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# **The influence of alcohol on economic risk-taking with overconfidence and risk perception as mediator variables**

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# 1 Introduction

Risk is very important in economics, especially in financial economics. Deciding on investment opportunities is inherently linked to risk assessment. Objective ways to attain risk levels to investment opportunities are calculating the standard deviation for example. But actors not always use objective measurements to attain risk, due to lack of knowledge or available information. That makes it very important how people perceive risk. How they perceive risk influences their behavior (Slovic, 1987). Acknowledging that, research shows us that risk perception significantly influences investment decisions (Nosić & Weber, 2010).

Rose et al. (2014) state that alcohol influences risk-taking but other studies have contradict findings (Reynolds et al., 2006; Reed et al., 2012; Bregu et al., 2017). That there is no robust effect of alcohol on decision making under risk is found doesn't mean anything for risk perception. A different risk perception could explain why there is increased risk-taking (Nosić & Weber, 2010). That intoxication with alcohol affects the cognitive functions of the human brain is well known. It is widely researched that risk perception are negatively influenced by alcohol during driving (Moskowitz & Florentino, 2000; Greenfield & Rogers, 1999; Frick et al., 2000). Taking that into consideration, the influence of alcohol on risk perception can give valuable insights. There seems to be a gap in literature about the influence of alcohol intoxication on risk perception in a context of investment decisions.

Since Bregu et al. (2017) found that alcohol intoxication influences overconfidence (Bregu et al., 2017) and overconfidence and Jain et al. (2023) found a influence of overconfidence on risk perception, overconfidence could be a mediator variable amid alcohol intoxication and risk perception. Using overconfidence and risk perception as mediator variables, there could be a relationship between alcohol intoxication and decision-making under risk. To decision-making under risk will be referred to in this study either as risk-taking or investment propensity. The main research question of this thesis is: *Does alcohol intoxication influences investment propensity, with overconfidence and risk perception as mediator variables?*

This thesis is scientifically relevant because there seems to be no other literature about the influence of alcohol intoxication on risk-taking using overconfidence and risk perception as mediator variables. Using mediator variables can possibly explain the different findings between the studies that found an effect of alcohol intoxication on risk-taking, as the effect possibly walks

through the mediator variables. This thesis wants to provide an insight of possible mechanisms, that contribute to decision-making under risk in a context of investment decisions. The mediator variables perhaps provide that insight.

The relevance for society is evident. If there is an indirect effect of alcohol intoxication on decision-making under risk in case of investment decisions, people can take more risk than their sober self would do. That could result in investment decisions that they wouldn't make while sober. It could be arguable that if the foregoing is the case regulation should rise that force investment brokers to ask control questions and make investors aware of the influence of alcohol on their decision-making. Regarding the driving under alcohol intoxication example, there is already regulation in every European country that prevents driving above certain levels of alcohol intoxication. Regulation that oblige brokers to make people aware of investing while intoxicated with alcohol could be something for the future. Besides possible regulation awareness from investors on their own biases is relevant.

This thesis will contain an experiment. The experiment will have a within-subject design. I chose for a within-subject design because the selection-bias stands on the corner for this topic. The selection bias could be a problem because people who abuse alcohol could differ in their base levels of risk-taking and impatience (Bregu et al., 2017). This study doesn't focus on alcohol abuse and have an alcohol intoxication of two drinks, which is approximately the same as .05 BAC. 0.05 BAC is also the legal limit in the Netherlands. Despite that this study doesn't focus on alcohol abuse the problem of the selection bias can still be apparent. This will be explained later in the methodology. That's why a within-subject design is chosen. The subjects will fill in a survey twice. The first time is when they are about to drink alcohol, the second time when they have had two drinks. The survey will contain two tasks. The first task contain a couple of questions for measuring overconfidence. All the questions measure overconfidence at the same way using a colored framework of blocks. Afterwards the aggregated score will be used. The second task shows an investment option and will measure the perceived risk and the investment propensity, so the actual likeliness the someone will make the decision under risk.

## **2 Literature review**

It is important to start with a definition of risk. Risk is exposure to a proposition of which one is uncertain (Holton, 2004). Holton (2004) addresses two essential components for risk, there has to

be exposure to a less favourable outcome and second there has to be an uncertainty. He gives an example of a man leaping from an airplane without a parachute. If it is certain that he will die then he faces no risk. Markowitz (1952) never gave a definition of risk but he states that expected return is desirable and that variance of return is undesirable. He also states that in financial writings 'risk' appears frequently. His suggestion is to switch from 'risk' to 'variance of return' and notes that "little change of apparent meaning would result" (Markowitz, 1952). This consideration of risk or variance of return makes it measurable. The definition of risk given by Holton (2004) is not measurable. Exposure and uncertainty can't be measured according to him, it is even possible that people are exposed without knowing it and it is also possible that people faces uncertainty without being aware. True risk is not existent and the best you can do is operationally define the perception of risk (Holton, 2004).

Markowitz (1952) proposed to select portfolios by using the mean-variance as measurement. His model, the mean-variance model, is common economic knowledge (Levy & Levy, 2004; Zhou & Li, 2000). On the other hand that doesn't mean that the mean-variance model is undisputed. Alternative theories developed throughout the years. The model developed by Von Neumann and Morgenstern (1944) is based on expected utility and already existed when Markowitz came up with his mean-variance model. The theory by Von Neumann and Morgenstern makes it possible to incorporate risk attitudes in decision-making (Karni, 2014). It became possible to incorporate concave, convex or linear utility functions. Regarding agents own utility function this expected utility theory is a normative model of rational choice (Schilirò, 2017). The mean-variance model is also a normative model (French & French, 1997). Normative models suggests how we should decide, while descriptive analysis aim to describe what people decide (French & French, 1997).

The expected utility theory is criticized for its limitations as a descriptive model (Kahneman & Tversky, 1979; Starmer, 2000). The mean-variance analysis is also criticized as a descriptive model (Levy & Levy, 2004). That is not surprising as they have common axioms, which were not questioned for a long time (Frankfurter & McGoun, 2001). The prospect theory and the cumulative prospect theory are proposed as descriptive models, who should better fit empirical observations (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). It turns out that the (cumulative) prospect theory describes decision-making under risk better than the expected utility theory (Barberis, 2013). However, there is also empirical evidence that the cumulative prospect theory

doesn't reflect the observed truth very well (Bernheim & Sprenger, 2023).

Regarding the limitations of the aforementioned models as descriptive models the position of Holton (2004) stands on the corner. He already stated that risk is hardly measurable. The best we can do is operationally define the perception of risk. Risk perception is also one of the determinants of investors risk-taking behavior (Nosić & Weber, 2010). The other determinants are risk attitudes and expected returns (Nosić & Weber, 2010). Sitkin and Pablo (1992) came up with a couple of determinants which influences risk-taking in a setting of managerial decisions. They propose that risk perception and risk propensity are two mediator variables, which are influenced by a lot of factors. However, risk-taking is domain specific and risk perception could be different in different domains (Rettinger & Hastie, 2001; Nosić & Weber, 2010). On the other hand that means that people could make inconsistent choices across different domains, that doesn't mean that the process of risk-taking is different. People can have other risk perceptions across different domains but risk perception can still be a mediator variable.

Rose et al. (2014) found that alcohol intoxication improves risk-taking. They used the BART-experiment for measuring risk-taking. This study from Rose et al. (2014) showed that the group intoxicated with alcohol took more risk in the BART-experiment than the placebo group. However, Reynolds et al. (2006) didn't find an influence of alcohol intoxication on risk-taking. Also Reynolds et al. (2006) used the BART-experiment. Peacock et al. (2013) also didn't find an effect of alcohol on risk-taking, while using the BART-experiment. Weafer and Fillmore (2016) reviewed on this topic and stated that there is no robust effect of alcohol intoxication on risk-taking using the well-known BART-experiment.

Corazzini et al. (2015) found no significant effect of alcohol on decision-making. They controlled for the potential miscalibration of probabilities in their experiment. Miscalibration of probabilities is part of people's risk perception (Slovic, 1987). That means that possibly an aspect of risk perception is controlled. Sitkin and Pablo (1992) proposed risk perception as a mediator variable. Considering Slovic (1987) and Sitkin and Pablo (1992) it is still possible that there is an effect of alcohol on risk-taking in Corazzini et al. (2015) but that it is controlled.

Bregu et al. (2017) found no significant effect of alcohol on risk-taking in a laboratory setting. Multiple standard tasks used to measure uncertainty show no significant effect of alcohol on risk-taking. The study also contained an overconfidence task. Subjects were shown frameworks with 100 blocks in different colours. They were asked to count the red blocks between a certain

time interval. After the time interval the subjects have to give the number of red blocks in the framework. Afterwards the subjects have to guess their accuracy level. If the guessed accuracy level is higher than the actual accuracy level subjects are identified as overconfident. Bregu et al. (2017) found a significant effect in the relationship between alcohol intoxication and overconfidence. They didn't find a significant relationship for all accuracy levels but only for the lower one. However, for every accuracy level overconfidence was higher after alcohol intoxication. Another study from Long et al. (2023) found also a significant relationship between alcohol intoxication and overconfidence. But they only found that relationship significant in a bar setting. They found a joint effect of a bar setting and alcohol intoxication that leads to overconfidence. That differs from Bregu et al. (2017) because there is the bar setting not required for a significant relationship. Both Bregu et al. (2017) and Long et al. (2023) found a positive relationship, that means that after alcohol intoxication overconfidence is higher.

Chaudhary et al. (2025) found no direct relationship between overconfidence and risk-taking but they found an influence of the overconfidence bias on risk perception. Alongside the negative relationship between overconfidence and risk perception they found a negative relationship between risk perception and risk-taking. Jain et al. (2023) found risk perception as a mediator variable in the relationship amid overconfidence and investment decision-making. Risk perception positively mediates amid that relationship, thus higher overconfidence leads to more risky behavior. The positively mediated effect is because of a double negative relationship. They discovered a negative relationship between overconfidence and risk perception and a negative relationship between risk perception and risk-taking. Not only an effect by the mediator variable is discovered, there is also a direct positive effect from overconfidence on risky behavior (Jain et al., 2023).

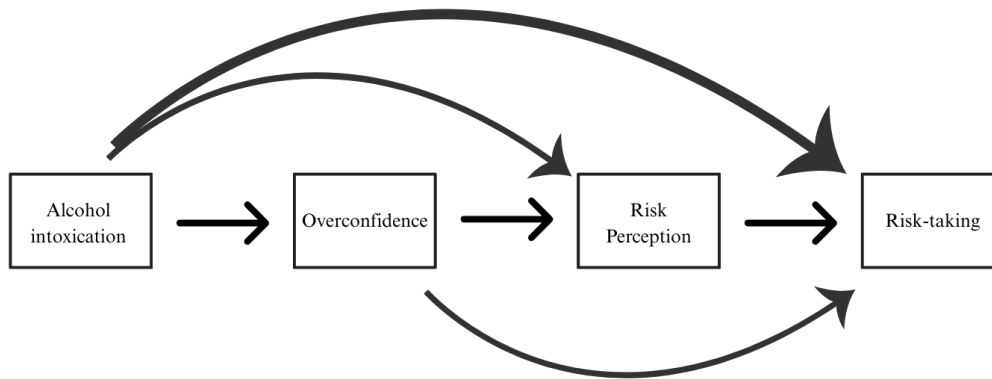
This study aims to provide an insight in the indirect effect of alcohol intoxication on risk-taking, using overconfidence and risk perception as mediator variables. The direct effect of alcohol intoxication on risk-taking will also be investigated. Giving a good fitting descriptive model of risk-taking is not the goal of this study at all.

Considering on one hand the possible relationship between alcohol intoxication and overconfidence, while on the other hand the possible relationship between overconfidence and risk perception. There might also be a relationship between alcohol intoxication and risk perception. This relationship will be studied using overconfidence as a mediator variable. There might be a

relationship between risk perception and risk-taking too. This study will also investigate if there is an effect of alcohol intoxication on risk-taking, using overconfidence and risk perception as sequential mediator variables. Alcohol intoxication will always be an independent variable. Overconfidence on the other hand will be seen as a dependent variable in a relationship with alcohol intoxication but can also be an independent variable when risk perception and risk-taking are measured. Risk perception can also be a dependent and an independent variable. Risk-taking will only be a dependent variable. The model as described is shown in Figure 1.

**Figure 1**

*The theoretical model*



The following hypotheses are proposed. The expectation is that there is no direct effect of alcohol intoxication on economic decision-making under risk, since most studies didn't find a direct effect of alcohol intoxication on risk-taking (Reynolds et al., 2006; Peacock et al., 2013; Corazzini et al., 2015; Bregu et al, 2017). So, the expectation is that for Hypothesis 1 the null hypothesis will not be rejected. Regarding Hypothesis 2 the expectation is that the null hypothesis will be rejected. Bregu et al. (2017) and Long et al. (2023) suggest an influence of alcohol intoxication on overconfidence. Jain et al. (2023) and Chaudhary et al. (2025) suggest risk perception as a mediator variable amid the relationship between overconfidence and risk-taking. Taking those possible relationships in consideration an indirect effect of alcohol intoxication on risk-taking is expected.

*Hypothesis 1:*

H<sub>0</sub>: There is no direct relationship between alcohol intoxication and risk-taking.

H<sub>1</sub>: There is a direct relationship between alcohol intoxication and risk-taking.

*Hypothesis 2:*

H<sub>0</sub>: There is no indirect effect of alcohol intoxication on risk-taking.

H<sub>1</sub>: There is an indirect effect of alcohol intoxication on risk-taking.

### **3 Methodology**

In the introduction, the experiment was briefly explained. This chapter will elaborate more extensively and choices will be motivated. As already mentioned in the introduction, the experiment will have a within-subject design. The respondents will all be approached in a bar-setting. People who are about to drink alcohol will fill in a survey where overconfidence, risk perception and risk-taking is measured. To measure overconfidence the design of Bregu et al. (2017) is used. To measure risk perception and risk-taking the design of Holzmeister et al. (2019) is used as a starting point. Both tasks will be explicitly explained in this chapter. Afterwards people will have alcoholic beverages and after consuming two alcoholic beverages people will fill in the exact same survey again. This gives the opportunity to investigate what the effect of alcohol intoxication is on risk perception and the effect of alcohol intoxication on risk-taking.

First of all; the within-subject design and the selection bias. Despite that Bregu et al. (2017) is about alcohol abuse and this study is not, I think their motivation holds. People who are going to drink could differ heavily from people who don't want to drink (Bregu et al., 2017). Using a within-subject design could solve that problem. The observed group have already the intention to drink alcohol so the assumption is that their intention doesn't change. Both observations, one before alcohol intoxication and one after alcohol intoxication, contain people whose intention is to drink alcohol. Besides that, the within-subject design is chosen because individual differences in overconfidence, risk perception and investment propensity are likely. A within-subject design takes those differences into account because the observations are compared to their own base level. The within-subject design also is assumed to have higher statistical power and less participants are required (Montoya, 2022).

Subjects will be approached in a bar setting. This setting is chosen by taking the findings of Long et al. (2023) in mind, in a bar setting the effect of alcohol on overconfidence is significant, while without a bar setting it is not (Long et al., 2023). It is important that both surveys filled in by the same respondents can be connected to each other while analyzing the data. The solution for that will be that everyone receives a number, written down in twofold. One of the first questions will

be that people have to fill in their own unique number. They have to keep their number and as a back-up I will also write down their numbers until the second survey starts. After starting the second survey I will destroy my notes. To give the subjects an incentive to participate, especially two times they will be included in an lottery where they can win snacks. Every evening snack will be distributed once through a raffle, using the wardrobe numbers which they have to submit after the second survey.

The possibility exists that people recognize the questions, especially when there is only a small amount of time in between. This is called memory effects. Studies about memory effects shows that this could be a problem (Schwarz et al., 2020 and Rettig et al., 2022). Rettig et al. (2022) showed that after an time-interval of 20 minutes 17% of the subjects can reproduce their answers correctly due to memory. Schwarz et al. (2020) come up with a percentage of 19.9% due to memory effects. It is important to make a difference between subjects who give the same answers and subjects who give the same answer due to memory effects. Both before mentioned studies make that distinguishment. Also both studies ask people if they remember the question and afterwards ask to reproduce their answer. That is different in the experiment in this study. In this study subjects are not asked if they remember the question and they don't have to reproduce their answer. So, in this study memory effects are only a problem if people recognize the question by themselves and reproduce their answer. Besides that, the time-interval would probably be longer than 20 minutes. Furthermore people will see similar looking investment opportunities so it will be harder to distinguish than normal survey questions. This finds backup in literature, where similar questions are a good way to reduce the memory effects (Van Meurs & Saris, 1990). I think that people don't recognize the questions and if they do that they don't remember what they filled in before, due to the similar questions as Van Meurs and Saris (1990) argued and a longer time-interval than Schwarz et al. (2020) and Rettig et al. (2022) used.

I chose for two alcoholic beverages because that is the quantity that is about 0.05 BAC (Ministerie van Algemene Zaken, 2025). Research has demonstrated that a BAC of 0.05 has a measurable impact on cognitive functions (Fillmore, 2007; Dry et al., 2012). Regarding that two factors I consider two alcohol beverages as the perfect intoxication level for this experiment. Two alcoholic beverages could give results because of the already measured impact on cognitive functions and is besides that also accessible and appropriate for respondents.

Furthermore the experimental design will be derived from the design that is used by

Holzmeister et al. (2019) and Bregu et al. (2017). Using RStudio I generated a five frameworks with 100 blocks in six different colours. People are asked to count the number of red blocks, just as in Bregu et al. (2017). The framework is shown six seconds and afterwards the survey automatically moves on. That information is explicitly shown to the subjects. At the next page the subjects are asked to how many red blocks were shown and how big they think their error margin is. Overconfidence is measured by the actual error margin minus the error margin that is indicated by the subjects. Afterwards subjects are shown a possible investment opportunity with an investment horizon of one year. Subjects will see a diagram where the on the y-axis the probability and on the x-axis the return on investment is shown. They are asked how risky they perceive this investment opportunity. Subjects have to answer on a 7-point Likert Scale. To measure risk-taking they are asked how likely it is that they will invest in that investment opportunity. The investment horizon of one year is the most plausible evaluation length (Benartzi & Thaler, 1995). According to Benartzi and Thaler (1995) a lot of things are presented annually, such as taxes and reports, and that makes an investment horizon of one year the most plausible. Appendix A contains a screenshot from one out of five questions per task.

Alcohol intoxication will be operationally defined using a dummy variable, which have the value 1 after intoxication. Overconfidence will be measured, as I stated earlier, by subtracting the self-indicated error margin from the actual error margin and is a ratio variable. Risk perception is operationally defined using the 7-point Likert Scale. Risk-taking is also operationally defined using the 7-point Likert Scale. Overconfidence, risk perception and risk-taking is measured in five questions. The aggregated scores will be used. The scores will be aggregated by using the sum of all questions. While using a Likert Scale implicates an ordinal variable, risk perception will be seen as an interval variable (Norman, 2010).

The methodology of mediation analysis is pioneered by Baron and Kenny (1986). More recently other methodologies for mediation analysis arose. The bootstrapping method seems to be the best method for mediation analysis (Shrout & Bolger, 2002; MacKinnon et al., 2004; Hayes, 2009). For serial mediation Hayes (2022) developed a good method using bootstraps. However, Hayes (2022) clearly indicates that it is derived from OLS. That means that those assumptions should hold as well. Using a within-subject design violates the assumption that the error terms are uncorrelated. Probably the error terms within the same subject is correlated. That's why Hayes (2022) can't be used. Judd et al. (2001) proposes to use difference scores. In this thesis that means

that the aggregated scores will be the aggregated difference scores. That means that the score for each question regarding overconfidence, risk perception and investment propensity after alcohol intoxication are distracted by the scores before alcohol intoxication. Those difference scores are accumulated to get the aggregated scores. Alcohol intoxication is a dummy variable, which can only be 0 or 1. Calculating the difference score in the same manner as the other variables means that the difference score for alcohol intoxication is always 1. Since, there is no deviation anymore in the case of alcohol intoxication it can't be used. Judd et al. (2001) states that the mean of the difference score is the actually the treatment effect, assuming that there are no confounding factors. They assume both temporal stability and causal transience. Those assumptions respectively mean that the variables don't change over time and the effect of the treatment isn't permanent. Taking difference scores and use them under the assumptions of Judd et al. (2001) means in this thesis that the difference in means of overconfidence, risk perception and investment propensity are caused by alcohol intoxication. That means also that alcohol intoxication will not explicitly be in the regressions.

The regressions below are made up, where 'OC' stands for overconfidence, 'RP' stands for risk perception and 'IP' stands for investment propensity. The last term is the error term and is written down identical in both equations but is of course different.

$$(1) RP_{it} = \beta_0 + \beta_1 * OC_{it} + \varepsilon_{it}$$

$$(2) IP_{it} = \sigma_0 + \sigma_1 * RP_{it} + \sigma_2 * OC_{it} + \varepsilon_{it}$$

$$(3) \text{Indirect effect} = 1 * \beta_1 * \sigma_1 + 1 * \sigma_2.$$

Equation (1) is to test the path between overconfidence and risk perception. Equation (2) tests two paths. The first one is to test the path between risk perception and investment propensity. The second one tests whether there is also a direct effect of overconfidence on investment propensity.

The equations (1) and (2) can't test for a total effect of alcohol intoxication on investment propensity. A t-test can be used on the difference score of investment propensity to test whether there is a relationship between alcohol intoxication and investment propensity. However, that zero-order effect from alcohol intoxication on investment propensity isn't necessarily for mediation analysis (Zhou et al., 2010). An important assumption from Judd et al. (2001) is that the mean difference in the first mediator is a causal effect of the treatment. A t-test will be done for the first mediator to test if the effect is significant. A t-test for the second mediator and the dependent variable will be done as well.

The indirect effect of alcohol intoxication on investment propensity is calculated by the product from 1,  $\beta_1$  and  $\sigma_1$  plus the product from 1 and  $\sigma_2$ . However, there is a possibility that there is also an effect from alcohol intoxication on risk-taking that follows only the path of risk perception, thus doesn't go through overconfidence. That direct path from alcohol intoxication to risk perception is also showed in Figure 1. It is not possible to measure the effect of alcohol intoxication on risk perception after using the difference scores because the independent variable will always have the value of 1. That part of the indirect effect can't be measured in this thesis, however the possibility exists that the t-test on risk perception will show a not significant relationship. That would mean that the total indirect effect is equal to Equation 3. Thus the equation for the indirect effect in this thesis, under the assumption that the difference in the first mediator is a causal effect of the treatment, is equation (3) above. 1 is also integrated in the formula, that is because of the assumptions made in Judd et al. (2001), those assumptions that refer to this one are a causal relationship and no confounding factors.

The survey was taken using Qualtrics. After downloading the data from Qualtrics the data was cleaned. Using a within-subject design means that there are two observations. People had their own unique number, the observations were linked through each other using that number. The latest observation with was used as the observation after alcohol intoxication. There were a few mistakes that people reported. That included some typos where people filled in a character instead of a number. I fixed the reported mistakes due to typos in Qualtrics. There was one case where a participant made the mistake of using percentages instead of absolute numbers. That subject also formulated his answer positive, while the question asked for a negative answer. The answers of this participant were excluded from the final dataset. Obviously participants who didn't filled in the second survey were also excluded. In some cases participants made mistakes with filling in their own unique number. During the process of linking the data it became crystal clear that a couple of observations had different unique numbers but that they belonged together. Other identifying data was available to link the observations to each other. For example, someone filled in an extra zero at the end of his unique number. The question was simultaneously but separate filled in with a couple of group members, also the same IP-address was used. Of course, observations which were not possible or too questionable were excluded from the final dataset.

## 4 Results

This chapter shows the results from the experiment. RStudio is used to run the regressions. First Table 1 and Table 2 were used for descriptive statistics and t-tests for the first results. Table 3 and Table 4 show the results from the equation (1) and equation (2). The methodology as described in Chapter 3 is followed. Equation (3) is not incorporated in a table but the results are given in text. In this results section overconfidence, risk perception and investment propensity are all difference scores.

**Table 1**

*Descriptive statistics*

	Overconfidence (n=44)	Perceived risk (n=44)	Investment propensity (n=44)
Mean	-3.17	-0.52	1.43
Standard deviation	8.95	4.13	5.25
Standard error	1.35	0.62	0.79

Table 1 shows that the mean for delta overconfidence is negative, that means that with alcohol intoxication the aggregated overconfidence is lower. There is a quite high standard deviation in comparison to the mean. Table 1 shows the same for perceived risk. There is a negative mean, thus after alcohol intoxication the aggregated perceived risk is decreased. Also the standard deviation is, taking the mean into consideration, again quite high. After alcohol intoxication the mean of investment propensity is positive. That means that the change in investment propensity is positive after alcohol intoxication. Again, the standard deviation is quite high in comparison with the mean. The high standard deviations could lead to less significant outcomes. The standard error for overconfidence is a bit high as Table 1 shows, which implies that the mean value is not very precise. For perceived risk and investment propensity Table 1 shows a lower standard error, which implies more precise mean values.

**Table 2***T-test on the difference scores after alcohol intoxication*

Term	Mean	p-value	t-value	95% CI
Overconfidence	-3.1705	.0235	-2.3496	[-5.8917, -0.4492]
Risk perception	-0.5227	.4057	-0.8398	[-1.7780, 0.7325]
Investment propensity	1.4318	.0774	1.8094	[-0.1640, 3.0277]

Table 2 shows whether there is a significant relationship between alcohol intoxication and the other variables. Table 2 shows a negative relationship with overconfidence as the mean value is negative. That relationship is significant on the 5% level, since the p-value is below .05 and the confidence interval doesn't include 0. There is a negative mean for risk perception as Table 2 shows. That indicates a negative relationship, however that relationship is not significant. The p-value is above definitely higher than .05 and the confidence interval includes 0. For investment propensity Table 2 shows a positive mean, indicating a positive relationship. So after alcohol intoxication the investment propensity is higher. The relationship is not significant on the 5% level as Table 2 shows, because the p-value is higher than .05. The confidence interval also includes 0, so the confidence interval shows as well that the relationship is not significant. The p-value is equal to .0774 and is just above .05, the lower bound from the confidence interval is also just below 0. That means that although the relationship is not significant, there seems to be a trend.

**Table 3***Overconfidence as independent variable and risk perception as dependent variable*

Term	Coefficient	Standard error	p-value
Constant	0.0111	0.6228	.9858
Overconfidence	0.1684	0.0663	.0148

Table 3 shows the relationship between overconfidence and risk perception. The coefficient for overconfidence shows that there is a positive relationship. The positive relationship is statistically significant at the 5% level because  $p = .0148$ , which is below 0.05 as Table 3 shows. Thus a change in aggregated overconfidence has a small effect on the change of aggregated risk perception.

**Table 4**

*Overconfidence as independent variable, risk perception as a mediator variable and investment propensity as dependent variable*

Model	Coefficient	Standard error	p-value
Constant	1.0785	0.7881	.1786
Overconfidence	-0.0319	0.0981	.7248
Risk perception	-0.4824	0.1952	.0177

Table 4 shows the second model. The direct relationship between overconfidence and investment propensity is the coefficient from overconfidence in Table 4. That direct relationship is the direct effect of the change in overconfidence on the change in investment propensity. That relationship is a negative relationship as Table 4 shows. Table 4 shows that the negative relationship is definitely not significant as the p-value is very high. The relationship between risk perception and risk propensity is negative and is significant.

To calculate the total indirect effect the assumption was made that the difference score of overconfidence is because of the treatment, the alcohol intoxication. That effect will thus be equal to 1. The indirect effect from alcohol intoxication through both the mediators, overconfidence and risk perception is calculated as the product of the overconfidence coefficient from Table 3, the risk perception coefficient of Table 4 and the assumed 1. That product equals -0.0812. That is the indirect effect through both mediators.

## **5 Conclusions, limitations and future research**

This chapter starts with a summary of the methodology. Afterwards the findings will be analyzed and discussed regarding the literature. Then a summary will be given and the hypotheses will be answered along with the research question. Afterwards the limitations following from the findings compared to the literature and other limitations will be summarized. This thesis ends with recommendations for future research. The central research question in this thesis was ‘*Does alcohol intoxication influences investment propensity, with overconfidence and risk perception as mediators?*’.

To answer the research question an experiment was done. A within-subject design was chosen because that was the best way to observe the effect of the treatment. The treatment was

alcohol intoxication, so people filled in the survey twice. The first time they filled in the survey was when they were already in the bar and their intention was to drink alcohol. The second time they filled in the survey when they had two alcoholic beverages, and thus were intoxicated with alcohol. Overconfidence, risk perception and investment propensity were measured in the survey and all had five questions where they were measured. Overconfidence was measured using a question where people had to count red blocks in a multicolor frame. After six seconds the multicolored frame disappeared and people were asked how many red blocks appeared in the frame, also they had to assign their own expected error margin. To operationally define overconfidence the actual error margin was distracted by the self-assigned error margin. That was done for each question. Risk perception and investment propensity were measured using questions where one figure per question were shown to the subjects. The subjects had to assign risk perception and investment propensity on a 7-point Likert Scale. Difference scores were used, so the value of the treatment observation was distracted by the value of the first observation without treatment. That was done for every variable and on every question. At last the sum of all difference scores on the different questions were taken, to obtain aggregated scores. The difference scores were used for the regressions.

Two models were made up for the regressions. The first model included overconfidence as an independent variable and risk perception as dependent variable. The second model included overconfidence and risk perception as independent variables and investment propensity as dependent variable. Also the descriptive statistics were gathered and a t-test was done on the first mediator and the dependent variable.

The methodology of Judd et al. (2001) was used and difference scores were used. The assumptions on their model is that the mean difference is a causal effect of the treatment. To test for that assumption first the descriptive statistics were used. Table 1 shows that there is a negative mean difference. So, that after alcohol intoxication overconfidence is lower. To test that mean difference a t-test on that difference score was done. The t-test turned out that the negative relationship is significant, as Table 2 shows. That gives an indication that the assumption holds but isn't prove. The significant relationship just shows that there is a relationship but that doesn't mean that it is causal. The assumption still has to be assumed, however there is actual a significant relationship between alcohol intoxication and overconfidence. Important to notice is that where Bregu et al. (2017) and Long et al. (2023) found a positive relationship between alcohol

intoxication and overconfidence this thesis shows a significant negative relationship. Long et al. (2023) don't give an explanation about how they operationally defined overconfidence. Bregu et al. (2017) used almost the same way of measuring overconfidence as this thesis. In Bregu et al. (2017) subjects had to choose between categories of error margins and in this thesis subjects filled in their own answer. Bregu et al. (2017) analyzed the change in overconfidence for every different error margin category. They found only for the smallest self-assigned error margin category a significant self-overestimation after alcohol intoxication. For the other categories after alcohol intoxication the self-overestimation was also higher but not significant. Bregu et al. (2017) used a between-subject design, where this thesis used a within-subjects design. The contradictory findings of Bregu et al. (2017) and this thesis are possibly explained by that difference in design. After completing the survey of this thesis, subjects were able to talk to other subjects because it was taken in a bar setting. The possibility exists that subjects talked to each other and spoke about the difficulty of the block framework questions. That could have led to subjects who are more aware of the difficulty because other subjects struggled as well. That could have led to subjects who filled in a higher error margin, which leads to lower or negative overconfidence. Another explanation can be that subjects became more skilled in quick counting the blocks, so that their error margin decreased. That is both not possible in a between-subject design.

The mean difference of investment propensity is positive as Table 1 shows. Table 2 shows that the relationship is not significant. However, that relationship is almost significant, as the p-value is not much above the 5% level. The 95% confidence interval also shows that the relationship is almost significant as zero is just within the interval. Most studies didn't find a significant positive relationship between alcohol intoxication and risk-taking (Reynolds et al., 2006; Peacock et al., 2013; Corazzini et al., 2015; Bregu et al., 2017). Only Rose et al. (2014) found a significant relationship between alcohol intoxication and risk-taking. This means that most studies didn't find more propensity to risk-taking. The findings in this thesis are in line with the above mentioned literature as Table 2 shows not a significant relationship. However, the relationship is almost significant, which indicated that there might be a trend.

Table 3 showed a significant positive relationship between overconfidence and risk perception. Jain et al. (2023) and Chaudhary et al. (2025) both found a significant negative relationship between overconfidence and risk perception. So, the findings in this thesis are opposite to the literature and the relationships are in all studies significant. There is again a discrepancy with

literature, where overconfidence is a variable. In this chapter possible explanations regarding measurements error in overconfidence were already discussed. Summarized the possibility exists that people were more aware of the difficulty of the block framework questions because subjects were able to talk to each other between the observations.

Table 4 showed a significant negative relationship between risk perception and risk-taking. The literature review showed also significant negative relationships between risk perception and risk-taking. Jain et al. (2023) and Chaudhary et al. (2025) both found a significant negative relationship between risk perception and risk-taking. These findings seems to be more robust. That a negative relationship exists doesn't mean that the relationship is causal. It could be causal but it isn't proven, as it is still a correlation.

Overconfidence doesn't show a significant relationship with risk-taking as Table 4 shows. Jain et al. (2023) and Chaudhary et al. (2025) also both didn't found a significant relationship between overconfidence and risk-taking. Thus, this finding is in accordance with literature. There is no direct effect from overconfidence on risk-taking. However, as earlier discussed there is a possibility that there is a measurement error with overconfidence.

Concluding, there is a significant positive relationship between alcohol intoxication and overconfidence, a significant positive relationship between overconfidence and risk perception and a significant negative relationship between risk perception and investment propensity. The indirect effect that walks through both mediator variables, overconfidence and risk perception, is equal to -0.0812. The path that was excluded from calculating the indirect effect was the path from alcohol intoxication to risk perception. Table 2 shows that the relationship between alcohol intoxication and risk perception is not significant. So the calculated indirect effect of alcohol intoxication is equal to the total indirect effect and is negative. The significant results allows to reject the null hypothesis from Hypothesis 2. Since, there is no significant relationship between alcohol intoxication and investment propensity in a direct relationship the null hypothesis from Hypothesis 1 can't be rejected. The research question in this thesis was: '*Does alcohol intoxication influences investment propensity, with overconfidence and risk perception as mediator variables?*' With rejecting the null hypothesis from Hypothesis 2 the answer to this research question is that there is a significant effect, and thus an influence, of alcohol intoxication on investment propensity, using overconfidence and risk perception as mediator variables.

However an important limitation of this study is that the bootstrapping method as Hayes (2022) proposed is not used because that was not possible in case of a within-subject design. The bootstrapping method is acknowledged as the best suitable method for mediation analysis (Shrout & Bolger, 2002; MacKinnon et al., 2004; Hayes, 2009). The within-subject design was chosen because of the possibility of the selection bias and potential differences between subjects. Future research could use a between-subject design to be able to use the bootstrapping method provided by Hayes (2022).

The relationship between alcohol intoxication and overconfidence and the relationship between overconfidence and risk perception are both significant but the direction of this effects are both opposite to the direction of the effects found in the literature. That results in an indirect effect that is the same as hypothesized regarding the literature but this raises the question of how valid the result is. Future research that uses a within-subject design should ensure that it is not possible that subjects have contact in between both surveys to prevent raising awareness about the difficulty of the task.

Another possibility for future research is moderator analysis. This thesis focused on mediator analysis, thus the effect from alcohol intoxication on investment propensity, using overconfidence and risk perception as mediators. Future research can investigate whether the indirect effect is equal among everybody or that there are significant deviations due to other factors.

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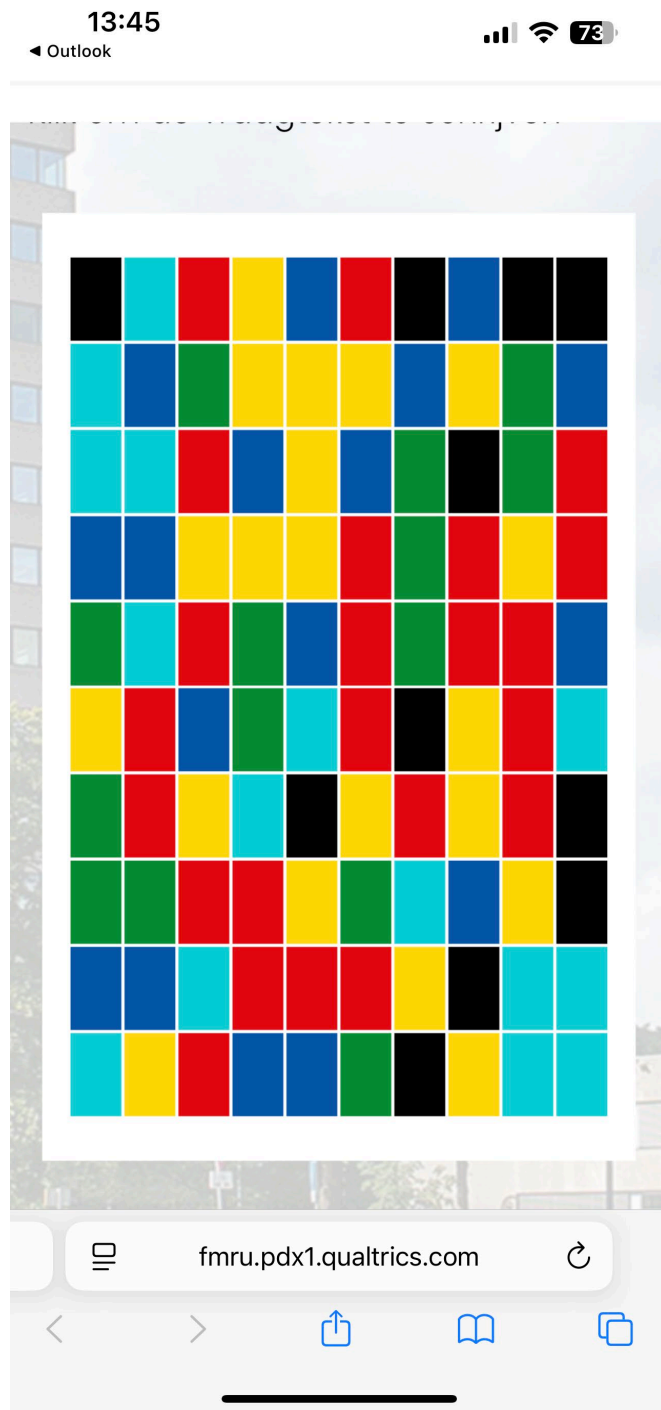
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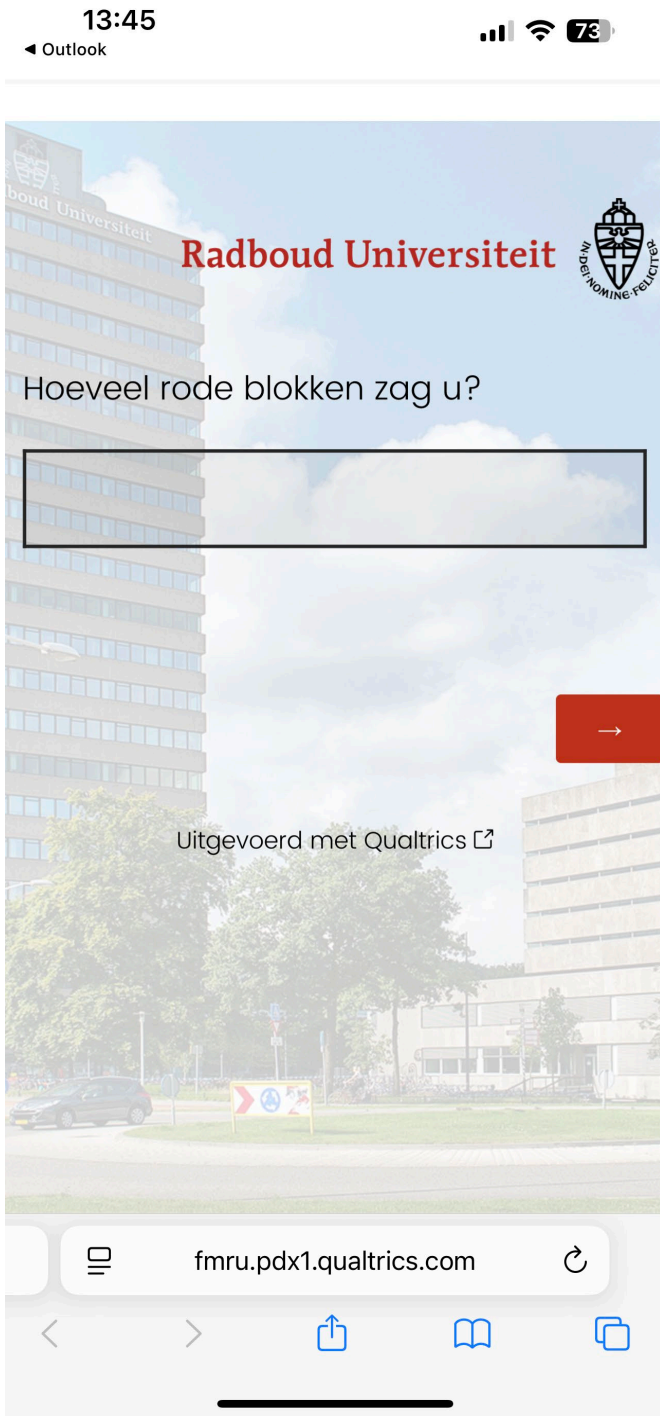
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## 7 Gen-AI statement

Generative AI tools were used to assist in coding for the survey used in this thesis. The frameworks with blocks and the graphs that are shown to people are created in R, using a R-code which I got using generative AI (ChatGPT). By submitting this thesis I declare that I am fully responsible for the accuracy and completeness of its content. Appendix 2 provides a detailed account of the use of Generative AI tools during the development of this thesis.

## 8 Appendix A





13:45  
◀ Outlook

**Radboud Universiteit**




In de vorige vraag heeft u het aantal rode blokken geschat. Hoeveel denkt u daar maximaal naast te zitten?

*Bijvoorbeeld u dacht dat er 50 rode blokken waren en u heeft 50 ingevuld. Hoeveel denkt u er maximaal naast te zitten. Als u '5' invult betekent dat u (nagenoeg) zeker weet dat het aantal rode blokken tussen de 45 en 55 zit.*

→

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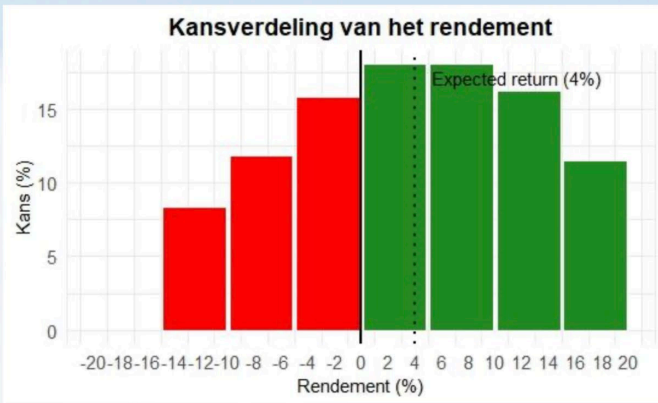
13:48  
◀ Outlook



Radboud Universiteit



Figuur 1

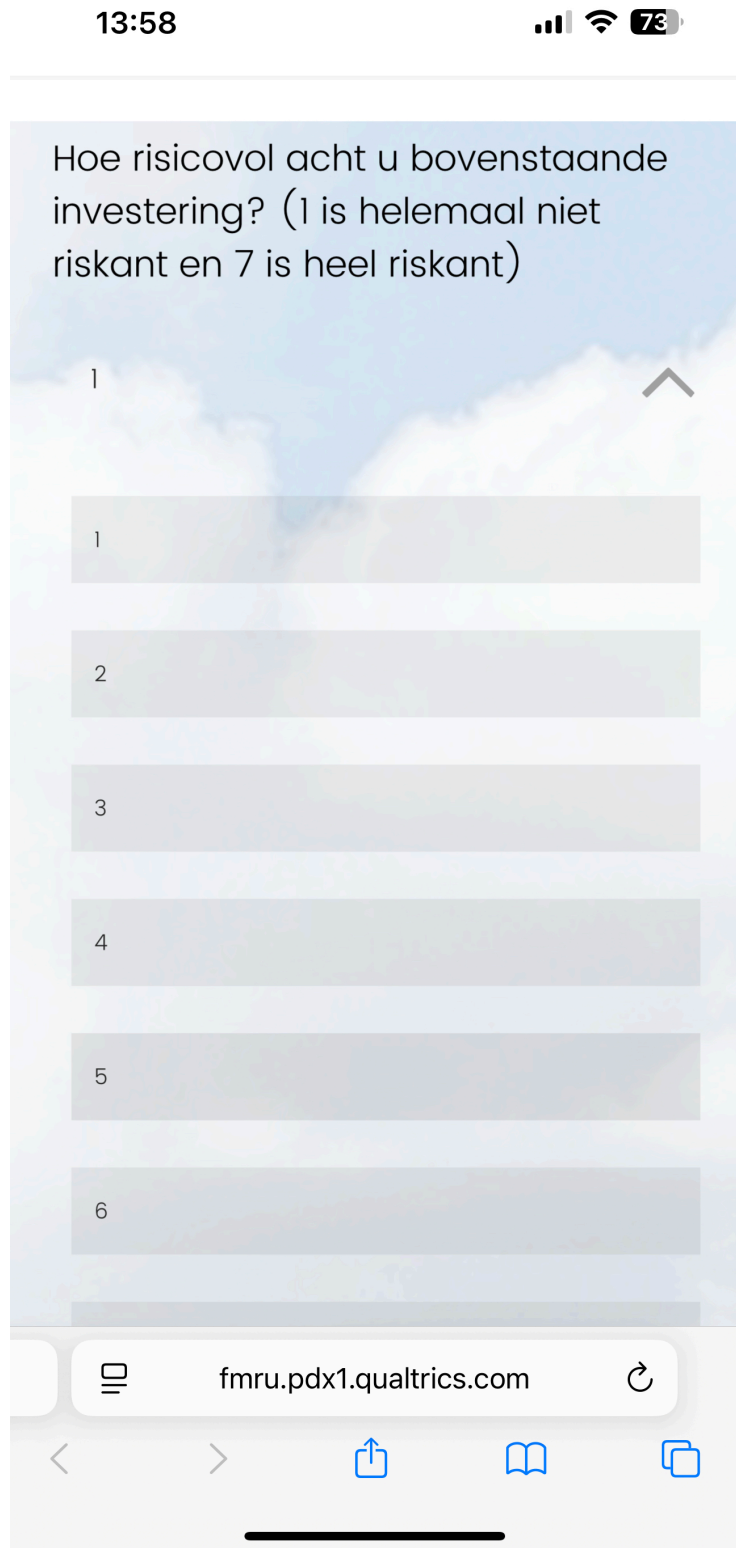


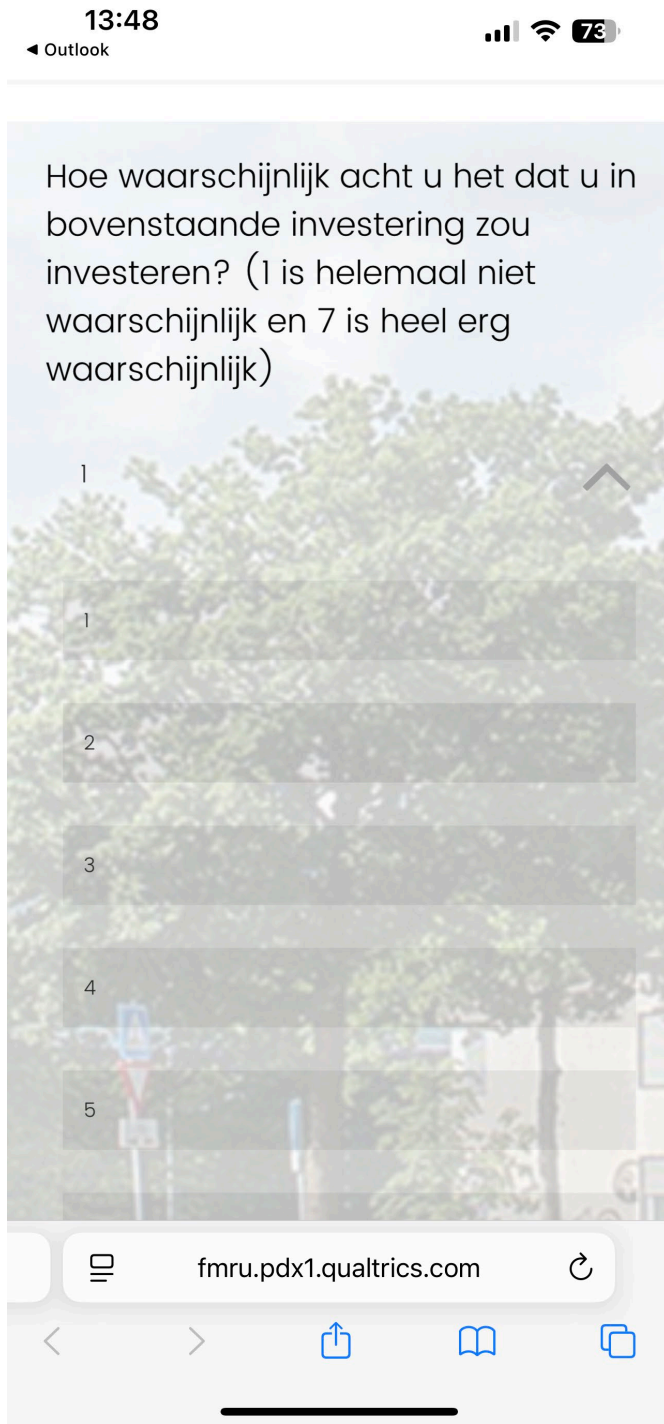
Hoe risicovol acht u bovenstaande investering? (1 is helemaal niet riskant en 7 is heel riskant)



fmru.pdx1.qualtrics.com







## 9 Appendix B

### Statement of Purpose

This appendix provides a detailed account of the use of Generative AI tools during the development and writing of this thesis. These tools were used to support coding. All outputs generated were critically evaluated and, where necessary, modified by myself to align with the objectives of this research.

### Tools used

- ChatGPT, version 4o and 4.5

### Coding and Data Analysis

- **Description:**
  - Tool: ChatGPT, version 4o and a couple of questions for version 4.5
  - Purpose: Generating initial R-code for generating the framework of blocks and the graphs used in the survey. Also, ChatGPT helped me optimizing that code. All the blocks and graphs used in the survey were made with R with help from Generative AI.
  - My Role: Checking if the generated framework and graphs are what I expected and needed for my survey. Adjusting for the following figures.
  - My Reflection: AI provided a good R-code and it saved me a lot of effort and search costs for providing good figures according my wishes. The figures were exactly what I wanted for my survey. Generating a framework with blocks I have never done before and wasn't taught in class so I didn't know how to do that. Using that R-code I could easily make small adjustments for the other figures that have the same lay-out but small differences.
  - All figures applied in the survey

**Complete log of AI Interaction** *Here I have a couple of questions. For making a R-code and optimizing it, I had a lot of interaction with the Generative AI. It is too extended for complete recording but the first query is given and a summary of the chat with the AI.*

- **Coding Assistance**
  - **Query to ChatGPT-4o/4.5:** Do you have a picture for me with a framework of blocks? The blocks have to be in 6 different colors, including red. Also there have

to be 10 rows of blocks and 10 columns of blocks. The blocks must be in random order.

- **Output from ChatGPT-4o/4.5:** The Generative AI provided me a picture and afterwards I discussed with the Generative AI to get a R-code instead of the picture. The R-code that I got was not yet complete. We discussed further about the lay-out such as distance between the blocks and also a loop to create instantly multiple different frameworks. The ratio red blocks was discussed as well.
- **How it was used:** The R-code was used to get the frameworks of blocks which were used in the survey for the overconfidence questions.
- **Coding Assistance**
  - **Query to ChatGPT-4o/4.5:** Could you generate a R-code for a hypothetical histogram. We live now in  $t = 0$ . It has to be a graphical illustration of an investment option with a return of 4%, I want a standard deviation from 10% and I want a normal distribution of returns. I want on the x-axis the return and on the y-axis the chance at that return.
  - **Output from ChatGPT-4o/4.5:** The Generative AI provided me a R-code and we discussed further on the lay-out of that graph. The Generative AI suggested red and green colors for the positive and negative returns. It was a long conversation about the histogram. I wanted for example that there was no bar within zero, so a bar left and a bar right from the y-axis. I asked multiple questions about how to do that.
  - **How it was used:** The R-code was used to get the figures which were used in the survey for the risk perception and investment propensity questions.