Cognitive Ability and Framing Effects

Abstract. This thesis examines the question whether individuals with a higher cognitive ability are more likely to avoid framing effects compared to people with lower cognitive ability. Knowing if a particular group of society is susceptible to framing effects can be useful information for various parties. For example, a company knows that it can be efficient to use framing effects when addressing people with relatively low cognitive ability and that this method is pretty useless when addressing people with relatively high cognitive ability. 223 people participated in a survey-experiment that included the Cognitive Reflection Test as a measure of cognitive ability and two different framing problems. The data is analyzed using an OLS regression. The data indicates that people with higher cognitive ability are more likely to avoid framing effects. Unfortunately, no hard evidence has been found to generalize these findings to the population. The final chapters discuss the limitations of this research and recommendations for further research.

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1. Introduction

Almost all of the standard economic theories assume agents to be rational (Simon, 1986). One of the characteristics of rationality is that the preference between certain options should not change when the framing of these options change (Tversky & Kahneman, 1981). Tversky and Kahneman actually find that this is not true and that changes in the formulation of prospects can cause preference reversals. Such a change in the formulation of prospect is called a framing effect. This finding means that the decision-making of individuals can be influenced by other parties, like employers, marketing departments and even governments. Marketing departments and employers may exploit this mechanism in their best interest without exploring what the full consequences may be for the influenced party. Governments should have the moral responsibility not to implement framing effects if it would not be in the best interest of the individuals whose preferences are possibly affected. However, there are situations in which this is not the case. The Guardian (Rathje, 2017) writes about the implications that framing effects could have on the election-process of government representatives. This article reports on the issue that political parties make use of framing effects to get more people to choose for their political party. Political parties here do clearly not have the best interest of the population in mind when engaging in such policies. Other media report on the fact that politicians are also not immune against framing effects. An article in the Washington Post (Sheffer & Loewen, 2018) a research is highlighted that examines whether politicians are influenced by, among other fallacies, framing effects (Sheffer et al., 2017). The authors conclude that representatives are equally unable to avoid framing effects as citizens are. This has serious implications regarding policies as these electives could easily be influenced by the presentation of information on which these politicians base their decisions.

According to Friedman (1953) it is important to understand that there is heterogeneity between individuals in order to apply insight from behavioral studies to real-world markets. This raises the question whether there are any characteristics that may influence the preference reversal that results from framing effects this preference reversal? Previous studies examined if cognitive ability may influence the fact whether such a preference reversal can take place (Stanovich & West, 1998; Peters et al., 2006). The relation between cognitive ability and framing effects is the subject of interest for this thesis. If there is indeed a relation between cognitive ability and framing effects, this can be exploited by several different groups. For example, marketing departments of companies can adjust their marketing-strategy depending on which group they are focusing on. It would not be of much use to run the same advertising campaign on both a university campus and a city college. It would be more efficient to use framing for the advertising campaign on the city college and to use a

different strategy at the university campus, as the students there would be less susceptible to framing effects.

Previous studies obtained their results with experiments that were conducted with a sample of students. For example, Stanovich and West (1998) find that students with higher cognitive ability are more likely to avoid framing effects compared to people with lower cognitive ability. It can be safely assumed that university students have a relatively high cognitive ability compared to the population. Whether these effects also hold when also people with lower cognitive ability are included in the analysis is still undecided. That is why this study examines a more representative sample of the population. 223 people participated in a survey-experiment in order to answer the following research question:

"Are people with higher cognitive ability more likely to avoid the fallacy of framing effects?"

The survey consisted of three different parts. In the first part the participants answered several questions regarding their personal characteristics. In the second part a level of cognitive ability was established using the Cognitive Reflection Test (Frederick, 2005) and the final part consisted of two different framing problems that the participant needed to answer.

The results show that people with higher cognitive ability tend to avoid framing effects more often compared to people with lower cognitive ability. Regarding significance, some results are significant while other results are not. Unfortunately, the results do not give a clear answer to the research question. The fact that not all of the results are significant hurt the external validity of this research.

The remainder of this report is constructed as follows. The introduction is followed up by an extensive literature review. This review itself consists of several parts where, besides the literature on cognitive ability and framing effects, the relation between cognitive ability and other concepts of irrationality are also examined. The next two chapters describe the research method and the dataset that followed from the experiment. Then follows the chapter that elaborates on the results of the experiment and whether the used method is the correct one. Finally, in the last chapter, the results of this research are discussed and recommendations for further research are presented.

2. Literature Review

This literature review consists of three parts. The first part reviews the existing literature regarding framing effects. The next part takes a closer look at the relation between cognitive ability and several violations of rationality. This part is included since preference reversals due to framing effects are considered irrational (Tversky & Kahneman, 1981), it may be useful to see whether cognitive ability is related to other types of irrational behavior. Finally, the last part of this section reviews the relation between cognitive ability and framing effects, which is the main topic of interest.

2.1 Framing effects

This part takes a closer look at framing effects, it discusses a few examples of framing effects that are used later in the survey experiment. Furthermore, this section discusses several implications of framing effects for real life decision-making.

Framing effects were first introduced by Tversky and Kahneman (1981). The authors present various decision problems that may cause preference reversals. Slight changes in the formulation of the decision problem (changes in how the information is presented) is the cause for this phenomenon. The authors describe three different kinds of framing: Framing of acts, framing of contingencies and framing of outcomes. They argue that the interaction between these different kinds of framing and the shape of the value- and decision weighting function of prospect theory is the underlying mechanism that allows for preference reversals.

Tversky and Kahneman (1981) present several examples in which preference reversals can be observed. My experiment later on uses two of these decision problems. One of these examples is called the Asian Disease Problem, which is found in Appendix 1.1. In this decision problem, participants are asked to make decisions regarding the cure for a disease that is expected to kill 600 people. The participants are asked two question regarding this problem. In each question they can choose between a risky- and a non-risky option. One question is framed in gains (how many lives will be saved), and the other question is framed in losses (how many people will die). The outcomes for both question are the same (the same amount of people will be saved), the only difference being the way in which the information is presented. The results show that people tend to choose the risky option when the question is framed in losses and choose the safe option when the question is framed in gains. With the outcomes of the two questions being the same, this tendency described above is a perfect example of a preference reversal.

From the above observations it can be concluded that framing effects occur when human behavior systematically deviates from the behavior that is predicted by standard economic theories. If people

would choose the same treatment in both questions it would be considered as rational behavior. Rabin (1998) argues that psychology can help explore in which ways human behavior deviates from behavior predicted by standard economic theories. Rabin provides various examples that help explain the relevance of framing effects for economics, one of these examples concerns the reaction of people to different prices for different services. This reaction tends to differ, this difference depends on the fact whether the lower price is called a discount or the higher price is called a surcharge. Kahneman et al. (1986) describe more examples that relate to this phenomenon. They examine the customer perception of fairness of several market transactions. They find that if a firm raises its prices when its profits are threatened, the customers perceive this change as fair. But it is perceived unfair when a firm tries to exploit changes in demand. In this article the authors introduce another example called the "Money Illusion". In this choice problem, the participants face a change in income that is framed in two different ways. The options differ in the circumstances in which the company decides to increase/decrease the wages. In the first option the company decides to decrease the wages with an inflation of zero percent. In the second option the company increases the wages, but they also face a price inflation leading to the same real income change as in the first option. The authors find that the perceived fairness differs significantly between the two different frames. This implies that firms have an incentive to alter the frames in which they are presenting certain information to make the information appear as fair (Kahneman et al., 1986).

The previously discussed studies are both examples of situations that are descriptively invariant, but still yield different preferences. Tversky and Thaler describe another anomaly that is related to framing effects (1990). In their article they discuss several cases of preference reversals. One of these reversals is caused by using different methods of eliciting preferences. According to standard economic theory these different methods of preference elicitation should yield the same preferences, which is called procedure invariance. The following experiment explains this concept. First, the participants need to make a choice between two gambles. One gamble that has a high probability of winning a relatively small price, the other gamble has a low probability of winning a relatively large price. When asked about their preference regarding these gambles, most participants prefer the first gamble over the second gamble. In the following part the participants show their willingness-to-pay for these two gambles. They tend to be willing to pay more for the second gamble compared to the first gamble, which is a clear preference reversal. Tversky and Thaler (1990) argue that preferences are not predetermined but are established in the process of decision making, this is called the constructive view of preference. As a result, preferences can be influenced by the procedure by which these preferences are elicited.

Rabin (1998) raises a serious dilemma in his essay. He acknowledges that the framing of a certain decision can determine the preferences of that person. If this is in fact the case, to what extent it is justified to influence and alter the decision-making of people? This issue is further examined by James Druckman (2001a). When discussing such issues it is important to make a distinction between framing effects and other concepts that can easily be confused with framing effects like, for example, persuasion techniques. Druckman (2001a) explains the difference between these two different concepts. Persuasion takes place when an individual's belief content is altered by communication, while framing techniques are focused on altering the relative importance that an individual's attach to his beliefs. Druckman uses the following example to emphasize this difference: It is a persuasion technique when a communicator successfully convinces the recipient that the economic impact of a new housing development is either positive or negative. But the communicator uses framing effects when he convinces the recipient to consider monetary concerns next to environmental concerns, regardless whether the monetary impact is positive or negative. In the first situation the communicator changes the belief content of the recipient, where as in the second situation he alters the belief importance of the recipient. Morally, compared to altering the content belief on an individual, altering the belief importance of this person feels much more innocent.

Implications of framing effects are not only important for economics. Other social studies also thoroughly discusses these implications.0 For example, Druckman (2001a, b) writes about the importance of framing effects in the study of public opinion. He writes about to which extent framing effects can be used as a tool to influence people. He further discusses the claim that framing effects can be viewed as a sign of citizen incompetence. Druckman (2001a) claims that people can only be influenced by frames that are presented by reliable sources. He examined this using two laboratory experiments in which people were presented information from either a reliable- or an unreliable source of information. The same framing was used for both sources of information. The results of this experiment shows that the framing did not have its intended effect when an individual perceives the source of information as an unreliable. In another article, Druckman (2001b) adresses the possibility that framing effects occur because of citizen incompetence. If this is indeed the case, this could have serious implications for the value of the public's opinion. If the public opinion can easily be influenced by a particular framing of information, is it justified for a government to make use of this public opinion in their decision making (Entman, 1993)? Druckman (2001b) finds that, aside of a few cases of incompetence, that in general citizens seem to carefully considerate the frames that are presented to them and are capable enough to deal with these frames. These claims do not rule out the possibility that regarding politics citizens can be influenced by other factors. Emotions, for example, can play an important part in the political choices of citizens (Clarke et al., 2017). They find

that emotional reactions had a significant effect in the decision-making of citizens regarding the Brexit.

Returning to the concerns that Rabin expresses (1998). The results of the articles of Druckman (2001a, b) seem to justify the use framing effects if, in the end, individuals are not persuaded into a certain decision and generally show competence to deal with the frames that are presented to them.

This concludes the first part of the literature review. The next part of the literature discusses the link between cognitive ability and violations of rationality, other than framing effects.

2.2 Cognitive ability & Violations of rationality

Framing effects can be seen as a violation of rational behavior, therefore it can be interesting to discuss findings from studies that investigate the relation between cognitive ability and other violations of rationality. Most of the available research that concerns this topic focuses on the relationship between cognitive ability and the following three concepts: Risk aversion, impatience and anchoring.

Benjamin et al. (2013) examine if cognitive ability is related to different types of behavior that are considered to be irrational. The two types of behavior that the authors investigate are short-term discounting and small-stakes risk aversion. They find that individuals with higher cognitive ability are less likely to show behavior that is coherent with small-stakes risk aversion and short run impatience. The authors use expected utility theory as a benchmark to judge the rationality of this behavior, and they discuss that these results are not in line with what expected utility theory predicts and can therefore be seen as irrational. An interesting side note of this research is that this irrational behavior is also present in the most cognitively able individuals. In their article, Benjamin et al. (2013) give various explanations for their findings. They find that when individuals face a so-called cognitive load, that their behavior becomes more irrational. In this case, the cognitive load consisted of a certain sequence of numbers that the subjects needed to remember. Furthermore, when the participants thoroughly thought about their choices, it led to more risk-neutral and patient behavior. These findings suggest that an individual needs cognitive resources in order to make rational choices.

Regarding cognitive load, Deck and Jahedi (2015) examine how cognitive loads affects decision-making that involves risk-taking, intertemporal decisions and anchoring effects. Anchoring effects occur when the decision of a person can be influenced by irrelevant information provided to this person as an anchor. In formulating an answer, the person uses this anchor as a starting point. Tversky and Kahneman (1974) find that using different anchors results in different answers. Deck and Jahedi (2015) find that increased cognitive load leads to more risk-averse behavior, a higher impact

of anchoring effects, and more impatient behavior. They also tested the effect of cognitive load on the numerical abilities of individuals. Interesting finding is that when individuals face a higher cognitive load they tend to behave more risk averse and are more susceptible to anchoring effects.

Dohmen et al. (2010) find similar results on the relation between risk-attitudes and cognitive ability. Furthermore, they also find that individuals with lower cognitive ability have a tendency to be more risk averse and more impatient than individuals with higher cognitive ability. What sets this research apart from other studies is that they use a more representative sample of the population by using a sample of more than 1000 adults and not relying solely on student subjects. Using a sample that only consists of student subjects hurts the external validity of most studies, no matter which topic is the subject of interest. Regarding the topic of cognitive, it makes even more sense to use a more representative sample of the population. It can be safely assumed that university students belong to the most cognitively able portion of the population. Conclusions that result from a study using only university students may not hold for people with lower cognitive ability that are not represented in such a sample.

The authors emphasize that the results should be interpreted with caution due to the complexity of the relation between cognitive and non-cognitive skills, they focus on correlations rather than making conclusions about causality. Still, such a correlation can have an important effect on economic outcomes. The authors give an example about how this relation can affect the process of contract design: Individuals can be selected upon whether they have more potential to show risk-seeking behavior or to be more patient, these traits are often difficult to observe.

Dohmen et al. (2010) discuss various reasons that could explain their findings. One of those reasons is the reduced influence of emotions that people with higher cognitive ability experience. Higher cognition tends to crowd out the influence of emotion on decisions, which results in more risk-neutral and more patient behavior. Another explanation for this finding according to the authors is that people with higher cognitive ability have the tendency to bracket choices more broadly than people with lower cognitive ability. This can cause people with lower cognitive ability to behave in a more risk-averse fashion because they do not incorporate other aspects, like lifetime-wealth, into their risky decisions.

Burks et al. (2009) also discuss the link between cognitive ability and risk-behavior. Similar to the previously discussed studies they too find that individuals with higher cognitive ability tend to be more patient and have a greater willingness to take risks. Besides these topics, they also examine how cognitive ability relates to strategic choices and job attachment. They find that individuals with

higher cognitive ability are better able to anticipate other peoples' behavior in a strategic game. With respect to job attachment, they find that cognitive ability increases the chance of job success. Burks et al. (2009) reason that these effects can be explained by an individuals' perception of certain options. They assume that this perception differs for every individual. The more noise is perceived by an individual, the less likely it is that an individual chooses that option when it can also choose an option that is perceived more precisely. They further assume that for people with lower cognitive ability this perceived noise increases faster with the complexity of choice options than for people with higher cognitive ability. Imagine that a person is confronted with a choice between two options. One option gives a guaranteed low pay-off, a lottery is played when the other option has been chosen. This lottery has two outcomes, there is a chance of getting a higher pay-off but there is also a chance of getting nothing at all. The lottery is where the noise enters the equation. The authors reason that a person with high cognitive ability is more inclined to choose for the risky option over the risk-free option as they are more able to deal with the noise that this option introduces.

Berkman et al. (2010) examine the relation between cognitive ability and anchoring effects. They find that higher cognitive ability reduces the influence of provided anchors. Even though cognitive ability seems to reduce anchoring effects, the results show that even some of the subjects with the highest cognitive ability can be influenced by anchors. Oechssler et al. (2009) investigated the same topic, they also report that there is evidence of anchoring among all subjects. However, they do not find that there is a difference in the degree of anchoring between people with different cognitive abilities.

In a study of Stanovich and West (2008) it is concluded that a lot of cognitive biases, including anchoring effects, are uncorrelated with cognitive ability. However, for some biases the authors find that there is a correlation between cognitive ability and the tendency to avoid these biases. Limitation of this study is that they only use university students in their experiments. As argued before, these results may not be representative of the entire population. In this paper, the authors construct a framework that tries to predict when cognitive ability correlates with thinking biases. This framework says that this correlation depends on an individual's ability of cognitive decoupling. Cognitive decoupling involves blocking out context and knowledge from former experiences while a correct response is computed. Cognitive decoupling usually requires a lot of cognitive capacity. Stanovich and West (2008) argue that when too much cognitive capacity is needed to sustain cognitive decoupling an individual is more likely to adhere to rational-thinking biases. This explanation is in line with the explanations of Benjamin et al. (2013), they reported that when individuals are faced with a higher cognitive load, their behavior becomes more irrational.

Berkman et al. (2010) argue that the difference in results between the above studies is caused by the method that is used to measure cognitive ability. Oechssler et al. (2009) use the Cognitive Reflection Test (CRT) of Frederick (2005) while Stanovich and West (2008) use self-reported SAT scores. Berkman et al. (2010) use both the CRT and the more comprehensive Cognitive Ability Test (CAT). They show that the anchoring effect is stronger when using the CAT test-scores. Furthermore, they claim that the SAT-scores from Stanovich and West (2008) can lead to spurious results because of the fact that these scores are self-reported by the subjects.

Not all the articles that concern this topic find a relation between cognitive ability and rational-thinking biases. For example, Andersson et al. (2013) do not entirely agree with the conclusions that are made in the previously discussed studies. They argue that the reported relation between cognitive ability and risk preference is dubious. The results from their experiment suggest that cognitive ability is not related to risk preferences, but to random decision making. The authors argue that elicited risk preferences can be biased due to errors in decision making, not due to cognitive ability. They do find that these errors are related to cognitive ability. Furthermore, they find that the direction of biased risk preferences depend on the methods that are used to elicit these risk preferences, in this case: Price lists. The authors demonstrated this by constructing two different price lists such that one list produced a positive correlation between cognitive ability and risk preference and the other list produced a negative correlation. This research only focuses on risk preferences and the price lists as elicitation-method, whether these results also hold for framing effects or other elicitation methods is still unclear, but the authors expect that similar results can be found when investigating these topics.

Next to laboratory experiments, some research has also been done on the relation between cognitive ability and real-life examples of irrational behavior. For example, Frisell et al. (2012) find that people who are convicted of committing a crime have lower cognitive ability than people who are not convicted for committing such a crime. Goto et al. (2009) discuss the evidence that people with higher cognitive ability are less likely to relapse after quitting smoking due to lower time discounting.

This real-life observations concludes this part of the literature review. Most of the research that has been done on the relation between cognitive ability and violations of rationality find that higher cognitive ability seems to reduce irrational behavior. However, even among the people with the highest cognitive ability there are still signs of irrational behavior.

2.3 Cognitive ability & Framing effects

This final section concerns the research question of the thesis: The relation between cognitive ability and framing effects. Stanovich and West (1998) examined this relation and found that people with higher cognitive ability are more likely to avoid the fallacy of framing effects. It has to be noted that in this study, the sample constituted solely out of students. Normally, this would not be a big problem, but regarding this topic, cognitive ability, it may be useful to use a more representative sample of the population.As mentioned before, by only using students the sample is limited to people with high cognitive ability when compared to the entire population. The experiment for this thesis uses a more representative sample of the population in order to see if the results of Stanovich and West (1998) still hold when not only students are investigated. The authors refer to the understanding/acceptance principle introduced by Slovic and Tversky (1974). This principle states that the better a person understands certain axioms of utility theory, the more this person is willing to accept this axiom. According to Stanovich and West (1998) cognitive ability directly correlates with task-understanding. They reason that people with a higher cognitive ability should have a better understanding of the fallacy of framing effects and therefore are more likely to avoid the fallacy of framing effects.

The authors use several framing problems to examine the relation between cognitive ability and framing effects, one of these problems is the "Asian Disease' problem which can be found in Appendix 1.1. They find that the majority of the subjects treated the two treatments as descriptively invariant, in other words: They were able to avoid the fallacy of framing effects. The minority of subjects who were not able to avoid the fallacy were subjects with a relatively lower cognitive ability than the subjects who were able to avoid the fallacy.

Stanovich and West (1998) speculate that large differences in decision making for people with different cognitive abilities are expected to appear when two conditions are met. The first condition is met when the task-in-hand engages both the so-called associative- and the rule-based system. Sloman (1996) classifies these two systems of reasoning as follows: The computations that are produced by the associative system reflect similarity and temporal structure. This system treats two problems in similar ways when these problems are perceived as similar by the individual. In the context of framing effects this means that an individual treats these problems as equals if this individual perceives these problems as equal. The rule-based system is more symbolic, and the computations that follow from this system reflect a rule-structure. According to Stanovich and West (1998), cognitive ability is the cornerstone of this rule-based system. The response that this system cues is more thoroughly considered when compared to the response that is cued by the associative

system. The second condition is met when these two systems cue different responses. Individual with higher cognitive ability interpret the cue from the rule-based system more easily, it triggers a different reaction compared with people with lower cognitive ability who have difficulty interpreting the cue from the rule-based system. If the associative system gives the same cue as the rule-based system, it still is impossible to distinguish between people with different cognitive abilities. Because this explanation is conjectured by Stanovic and West (1998) the question remains whether these different cueing systems truly account for the observed differences between individuals with low- and high cognitive ability with respect to displayed framing effects is still unclear.

The relation between cognitive ability and framing effects is also studied by Peters et al. (2006). This study examines the relation between the performance on decision tasks and numeracy. The authors define numeracy as the ability to process basic probability and numerical concepts. From this it follows that highly numerate people are more likely to be better in processing these numerical concepts. Although numeracy is not a direct indicator of cognitive ability, it can be assumed that people with high cognitive ability are more likely to be highly numerate. The authors hypothesize that highly numerate people are more likely to avoid framing effects. The results of the first two experiments in this paper confirm this hypothesis. The authors find that general intelligence (cognitive ability) is correlated with numeracy. In an additional analysis, it is investigated whether the effect of numeracy on decision-making is caused by cognitive ability rather than that numeracy causes this effect by itself. The results of this study do not support this hypothesis.

This section concludes the literature review. The most important findings of previous studies have been discussed in this part of the thesis.

3. Method

This part of the thesis summarizes which methods are used to answer the research question:

"Are people with higher cognitive ability more likely to avoid the fallacy of framing effects?"

This thesis answers this research question using a survey experiment. The survey itself can be found in Appendix 3.

First, it is necessary to elicit an individuals' level of cognitive ability. This thesis uses the Cognitive Reflection Test (CRT) constructed by Shane Frederick (2005) in order to elicit the level of cognitive ability. This test uses three questions to measure cognitive ability, these questions can be found in Appendix 2.1. The three questions are relatively easy when one thinks about it thoroughly. The difficulty of the CRT is suppressing the initial answer that comes to mind when answering the question. With respect to other measures of cognitive ability, like SAT-scores and the Wonderlic Personnel Test (WPT) this test is rather attractive. It is not self-reported, SAT-scores are, which increases the validity of the test. Furthermore, it consists of only three questions that can be answered in a short amount of time. Compared to the WPT, which consist of 50 questions and approximately takes 12 minutes to complete, the CRT is more time-efficient in measuring the cognitive ability.

The main part of the experiment consists of several choice problems that the participants need to answer. The choice problems clarifies how the participants react to the framing effects that are presented to them. The first choice problem that participants face is a variation on the Asian Disease problem (Appendix 1.1). With this problem a preference reversal can be easily observed as the outcomes of the questions in this problem are identical but one question is framed in gains while the other question is framed in losses. Following Li et al. (2017) the Asian Disease problem is transformed into a monetary version. The stimuli in this version are designed to test for preference reversals. The monetary version of the Asian Disease problem can be found in Appendix 1.2 and has been taken from Vieider (2011).

The second framing problem that is presented to the participants face is a problem where the participant is faced with a monetary loss of €10. This problem can be found in Appendix 1.3. This monetary loss is presented to the participants in two different frames.

These framing problems were not answered consecutively by the participants but were answered in different parts of the survey. This was done to make sure that the participants did not discover that

the questions were essentially the same but framed in a different way, so that the participant's answers' to the second set of framing questions were not influenced by the first question.

Additionally, the monkey-business illusion has been included in the survey. This illusion has nothing to do with the research question but is included to give the participant some different impulses before they answer the second part of the framing problems. In this illusion the participant watches a video of a group of people who are tossing a ball around. There are people wearing white t-shirts and people wearing black t-shirts. At the start of the video the participants are asked to count the amount of passes that the white team perform. What they do not know is that during the video a bear appears performing a moonwalk. After the video the participants are asked if they noticed this 'moonwalking' bear. Again, the only purpose of this part of the survey is to enhance the chance that participants are not influenced by the first framing problems while answering the second framing problems.

4. Data

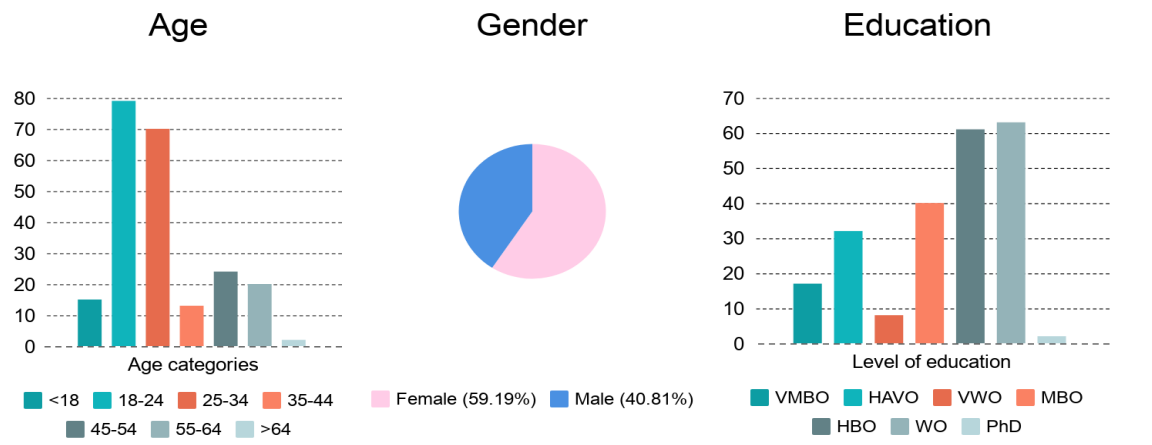
This section describes the data that is obtained from the experiment described in the previous chapter.

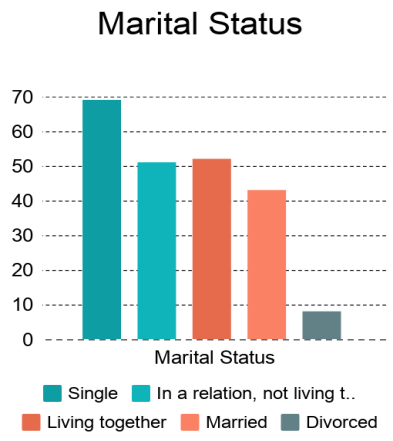
In total there were 228 people who participated and answered the survey. The subjects consists mostly out of friends, family and colleagues. The survey was also posted in several social media-groups. In approximately two days, the survey already had over 200 reactions. Five of the observations were not usable, the answers to the CRT did not make any sense and were an obvious sign that these respondents did not answer the survey with the right intention. That leaves the dataset with 223 usable observations. The descriptive statistics are found in Appendix 3. A summary of these descriptive statistics are discussed found below.

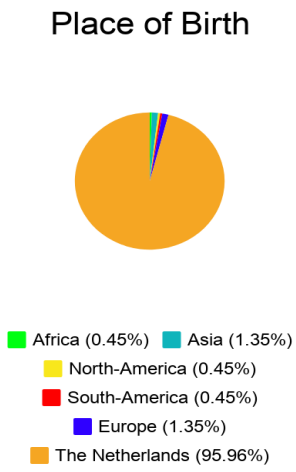
The next step was to manually check for each participant what the score was for the CRT. The answers were often formulated in different notations because the questions in the survey were open-ended. The results show that the majority of participants either answered zero or all three questions correctly, respectively 34.5% and 29.6%. 21.9% of the participants had one correct answer and 13.9% answered two questions correctly. Two additional variables were added, these variables indicated if a framing effect is present for both the lottery questions and the so-called cinema questions.

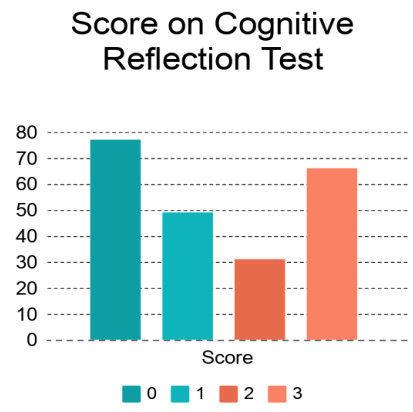
Before we start analyzing the data the variables that are used are displayed on the next page, in appendix 3 and are described below. From the 223 observations, 132 of them were female and 91 were male respondents. The majority of the sample, 95%, originates from The Netherlands. Only six people originate from other continents (North- and South-America, Asia and Africa). Looking at the table that describes the variable age, it can be observed that more than half of the respondents were in the age range <35. Still, the other categories are substantially represented in the sample. Most of the participants are in some kind of relationship: 43 people are married, 52 are living together and 51 people are in a relationship but are still living apart. 69 participants are single and eight people are divorced. Regarding education, 30% obtained a bachelor's/master's degree. 27% finished a HBO study and roughly 18% finished a MBO study. The remainder of the sample is still in high school or dropped out of education after graduating high school. One goal of this experiment was to obtain a more representative sample of the population compared to previous studies. In most of the previous studies only university students were participants. In this sample, other levels of education are represented too in the sample.

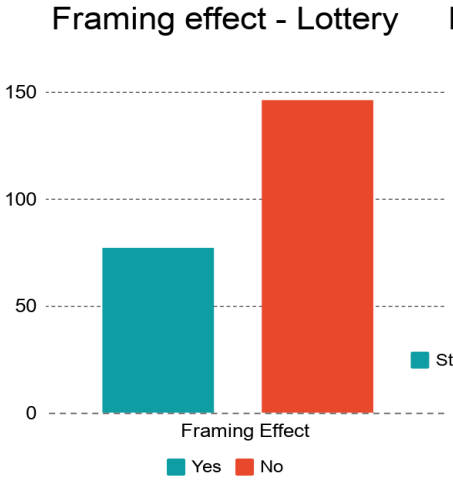
As mentioned before, two variables were added that indicate whether participants were influenced by framing effects. 34.5% of the participants had different answers for the questions from Appendix 1.3 (questions that involve a lottery). In comparison, 22.8% displayed framing effects for the cinema-questions.

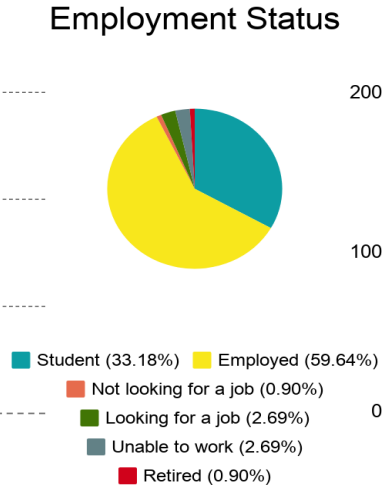


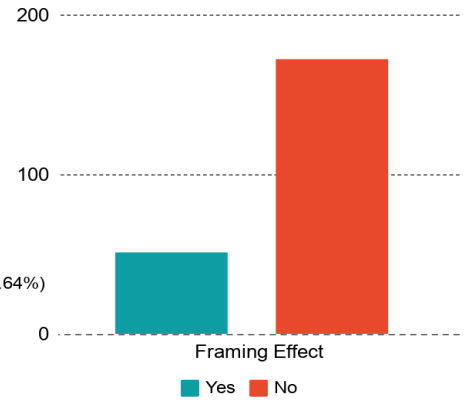












5. Results

5.1 Regression Analysis

To examine whether individuals with higher cognitive ability are more likely to avoid the fallacy of framing effects the data is analyzed using an Ordinary Least Square-regression (OLS). The data is analyzed using a 5% significance level, marginal significance is indicated by the 10% significance level. The dependent variable in this regression is the variable named “total_framing”, this variable indicates how many times an individual was unable to avoid a framing effect. The explanatory variables that are used are the variables that indicate: Age, gender, the level of education, and an individuals’ score on the Cognitive Reflection Test. These variables are jointly significant (see Appendix 4.1, table 1). The data also consists of indicators for employment status, marital status and the place of birth. These variables however are not included in the analysis. This is because there is no theoretical foundation for including these variables. These variables are not expected to have an effect on an individuals’ susceptibility to framing effects. This is also suggested by looking at the data: These variables are not jointly significant, this is illustrated in table 1 and 2 of Appendix 4.1. This means that the model excluding these three variables is more useful for predicting whether individuals with higher cognitive ability are more likely to avoid framing effects. The adjusted R-Squared for the model excluding these variables is also higher compared to the model that includes these variables.

On the next page the Stata output of this regression is presented. Unfortunately, most of the variables presented are statistically insignificant. This does not mean that the results cannot be discussed to see whether the expected signs and trends are obtained. When looking at the main explanatory variable, the score of participants on the CRT, a negative sign of the coefficient is observed. The variable is divided into four different categories: zero correct answers, one correct answer, two correct answers and three correct answers. Zero correct answers is the reference category in this regression. Only the first category has a significant effect, the effect has a negative sign. This means that people who answered one question correctly, who are therefore slightly more cognitive able than people who answered zero questions correctly, are more likely to avoid framing effects. The remaining two categories show a similar negative sign. These coefficients are lower than the coefficient of the first category, indicating that people who answered two or three questions correctly are less likely to avoid framing effects compared to people who answered one question correctly. However, these effects are not significant.

The most interesting comparison in this analysis is the comparison between the reference category (zero correct answers) and the fourth category (three correct answers). The difference in cognitive ability between these two categories is the largest. These results indicate that people with high cognitive ability are more likely to avoid framing effects when compared to people with low cognitive ability. Unfortunately, this effect is not signifcant. This same trend can be observed if we do not distinguish between the four different categories of "crt_score" in our regression (Appendix 4.1, table 3).

Source	SS	df	MS		
Model	12.9370055	16	.808562841	Number of obs	= 223
Residual	85.4396762	206	.414755709	F(16, 206)	= 1.95
				Prob > F	= 0.0179
				R-squared	= 0.1315
				Adj R-squared	= 0.0640
Total	98.3766816	222	.443138205	Root MSE	= .64402

total_fram~g	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
crt_score						
1	-.2960503	.1231683	-2.40	0.017	-.5388824	-.0532181
2	-.1641393	.1507024	-1.09	0.277	-.461256	.1329775
3	-.0869272	.1333117	-0.65	0.515	-.3497573	.175903
gender						
Male	-.1844721	.1035886	-1.78	0.076	-.3887018	.0197576
age						
25-34	-.1446481	.1181913	-1.22	0.222	-.3776677	.0883715
35-44	-.0917525	.1970926	-0.47	0.642	-.4803298	.2968247
45-54	-.1329545	.1555905	-0.85	0.394	-.4397084	.1737995
55-64	-.2956391	.1786521	-1.65	0.099	-.6478601	.0565819
< 18	.2947586	.1987687	1.48	0.140	-.0971231	.6866403
> 64	.2886994	.4667498	0.62	0.537	-.6315195	1.208918
education						
HAVO	-.0934682	.1985129	-0.47	0.638	-.4848456	.2979092
VWO	-.2723372	.2965411	-0.92	0.359	-.8569818	.3123074
MBO	-.08243	.1993415	-0.41	0.680	-.475441	.310581
HBO	.174455	.1976998	0.88	0.379	-.2153193	.5642294
WO	-.0223598	.2189627	-0.10	0.919	-.454055	.4093354
PhD	.7061927	.5068782	1.39	0.165	-.2931413	1.705527
_cons	.8267417	.1890073	4.37	0.000	.4541051	1.199378

Most of the coefficients for the remaining predictor variables are not significant. So, for most of the below-described there is no hard evidence. The only variable that is marginally significant is gender. The negative coefficient indicates that males, when compared to females, are more likely to avoid framing effects. The remaining predictor variables show insignificant results. Regarding age, there is a noticeable trend. This trend shows that older individuals are more likely to avoid framing effects. With the level of education, a divide has to be made between people who did and people who did not continue with education after high school. Let us first regard the people that did not continue with education after high school. It can be observed, by noticing that the coefficients of HAVO and VWO are increasingly negative, that people with a higher level of education are more likely to avoid framing effects. To see whether this trend also holds for people that did continue with education after high school the reference category needs to be changed from VMBO (Pre-vocational secondary education) to MBO (Secondary vocational education).

education						
VMBO	.08243	.1993415	0.41	0.680	-.310581	.475441
HAVO	-.0110382	.1600736	-0.07	0.945	-.3266307	.3045543
VWO	-.1899072	.2750231	-0.69	0.491	-.7321281	.3523137
HBO	.256885	.1383905	1.86	0.065	-.0159582	.5297283
WO	.0600702	.1588338	0.38	0.706	-.2530781	.3732184
PhD	.7886227	.4819382	1.64	0.103	-.161541	1.738786

These results suggest that the above-described trend does not hold for people that receive education beyond high school. But again, these results are not significant, so we cannot derive any conclusions regarding predicted effects from these results.

5.2 Testing the Assumptions of OLS

In this section a few additional tests are performed to examine if the model violates the assumptions of OLS. The regression is checked for a correct specification of the model, homoscedasticity, multicollinearity and a normal distribution of the error terms.

To test whether the functional form of this model is correctly specified, the Ramsey Regression Equation Specification Error Test (RESET) is performed. The results of this test are displayed in the following table:

```
Ramsey RESET test using powers of the fitted values of total_framing
       Ho:  model has no omitted variables
                 F(3, 203) =      0.45
                  Prob > F =      0.7193
```

Using a 5% significance level, H0 is not rejected. The model does not suffer from misrepresentation. The model is correctly specified. Although the H0 says that it tests whether there are no omitted variables, this is not the main goal of this test. It tests if this model uses the correct functional form, which is the case for this model.

To test whether the assumption of homoscedasticity (constant variance of the error terms) holds the Breusch-Pagan test is used. When heteroscedasticity is present, OLS is not the Best Linear Unbiased Estimator (BLUE) anymore. The estimates are still unbiased but are not the most efficient. The results from the Breusch-Pagan test are displayed in the following table:

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: 0b.crt_score 1.crt_score 2.crt_score 3.crt_score 1b.gender 2.gender
                    2b.age 3.age 4.age 5.age 6.age 8.age 9.age 1b.education 2.education
                    3.education 4.education 5.education 6.education 7.education

         chi2(16)      =    15.17
         Prob > chi2   =   0.5120
```

The Null-hypothesis is not rejected by this test. This suggests that there is constant variance and that the assumption of homoscedasticity is not violated by this model.

The next assumption that is tested is that of multicollinearity. Multicollinearity occurs when there is a linear relation between the independent variables used in the model. If the degree of multicollinearity increases the estimates of the model become more unstable, so it is important to keep the degree of multicollinearity as low as possible. In Stata the degree of multicollinearity is calculated using the “Variance Inflation Factor” (VIF). The results of this test are found in the following table:

Variable	VIF	1/VIF
crt_score		
1	1.40	0.715078
2	1.46	0.684217
3	1.99	0.502247
2.gender	1.39	0.717560
age		
3	1.62	0.618211
4	1.15	0.872156
5	1.25	0.799957
6	1.40	0.713764
8	1.33	0.750321
9	1.04	0.960521
education		
2	2.60	0.384005
3	1.64	0.611504
4	3.14	0.317973
5	4.18	0.239464
6	5.23	0.191380
7	1.23	0.814456
Mean VIF	2.00	

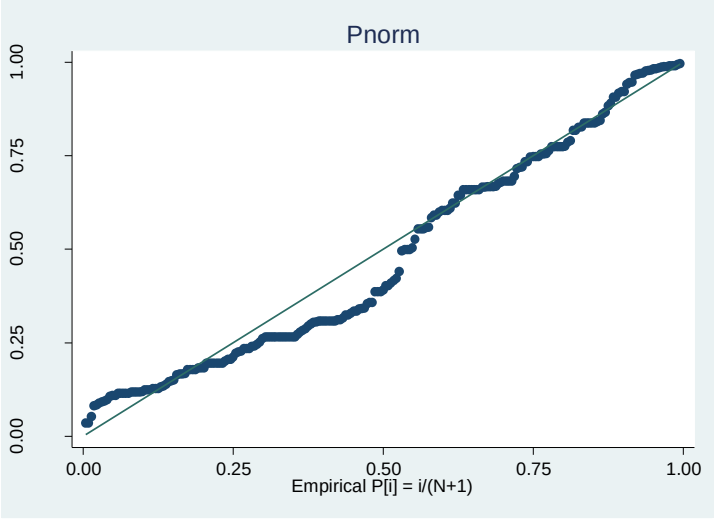
A commonly used rule-of-thumb for an acceptable VIF is ten (O'Brien, 2007). In the table we can see that none of the VIF's exceed this rule-of-thumb and that the mean VIF is 2.0. It is safe to say that this model does not suffer from multicollinearity.

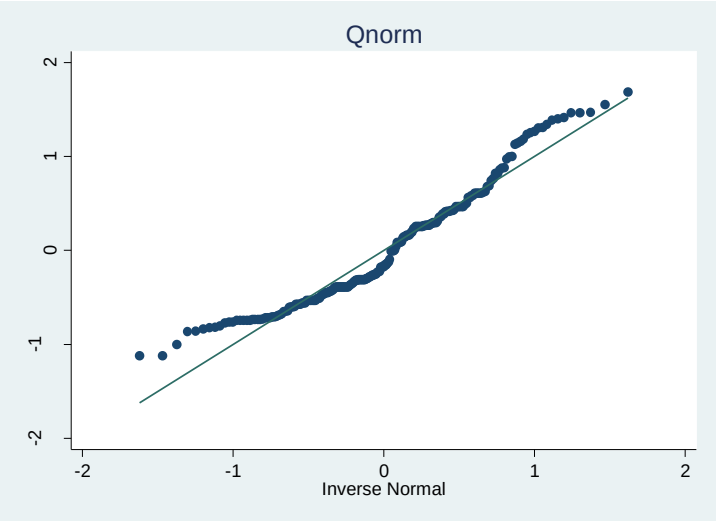
The last additional test that is performed is the Shapiro-Wilk W test. This statistic indicates whether the residuals are normally distributed. For valid hypothesis testing, the residuals need to be normally distributed. This assumption does not need to hold to obtain unbiased estimates and therefore the assumption is not needed for OLS to be the Best Linear Unbiased Estimator (Wooldridge, 2015, p.xiii). The results of this test are displayed in the following table:

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
e	223	0.94655	8.768	5.023	0.00000

The p-value is below the significance level of 0.05. This means that the hypothesis that the residuals are normally distributed is rejected. This can be confirmed by looking at the p-norm and q-norm graphs. In these graphs the residuals are plotted against a normal distribution. It can be seen in both graphs that the residuals do not follow a normal distribution. Otherwise the dots would have been on the 45-degree line.





5.3 Logistic Regression

It is also possible to analyze the two framing problems separately. This can be useful to examine because the two framing problems of this experiment use different methods to induce a framing effect. To examine whether individuals with higher cognitive ability are more able to avoid the fallacy of framing effects for each of the two problems the data is analyzed using a logistic regression. A logistic regression is used because in this case the dependent variable is a categorical variable with two outcomes: Yes or no. The analysis uses the same independent variables as the ones used in the OLS-regression, the logistic regression is performed for both the framing problems. The data is analyzed using a 5%-significance level.

framing_lottery	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
crt_score						
1	-1.312318	.4897522	-2.68	0.007	-2.272214	-.352421
2	-.5488626	.5211446	-1.05	0.292	-1.570287	.472562
3	.4572892	.4601248	0.99	0.320	-.4445389	1.359117

The full tabulated results of this analysis are displayed in table 1 of Appendix 4.2. The above table shows mixed results. The first coefficient of crt_score, which relates to the category of people who answered one question correctly on the CRT, has a negative sign and is significant. This means that people who answer one question correctly have a higher chance of avoiding framing effects, compared to people who answered zero questions correctly. The results change after this category: People with higher cognitive ability are actually less likely to avoid framing effects according to these results, however these effects are not significant. There is only a significant effect between people who answer one questions correctly and people who answer zero questions correctly. This observation is confirmed by the following table:

framing_lottery	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
crt_score						
0	1.312318	.4897522	2.68	0.007	.352421	2.272214
2	.7634551	.5938336	1.29	0.199	-.4004374	1.927347
3	1.769607	.5465256	3.24	0.001	.6984363	2.840777

In this table, the category that represents people who answered one question correctly on the CRT is the reference category. Both the coefficients that corresponds with zero correct answers and three correct answers have a positive sign and is significant. This means that relative to people who answered one question correctly, people with both lower (zero correct answers) and higher cognitive ability (three correct answers) have a lower probability of avoiding framing effects. The results of this experiment are therefore somewhat mixed. If only the first two categories (zero and one correct answers) are considered, the results suggest that people with higher cognitive ability are more likely to avoid framing effects. But considering the last categories (three correct answers), the results show a reversal in this susceptibility to framing effects. The next table presents the results from the logistic regression that is performed for the second framing problem.

framing_cinema	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
crt_score						
1	-.508033	.4753973	-1.07	0.285	-1.439795	.4237286
2	-.2259287	.5715281	-0.40	0.693	-1.346103	.8942458
3	-1.12471	.5539368	-2.03	0.042	-2.210407	-.0390141

The full tabulated results of this regression are found in table 2 of Appendix 4.2. The results shows significant results, with a negative sign of the coefficient, for the category that corresponds with three correct answers on the CRT. This means that individuals that answer all questions correctly have a higher probability of avoiding framing effects, relatively to people that have zero correct answers. The difference in cognitive ability is the largest between these two categories, so for this framing problem a clear difference in susceptibility to framing effects is observed between people with high- and low cognitive ability.

This analysis concludes this part of the thesis.

6. Discussion

This thesis has investigated the relation between cognitive ability and framing effects. More precisely, whether individuals with higher cognitive ability are more likely to avoid the fallacy of framing effects. No hard evidence for this effect has been found in this research. The coefficients in the regression indicate that there is a small tendency for individuals with lower cognitive ability to be more susceptible to framing effects. While some of the coefficients in the regression prove to be significant, a lot of them are insignificant. It is therefore not possible to make conclusions regarding the relation between cognitive ability and framing effects beyond this sample.

This research used a more representative sample of the population compared to previous research. For example, Stanovich and West (1998) only used students in their experiment, and found that people with higher cognitive ability were more able to avoid framing effects. This study collected a more diverse sample regarding the spectrum of cognitive ability. The results report mixed results regarding the relation between cognitive ability and framing effects. Some analyses show the expected effects, for example the logistic regression for the second framing problem show that people with higher cognitive ability are more likely to avoid framing effects. Other analyses, for example the OLS-regression, report insignificant effects. Despite the fact that these effects are insignificant, the results for that analysis also indicate that people with higher cognitive ability are more likely to avoid framing effects. There are also cases that indicate that people with higher cognitive ability are less likely to avoid framing effects.

Consistent with the findings of Stanovich and West (1998) is that only a minority of the subjects displayed framing effects. 25% of their subjects displayed framing effects. For the two experiments that this survey had, respectively 34.5% and 22.8% displayed framing effects. There can be various reasons why the results from this research do not resemble the results obtained in previous research. Probably the biggest reason for this is that the setup of the experiment is completely different. For example, Stanovich and West (1998) used self-reported SAT-scores as a measure of cognitive ability while this study uses the CRT. The CRT gives a good measure of cognitive ability and is time-efficient (only three questions are asked). While SAT scores may give a more precise result, the fact that such a statistic is self-reported might make the obtained results less valid. This may for instance be because people may have an incentive to overstate their SAT-score to appear more intelligent.

One may wonder if the experiment could have been designed in such a way that the results would have been significant. For example, a more extensive measure of cognitive ability could have been

used in order for the measurement to be more precise. It was also possible to include more framing problems to the experiment in order for the difference in framing effects between people with low- and people with high cognitive ability to become more distinct. The reason why these examples were not included in the research design is simply because these ideas were not time-efficient. People may have been less inclined to participate if they knew the experiment would require 30 minutes to complete instead of the 5-10 minutes that this experiment required of their time. Furthermore, the participants of the experiment were not faced with real incentives. Although the experiment included proper economic stimuli, the question remains whether the participants would act with real money on the table.

A more extensive measurement of both cognitive ability and susceptibility to framing effect is an aspect that future researchers may focus on. Using a representative sample of the population and using real monetary incentives the question whether people with higher cognitive ability are more likely to avoid framing effects may be answered once and for all. If future researchers do find that there is a relation between cognitive ability and framing effects, it may be interesting to see if this also extends to other phenomena that are violations of rational behavior. For example: Do people with lower cognitive ability make more use of anchors in their decision-making? Or: Do people with higher cognitive ability deviate more often from the status quo when compared to people with lower cognitive ability?

7. Conclusion

This thesis explores the relation between cognitive ability and framing effects. More precisely, the following research question has been investigated:

"Are people with higher cognitive ability more likely to avoid the fallacy of framing effects?"

In the literature review it is established that there is a relation between cognitive ability and various violations of rational behavior (Benjamin et al., 2006; Deck & Jahedi, 2015; Dohmen et al., 2010; Burks et al., 2009; Berkman et al., 2010). Concerning framing effects, preceding studies have shown that there is a positive relation between cognitive ability and framing effects (Stanovich & West, 1998; Peters et al., 2006) but this subject has not been studied in samples that do not consists of only students.

This study uses a survey experiment with 223 participants to analyze the aforementioned research question. The Cognitive Reflection Test designed by Shane Fredrick (2005) is used to establish a measure of cognitive ability and during the experiment the participants were faced with two different framing problems. After the experiment, the data has been analyzed using an OLS-regression. The data mostly suggests that people with higher cognitive ability are more likely to avoid framing effects. Unfortunately, there is not enough evidence in the data to support this claim significantly. But it is important to establish if there is indeed a relation between cognitive ability and framing effects. This also is the case for other violations of rational behavior. Some implications that these relations could have for real-life situations have been further explored in this thesis.

8. References

- Andersson, O., Tyran, J. R., Wengström, E., & Holm, H. J. (2013). Risk aversion relates to cognitive ability: Fact or fiction?
- Benjamin, D. J., Brown, S. A., & Shapiro, J. M. (2013). Who is 'behavioral'? Cognitive ability and anomalous preferences. *Journal of the European Economic Association*, *11*(6), 1231-1255.
- Bergman, O., Ellingsen, T., Johannesson, M., & Svensson, C. (2010). Anchoring and cognitive ability. *Economics Letters*, *107*(1), 66-68.
- Burks, S. V., Carpenter, J. P., Goette, L., & Rustichini, A. (2009). Cognitive skills affect economic preferences, strategic behavior, and job attachment. *Proceedings of the National Academy of Sciences*, *106*(19), 7745-7750.
- Clarke, H. D., Goodwin, M., & Whiteley, P. (2017). Why Britain voted for Brexit: an individual-level analysis of the 2016 referendum vote. *Parliamentary Affairs*, *70*(3), 439-464.
- Deck, C., & Jahedi, S. (2015). The effect of cognitive load on economic decision making: A survey and new experiments. *European Economic Review*, *78*, 97-119.
- Dohmen, T., Ruth, A., Huffman, D., & Sunde, U. (2010). Are risk aversion and impatience related to cognitive ability?. *The American economic review*, *100*(3), 1238-1260.
- Druckman, J. N. (2001a). On the limits of framing effects: Who can frame? *Journal of Politics*, *63*(4), 1041-1066.
- Druckman, J. N. (2001b). The implications of framing effects for citizen competence. *Political behavior*, *23*(3), 225-256.
- Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of communication*, *43*(4), 51-58.
- Frederick, S. (2005). Cognitive reflection and decision making. *The Journal of Economic Perspectives*, *19*(4), 25-42.
- Friedman, M. (1953). *Essays in positive economics*. University of Chicago Press.
- Frisell, T., Pawitan, Y., & Långström, N. (2012). Is the association between general cognitive ability and violent crime caused by family-level confounders?. *PloS one*, *7*(7), e41783.
- Goto, R., Takahashi, Y., Nishimura, S., & Ida, T. (2009). A cohort study to examine whether time and risk preference is related to smoking cessation success. *Addiction*, *104*(6), 1018-1024.
- Kahneman, D., Knetsch, J. L., & Thaler, R. (1986). Fairness as a constraint on profit seeking: Entitlements in the market. *The American economic review*, 728-741.
- Li, Z., Rohde, K. I., & Wakker, P. P. (2017). Improving one's choices by putting oneself in others' shoes–An experimental analysis. *Journal of Risk and Uncertainty*, *54*(1), 1-13.
- O'brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, *41*(5), 673-690.

- Oechssler, J., Roider, A., & Schmitz, P. W. (2009). Cognitive abilities and behavioral biases. *Journal of Economic Behavior & Organization*, *72*(1), 147-152.
- Peters, E., Västfjäll, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and decision making. *Psychological science*, *17*(5), 407-413.
- Rabin, M. (1998). Psychology and economics. *Journal of economic literature*, *36*(1), 11-46.
- Rathje, S. (2017, July 27). The power of framing: It's not what you say, it's how you say it. Retrieved from https://www.theguardian.com/science/head-quarters/2017/jul/20/the-power-of-framing-its-not-what-you-say-its-how-you-say-it
- Sheffer, L., Loewen, P. J., Soroka, S., Walgrave, S., & Sheaver, T. (2017). Nonrepresentative Representatives: An Experimental Study of the Decision Making of Elected Politicians. American Political Science Review, 1-20.
- Sheffer, L., & Loewen, P. J. (2018, January 11). This fallacy helps explain why Republicans have pursued such unpopular policies. Retrieved from https://www.washingtonpost.com/news/monkey-cage/wp/2018/01/11/why-has-the-republican-congress-chased-such-unpopular-policies/?utm_term=.1fb710b3263f
- Slovic, P., & Tversky, A. (1974). Who accepts Savage's axiom?. *Systems Research and Behavioral Science*, *19*(6), 368-373.
- Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological bulletin*, *119*(1), 3-22.
- Stanovich, K. E., & West, R. F. (1998). Individual differences in framing and conjunction effects. *Thinking & Reasoning*, *4*(4), 289-317.
- Stanovich, K. E., & West, R. F. (2008). On the relative independence of thinking biases and cognitive ability. *Journal of personality and social psychology*, *94*(4), 672.
- Thaler, R. H., & Sunstein, C. R. (2003). Libertarian paternalism. *The American Economic Review*, *93*(2), 175-179.
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *science*, *185*(4157), 1124-1131.
- Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, *211*, 453-458.
- Tversky, A., & Thaler, R. H. (1990). Anomalies: preference reversals. *The Journal of Economic Perspectives*, *4*(2), 201-211.
- Vieider, F. M. (2011). Separating real incentives and accountability. *Experimental Economics*, *14*(4), 507-518.
- Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach (p.xiii)*. Nelson Education.

9. Appendix

Appendix 1.1

Imagine that your country is preparing for the outbreak of an unusual disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:

Participants were randomly assigned to either condition 1 or condition 2. The two groups received two versions of the programs which were identical, except for the framing of the outcomes. In condition 1, the two reported programs were stated in positive terms (lives saved):

- If Program A is adopted, 200 people will be saved.
- If Program B is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved.

In condition 2, the two reported programs were stated in negative terms (lives lost):

- If Program A is adopted 400 people will die.
- If Program B is adopted there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.

Appendix 1.2

A:
The experimenter gives you a cash gift of €20. These €20 are yours to dispose of. Additionally, you are given the choice between the following two options:

- Option A: Winning €5 for sure.
- Option B: Winning €20 with a 25% probability, and winning nothing with a 75% probability.

Which option do you choose?

B:
The experimenter gives you a cash gift of €40. These €40 are yours to dispose of. Additionally, you are given the choice between the following two options:

- Option A: Losing €15 for sure.
- Option B: Losing €20 with a 75% probability, and losing nothing with a 25% probability.

Which option do you choose?

Appendix 1.3

Question A.

Imagine that you have decided to see a play where the admission fee is €10 per ticket. As you enter the theater you discover that you lost a €10 bill. Do you still pay €10 for a ticket for the play?

Question B

Imagine that you have decided to see a play and paid the admission price of €10 per ticket. As you enter the theater you discover that you lost the ticket. The seat was not marked and the ticket can't be recovered. Would you pay €10 for another ticket?

Appendix 2

Question 1

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

Question 2

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

Question 3

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

Appendix 3

1: Description of the dataset.

```
. des

Contains data from D:\Studie\Behavioral Economics Msc\Thesis\datafile_stata.dta
  obs:           223
 vars:            14                          16 Jan 2018 13:12
 size:        38,579
```

2: Gender

```
. tab gender2
```

gender2	Freq.	Percent	Cum.
Female	132	59.19	59.19
Male	91	40.81	100.00
Total	223	100.00	

3: Age

```
. tab age2
```

age2	Freq.	Percent	Cum.
<18	14	6.28	6.28
18-24	79	35.43	41.70
25-34	70	31.39	73.09
35-44	13	5.83	78.92
45-54	24	10.76	89.69
55-64	20	8.97	98.65
>64	2	0.90	99.55
< 18	1	0.45	100.00
Total	223	100.00	

4: Place of birth

```
. tab place_of_birth2
```

place_of_birth2	Freq.	Percent	Cum.
Africa	1	0.45	0.45
Asia	3	1.35	1.79
North-America	1	0.45	2.24
South-America	1	0.45	2.69
The Netherlands	214	95.96	98.65
Western-Europe (excluding The Netherlan	3	1.35	100.00
Total	223	100.00	

5: Education

```
. tab education2
```

education2	Freq.	Percent	Cum.
VMBO	17	7.62	7.62
HAVO	32	14.35	21.97
VWO	8	3.59	25.56
MBO	40	17.94	43.50
HBO	61	27.35	70.85
WO	63	28.25	99.10
PhD	2	0.90	100.00
Total	223	100.00	

6: Marital Status

```
. tab marital_status2
```

marital_status2	Freq.	Percent	Cum.
Single	69	30.94	30.94
In a relationship, not living together	51	22.87	53.81
Living together	52	23.32	77.13
Married	43	19.28	96.41
Divorced	8	3.59	100.00
Total	223	100.00	

7: Employment Status

```
. tab employment_status2
```

employment_status2	Freq.	Percent	Cum.
Student	74	33.18	33.18
Employed	133	59.64	92.83
Not employed, looking for a job	6	2.69	95.52
Not employed, not looking for a job	2	0.90	96.41
Unable to work	6	2.69	99.10
Retired	2	0.90	100.00
Total	223	100.00	

8: Score on Cognitive Reflection Test

```
. tab crt_score
```

crt_score	Freq.	Percent	Cum.
0	77	34.53	34.53
1	49	21.97	56.50
2	31	13.90	70.40
3	66	29.60	100.00
Total	223	100.00	

9: Framing effect lottery questions

```
. tab framing_lottery2
```

framing_lottery2	Freq.	Percent	Cum.
No	146	65.47	65.47
Yes	77	34.53	100.00
Total	223	100.00	

10: Framing effect cinema questions

```
. tab framing_cinema2
```

framing_cinema2	Freq.	Percent	Cum.
No	172	77.13	77.13
Yes	51	22.87	100.00
Total	223	100.00	

Appendix 4.1

1: Test of Joint Significant of gender, age and education

```
. testparm i.gender i.age i.education

 ( 1)  2.gender = 0
 ( 2)  3.age = 0
 ( 3)  4.age = 0
 ( 4)  5.age = 0
 ( 5)  6.age = 0
 ( 6)  8.age = 0
 ( 7)  9.age = 0
 ( 8)  2.education = 0
 ( 9)  3.education = 0
 (10)  4.education = 0
 (11)  5.education = 0
 (12)  6.education = 0
 (13)  7.education = 0

       F( 13,   206) =    1.91
            Prob > F =    0.0311
```

2: Test of Joint Significance of marital status, employment status and place of birth

```
. testparm i.marital_status i.employment_status i.place_of_birth

 ( 1)  2.place_of_birth = 0
 ( 2)  3.place_of_birth = 0
 ( 3)  4.place_of_birth = 0
 ( 4)  5.place_of_birth = 0
 ( 5)  6.place_of_birth = 0
 ( 6)  3.marital_status = 0
 ( 7)  4.marital_status = 0
 ( 8)  5.marital_status = 0
 ( 9)  6.marital_status = 0
 (10)  2.employment_status = 0
 (11)  3.employment_status = 0
 (12)  4.employment_status = 0
 (13)  5.employment_status = 0
 (14)  6.employment_status = 0

       F( 14,   192) =    0.67
            Prob > F =    0.7999
```

3: Regression results, not distinguishing for different categories of crt_score

Source	SS	df	MS		
Model	10.5087022	14	.750621588	Number of obs =	223
Residual	87.8679794	208	.422442209	F(14, 208) =	1.78
				Prob > F =	0.0438
Total	98.3766816	222	.443138205	R-squared =	0.1068
				Adj R-squared =	0.0467
				Root MSE =	.64996

total_fram~g	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
crt_score	-.0224566	.0441792	-0.51	0.612	-.109553	.0646398
gender						
Male	-.1734735	.1043065	-1.66	0.098	-.3791069	.0321599
age						
25-34	-.1653432	.1179932	-1.40	0.163	-.3979591	.0672728
35-44	-.1076855	.198799	-0.54	0.589	-.4996048	.2842337
45-54	-.1501953	.1562463	-0.96	0.338	-.4582246	.157834
55-64	-.3662675	.1777032	-2.06	0.041	-.7165977	-.0159372
< 18	.2575351	.1999778	1.29	0.199	-.1367082	.6517783
> 64	.2182003	.4693996	0.46	0.643	-.7071903	1.143591
education						
HAVO	-.1204322	.1994831	-0.60	0.547	-.5137002	.2728358
VWO	-.2792571	.2991495	-0.93	0.352	-.8690108	.3104966
MBO	-.1221769	.2003941	-0.61	0.543	-.5172408	.272887
HBO	.1176408	.1970198	0.60	0.551	-.2707708	.5060524
WO	-.0605322	.2200309	-0.28	0.784	-.4943089	.3732444
PhD	.4763779	.5020057	0.95	0.344	-.5132935	1.466049
_cons	.7981586	.1899818	4.20	0.000	.4236219	1.172695

.

Appendix 4.2

1: Logistic Regression framing problem 1 (lottery)

```
Iteration 0:   log likelihood = -143.71972
Iteration 1:   log likelihood = -129.55089
Iteration 2:   log likelihood = -129.12487
Iteration 3:   log likelihood = -129.12287
Iteration 4:   log likelihood = -129.12287

Logistic regression                               Number of obs   =        223
                                                  LR chi2(16)     =      29.19
                                                  Prob > chi2     =     0.0227
Log likelihood = -129.12287                       Pseudo R2       =     0.1016
```

framing_lottery	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
crt_score						
1	-1.312318	.4897522	-2.68	0.007	-2.272214	-.352421
2	-.5488626	.5211446	-1.05	0.292	-1.570287	.472562
3	.4572892	.4601248	0.99	0.320	-.4445389	1.359117
gender						
Male	-.3494406	.3625935	-0.96	0.335	-1.060111	.3612297
age						
25-34	.0302895	.3999147	0.08	0.940	-.753529	.814108
35-44	.1369599	.6757204	0.20	0.839	-1.187428	1.461348
45-54	.2551644	.5331693	0.48	0.632	-.7898282	1.300157
55-64	-.5489463	.7445201	-0.74	0.461	-2.008179	.9102863
< 18	1.319931	.7170049	1.84	0.066	-.0853727	2.725235
> 64	.658797	1.48922	0.44	0.658	-2.260022	3.577616
education						
HAVO	.0073382	.7473425	0.01	0.992	-1.457426	1.472103
VWO	-2.026109	1.343486	-1.51	0.132	-4.659293	.6070756
MBO	.5627349	.7558128	0.74	0.457	-.918631	2.044101
HBO	1.137347	.747208	1.52	0.128	-.3271539	2.601848
WO	.1961211	.81799	0.24	0.811	-1.40711	1.799352
PhD	2.354765	1.674282	1.41	0.160	-.9267662	5.636297
_cons	-.8980169	.7179333	-1.25	0.211	-2.30514	.5091066

2: Logistic Regression framing problem 2(cinema)

```
Iteration 0:   log likelihood = -119.90715
Iteration 1:   log likelihood = -106.23954
Iteration 2:   log likelihood = -105.45976
Iteration 3:   log likelihood =   -105.457
Iteration 4:   log likelihood =   -105.457

Logistic regression                             Number of obs   =        223
                                                LR chi2(16)     =      28.90
                                                Prob > chi2     =     0.0246
Log likelihood =   -105.457                     Pseudo R2       =     0.1205
```

framing_cinema	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
crt_score						
1	-.508033	.4753973	-1.07	0.285	-1.439795	.4237286
2	-.2259287	.5715281	-0.40	0.693	-1.346103	.8942458
3	-1.12471	.5539368	-2.03	0.042	-2.210407	-.0390141
gender						
Male	-.8268618	.452503	-1.83	0.068	-1.713751	.0600278
age						
25-34	-.9814734	.501059	-1.96	0.050	-1.963531	.0005842
35-44	-.830556	.8443684	-0.98	0.325	-2.485488	.8243755
45-54	-1.005962	.6305312	-1.60	0.111	-2.24178	.2298564
55-64	-1.197519	.775075	-1.55	0.122	-2.716638	.3216005
< 18	-.1444083	.6657519	-0.22	0.828	-1.449258	1.160441
> 64	.7259761	1.480218	0.49	0.624	-2.175198	3.62715
education						
HAVO	-.6692617	.7206425	-0.93	0.353	-2.081695	.7431715
VWO	.3483357	1.041811	0.33	0.738	-1.693577	2.390248
MBO	-1.122447	.7614982	-1.47	0.140	-2.614956	.3700623
HBO	-.3192428	.7245446	-0.44	0.659	-1.739324	1.100838
WO	-.2772835	.8328488	-0.33	0.739	-1.909637	1.35507
PhD	1.514279	1.684248	0.90	0.369	-1.786786	4.815343
_cons	.3886587	.679477	0.57	0.567	-.9430918	1.720409