing savings would leave no room for hedonic spending and is therefore not optimal for maximum utility across different endeavors. More simply put, we need to spend money at some point to get anything at all out of our investments.

Regardless of the preference for a safe economic future compared to hedonic spending, efficient investment strategies make it easier to obtain the preferred goal. Furthermore, low-income individuals are more likely to play the lottery, and they tend to play more when they see every ticket purchase independent of other ticket purchases (Haisley, Mostafa, & Loewenstein, 2008). This tendency to make shortsighted attempts to increase wealth by large gains with small probabilities illustrates how counterproductively people can behave.

It is not only important what information an investor relies on to trade one way or the other. It is also important how often trades are made, and inves-
tors tend to trade their stocks too often. This behavior results in smaller returns and is exhibited by both individual and professional investors (Barber & Odean, 2000; Carhart, 1997). Overconfidence is one factor that leads to more frequent trading. Men tend to be more confident (overconfident) than women, and are therefore more prone to trade excessively, which leads to poorer returns when the risk is great (Barber & Odean, 2001). Furthermore, trading occurs when there are large changes in the market (Andreassen, 1988). These behaviors may also be a product of trying to quickly gain large increases in wealth by taking risks, as with the lottery. In this thesis’s studies the participants were told that their invested assets would be locked in the fund for five years. Hence, trading too often could not occur within the experimental setting.

People do not seem to understand all of the consequences, or expected consequences, of their economic behaviors. Therefore, understanding how people think about gains, losses, and risks can help reduce unwanted behaviors. Furthermore, it can be used to help individuals make well-informed financial decisions in line with their preferences and thus have as satisfying a financial position as possible over the life span.

Prior gains and losses

People tend to have an overreliance on the past when predicting the future of funds. This also means that additional and more relevant information is ignored (Choi, Laibson, & Madrian, 2010; Newall & Love, 2015; Wilcox, 2003). In stock markets a growing market is called a bull market and a declining market is called a bear market. Investors tend to be too optimistic in bull markets and too pessimistic in bear markets (Shiller, 2005).

Two common but opposite effects found in the investment and decision-making literature are the disposition effect and the house-money effect. The disposition effect refers to the tendency to hold on to losing investments for too long and selling winners too early (Shefrin & Statman, 1985). The disposition effect has been found both in the lab (Andreassen, 1988; Weber & Camerer, 1998), in the field, that is, data of actual stock trading (Dhar & Zhu, 2006; Odean, 1998), and for mutual fund trading (Frazzini, 2006).

The opposite effect, risking more capital following wins compared to losses, is called the house-money effect (Thaler & Johnson, 1990), or the reverse-disposition effect (Gärling, Blomman, & Carle, 2017). The house-money effect has, like the disposition effect, been found in both laboratory investment experiments (Ackert, Charupat, Church, & Deaves, 2006) and in the field (Frino, Grant, & Johnstone, 2008). For taxable investments it is the realized marginal gains that are taxed, therefore, it is more economically
advantageous to sell losers and keep winners (Dhar & Zhu, 2006; Odean, 1998). In other words, house-money behavior is more lucrative and gives a higher after-tax return than disposition behavior.

It has been suggested that the disposition effect can be explained by prospect theory, in particular, the reference point of that theory (Weber & Camerer, 1998). However, annual gains and losses do not predict the disposition effect well (Barberis & Xiong, 2009). Instead, it has been suggested that it is the marginal utility loss and bursts of gain in utility (in relation to a reference point) from realization of invested assets that explains the disposition effect (Barberis & Xiong, 2012; Ingersoll & Jin, 2013). Another explanation, which is not centered on gains and losses, is that disposition behavior occurs because of under-reaction to news (Andreassen, 1990; Frazzini, 2006). However, it has been found that good and bad news in narrative form are relied upon more than historical price series of assets (Sobolev, Chan, & Harvey, 2017). This suggests that different types of factors may drive the disposition effect, and hence, investment behavior.

Another aspect suggested as important for trading strategy and the disposition effect is emotions. Gärling, Blomman, and Carle (2017) suggested that people hold on to their investments as long as there is hope for gains. When the fear of loss equals the hopes for gains, a preference for selling is formed. Furthermore, individual factors are related to the disposition effect. The effect has been found to be weaker within individuals who are wealthier, have professional occupations, or trade more frequently (Dhar & Zhu, 2006).

In the studies of this thesis the effect of prior gains and losses was investigated in relation to information about the future. Some confusion may arise from terminology, such as what holding on to a stock for too long or short means or what risking capital may mean. To keep it simple, I will treat the distinction between the two effects as whether or not the willingness to reinvest in (or keep) rising prospects is greater or smaller than the willingness to reinvest in (or keep) losing prospects.

Subjective understanding of one’s own decisions

For decisions in general it can be argued that insight into how one’s own decisions are made is of great benefit to the decision maker. Two aspects are relevant regarding this insight. First, it can be beneficial to know what information you base your own decision on, that is, belief-congruent decisions. Second, it can be beneficial to make decisions in accordance with how you value different options, that is, preference congruent decisions. It was demonstrated several decades ago that this is not always the case. How people judge and how people decide are not always the same (Slovic, 1975; Slovic et al., 1990; Slovic & Lichtenstein, 1983). This is relevant in the con-
text of judging asset accumulations, because these judgments do not necessarily predict investment decisions.

Financial analysts have been shown to have an understanding of how they use different cues as a basis for their decisions (Mear & Firth, 1987). This is not necessarily the case for non-professional individual investors. An analyst has a lot more understanding and experience in the field of finance than an inexperienced investor. The analyst have practiced and hopefully elaborated on investment strategies and how to execute those strategies. This may not always be the case for the inexperienced individual investor, who may not understand how different information cues affect their own decisions. Another note is that the individual investor is personally involved in the outcome of the investments, because the investments have a direct effect on the individual’s personal financial position. Therefore, it is important for the investor to understand what she or he is doing. The relationship between the financial risks people actually take and their subjective risk preference is weak, and it has been suggested that it should not be used as a measure of objective risk (Hermansson, 2018). This further indicates the limitations of the insight of the individual investor.

The world of investments is complex, and when a person is confronted with complex problems there is a tendency to simplify, certainly when time and expertise are lacking. To simplify and to save time and effort, we tend to use mental shortcuts; this will be my next topic.
Heuristics and cues

Kahneman and Tversky started the heuristics and biases tradition. They assumed that for complex problems we often make systematic (biased) judgments and decisions that are suboptimal. This occurs because we use mental shortcuts (heuristics) to obtain simplified solutions (Tversky & Kahneman, 1974). A more positive view on heuristics is that heuristics are often very valuable, and ignoring some information may be even better than trying to arrive at a decision based on all of the information (Gigerenzer & Gaissmaier, 2011). In my understanding, the Kahneman and Tversky viewpoint is not that heuristics are inherently bad, but Gigerenzer puts greater emphasis on the usefulness of heuristics.

In the studies of this thesis, to optimize expected value the only information needed was that the gain and loss interest rates of the possible outcomes were of the same number. All information apart from the equality of the forecasted positive and negative interest rates was irrelevant for maximization. Because the interest rates were equal for the gain and loss outcomes, the gain accumulated a greater marginal gain than the loss accumulated marginal loss, illustrated by equation 4. The left side of the equation indicates how much greater the starting value $V_0$ has become after time period $t$ with the gain $g$ for each period (marginal gain). The right side of the equation indicates how much smaller $V_0$ has become after the same length of time period $t$ and a loss of the same magnitude as the gain $g$.

$$V_0 (1 + g)^t - V_0 > V_0 - V_0 (1 - g)^t$$  \hspace{1cm} (4)

The probability was 50/50 for the gain and loss outcomes; hence EV was always positive and increasing with investment size. Thus, the maximizing solution was to realize the positive gain/loss asymmetry and just invest all of the available assets at all times. This can be seen as normative behavior, that is, what homo economicus would do. However, it should be noted that the gain/loss asymmetry increases with greater annual gains and losses $g$. In other words, the greater the annual gain and loss rate, the greater the difference between marginal gain and marginal loss, in positive direction.

A good foundation for prescriptive models is directing people towards decisions that, based on a reduced amount of information, have the potential to yield the highest value or utility. However, this can be problematic in cases where people value the importance of different information in different
ways from each other, even when they seek the same outcome in some re-
spect. Svenson (1979) suggested that what determines a choice is not the
objective or subjective value of different attributes of alternative choices.
Instead, the decision maker relies on the attractiveness of the different attrib-
utes of the alternatives. In the simplest case a rank order of the attributes can
help discriminate between alternatives and determine the choice. For exam-
ple, a person may select an apartment based on the attractiveness of attrib-
utes such as size, rent, and surroundings, but people vary as to what attrib-
utes they see as important and what attributes they chose ignore. In other
words, people will perceive values of attributes differently, depending on
their personal preference for each of the attributes. In the context of invest-
ments this can be translated into how attractive a person perceives different
information regarding investment prospects to be, for example, prior fund
performance, how a professional forecast is presented, or the potential value
of future assets gained or lost from an investment.

That people use heuristics and focus on different information is very rele-
vant in investment settings. A reason for this is that the salience of different
attributes or information may lead to attention being allocated to that infor-
mation (Andreassen, 1988; Hirshleifer & Teoh, 2003; Lambert, 2003; Libby,
Bloomfield, & Nelson, 2002). This indicates that both preferences and be-
liefs, again, will be involved in the decision-making process.
Methodology

Two important aspects considered for the experiments in this thesis are personal wealth and the behavior of the individual. Personal wealth is important because people tend to judge and decide in relation to a reference point (Kahneman & Tversky, 1972; Tversky & Kahneman, 1992), and reference points can depend on wealth. Analyzing the behavior of each person individually is important in the task of describing how people use numerical information for their own decisions. These are the two following topics.

Personal wealth

Becker & Mulligan (1997) suggested that wealthier people have a lower time preference than less wealthy people, that is, they can wait longer to realize their gains. Furthermore, it has been consistently shown that once the basic needs are met, when wealth increases, happiness only increases temporarily (Ahuvia, 2008). For obvious reasons, precautionary saving is a greater factor for a person who is closer to falling below the basic needs threshold, that is, the less you have, the more you benefit from an economic buffer. If wealth is below a target value, savings increases because people do not want to become poor in the future (Carroll, 1997). In all of the studies in this thesis the participants were informed that they should assume that they have enough assets to handle eventual losses. This was done in an effort to ameliorate effects of personal wealth.

This was assumed to be important because the population examined was students, and students tend to have low wealth. The aim was primarily to investigate how the numerical information was used by the participants; therefore, we wanted to reduce effects of varying wealth among the participants, especially if some participants would have difficulties in making ends meet because of their studentship. It could be interesting to investigate how the use of information might differ depending on wealth, but this is outside the scope of this thesis.
Individual behavior

It is common in psychological and behavioral research to try to explain psychological processes from averaged values of quantified data. A problem is that several different processes may yield different results that together create an average person in the data that does not exist.

In neoclassical economics it is common to use as-if arguments. Friedman (1953) describes as-if models as models that make predictions that are accurate within a margin of error. However, these models do not actually describe the mechanism behind the predicted outcome. For example, how a pool player shoots the ball can be described by a mathematical formula. The player, however, does not think in terms of the formula. The player will rather use experience and motor coordination and may not even be able to describe how to arrive at the exact shooting of the ball. Therefore, as-if models can be simple and effective ways of making predictions, but in terms of describing actual cognition, they lack explanatory value.

Behavioral economics aims to add the aspect of psychological processes in economic behavior and thus to become more realistic in its explanations of outcomes and the behaviors causing these outcomes. However, criticism has been directed toward theories in behavioral economics because they often justify psychological models from as-if arguments (Berg & Gigerenzer, 2010).

In this thesis I have extended several analyses beyond the average person and analyzed, within each individual, relationships between the experimental problem information and investment behavior. This was done to better describe different ways to process the information available and how it can vary between individuals. In other words, I have tried to move away from describing behavior as if people behave in a certain way and get closer to how they actually behave.
Empirical studies

This thesis consists of three studies. All three studies investigated long-term fund investment decisions in relation to historical and forecasted interest rate information. The studies also included judgments of accumulated assets to find out to what extent beliefs about future asset outcomes can be related to how a person invests. The studies were experimental, and data were gathered with surveys. Figure 3 illustrates an example of a problem of the type used in the thesis studies.

![Example Problem](image)

At the end of year 5 I would save ______ of the capital in the fund locked for the years 6-10. Under the assumption that both outcomes have EQUAL probability to occur.

*Figure 3: Problem example: Illustration of the problem type used in all three of the studies in this thesis.*

The funds started at a value of SEK 10 000, invested in the beginning of year 1. Then, there were two investment periods of accumulation by interest rate, five years each. The first period, years 1–5, had an annual interest rate that was either positive (+) or negative (-), that is, gain or loss. The second period, years 6–10, had one gain and one loss outcome. There was equal probability of a gain or a loss during the second period, p = 0.5.

First, the participants were asked to judge the assets accumulated at the end of year 10, assuming that no assets had been withdrawn at any point during the years 1–10. Asset judgments where made after both the gain and loss outcomes of years 6–10.
Second, the participants were asked to state how much of the assets accumulated during the years 1–5 they would be willing to lock into the fund for the period years 6–10. It is important to note that in all of the experiments in this thesis the gain and loss outcomes (years 6–10) are described as annual gains and losses of the same absolute percentage, for example, 10% gain and loss, as in Figure 3. This means that the gain each year is greater than the year before, while the loss each year is smaller than the year before. Hence, the accumulated marginal gain will always be greater than the accumulated marginal loss. Because the probability of gain and loss is equal, this means that to maximize expected value all of the assets should be reinvested for the second five-year period (years 6–10). In the following, short summaries of the central parts of the studies are described. Details can be found in the full articles. Supplementary figures and graphs, illustrating distributions and so on, can be found in the appendix.

Study I: Growth and decline of assets: On biased judgments of asset accumulation and investment decisions

Background

It is well known that it is difficult to accurately judge exponential changes such as asset accumulations (Benzion et al., 2004; Timmers & Wagenaar, 1977; Wagenaar & Sagaria, 1975). When people value assets in the future, the value is perceived as less the longer into the future the value will be realized. It has been suggested that the decline can be described by a hyperbolic function (Loewenstein & Prelec, 1992). This means that the rate of the value discounted over time becomes lower with time, that is, a concave function describes the value over time. This suggests that if a time period of value change is split into two consecutive periods, the first period should be given greater weight. Therefore, the first aim of this study was to find out whether people give greater weight to the first or second period of asset accumulations when judging finally accumulated assets. Note that, objectively, the order of two periods does not affect the outcome of accumulated assets because of the fact that the changes from the interest rates are simply multiplied by each other.

The second aim of this study was to investigate how judgments of accumulated assets are related to investment decisions. We also wanted to know how gains and losses of different interest rates affected investment decisions.
Method

Participants
There were 46 participants recruited from the Department of Psychology, Stockholm University, 12 male and 34 female. The average age was 24.6 years (SD = 4.6) ranging from 19 to 38 years. The participants were compensated with either a one-hour course credit or a cinema ticket voucher.

Procedure
The participants received a questionnaire with all instructions included. The participants were allowed to ask the experimenter questions if they were uncertain about how to fill out the questionnaire. First, they signed an informed consent, and then, they proceeded to fill out the questionnaire. The experiment took place in a quiet classroom, and participants filled out the questionnaire at their own pace, without time limit. No external aids were allowed (i.e., calculators or making notes). The questionnaire included two conditions described below.

Condition 1
The first condition included only judgment problems. The task was to judge the accumulated asset value of bank funds. To exemplify, at the start of year 1 the value was SEK 10 000; years 1–5 the fund value changes by -5% each year and years 6–10 it changes by +15%. What is the fund value at the end of year 10?

Each fund started at a value of SEK 10 000. The fund value then accumulated over 10 years, described as two consecutive five-year periods. Each five-year period had a constant annual interest rate. The interest rate was never the same for the first and second period in the same fund. The annual interest rates were -15%, -10%, -5%, +5%, +10%, and +15%. Every combination of the different percentages was presented once (except for the same percentage during both periods).

Condition 2
The second condition used the problem formulation described in Figure 3. The percentages used were -15%, -10%, -5%, +5%, +10%, and +15%. The absolute numerical percentages were equal between the first and second period; for example, if the percentage was +5% during years 1–5, the gain and loss outcomes of years 6–10 were +5% and -5%. This way, six problems were generated.
Results

Condition 1

As predicted from previous studies (Benzion et al., 2004; Timmers & Wagenaar, 1977; Wagenaar & Sagaria, 1975), accumulated assets were underestimated for funds with greater growth. The smallest but statistically significant underestimation was for the fund with -5% the first five years and +15% the second five years. The average judgment was SEK 13 162 and the correct accumulation was SEK 15 564. The greatest underestimation was for the fund with 10% the first period and 15% the second period, judged SEK 23 502 and correct SEK 32 393.

The main question was whether people put greater weight on the first period’s interest rate or the second period’s interest rate. On average, judgments were greater when the most positive/least negative interest rates were present during the first period compared to the second period, 12.7% (partial \( \eta^2 \)) of the judgment variance accounted for. This finding is in line with the hyperbolic model. However, when the individuals were analyzed separately it was found that 1/3 of the participants systematically gave greater weight to the second period. In other words, a substantial number of people put more weight on the more distant future, which is not expected from the hyperbolic model.

Condition 2

Whether there had been a gain or a loss before a reinvestment opportunity (years 1–5) accounted for a statistically significant 5% of the investment variance in a linear regression. Investments were on average greater following gains (56% of assets reinvested) compared to losses (39% of assets reinvested). Interestingly, neither the numerical interest rates of the gains and losses nor the judged asset outcomes at the end of year 10 accounted for additional variance in the investments, which was not already accounted for by the gain/loss factor. In other words, these analyses indicate that people rely only on the sign (+/-) of the period before the reinvestment opportunity and that they invest more after gains.

Conclusions

People tend to underestimate asset accumulations over time when the total growth has increased beyond a certain point, but they are affected differently by the order of interest rates in a time series. Furthermore, a person’s asset judgments may be of little importance for that person’s investment decisions. Instead, investments seemed to be mostly affected by whether there had been a gain or a loss before the investment, regardless of the size of the gain or the loss.
Study II: Different investors—different decisions: On individual use of gain, loss and interest rate information

Study I (Gonzalez & Svenson, 2014) as well as other studies (Choi et al., 2010; Newall & Love, 2015; Wilcox, 2003) have shown that people tend to rely too heavily on past performance and ignore other more relevant information. In this second study the aim was to investigate in greater detail how people use interest information. Two experiments were conducted, where the first experiment was a replication of the investment experiment in study I, and the second experiment was conceptually the same but with a greater variation of fund interest rates. To gain further insight into different strategies, the strategies for each individual participant were analyzed. Furthermore, subjective protocols were added to investigate what information the participants perceived as important for their decisions.

Experiment 1

Method

There were 45 participants recruited from Stockholm University, 13 male and 32 female. Ages ranged from 19 to 50, M = 24.69, SD = 5.64. The problems and procedure were the same as in Study I.

After judging accumulations and making investment decisions, the participants were asked to rate how important the different types of information were. The scale ranged from 0 (no importance) to 10 (maximum importance). The following questions were asked (translated from Swedish):

1. If you disregard the size of the percentage, what importance did a fund increase (+) or decrease (−) during the first five years have for your investment decision?
2. When a fund had increased (+) in value during the first five years, what importance did the percentage size have for your investment decision?
3. When a fund had decreased (−) in value during the first five years, what importance did the percentage size have for your investment decision?
4. What importance did the percentage size have for the possible gain outcome (upper arrow) during years 6–10 have for your investment decision?
5. What importance did the percentage size for the possible loss outcome (lower arrow) during years 6–10 have for your investment decision?
6. What importance did your judgment of value after 10 years when there was a gain (upper arrow) during the last 5 years (years 6–10) have for your investment decision?
7. What importance did your judgment of value after 10 years when there was a loss (lower arrow) during the last 5 years (years 6–10) have for your investment decision?
Results

The investments were analyzed with a repeated measures ANOVA 2(sign, +/-) × 3(percentage, 5%, 10%, 15%), and only the sign accounted for investment variance significantly F (1, 44) = 18.70, p < 0.001, partial $\eta^2 = 0.298$. The judgments of accumulated assets at the end of year 10 following gain and loss outcomes did not add any explanatory value to what was already accounted for by the sign.

To gain further insight into investment strategies, the Pearson’s correlation between each of the different information cues and the investments was calculated for each participant separately. These are referred to as the individual correlations, or importance. If a cue accounted for at least 50% of the variance of the investments it was coded as highly important for that participant’s investments. The 50% threshold was chosen because then no other cue can account for more variance in the investments unless the predictors of investments also are highly correlated.

The frequencies of highly important information cues showed that the sign was highly important for about half of the participants. In general participants wanted to invest more following gains and less following losses, except for two participants for whom the reverse was true. There were only a few participants who also included the information about the magnitude of the interest rates. In other words, participants focused on the sign of the interest rate but not on the percentage number. These results correspond to the group-level analysis. However, looking at how interest rate affected individuals for gain funds and loss funds separately revealed that this information was highly important for the majority of participants, but they were affected very differently; some invested more with increasing interest rates, while others invested less. This indicates that the interest rate numbers affected participants differently within the gain and loss domains separately. Judgments of accumulated assets were highly important for only a few participants, corresponding to the group analysis.

We also asked the participants how important they thought the different information cues were for their own decisions. The participants’ ratings showed a statistically significant but weak relationship (Spearman’s $\rho$) between the importance they perceived the information had and the importance the information actually had. To ameliorate difficulties in judging accurately how important information was, the importance was rank ordered within each individual. This was done for both the judged importance and the importance derived from the investment data. Only 1.9% of the variation in how important the different information was for the decisions was accounted for by the subjective ratings of how important that information was perceived to be for their own investments.
Experiment 2

Method

There were 58 participants recruited from Stockholm University, 11 male and 47 female. Ages ranged from 19 to 64, M = 28.07, SD = 8.66. The problems and procedure were the same as in experiment 1, with the exception that the annual interest rate percentages now were -20%, -10%, -1%, +1%, +10% and +20%.

Results

As in experiment 1, the data were analyzed first on a group level and then on an individual level. A main effect of sign was found in a repeated measures ANOVA 2(sign, +/-) × 3(percentage, 1%, 10%, 20%), F (1, 52) = 15.48, p < 0.001, partial $\eta^2 = 0.229$. However, there were some different results in the second experiment, which had a greater range of annual interest rate percentages than experiment 1. There was a small interaction effect between sign and percentage, F (2, 104) = 4.525, p < 0.05 partial $\eta^2 = 0.080$, meaning that the percentages following gains and losses may have affected investments differently.

Analysis of the individual correlations showed that the sign was not highly important (23%) for as many participants as in experiment 1 (51%). Instead, it was more common for participants to put great weight on the numerical interest rates and even their own judgments of accumulated capital.

As in the first experiment, the participants’ own ratings of how important the cues were for their own investments only corresponded weakly to how well the cues correlated with the investments (2.2% of the variance accounted for).

Conclusions

Similar to the first study, this study showed that sign (gain or loss) during the first five years, before the investment, was the main explanatory variable on the group level. However, in this second study, by analyzing each participant’s investment strategy separately, it was found that the interest rates influenced the participants differently; some invested more and others less with increased annual interest rates. Furthermore, when the range of the annual interest rates was increased, the participants’ own judgments of accumulated assets were highly important for their own investment decisions for a substantially greater proportion of the participants. The greater differences among interest rates and judged asset outcomes may have led participants to focus more on these variables compared to the first experiment.

An important implication of this is that it is relevant to consider the development (interest rates) of different fund prospects that are presented to
investors. The importance of considering fund variations that are presented is further strengthened by the finding that investors in general show very little insight into what cues they rely on when making investments.

Study III: Nominal or proportional investments: Investment strategies, judgments of asset accumulations and time preference

Study I and Study II showed that on a group level people rely primarily on the sign (gain or loss) of the fund history and invest more after gains. Study II revealed that greater variation in fund interest rates led participants to be influenced more by the numerical percentages of gains and losses as well as relying more on their own judgments of asset accumulations. The third study used the same problem type as Studies I and II to gain even further understanding of the use of interest information.

In Studies I and II participants made their investments as a percentage of their available fund assets. The main question in Study III was whether people invest differently depending on whether they are asked how much they would like to invest in the present currency (SEK) compared to how they invest when they are asked how big a proportion of their assets they would like to invest. This is important, because asking about the actual amount of assets gives judgments that are closer to the objectively correct numbers, compared to asking about proportions of assets (Eriksson & Simpson, 2012). Hence, people may perceive their investments differently depending on the response format.

A further addition to the previous studies was to investigate how time preference relates to investments and judgments of accumulated assets. Time preference refers to the tendency for people to prefer smaller rewards in the present compared to greater rewards in the future. In other words people tend to act as if the utility of rewards declines with time. Different models have aimed to describe time preference, for example, hyperbolic discounting (Loewenstein & Prelec, 1992), which was the inspiration for investigating judgments of asset accumulations in study I. Because future oriented judgments (a belief) and future-oriented preference can be different, we wanted to know to what extent time preference is important for this type of long-term investment decision.
Method

Participants and procedure
There were 87 participants recruited from Stockholm University, 22 male and 65 female. Ages ranged from 19 to 53, $M = 25.78$, $SD = 7.28$. The procedure was in general the same as for the first two studies.

Material
The problems in this study were formulated in the same way as in the first two studies (Figure 3), with the exception that the assets accumulated at the end of year 5 were also judged. This was added primarily to enable conversion of investments made as SEK to proportions, hence making these investments comparable with the investments made as proportions.

New combinations of interest rates were also added. In this study the interest rates -20%, -10%, -1%, +1%, +10%, and +20% were used, and all combinations of interest rates during the first and second periods were used. This gave a $6 \times 3$ factorial design.

Finally, a section with safe investments was added, that is, investments with guaranteed gain. The guaranteed gain was 1%, 10%, or 20%. Figure 4 illustrates an example of this type of fund problem.

![Figure 4: Example of an investment with guaranteed gain.](image)

At the end of year 5 I would save _____ of the capital in the fund locked for the years 6-10.

These problems were used as a measure of time preference. The more a participant would invest, the more patient that participant was assumed to be, that is, the participant showed a greater willingness to wait for a greater amount of assets in the future compared to receiving a smaller amount of assets now.

Results
Analysis of the group data showed no effects of response format, SEK or percentage, on investment decisions. As in study II, we proceeded by analyzing the participants’ individual strategies. The importance of an information
cue was considered high if it accounted for 50% of the variance in an individual’s investments. This analysis revealed that more participants relied highly on the second period interest rates in the SEK condition (18.4%) compared to the percentage condition (4.7%). Furthermore, when analyzing the reliance on interest rates separately for funds that lost compared to gained prior to the investment opportunity, it was found that it was about twice as common to disregard forecasted future interest rates following losses in the SEK condition compared to the percentage condition. It was also more common in the SEK condition to reinvest all of the assets following losses, 16% compared to 2% in the percentage condition. These differences between conditions go in different directions, but they all indicate a more categorical thinking after losses if the investments are made as a number of SEK compared to as a percentage of assets.

We also investigated the relationship between time preference and investment decisions as well as judgments of accumulated assets. Time preference was to some degree important for the investments. Investments in funds with 10% and 20% guaranteed annual interest rates (time preference measure) accounted for 7%–10% of the variance of investments in funds with risk. Similar to Study I and Study II, it was found that judgments of asset accumulations were only weakly related to investments in both groups (SEK and percentage). Furthermore, judgments of accumulated assets were very weakly related to time preference measured with different interest rates; the variance accounted for was between 0% and 1.6% for the different measures. In short, time preference and investments were found to be related to an important degree, while judgments of asset accumulations seem to have a very limited relation to the former two variables.

Conclusion

For group-level predictions it does not seem to be that important whether investors are asked to make their investments as a number of currency units or just to make the investment as a proportion of the available assets. However, when looking at individual investors, making investments as a number of monetary units (SEK) can trigger more categorical thinking. This means that the investors rely heavily on certain information and disregard other information completely. Alternatively, they decide to either just invest everything or completely withdraw their assets from ongoing investments across fund prospects.

Judgments of asset accumulations were not important for investments but time preference was. This indicates that impatience for rewards is, as expected, a factor relevant for this type of investment. Importantly, judgments of assets were very weakly correlated with time preference. This indicates that the underestimation of asset accumulations that has been found repeatedly is not driven by an impatience for rewards.
Summary of key findings, Studies I – III

The empirical studies of this thesis investigated the influence of interest rate information when making long-term investments. These studies also investigated judgments of asset accumulations and time preference in relation to investments. Importantly, the studies distinguished between group analyses and analysis of each individual separately.

On the group level the studies showed a clear picture regarding the investments; the investments were greater after gains than after losses. The gain/loss factor, also known as the sign, was the only predictor of average investments that was statistically significant across all experiments.

The most important finding was that the large variance around the means, consistently found, which was not just random investments or noise. The individual analyses showed that what cue was important for an investor varied among participants. Furthermore, the same cue affected the investments of different participants very differently, for example, some invested more when interest rates increased, while others invested less. This indicates that the cognitions were clearly different between individuals, and that conclusions about how people think about their investments may be very misleading if they are drawn from averaged measures of behavior.

It was also illustrated that the judgments of asset accumulations were consistently biased, that is, great underestimations of great growths. However, the difficulties in judging asset accumulation accurately may have limited impact on investment strategies because they had very little influence over investment sizes. These judgments, as well as the investments, were shown to be made differently by different individuals.

Finally, judgments of asset accumulations had little to do with time preference but time preference was shown to be a factor influencing investment decisions to some extent.
General discussion

In accordance with Simon’s idea that people are not maximizers, extremely few participants of the empirical studies of this thesis used a maximizing strategy. Instead, different participants relied on different types of information and were affected by their preferences when they made their investment decisions. In the following discussion the first topic will be the general house-money effect that was consistently found on the group level. Then, asset judgments and time preference will be discussed. This will be followed up by the individuality of investors and the investors’ understanding of their own decisions. Methodological issues and future suggestions are recurring during the entire discussion but in the final sections they were discussed specifically.

The house-money and disposition effects

On the group level it was repeatedly found across Studies I–III that investments were greater after gains than after losses, that is, a house-money effect. However, there were several participants who acted the opposite way in Studies II and III, that is, a disposition effect. Aspara and Hoffmann (2015) found house-money behavior for individuals making investments with someone else’s money, while a disposition effect was found for investments of their own money. Furthermore, when gains were attributed to external factors and losses to the investors’ own faults, the disposition effect is reversed to a house-money effect. The reversal of investment behaviors may occur because of feelings of responsibility being shifted (Aspara & Hoffmann, 2015). The studies in this thesis used hypothetical funds, where participants started off with several funds worth SEK 10,000 each. The gains and losses, historical and forecasted, were presented to the participants before they made their investment decisions. Furthermore, the participants were told that they should imagine that eventual losses from their decisions would not impact their finances such that they would have severe implications for their lives. Hence, they were presented with a situation where they could imagine assets being added to their regular finances, and they could “gamble” with this money any way they saw fit because of a more risk-free
environment. This may have driven the consistent finding that investments were greater after gains than after losses, i.e. house money behavior.

Another important finding regarding the disposition effect is that it can be reduced if the stock purchase prices are not displayed and therefore less salient (Frydman & Rangel, 2014). In the investment problems of Studies I–III purchase price was never shown, only the total fund value before any value change had occurred and the historical and forecasted annual percentage gain or loss. Hence, this may be an explanation of why a house-money effect was repeatedly found in Studies I–III, instead of a disposition effect. Because, a house-money effect was found and there were no prices involved, these results corroborate the suggestion of Frydman and Rangel that decreased saliency of stock prices can reduce the disposition effect.

Investors often invest based on market trends (Jonsson et al., 2017b). Our results indicate that this effect is strong, because the problems used in the studies in the present thesis all presented forecasts in addition to the trend shown as history. Even though the forecasts were given, a substantial number of the participants relied heavily on the historical data and ignored information about the future. In other words, they based their decisions on whether or not a previous trend was positive or negative.

Economists often include only predictions about the sign (gain or loss) of different effects, and hence ignore magnitudes in their theories (Thaler, 2016). In Studies I–III, on the group level people behaved as if they relied on the sign and behaved in accordance with a house-money behavior, ignoring the rest of the information. Reliance on only the sign was also found among some of the individual participants. However, this behavior was only common when the variation in gain and loss interest rates was small, and many participants relied on different magnitudes of interest rates. This is an example of how the traditional economic approach can be good for predicting outcomes, that is, people behave as if they only care about the sign. What this approach lacks is descriptions of what people actually do. The sign-driven house-money behavior was shown across experiments, even though participants in different experiments relied on different information cues. Much of the information about behavior was lost in the aggregate data analyses used to examine group behavior, in part because people were affected in different directions.

Judgments of asset accumulations and time preference

Beliefs and preferences are important in understanding economic decision-making. Beliefs are ideas about what facts are, or will become, true in this world. In Studies I–III, judgment of asset accumulation was used as a
measure of belief. These judgments are supposed to reflect beliefs about how much funds can be worth in the future. Because, funds will have a clearly defined measurable value, these can be compared to the beliefs people have about what the value will be. Preference refers to what a person would prefer among a set of available options. Time preference, a preference for waiting for greater rewards compared to receiving smaller rewards sooner, was also measured. The aim of using these measures was to gain understanding about people’s future-oriented cognitions. First, I will discuss the asset judgments, and then, time preference and how it relates to both the investment decisions as well as the asset judgments.

Judgments of asset accumulations

Judgments of asset accumulations have been shown to have a positive relationship with some aspects of people’s wealth (Stango & Zinman, 2009). However, the results from Studies I–III suggest that judgments of asset accumulations have very limited effect on fund asset allocation decisions. This may indicate that there is no direct link between these judgments and economic decisions but that wealthier people in general also have better mathematical education and understanding of accumulating functions.

The weak, or non-existing, relationship between asset judgments and investments can be seen as a positive thing. Because, participants were repeatedly found to be very inaccurate in their beliefs of future values it is presumably good for those people that they did not rely on their own faulty judgments. They may have understood that it is a difficult task to judge accumulations. Therefore, they may not have considered their own judgments as basis for their investment decisions. The idea that people may realize the limited accuracy of their judgment and therefore not rely on it is an interesting topic for further study. Ideas for further studies are, for example, giving people the option to use a calculator or comparing people that use a calculator to those who do not, to see if their strategies may differ. In real life it is of course advisable to calculate different outcomes to get a clearer picture of the actual amounts of assets that can be gained or lost over different time periods.

Time preference, asset, judgments and investment decisions

In Study III, time preference was investigated and found to correlate with investment decisions. Participants who were willing to set aside more of their assets for five years to receive greater asset increases after the period were also more willing to invest in funds with risk during the five years. However, time preference was not related to judgments of asset accumulations. Because time preference can be assumed to be a preference depending on impatience and other traits within the individual, it is more likely that
time preference moderates investments than vice versa. Figure 5 illustrates a suggested relationship that could be the subject for further testing.

![Diagram](image.png)

*Figure 5: Illustration of suggested relationship between time preference, judgments of accumulated assets, and investments. The red arrows indicate that there is no, or negligible, relationship between the constructs.*

The weak relationship between asset judgments and time preference may indicate that biased judgments of asset accumulation are primarily a result of difficulties in handling mathematical power functions intuitively. In terms of the behavioral economic approach suggested by Thaler, one may argue, regarding future-oriented preference and beliefs, that the preference (time preference) is more important than the beliefs (judgments of future asset accumulations).

**Investor individuality in information processing**

As illustrated primarily in Study II, participants relied on different information for their decisions. In Study III it was shown that different participants disregard different information. This shows how different people use the provided information.

Andreassen (1988) pointed out that it can be difficult to explain heterogeneity of investors’ strategies. He suggests that one explanation for why opposing strategies occur is that people focus on different aspects of a historical series of price changes. This way, the same general rule for investments
can generate different results for different investors. The studies of this thesis indicate that people tend to focus on certain aspects of the development of the funds. When the variation (interest rate) was constant between the historical and forecasted period, a substantial number of the participants relied heavily on some information. However, the information relied upon, and whether that information led to increased or reduced investments, differed between participants. It should be noted that this conclusion was also based on the strict criterion of an information cue explaining at least 50% of the variance in the investments of an investor.

Ranyard (1987) showed with verbal protocols that when making a choice among gambles people can group or pair alternatives to make comparisons easier. The idea here is that by grouping or pairing alternatives cognitive load is reduced. Comparisons need only to be made on variables in that group. Study III had variation between investment periods in contrast to Studies I and II, which had the same numerical percentage across both periods. Hence, grouping or pairing funds as a strategy may explain why disregarding information completely was common in Study III. A grouping or pairing strategy can generate different results, depending on what variable a person groups on before making comparisons within the group. This may also explain why participants in Study III did not show as many highly important cues as those in the first two studies. Participants may have categorized the 18 funds into subgroups that I did not think of before analyzing the data. Hence, verbal protocols may be a much-needed type of study in similar contexts.

Several factors that moderate investment behavior have been found by other researchers. The risk tolerance of an individual investor and that investor’s perception of personal investment competence leads to contrarian behavior, which means buying stocks when their prices are dropping (Jonsson et al., 2017b). Some of the variability in investor behavior can be attributed to subjectively perceived risks, and it is a better predictor than the objective risk (Nosić & Weber, 2010). However, objective risky investment behavior and self-perception of risky investment behavior have been found to be only loosely correlated, and the former was the better predictor of investments (Hermansson, 2018).

The ability to make well-informed financial decisions is often referred to as financial literacy. A high level of financial literacy means that sufficient understanding and knowledge about financial information are relied upon when deciding how to allocate assets (Agarwal et al., 2011). Financial literacy is difficult to improve, and some evidence suggests that people do not change their behavior, even after financial education. Furthermore, behavioral changes tend to decay over time. This was illustrated by a meta-analysis where only 0.1% of financial behavioral change was accounted for by financial educational initiatives (Fernandes et al., 2014). It should be not-
ed that financial literacy often refers to technical knowledge such as computing compound interest rates (judgments of accumulated value is an unaided computation of this sort). Jonsson, Söderberg, and Wilhelmsson (2017a) found that this type of knowledge did not reduce the disposition effect, but knowledge about mutual funds and the stock market did.

Aside from financial literacy, which is coupled with investments, there is basic statistical understanding. One fallacy commonly found in gambling situations is the gambler’s fallacy. This fallacy refers to the tendency to believe that random chance acts according to some pattern, that is, dismissing the fact that when there is random chance each consecutive gamble is independent of the next. In reality, if there have been three heads in a row when tossing a coin, there is still a 50% chance for another head in the next toss, assuming a fair coin. A person susceptible to the gambler’s fallacy would instead believe that the chance for heads increases with each toss showing tails. Concerning investments, the gambler’s fallacy has been suggested to drive a disposition effect. Even when participants themselves perceived the price changes to be random, they expected prices to go up if they had gone down for several periods (Talpsepp, Vlcek, & Wang, 2014). This suggests that different types of knowledge about numbers and chance have different impact, and distinctions between different types of numerical capabilities have to be made with care.

A suggestion regarding the goal of making value-based decisions is to primarily manage a social and personal identity within social relationships (Ahuvia, 2008). This may explain some of the variety of strategies. For example, some individuals may stick to safer investments to appear responsible; others may want to appear as great investors and invest more in riskier prospects. Furthermore, time preference may be moderated by social relations because spending money with friends may be important to be able to maintain relationships by participating in the same costly activities, for example, dinners or going to a show. These social motives may influence the information relied upon as well as leading to a lower time preference (showing of money to friends). The time preference in turn moderates investments. Furthermore, different motives to save money may moderate the likelihood of saving to occur (Fisher & Montalto, 2010), but the support for the relationship between motives and actual savings were mixed. Motives to save can be seen as motives to have a lower time preference, that is, motives to wait for greater rewards. Therefore, Study III is in line with this finding by finding time preference as a partial explanation of the investment sizes.

These different explanations of investment behavior can be used in conjunction with an information usage approach, as in Studies II and III, to gain further insight into whether these variables can explain what information will be focused on.
Understanding one’s own decision

Svenson (1979) suggested that in some cases only rank order relations between aspects of alternatives (in this case, interest rates, etc.) are defined by the decision maker when making a decision. In other words, people do not use complex weighting functions; rather, they compare alternatives in relation to their preferences. This line of thinking inspired an analysis of Study II. The participants rated how important the different information was for their decisions. These subjective importance ratings were rank ordered and compared to the rank order of how much the different problem information cues correlated with the participants own decisions (objective importance). In both of the Study II experiments it was found that rankings of how important the participants perceived information cues (i.e. attributes) correlated only 2% or less with how much they actually were affected by these cues. This suggests that there is a distinction within a person between how much they rely on, or value, different information and what this information actually means for their decision made later on. Importantly, this reveals that if we assume that people are not maximizers, and rather act according to some other preference, participants did not act according to their own preferences.

Subjective understanding of financial products (e.g., funds), that is, thinking that one understands financial information, has been found to moderate investment behavior (Hadar, Sood, & Fox, 2013). People with greater belief in their own knowledge are prone to make riskier investments; this can be good as well as bad. If prospect information that is too much and too technical is presented, subjective understanding may be lowered. This can in turn lead to people being deterred from investing. Furthermore, other studies have found that higher belief in one’s own knowledge leads to reduced information search (Alba & Hutchinson, 2000; Bettman, Park, & Whan Park, 1980). This can indicate that complexity of problems and confidence in one’s own capabilities moderate investments. Together, the complexity and confidence may cause behaviors that deviate substantially from what is expected from the investor’s own beliefs and preferences. This is important because of the low correspondence between what information the participants thought was important for their decisions and what actually influenced them, in Study II. Many participants may have been overwhelmed by the long accumulation periods or different interest rates, or they may have had strong beliefs in their capacities and only looked at certain types of information.

To change behavior requires more than skills and knowledge (Webb & Sheeran, 2006). According to Vlaev and Elliott (2017), behavioral sciences have recently shown that people are very limited in their understanding of what has influenced and will influence them. This insight is corroborated by the findings in Study II, where participants showed very limited understand-
ing of what information influenced their decisions. To clarify, there are several factors involved in decision-making other than just technical knowledge. This is one reason why it can be useful to understand how people think. This knowledge can be used to help people understand their own decision-making and subsequently to help them change their behavior when needed. If one not only has knowledge but also knows how to identify when, why, and what knowledge may be lacking, it is reasonable to assume that the chances of changing one’s own behavior may increase. This is important with respect to the relations mentioned earlier between different numerical capabilities and financial knowledge related to investment decisions. It can be of great benefit to further examine whether understanding of one’s own decision increases with better knowledge about statistics and finance.

Regarding development of decision aids and information for inexperienced investors, it can help to focus on the main points and show only the most relevant details. This can improve understanding, in particular for low numerate individuals (Peters et al., 2007). Low numerate individuals tend to focus better on narratives than on statistical information. Furthermore, it changes how they perceive forecasts (Dieckmann, Slovic, & Peters, 2009). Because, some individuals focused on historical information and others on forecasted information in the investment decisions in this thesis’s studies, this is an interesting topic for further study. For example, participants could be told the following. Your fund investment has gone down by 10% each year for five years. Now, we don’t know if the market will turn or not. Assuming it is as likely for it to turn as to keep going down, how much of your assets would you like to keep in the fund?
Methodological considerations

All three studies of this thesis were experimental and hypothetical. Of course, this has benefits as well as limitations. In favor of the hypothetical approach, real money experiments pose some problems for long-term investments. Not only are vast amounts of time and money needed but participants may feel uncertain that they will really get paid in five years (Thaler, 1981). A general limitation with experimental results is their generalizability. Therefore, it is good to know that overreliance on past performance has been shown to be a robust phenomenon found both in experimental settings (De Bondt, 1993; Mussweiler & Schneller, 2003) and in the real world (Greenwood & Shleifer, 2014). This suggests that even if the generalizability problem still exists, it is hopefully not a large problem in this regard. Another generalizability problem comes from the samples. Studies I–III consisted of young (average age ranging from 25 to 28), mostly female, university students. It can, from this demographic, be assumed that they mostly had limited investment experience. Therefore, it is not safe to assume that the distributions of different strategies can generalize to other groups of people. However, a strength that comes from the homogeneity of the groups is that the findings that strategies can be very heterogeneous become more salient. Furthermore, results can be compared more reliably between experiments. This is valuable in respect to the shifting of strategies depending on the information provided in the fund problems.

Problem formulation and house money

A consistent house-money effect was found across Studies I–III. The effect may have been driven by the fact that the participants were given funds, each starting at SEK 10,000, and instructed to assume that they could lose the money without critical implications for their private finances. This instruction was implemented in an attempt to reduce differences in the perceived utility of the assets caused by loss aversion or other factors. This was assumed to be important because the participants were university students who in general cannot afford losses to a great extent. However, this instruction may have led the participants to perceive the investment money as outside their standard financial assets and for that reason to treat the fund assets as “house money.”
The disposition effect (opposite to the house-money effect) is usually observed for sellers and may be dependent on whether a person buys or sells (Gärling et al., 2017). Because the participants in this thesis were asked how much they would like to keep in the fund, technically their decision was how much to sell. Participants could not add assets to the fund on top of what was already in the fund. However, because they were asked how much they were going to keep in the fund (not sell), it is possible that the participants saw the decision as an act of buying, instead of selling. The framing of the decision can be an interesting topic for further study to find out whether simple rephrasing of questions about how to proceed with investments might alter strategies of the investors. If this is true, investment advice may be better adapted to the preferences of the investor who is being advised.

Some may argue that the repeated house-money effect in this study is just a product of the experimental setting that creates an anomaly. If that is the case, it is useful information, because it provides an opportunity for hypotheses about how to reverse the disposition effect, or disposition behavior, when it is preferred to do so.

Regarding taxation of gains, a usual argument is to not follow a disposition strategy. However, investment savings accounts (in Swedish: investerings kapital konto, ISK) have a standard taxation for all the assets in the account instead of the traditional taxation of realized gains. When standard taxation applies, investors with disposition-effect investment behavior should not suffer less after taxation, based on their sell-high, buy-low strategy. This is an important factor to consider when thinking about developing decision aids. It also suggests that how information about taxation affects what information people rely on for their investment strategies should be investigated.

The long horizon

It can be assumed that people evaluate their investments once a year. This is because tax reports and comprehensive summaries of mutual funds and retirement savings are sent out once a year (Benartzi & Thaler, 1995). Therefore, having the restriction that the fund investments were locked in the fund for five years may have been too long in terms of ecological validity. Furthermore, it is usually possible to buy and sell funds at any given time. However, the benefit of this restriction is that people may actually think of it as a long-term investment at the time of the decision. This is useful because some advisors inform their investors to think of their fund savings over horizons of three to five years. Even if in reality an investor may have the possibility to reallocate assets between funds, it can be recommended that the decision to invest in a fund be thought of as if it were for a long period.
Overtrading has been found to be advised against, and hence, at the time of the investment the recommendation could be to actually think of the investment as being locked away for several years. Furthermore, men tend to be more overconfident in their investment capabilities, and this leads to overtrading (Barber & Odean, 2001). Hence, gender differences in this regard should be limited because the decisions were made for a long horizon. Because of the female-dominant samples in Study I–III, the inability to overtrade in the present context should increase generalizability across genders.

Another aspect of the assets being locked for five years is that in reality the resolution of uncertainty often occurs gradually over time instead of at a single point in time as in a lottery. People generally prefer that such uncertainty is resolved gradually over time rather than all at one point in the future (Ahlbrecht & Weber, 1997). Because the long horizon required a large commitment to the investment, this may have affected how people thought about their investments.

Yet another consideration about the time periods is that the time period for which a fund has had a downward trend affects how households make their investments. Short-term price increases (less than three days) have been shown to lead to momentum trading, while longer term increases (up to four months) lead to contrarian trading (Talpsepp et al., 2014). Therefore, how people act with five-year spans of investments may not generalize to short-term investments. Time spans may be perceived differently depending on the type of investment, for example, regular stock trading compared to long-term fund investments or pension savings.

Currencies and time preference

An important consideration to make is the money illusion; this refers to the tendency to think about money in terms of the nominal value (the numbers) rather than real value (what it can be exchanged for) (Shafir, Diamond, & Tversky, 1997). The funds in the present experiments always started at SEK 10 000, and the results may be different with other currencies because of the money illusion. However, the differences were small and statistically non-significant between investments made as SEK and investments made as a percentage (%) of available assets (Study III). In other words, it did not seem as if the numerical differences between the large currency numbers and the small percentage numbers had an important influence on the investment sizes. This means that in the aggregate it may not be important what type of currency was used. However, it should be noted that on the individual level people relied upon the information differently depending on the response format. Participants in the SEK group were more prone to use a fixed strategy or to disregard information completely, compared to the percentage group.
Regarding the time preference, a difference between Study III and traditional intertemporal choice tasks was that the preference was measured as a continuous variable. The willingness to save was measured by asking how much of one’s available assets a person would lock in a fund for five years with guaranteed gain, that is, how much they would reserve for later but greater consumption. This is perhaps a more realistic and ecologically valid approach. The reason is that in the real world it is uncommon to choose between pre-defined values that are dichotomized and fixed at two different points in time, as in the more traditional approach. Instead, when it comes to savings, people have to decide on a certain amount to set aside for the future and have the rest available for consumption in the present. Furthermore, banks have the option to lock assets in savings accounts, and the longer the period (usually years), the greater the received interest rate will be.
Future directions

Making investors aware of their biases has been suggested as a good way of helping these investors to improve their investment strategies (Dhar & Zhu, 2006). However, in some situations when people know about biases that affect them, the biases becomes even stronger (Hansen, Gerbasi, Todorov, Kruse, & Pronin, 2014). Therefore, I suggest that in future studies it will be useful to investigate how knowledge about different biases may change or improve investors’ decisions. It can be investigated in terms of both informing the investor about general biases as well as giving feedback about the investor’s own biases.

In general, people have a difficult time understanding numerical information (Lipkus, Samsa, & Rimer, 2001). Low numerate individuals tend to draw more meaning from irrelevant information than do high numerate individuals (Peters et al., 2006). Therefore, in designing information material and procedures, an approach that includes information about categorical behaviors of the investor’s own behaviors may be effective in advising inexperienced investors and low numerate individuals. The finding that financial literacy has a miniscule effect on investment performance (Fernandes et al., 2014) may be changed if a simplified form of increasing financial literacy is used. Such aid is perhaps better seen as a simplified decision aid with instructions about effective heuristic thinking. This may be more effective than instructing with the aim of giving complete understanding of the financial situation or task. Heuristics can be effective when used in an appropriate way.

When it comes to financial advice, it is very important to understand that there is no one way to advise that suits all individuals. It has previously been suggested that the context and motives of the person seeking advice are of importance, for example, whether they wish to save for retirement or for a rainy day (Hermansson, 2017). I have illustrated the different information that can be important. Therefore, questions formulated to gain understanding of what information the individual investor focuses on when considering their investments may be of great benefit. Furthermore, future studies of how the individual differences in context and motives relate to information processing may be of great benefit in the endeavor to give better and more understandable advice.
Concluding words

The finding that different cues have different but very strong effects on different investors has important implications. It indicates that we should be cautious when drawing conclusions about investment behavior from average investments. Averages can be made up from different behaviors that by themselves are not described by the average. This has important implications. For market predictions the averages are very useful. It does not matter how each individual behaves if the aim is to predict market outcomes. However, in cognitive psychology the aim is often to understand cognition in relation to some task, at least within the judgment and decision-making field.

I have illustrated how average behaviors miss how numerical information affects different individuals very differently. This is important both for formulating theories and for practical applications such as investment advice and helping people understand their own decision-making. Furthermore, understanding of one’s own decisions was found to be very limited, which strengthens the importance of understanding investment-related cognitions. Understanding these cognitions in better detail may very well be a good foundation for further understanding how people think about investment-related information and in developing decision aids for advisors and investors.

Early economic theories assumed rational choice and unlimited processing capacity of individuals. This has over the years been questioned, and the field of behavioral economics and economic psychology has grown increasingly. With my thesis I hope that I have illustrated the importance of recognizing how differently people may behave and still produce similar average results. Hopefully, this will promote somewhat more careful theorizing and testing of different models that describe behavior. We should not only be aware that people judge differently within the same scales and have different preferences. We should also be aware that they may behave categorically differently based on the same available information.

In the end, I hope that this thesis can in some way be a small part of a better understanding of information processing of complex information. Also, I hope that it can be used as a stepping-stone in the process of developing better material for investment advice.
Appendix: Supplementary figures and graphs

This appendix includes figures summarizing results from Studies I – III.

Figure A: Boxplots of investments depending on only the sign of the annual value accumulation the first five years. Whiskers indicate 95% CI for collapsed data over funds that gained and loosed.
Figure A2. Boxplots of investments depending on the annual interest rate during the first five years. Whiskers indicate 95% CI. Study III funds only include funds with the same numerical interest rate during the first and second five-year periods.
Figure A3. Judgments of accumulated asset value after 10 years of annual gain or loss. The green curve illustrates the correct accumulated assets after 10 years of annual interest. The blue dotted line illustrates the starting value. Dots are sample means from Studies I – III (2 experiments in study II), that is, all of the experiments included in this thesis. Whiskers indicate 95% CI.
Figure A4. Individual correlations, between investments and cues, corresponding to the individual correlations reported in the Study II paper (Experiment 1, Table 1). The bars illustrate each participant’s $r$ value. Each graph illustrates the distribution of $r$ for a specific cue. The blue line indicates the cut off for high importance $r > .707$, and the red line $r < -.707$. The first four graphs pertains the first period and the bottom three the second period.
Figure A5. Individual correlations, between investments and cues, corresponding to the individual correlations reported in the Study II paper (Experiment 2, Table 2). The bars illustrate each participant’s $r$ value. Each graph illustrates the distribution of $r$ for a specific cue. The blue line indicates the cut off for high importance $r > .707$, and the red line $r < -.707$. The first four graphs pertains the first period and the bottom three the second period.
Figure A6. Individual correlations between investments and objective cues, corresponding to the individual correlations reported in the Study III paper (Table 1). The bars illustrate each participant’s $r$ value. Each graph illustrates the distribution of $r$ for a specific cue. The blue line indicates the cut off for high importance $r > .707$, and the red line $r < -.707$. 
Figure A7. Individual correlations between investments and subjectively generated cues, corresponding to the individual correlations reported in the Study III paper (Table 4). The bars illustrate each participant’s r value. Each graph illustrates the distribution of r for a specific cue. The blue line indicates cutoff for high importance $r > .707$, and the red line $r < -.707$. Note that judged EV and judged EV marginal gain were calculated using judged asset outcomes after gain and after loss, that is, EV was not judged directly by the participants, instead it was derived mathematically.
References


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