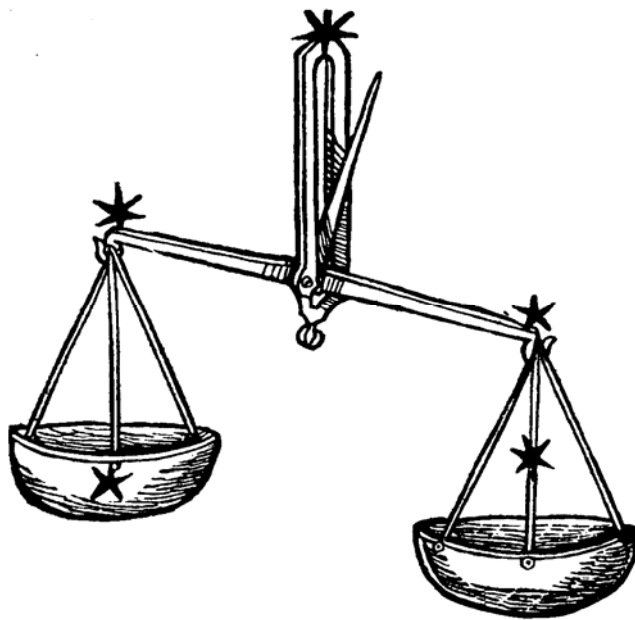


Framing and the cost of not knowing

The effects of framing on the trade-off between the cost of not knowing and the cost of finding out



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Abstract

Decision making is a very important human activity. Previous research on framing has established the effects of the decision representation on decision making (Kühberger, 1998). A previous study by De Hoog & Kooken (2006) established that a trade-off between the cost of not knowing and the cost of finding out leads to overall risk averse behavior. In this research, different frames are used to examine if these effects remain in different conditions. In the first experiment, it is examined what the effects are of adding less extreme values for the cost of not knowing and cost of finding out in the experiment. The questionnaire created by De Hoog & Kooken (2006) was extended and the participants had to answer sixteen instead of four questions. Furthermore, it was examined if the use of numbers created a change in risk behavior of the participants and it was tested if low costs of information and not knowing created different responses from a condition in which high costs were used. The variable probability method presented by Von Winterfeldt & Edwards (1986) was used in the two numerical conditions. In total, 93 Psychology students of the University of Twente participated in the research. It was expected that risk averseness would remain in the extended version of the questionnaire, this effect was indeed found. In the numerical condition, risk averseness largely disappeared, which was expected according to the literature (McElroy & Seta, 2003). In the low and high cost condition, largely the same results are found. Since it was expected that high costs would lead to more risk aversion, the hypotheses are rejected. Of course, future research can further examine these effects.

1. Introduction

Decision making is a very important activity for human beings. Everyday, many smaller and larger decisions have to be made and of course, people want to make the best decision. From decision research, it is clear that many factors play a role in decision making. Most often, decision research is focused on comparing a risky option with a sure option, mostly in the context of gambling situations (Kühberger, 1998). However, this is often not the situation people encounter in daily life. In this research, a more familiar situation is used to examine decision making and its associated concepts of risk.

Since decision making can be very important, it is necessary to provide information in such a manner that it is easy for a person to make the best decision. In this research, decision making theory is combined with a previous study by De Hoog & Kooken (2006) on decision making in which participants had to make a decision, but could decide to search for information. They had to decide to either take the risk, make the decision without information, or to search for information, the sure option. Thus, the participants had to conduct a trade-off between the cost of not knowing and the cost of finding out. Overall, participants in this research decided to search for information quite often. In other words, they are not willing to take risks. The results of this study are further examined to find out if presenting the same information in a somewhat different way leads to different responses.

First, an introduction is given in basic decision theory, next, information is provided on the previous study by De Hoog & Kooken (2006) and finally, the occurrence of framing is discussed and the hypotheses are presented.

1.1. Basic decision making theory

Decision making is a complex subject of study and many different ideas have emerged. First, the normative models are described and second, the descriptive models are explained. This way, the different views on decision making behavior are examined.

Normative, rational decision theory

For a long time normative, rational decision models have dominated research in decision making. Presumably, when dealing with uncertainties, a 'rational' decision, and therefore the best decision for a person to make, is made by trying to achieve the highest subjective expected utility. In other words, when dealing with different options and uncertainties the likelihood of occurrence and the value of an outcome are combined and lead to a utility score. The option with the highest score and therefore the best expected utility, is the best choice a person can make (Hastie and Dawes, 2001; Von Winterfeldt & Edwards, 1986). For example, in a gamble situation, a person is offered two options:

Option A: 50 euros is received for sure &

Option B: a probability of 50% of winning 200 euros and a probability of 50% of winning nothing.

In that case, option B has the best expected utility (0.5 times 200 = 100 euros) in comparison with the expected value of option A (50 euros). Therefore, option B is the best option.

For the calculation of the expected utility, decision trees can be used. Their main function is the simplification of the situation and it is therefore an easy way to see what the best decision is. In this research, the decision participants have to make is about obtaining information or not in a specific situation. The value of the information has a large influence on the expected value of an outcome and therefore on which decision a person should make. If the information is perfect, the value is very high and the information will largely influence your decision. Its capacity to reduce uncertainty is very large. The value of perfect information is seen as the difference between the expected utility of acting with perfect information and the expected utility of acting without perfect information (Von Winterfeldt & Edwards, 1986). In other words, the value of information is higher in more uncertain situations and its value is dependent on the context.

Descriptive, psychological decision theory

Models like subjective expected utility theory are called normative, because they show how people should make their decisions and not how they actually do make them. Of course, the combination of the payoff of a certain outcome and the probability of occurrence is not necessarily the way a human being makes a decision. Many personal factors also play a large role and the decision made is not necessarily irrational.

According to Tversky & Kahneman (1981), people can react in three different ways with respect to a decision making situation. People can be risk averse, which means that they rather choose the certain option, even if, according to rational decision theory, it would be better to choose the risky option. According to the formal definition, they are willing to sell a lottery ticket for less than its expected value. Risk neutral persons react like they should according to rational decision theory and try to maximize their expected utility. Finally, people can be risk prone, which means they are willing to take a risk, even it would be better to choose the sure option according to rational decision theory. In other words, they refuse to sell the lottery ticket even if the amount offered is higher than the expected value of the lottery ticket. In general, it seems that people are risk averse for gains and risk seeking for losses, which leads to an S-shaped value function over probabilities. The shape of this function is concave for gains and convex for losses (Tversky & Kahneman, 1981).

In recent decades, descriptive models, models that describe how people actually do make a decision, have become more influential (Von Winterfeldt & Edwards, 1986). These models see decision making as more complex and show that other factors also play a role in decision making.

Tversky and Kahneman's Prospect Theory (Tversky & Kahneman, 1981) is one of the most influential psychological decision theories. This theory is based on expected utility theories and also uses a formula to represent decision processes. This formula consists of values and decision weights. The value of an outcome is associated with the actual outcome of an option and its function is S-shaped. As mentioned previously, this is because people evaluate losses and gains differently. Decision weights are associated

with the probabilities of the different outcomes. As a result, not the actual probabilities are used in decision making; personal weights are important. For example, people tend to overweight low probabilities and underweight moderate and high probabilities. In Figure 1, this effect can be seen. For low actual probabilities, for example 0.1, the decision weight is larger, about 0.25. This means that people treat a probability of 0.1 of winning an amount of money as a probability of 0.25 and people are more willing to take risks and take the risky option.

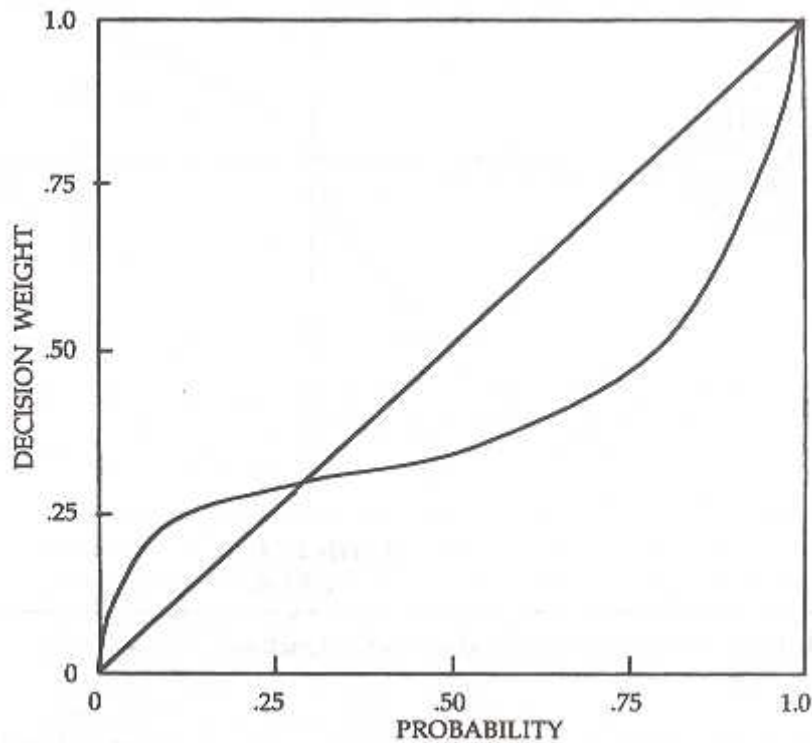


Figure 1. The Prospect Theory decision weight function (Hastie & Dawes, 2001)

These values and decision weights are combined into an overall value for each outcome; the different overall values show which option is best. In this case the values and decision weights are based on 'objective values', but are translated into personal values and weights. According to prospect theory, the decision making process consists of two phases. In the first phase, the available options are edited, simplified and coded as gains or losses, with respect to a neutral reference point. In the second phase, the options and its values and probabilities are evaluated. The last, evaluation phase also consists of three steps. In the first step, the value function is applied to each consequence associated with each outcome. Secondly, the decision is weighed, in which each valued consequence is weighed for impact. Finally, adding them up combines the weighed or overall values associated with a prospect. Although the values and decision weights are personal, it is possible to predict decision making based on the generalized parameters in the prospect theory formulae (Hastie & Dawes, 2001).

Framing

Due to this process, decisions can be different than expected, because of the frames they are presented in. In framing, the 'decision makers respond differently to different but objectively equivalent descriptions of the same problem' (McElroy & Seta, 2003). Overall, the frame in which the situation is presented has a large influence on the encoding in the first phase. Different frames lead to different reference points, different evaluations occur and eventually, decisions change. (Kühberger, 1998; Tversky & Kahneman, 1981) An important method in framing research is by presenting the problem as gains or losses. As mentioned previously, people respond differently to losses in comparison to gains.

Framing is a familiar term in decision making and an important factor in creating risk behavior that deviates from the expectation according to the normative models. Framing is related to the way in which identical problems are worded. In other words, the situation stays the same, but prospects seem different because the situation is described differently. If decisions change because of this, it is called a framing effect (Kühberger, 1998).

1.2. The cost of not knowing versus the cost of finding out

In a previous study by De Hoog & Kooken (2006), the tradeoff between searching for information and taking a risk is examined. For different values of information costs and cost of not knowing the participant had to decide to either take the risk or search for information. For example, if the cost of not knowing is high and the costs of finding out are low, will you take the risk or search for information? According to rational decision theory, conducting a rational trade-off between the risk costs and the information costs will lead to the decision to take the risk or to search for information (Stigler, 1961). The option with the highest profit or smallest loss is the option that is the most attractive. Thus, if the risk costs are high and the information costs are low, it is most profitable to search for information according rational decision theory. The previous study by De Hoog & Kooken (2006) did not support this theory. It seems that the participants are not that rational in making a decision; they rather search for information than taking a risk, even if an economic trade-off shows that it is more profitable to take the risk (De Hoog & Kooken, 2006).

There were some limitations of the study. First, it only measured the extreme values of risk costs and information costs; high or low risk costs and high or low information costs. Therefore, it is interesting to find out how people act when the costs are not that extreme. Second, the situation was examined in only one problem representation. For every participant, the questions were presented in the same way and the same number of questions was used. In decision making it is known that small differences in the presentation of the problem can lead to a quite different response: framing effects. Since these effects are very prominent and can largely influence the study results, it is important to examine the results when different frames are presented. Therefore, in the present research, less extreme situations and different problem presentations are used to examine the same concept. Therefore, the main research question is:

What is the influence of the different ways in which the decision problem is presented on the tradeoff between the cost of not knowing and the cost of finding out; when will people search for information and when will they take the risk?

Furthermore, the first limitation of the study by De Hoog & Kooken (2006) leads to a more specific research question:

RQ1. *What is the influence of including less extreme situations in the research on the tradeoff between the cost of not knowing and the cost of finding out; when will people search for information and when will they take the risk?*

This leads to a comparison of two different formats; the four questions format presented by De Hoog & Kooken (2006) and a sixteen questions format in which the less extreme values are added.

In the next section, different frames are presented to show how different problem representations can lead to different responses and decisions in objectively the same situation presented by De Hoog & Kooken (2006).

1.3. Occurrence of framing effects

Since framing effects are not always obtained, a key question is under what conditions framing effects are most likely. In this section, two factors that can influence the decision making tradeoff are examined and the hypotheses that follow from it are presented. First, different information-processing styles are introduced and next, the influence of different values of costs is examined.

Information-processing styles

McElroy and Seta (2003) present two different information-processing styles in their research: the holistic style, which is quite automatic and very susceptible to external influences and the analytical style, which is controlled and less susceptible to external influences. This style is personal; some people are more holistic and others are more analytical in their style. Furthermore, the information-processing style can also be influenced by the way information is presented (McElroy and Seta, 2003).

If a person has fewer possibilities to examine the situation more thoroughly, he or she will probably use the holistic information-processing style in making a decision. For example, if less information is provided or if information is vague, it is not possible to get a clear picture of the situation and people have no choice but to use the holistic style. Then, personal values have a larger influence on the decision, because there is more space for personal translation of the values and decision weights in the second phase of prospect theory. Therefore, using the holistic style will lead to a larger influence of personal risk behavior and will therefore lead to more risk averse behavior, also found by De Hoog & Kooken (2006).

If it is possible to examine the situation more analytically, for example, if numbers are used to explain the situation, the analytical information-processing style is activated. This way, 'objective' probabilities and values are present more explicitly in the decision situation and the influence of personal risk behavior will be smaller. Thus, it is

expected that the risk averseness found in the research by De Hoog & Kooken (2006) will be diminished if people are stimulated to use the analytical processing style, which leads to the following two hypotheses:

- H1. If the decision problem is presented non-numerically (verbally), people will use a more holistic processing style and personal risk behavior will have a larger influence in comparison with a numerical presentation. Therefore, people will be more risk averse.*
- H2. If the decision problem is presented numerically, people will use a more analytical processing style and personal risk behavior will have a smaller influence in comparison with a non-numerical (verbal) representation. Therefore, people will be more risk neutral.*

According to the research conducted by McElroy & Seta (2003), the numerical presentation of the decision problem will lead to a more analytical information-processing style and will therefore lead to a more risk neutral decision. Therefore, it is expected that in this condition, the holistic information-processing style is used and participants will be more influenced by their personal risk behavior. This will lead to a more risk averse decision.

Values of costs

In previous research conducted by Kühberger, Schulte-Mecklenbeck and Perner (2002), it became clear that participants are more risk averse when presented with higher values for the cost of being wrong and the information costs in decision making. This means that not only the way the situation is presented, numerically or non-numerically, has an influence on the decision people make, also the size of the risk costs and information costs play an important role. Therefore, for the numerical condition, two different levels of costs are used. This leads to two different hypotheses:

- H3. If the decision problem is presented numerically and with low costs of not knowing and cost of finding out, participants will be more risk neutral in comparison with the high cost condition.*
- H4. If the decision problem is presented numerically and with high cost of not knowing and cost of finding out, participants will be more risk averse in comparison with the low cost condition.*

It is expected that the participants in the low cost condition are less risk averse than the participants in the high cost condition. According to Kühberger et al. (2002), this effect emerges because the participants are more interested in the thrill of the game and the risk is accepted easier because of this.

Concluding, four different situations emerge. In the first situation, examined by De Hoog & Kooken (2006), the decision to make is presented in a dichotomous format and the behavior was risk averse. Furthermore, three decision presentations are added in this research. In table 1, expected risk behavior for the three situations in this research is presented.

Table 1

Expected risk behavior for the different decision presentations

Decision presentation	Expected risk behavior
Decision is presented non-numerically (verbally)	Most risk averse
Decision is presented numerical with high costs	Less risk averse
Decision is presented numerical with low costs	Least risk averse

2. Method

In this section, the research methods are described. In order to answer the research question and test the hypotheses, two different studies are necessary. In the first study, a questionnaire is used to measure the risk behavior in the non-numerical condition. In the second study, the trade-off approach is used to measure risk behavior for respectively the low cost and high cost condition.

2.2. Study 1

First, the descriptives of the participants are mentioned, next, the material is described and finally, the procedure is explained.

Participants

For the research, Social Science students from the University of Twente were asked to participate in the research. Seventy-two participants filled in the questionnaire, of which sixty were completed and are used in the analysis. Of these sixty participants, 41.7% are men and 58.3% are women. 91.7% are Dutch and the other 8.3% are German. The mean age of the participants is 21.7 years (ages between 18 and 28).

Material

The questionnaire used in the research conducted by De Hoog & Kooiken (2006) was revised. In the previous study, the two variables, cost of being wrong and cost of finding out, were combined to create four situations. These were the ‘extreme’ situations, a combination of low and high risk costs and low and high information costs. In the present research, also the less extreme situations were offered to the participants. This way, a better examination of the middle ranges is possible. Therefore, the options relatively low and relatively high were added. This leads to a total of sixteen questions, varying on the dimensions risk costs and information costs on four levels.

The questions were phrased as follows, only varying in the different levels by changing the italicized terms.

‘You have to take a decision with a high amount of money involved. The chance that you will make a wrong decision is *very low*. It is possible to avoid the risk of making a wrong decision by searching for information. The information costs are *relatively low*. What will you do?’

The participants had the option to search for information, or they could take the risk. Furthermore, the age, sex and nationality of the participants are asked.

Procedure

Because it is very important to prevent undesirable anchoring effects, a computer program was used to create a digital questionnaire, which changed the order of the questions for every participant. According to Hastie and Dawes (2001), people tend to remain too close to the anchor, which is the first situation the participant is confronted with. If the anchor is the same for every participant, this anchor probably biases the

results found. Therefore, it is important to create a different anchor for different participants to receive more reliable results.

2.3. Study 2

In this study, two different conditions are used. In the first condition, the cost of being wrong is 200 euro and in the second study, the cost of being wrong is 5000 euro.

The different values are chosen with respect to the participants in the research, which are students. For a student, 200 euros is a large amount, but it is realistic to pay for yourself if you need to. An amount of 5000 euros is much larger and savings or loans are needed to pay for it. This way, two different frames emerge in which the same situation is presented.

Participants

In total, thirty-three participants, Social Science students from the University of Twente, are used in the research. In the first condition, with low cost of being wrong, sixteen students participated. Seventeen participants are in the second, high cost of being wrong condition. In the table below, descriptives for both conditions are presented.

Table 2

Descriptives of the participants in experiment 2

Descriptive	Study 2 – condition 1	Study 2 – condition 2
No. of participants	16	17
Male	25%	35.3%
Female	75%	64.7%
Dutch	68.8%	88.2%
German	31.3%	11.8%
Mean age	20.4	20.5
Range	17-25	18-28

Material

In this study, a different technique is used to examine the trade-off between the cost of not knowing and the cost of finding out. In these conditions, numbers are used and therefore it is possible to arrive at a very precise estimate of the way people weigh the two variables. In Von Winterfeldt & Edwards (1986), different techniques are presented to measure the trade-offs for single- and multi-attribute decision problems.

In this situation, the goal is to find a value function over risk information. This can be found by finding out in which situation people are indifferent about searching for information or taking the risk. This way, it is possible to determine exactly when people will take the risk or search for information, because the exact combination of probabilities and information costs is known. In the variable probability method, different fixed information costs are used and the participant is asked to decide at which probability of being wrong he or she is indifferent about searching for information or taking the risk. Because this is quite difficult for the participant, the different steps mentioned by Von Winterfeldt & Edwards (1986) are used. First, an introduction is given:

‘You have to make a decision in which 200 euros is involved. If the decision you make is right, there are no financial consequences; if the decision is wrong, you will lose 200 euros. You can search for information. This will lead to the right decision, but it does cost money. Below, different situations are given. Decide for yourself what you will do.’

After this, five different situations are presented in which the cost of not knowing is fixed.

‘The information costs are 25 euros. This means, you have to make a decision and if it is the wrong, you will lose 200 euros. You can search for information to be sure of making the right decision; this will cost 25 euros.

1. How large must the probability of losing 200 euros be in order for you to search for information? (Keep asking until the smallest probability is found.)
2. How large can the probability of losing 200 euros be in order for you to not search for information? (Keep asking until the largest probability is found.)
3. Somewhere between these two points is the point of indifference. With that probability of making the wrong decision, you are indifferent about searching for information or taking the risk. Where is that point for you?’

In the first condition, taking the wrong decision will cost the participant 200 euros. The participant can lose 200 euros or nothing if he or she takes the right decision. It is possible to search for information and in the five different situations presented the information costs are 25, 50, 100, 150 and 175 euros. These amounts are chosen, because they are quite spread and are easy to imagine by the participants.

In the second condition, the costs of taking the wrong decision are 5000 euros. The information costs presented are 500, 1500, 2500, 3500 and 4500 euros, for the same reasons mentioned previously. The steps mentioned in the example above are the same in the second condition.

Furthermore, the variable certainty equivalent method is used. In this method almost the same technique is used, but in this case the probability of being wrong is fixed and the information costs have to be filled in. Again, the goal is to find out when the participants are indifferent between searching for information and taking the risk. The introduction is the same as with the variable probability method. After the introduction and the previous five questions, two different situations are presented in which the probability is fixed.

‘The probability of losing 200 euros is 25%. This means, you have a 25% probability of making the wrong decision and losing 200 euros.’

1. How large should the costs of information be, in order for you to search for information? (Keep asking until the smallest amount of money is found.)
2. How large can the costs for information be, in order for you to not search for information? (Keep asking until the largest amount of money is found.)

3. Somewhere between these two points is the point of indifference. With that information costs, you are indifferent about searching for information or taking the risk. Where is that point for you?’

It is expected that the results for both methods are the same, but it is interesting to examine how participants react when presented with fixed probabilities instead of monetary amounts. For both the conditions, in one situation the probability of taking the wrong decision is 25% and in the other it is 75%. These probabilities also are used because they are easy to imagine and spread evenly.

Procedure

In both the conditions, the participants met with the researcher in a research cubicle. The participants were randomly allocated to one of the conditions. First, the age, sex and nationality of the participants are asked. After a brief introduction, the participants received a paper with some information about the different situations. In the beginning, it is quite difficult for the participants to answer the questions. This way, the situation and different questions are clearer to the participants. Furthermore, if the participants had questions, the researcher explained the situation more extensively. Overall, the paper the participants received with information was supportive enough and no further explanation was necessary.

Also in these conditions, anchoring effects should be prevented. Therefore, three different versions are used for both conditions. The different fixed information costs and fixed probabilities are presented in a different order. The versions were randomly administered to the participants. This way, the influence of sequence is minimal and the results are more reliable.

3. Results

In this section the results of the research are presented. First, the results of the first study are examined and second, the results of the second study are described.

3.1. Experiment 1

The questionnaire of the first study is used to answer the research question and examine the first hypothesis:

RQ1. *What is the influence of including less extreme situations in the research on the tradeoff between the cost of not knowing and the cost of finding out; when will people search for information and when will they take the risk?*

H1. *If the decision problem is presented non-numerically (verbally), people will use a more holistic processing style and personal risk behavior will have a larger influence in comparison with a numerical presentation. Therefore, people will be more risk averse.*

In the previous study by De Hoog & Kooken (2006), almost the same questionnaire is used to examine the risk behavior of the participants. As mentioned previously, in this study less extreme situations are introduced. Therefore, it is interesting to find out if more information on the risk behavior of participants can be found by using sixteen questions instead of four. Therefore, it is necessary to examine the risk behavior in the adjacent categories. If the risk behavior is almost the same for these categories, no further information on risk behavior is added by using sixteen instead of four questions. In the table below, the adjacent categories are in italics. This way, it is easy to compare the results and find out if new information is presented.

Table 3
Risk behavior of participants in sixteen questions format compared to the four questions format

Risk costs	Information costs	Taking the risk %	Searching for information %
Very high	<i>Very low</i>	3	97
	<i>Relatively low</i>	0	100
	Relatively high	8	98
Relatively high	<i>Very low</i>	0	100
	<i>Relatively low</i>	0	100
	Very high	32	68
Relatively low	Very low	21	80
	<i>Relatively high</i>	75	25
	<i>Very high</i>	75	25
Very low	Relatively low	42	56
	<i>Relatively high</i>	81	19
	<i>Very high</i>	84	16

As can be seen from the table, it is clear that risk behavior in adjacent categories is almost the same. With relatively high risk costs, the results for the different low information costs are identical. The same result can be found in the relatively low risk cost situation. Furthermore, the results in the other categories also show very clear that adding two categories does not lead to more information on risk behavior.

Furthermore, the situations in which risk costs and information costs are the same can be examined to show if more information on risk behavior is found.

Table 4

Risk behavior of participants in non-numerical condition for equal costs

Risk costs	Information costs	Taking the risk %	Searching for information %
Very low	Very low	20	80
Relatively low	Relatively low	20	80
Relatively high	Relatively high	7	93
Very high	Very high	18	82

The results are the same as in table 3. Extending the range does not provide more information on risk behavior in less extreme situations. The combination of both the low cost situations shows the same results on risk behavior. Also in the high cost situations almost the same results emerge. Thus, four questions seem enough to examine risk behavior in information searching. Therefore, the research question can be answered: including less extreme values does not lead to a difference in risk behavior.

Next, the results for H1 are examined. According to normative decision theory, the cost of not knowing must exceed the cost of finding out in order for participants to seek information. According to this theory, it is expected that if the risk is higher than the information costs, participants will search information; if the risk is lower than the costs, the participants will take the risk. But, if the risk is lower than the information costs and participants still search for information, this behavior is risk averse. In this section, the term ‘expected value’ refers to the expected value according to the normative decision theory or, in other words, risk neutral behavior.

In the table below, the results are shown. The different combinations are ordered according to the number of participants taking the risk.

Table 5

Results for participants in non-numerical condition

Risk costs	Information costs	Taking the risk		Searching for information	
		%	N	%	N
Very low	<i>Very high</i>	83,3	50	16,7	10
Very low	<i>Relatively high</i>	81,7	49	18,3	11
Relatively low	<i>Relatively high</i>	75	45	25	15
Relatively low	<i>Very high</i>	75	45	25	15

Very low	Relatively low	41,7	25	58,3	35
<i>Relatively high</i>	<i>Very high</i>	31,7	19	68,3	41
Relatively low	Very low	21,7	13	78,3	47
Relatively low	Relatively low	20	12	80	48
Very low	Very low	20	12	80	48
<i>Very high</i>	<i>Very high</i>	18,3	11	81,7	49
<i>Very high</i>	<i>Relatively high</i>	8,3	5	91,7	55
<i>Relatively high</i>	<i>Relatively high</i>	6,7	4	93,3	56
<i>Very high</i>	Very low	3,3	2	96,7	58
<i>Relatively high</i>	Relatively low	0	0	100	60
<i>Very high</i>	Relatively low	0	0	100	60
<i>Relatively high</i>	Very low	0	0	100	60

As can be seen in the table, people tend to search for information quite frequently. Even if the risk is very low and the cost of information is very high, still some participants (16.7%) will search for information. But, when information costs are very high, or even relatively high, people overall search for information, almost without consideration for the information costs. Furthermore, since the different combinations are ordered according to the number of participants taking the risk, it is expected that high risk costs are found in the lower part of the table and high information costs are found in the upper part of the table. As can be seen, for risk costs this is the case. Only one combination with high risk costs is somewhat higher in the table. But, the information costs are more spread out in the table. High information costs are found quite frequently in the lower part of the table, which means that even with high information costs, participants are willing to search for information quite frequently. According to this table, the participants seem quite risk averse and more focused on the risk than on the information costs.

If the behavior is risk neutral, it is expected that in the cases of a higher risk than information costs, all the participants will search for information. Also, if the information costs are higher than the risk, it is expected that no participant will search for information. In table 5, the expected, risk neutral values for the different conditions are compared to the actual values. Using a Chi-square test, it is possible to examine if the found scores in the table are significantly different from the scores expected. Two groups of combinations are excluded from the research. First, the decision situations in which the risk costs and information costs are equal is excluded. It is not possible to expect a specific outcome according to the normative decision theory, because the costs are equal. Second, the three combinations found in the lowest section of table 4 show the exact expected score, so no further research is needed. In these cases, participants are risk neutral.

Table 6

Comparison of actual values with expected values in non-numerical condition

Risk costs	Information costs	Chi-square	Degrees of freedom	P
Relatively low	Very low	19.267	1	0.000
Very high	Very low	52.267	1	0.000
Very low	Relatively low	1.667	1	0.197
Very low	Relatively high	24.067	1	0.000
Relatively low	Relatively high	15.000	1	0.000
Very high	Relatively high	41.667	1	0.000
Very low	Very high	26.667	1	0.000
Relatively low	Very high	15.000	1	0.000
Relatively high	Very high	8.076	1	0.005

The results show that overall the actual values are significantly different from the expected, risk neutral values. As can be seen before, this means that participants are risk averse. Only when the risk is very or relatively high in combination with very low or relatively low information costs, participants respond risk neutral and decide not to search for information. Only in extreme circumstances people tend to take the risk. If the difference between information costs and taking the risk is smaller, people choose the save option and search for information, even if they should not.

Furthermore, risk attitudes of individuals can be examined by looking at the frequency of information searching. Overall, risk averse people tend to search for information, even if the risk is low and information costs are high. The results in the previous tables show this risk averse behavior.

The results in table 6 show in how many of the sixteen situations participants will search for information. This way, a score of five indicates that in five of the sixteen situations the participants, in that case two, searched for information and in eleven of the sixteen situations the risk is taken.

According to normative decision theory, it can be expected that in six situations the risk is taken, because the risk is lower than the information costs. In six other situations the information is searched; the risk is higher than the information costs. In the four other cases, the risk and information costs are equal and therefore not much can be said about risk behavior according to these situations. Therefore, it can be said that the participants who search for information less than six times are risk prone and participants who search for information eleven times or more are risk averse. If participants search for information between six and ten times, they are labeled risk neutral.

Table 7

Frequency of searching for information per participant in non-numerical condition

Risk behavior	Information searching	Frequency	Percentage
<i>Risk prone</i>	5	2	3.3
	6	2	3.3
	7	1	1.7

<i>Risk neutral</i>	8	2	3.3
	9	7	11.7
	10	10	16.7
	11	8	13.3
	12	14	23.3
<i>Risk averse</i>	13	3	5.0
	14	5	8.3
	15	1	1.7
	16	5	8.3

According to the table above, it can be said that 6.7% of the participants is risk prone, 33.4% is risk neutral and 59.9% is risk averse. The results are clear; participants rather search for information and are not willing to take the risk.

As can be seen, the situations in which the risk and information costs are equal are excluded from the analysis. The reason for this is that nothing can be said about these situations in isolation. Since the values are the same for both the risk costs and information costs, it is impossible to derive risk proneness or risk averseness from the results. But, the situations can be compared in order to find out if participants are consistent in their answers: they take the same decision if costs of not knowing and costs of finding out are equal. In table 8, the scores for the different combinations can be found. It can be seen that the results for the low cost situation are quite different than the results for the high cost situations. In the table below, the scores for the different combinations are compared and it is possible to find out if these results differ significantly.

Table 8

Comparison of results for equal costs in non-numerical condition

Combination of situations	P
RL-RL and VL-VL	1.00
RH-RH and VL-VL	0.39
VH-VH and VL-VL	1.00
RH-RH and RL-RL	0.39
VH-VH and RL-RL	1.00
VH-VH and RH-RH	0.16

Note. RL is relatively low, VL is very low, RH is relatively high and VH stands for very high.

As can be seen, no combination of situations is significantly different than other situations. Previously, it was mentioned that in the cases of high risks, people tend to search for information very quick. The question remains why this is not the case in the VH-VH situation. Further, no clear results emerge from table 8.

Taken together, the results are very clear. The participants clearly show risk averse behavior in the non-numerical condition. But, a comparison with the numerical conditions is needed to confirm or reject H1. In the next section, the results for the numerical conditions are examined.

3.2. Experiment 2

The variable probability method is used to answer the other three hypotheses:

- H2. *If the decision problem is presented numerically, people will use a more analytical processing style and personal risk behavior will have a smaller influence in comparison with a non-numerical (verbal) representation. Therefore, people will be more risk neutral.*
- H3. *If the decision problem is presented numerically and with low costs of not knowing and cost of finding out, participants will be more risk neutral in comparison with the high cost condition.*
- H4. *If the decision problem is presented numerically and with high cost of not knowing and cost of finding out, participants will be more risk averse in comparison with the low cost condition.*

First, the results of the low cost condition and the high cost condition are examined separately. Finally, the results of both conditions are compared.

Low cost condition

Mostly, the variable probability method is used to create a value function for *individual* decisions in order to clarify individual decision problems. In this research, the data provided by the method is used to test different hypotheses across individuals, not for make a decision clearer for an individual person. Therefore, it is necessary to combine the results of the different participants to be able to test the hypotheses. Of course, individual curves and results are also used to investigate the hypotheses and to make sure how the mean scores are composed. It is possible that risk averse and risk prone behavior together lead to an overall risk neutral picture and the individual data have to make clear if this is the case.

First, the overall results are presented for an overview of the scores and standard deviations. Next, individual scores are examined. After this, the overall results are examined more thoroughly. Finally, the scores for the variable certainty equivalent method are presented.

In table 9, the results of the trade-off technique for the low cost condition can be found. Costs for making a wrong decision are 200 euros. The probabilities shown in the fourth column represent the mean probability indifference score. In other words, if the probability is lower, people are willing to take the risk and if the probability is higher, people search for information for the price found in the first column.

Table 9
Results in low cost condition

Information costs	Minimum	Maximum	Mean probability	Std. deviation
25	.01	.35	.1294	.09299

50	.15	.68	.3038	.15991
100	.30	.67	.4806	.09855
150	.38	.95	.6531	.17242
175	.50	1	.8038	.14514

It can be seen that the standard deviations found are quite high. It is possible that one or two participants cause this by showing a very different response pattern with extreme scores. In this condition, this is not the case.

In table 10, individuals are scored on risk prone, risk neutral or risk averse behavior. The risk behavior is calculated according to normative decision theory: if the probability of making the wrong decision is growing, the amount of money a participant is willing to pay will rise with the same amount. For each individual situation, the combination of the probability of making the wrong decision and the costs (decision costs times probability) should be the same as the information costs. For example, if the decision costs are 200 euros and the information costs are 100 euros, the expected response of the participant is an indifference score at a probability of 0.5 ($0.5 \times 200 = 100$ euros).

Of course, it is possible that a participant shows both risk averse and risk prone behavior in the five situations presented. In that case, the most prevalent behavior is scored.

Table 10

Risk behavior of participants for the low cost numeric condition

Participant	Risk averse behavior (N)	Risk neutral behavior (N)	Risk prone behavior (N)	Overall risk behavior
1	0	2	3	Risk prone
2	3	0	2	Risk averse
3	3	0	2	Risk averse
4	4	0	1	Risk averse
5	5	0	0	Risk averse
6	3	0	2	Risk averse
7	3	0	2	Risk averse
8	3	0	2	Risk averse
9	3	0	2	Risk averse
10	3	0	2	Risk averse
11	4	0	1	Risk averse
12	2	2	1	Risk averse / neutral
13	2	1	2	No typical behavior
14	4	0	1	Risk averse
15	1	2	2	Risk prone / neutral
16	3	0	2	Risk averse

In the table above, it seems that participants are overall risk averse. But, most of the risk prone and risk averse behavior is not extreme, this means it is very close to the expected

value, and can also be seen as risk neutral. Of course, some extreme scores are found, which explain the extreme standard deviations. Since risk neutral behavior in the table above is only counted if the absolute ‘right’ information costs are given, risk neutral behavior is not found that frequently. Scores somewhat below or above the absolute risk neutral point can also be seen as risk neutral, since it is difficult to arrive at absolute risk neutrality. Therefore, it is decided to extend the scope of risk neutrality and to also see a deviation of 0.05 of the probability as risk neutral behavior. If a deviation of 0.05 of the probability shown below or above the perfect score is also seen as risk neutral, the results are as follows.

Table 11

Risk behavior of participants for the low cost condition with broader risk neutral section

Participant	Risk averse behavior (N)	Risk neutral behavior (N)	Risk prone behavior (N)	Overall risk behavior
1	0	2	3	Risk prone
2	1	3	1	Risk neutral
3	2	2	1	Risk averse / neutral
4	4	0	1	Risk averse
5	5	0	0	Risk averse
6	2	3	0	Risk neutral
7	2	1	2	No typical behavior
8	2	1	2	No typical behavior
9	2	1	2	Not typical behavior
10	1	2	2	Risk prone / neutral
11	3	1	1	Risk averse
12	1	3	1	Risk neutral
13	0	3	2	Risk neutral
14	3	1	1	Risk averse
15	0	3	2	Risk neutral
16	3	1	1	Risk averse

As can be seen, the results are quite different. In this case, only five risk averse participants remain. Most of the behavior is risk neutral or shows no typical pattern.

In Figure 2, the mean scores of the participants can be found. This graph also shows quite risk neutral behavior patterns. Although it seems that for the relative low probabilities people are somewhat risk prone and for the relative high probabilities people are more risk averse; a pattern also found in the Prospect Theory, as can be seen in Figure 2 (Tversky & Kahneman, 1981).

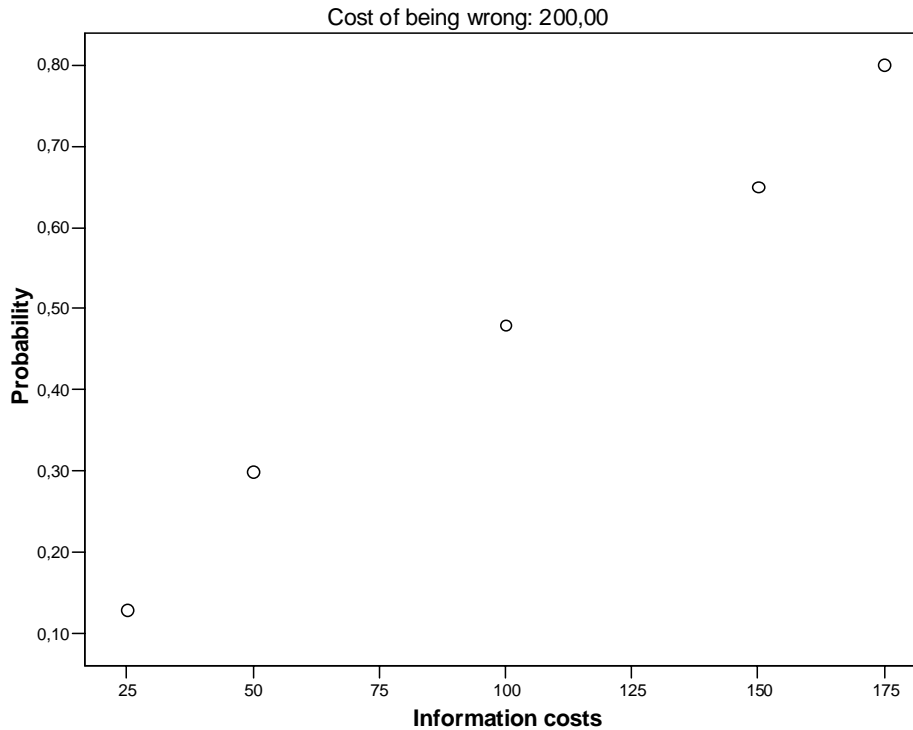


Figure 2. Mean scores in the low cost condition

In table 12, the results and the expected values according to normative decision theory are shown. Furthermore, the risk neutral value and the results are compared by conducting a T-test. This way, it is examined if the difference between the risk neutral value and found value is significant.

Table 12

Results and expected values compared in low cost condition

Known variable to participant	Risk neutral value	Value	T	P
Information costs 25 euros	0.125	0.129	0.188	0.853
Information costs 50 euros	0.250	0.304	1.344	0.199
Information costs 100 euros	0.500	0.481	-0.786	0.444
Information costs 150 euros	0.750	0.653	-2.247	0.040
Information costs 175 euros	0.875	0.804	-1.964	0.068

Only the risk averseness for higher information costs is found. Although, when information costs are relatively low, it seems that participants are somewhat risk prone, although the results are not significant.

If the behavior is risk neutral, the difference in probability between 25 and 50 euros information costs should be the same as the difference between 150 and 175 euros. Furthermore, the difference in probability for 50 and 100 euros should be the same as the difference between 100 and 150 euros. As can be seen in table 13, for 50, 100 and 150

euros there is no difference and for the 25-50 and 150-175 comparison, the difference is so small that for both comparisons risk neutrality is displayed.

Table 13

Indifference method for low cost condition

Information costs	Indifference probability	Difference
25	0.13	
50	0.30	0.17
100	0.48	0.18
150	0.65	0.18
175	0.80	0.15

In the low cost condition, H2 is confirmed. Risk behavior is overall risk neutral. Furthermore, a comparison with the results for experiment 1 provides evidence for the conformation of H1.

Also, the variable certainty equivalent method was used to compare the results of the variable probability method. Of course, it is expected that the results are the same for both methods, because they intend to measure the same. In the graph below, the results for this method are shown in comparison with the results of the variable probability method.

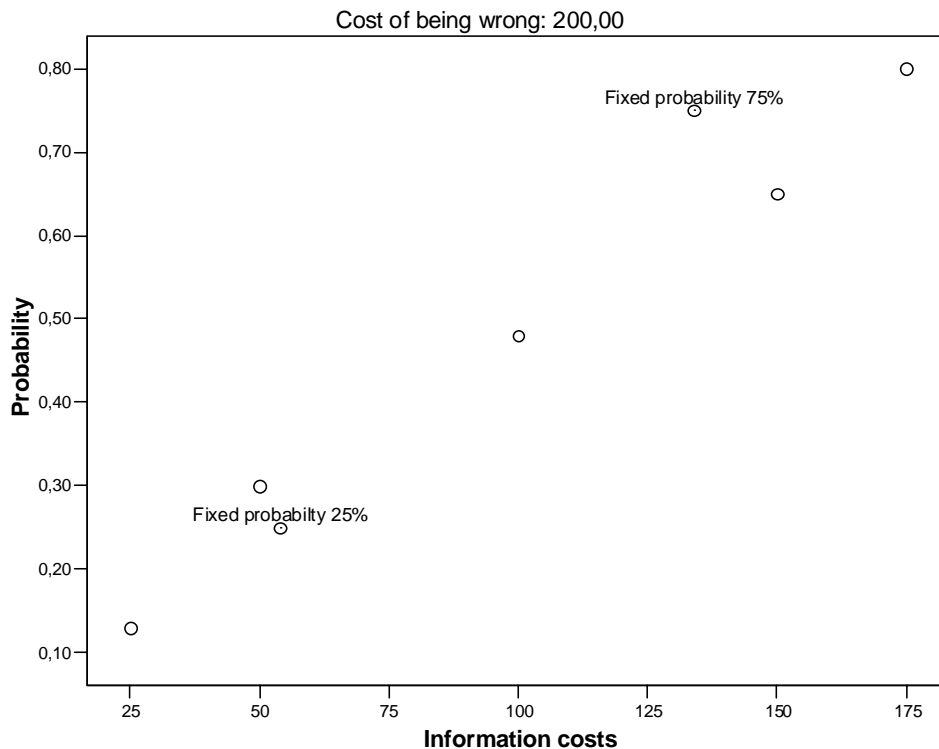


Figure 3. Mean scores for the variable equivalent certainty method in the low cost condition

As can be seen in Figure 3, the results are more extreme than in the variable probability method, especially for the high probability of being wrong. In that case, participants are quite risk prone. In table 14, it is shown that this effect is significant.

Table 14

Results and expected values compared for variable certainty equivalent method in low cost condition

Probability of being wrong	Expected value	Value	T	P
25%	50 euros	54.38	0.945	0.360
75%	150 euros	134.38	-2.625	0.020

The risk proneness in the high probability situation is significant. According to Prospect Theory (Tversky & Kahneman, 1981), high probabilities are underweighed. This is the case here, because participants are not willing to pay the expected amount of money for information. Thus, for the variable certainty equivalent method, **more** risk prone behavior is found.

High cost condition

In this condition, the same sequence of information is presented as in the low cost condition. Also, first mean results are presented to examine the standard deviations.

In table 15, the results of the trade-off technique for the high cost condition are presented. In this case, the cost for making a wrong decision is 5000 euros. The probabilities shown in the fourth column are the mean probability indifference score.

Table 15

Results in the high cost condition

Information costs	Minimum	Maximum	Mean probability	Std. deviation
500	.01	.50	.1641	.15150
1500	.01	.90	.3865	.19821
2500	.10	.90	.4982	.15789
3500	.20	.90	.6176	.17312
4500	.50	.97	.8571	.11910

Again, standard deviations are very high. For a more thorough examination of these scores, the distribution of these answers is examined. When looking at the graphs representing the number of cases for each score, it shows that the extreme scores occur only once, indicating that just one extreme answer leads to the high standard deviations. Further examination showed that two participants caused almost all the extreme scores. Therefore, they are excluded from further research. In the table below, the findings without the two participants are shown. Fifteen participants remain.

Table 16

Results in the high cost condition with two participants removed from the research

Information costs	Minimum	Maximum	Mean probability	Std. deviation
500	.01	.40	.1520	.12774
1500	.15	.65	.3773	.12589
2500	.40	.65	.4980	.07504
3500	.20	.80	.6133	.15860
4500	.72	.97	.8780	.08064

Also in the high cost condition, the individual behavior patterns are examined. Also in this case, if the probability and expected probability, according to normative decision theory, only differ 0.05 or less it is labeled as risk neutral behavior.

Table 17

Risk behavior of participants for the high cost condition with broader risk neutral section

Participant	Risk averse behavior (N)	Risk neutral behavior (N)	Risk prone behavior (N)	Overall risk behavior
1	0	5	0	Risk neutral
2	0	2	3	Risk prone
3	3	1	1	Risk averse
4	0	3	2	Risk neutral
5	2	3	0	Risk neutral
6	1	1	3	Risk prone
7	2	3	0	Risk neutral
8	0	4	1	Risk neutral
9	2	2	1	Risk averse / neutral
10	0	5	0	Risk neutral
11	3	2	0	Risk averse
12	1	1	3	Risk prone
13	2	1	2	No typical behavior
14	1	3	1	Risk neutral
15	1	2	2	Risk prone / neutral

In the high cost condition, even clearer than in the low cost condition, risk behavior is neutral overall. Only two risk averse and three risk prone participants can be found. In the graph below, the mean scores for all the participants can be found. Clearly, individual and group analysis both show quite risk neutral behavior.

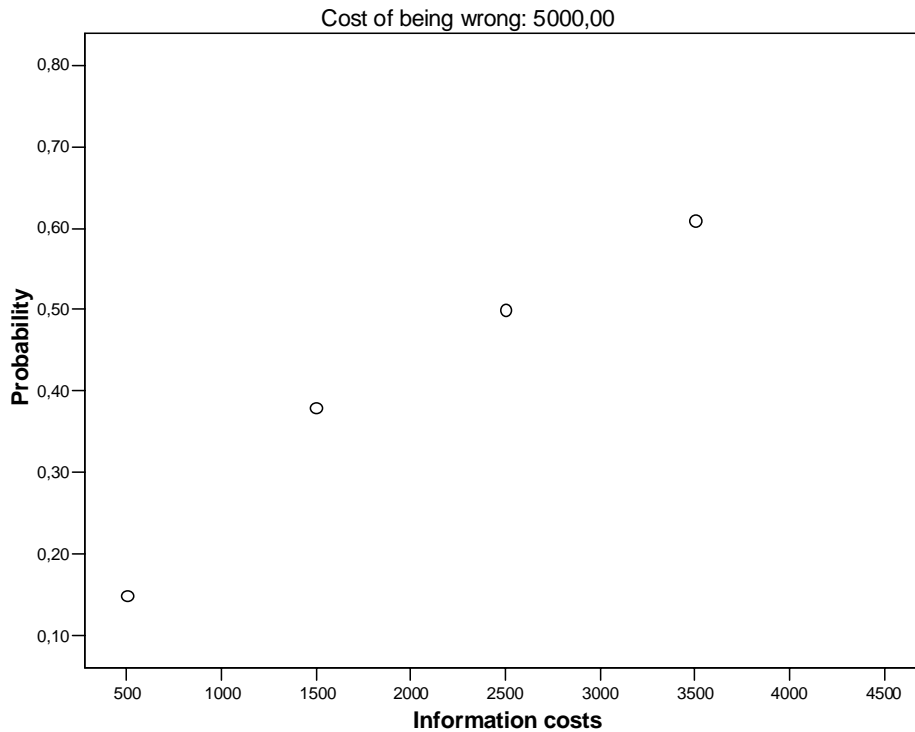


Figure 4. Mean scores in the high cost condition

Also in the high cost of being wrong condition, it seems that participants are more risk prone for low information costs and more risk averse for higher information costs. In the table below, the results and the expected values according to normative decision theory are shown. Furthermore, the risk neutral value and result found are compared by conducting a T-test.

Table 18

Results and expected values compared in the high cost condition

Known variable to participant	Risk neutral value	Value	T	P
Information costs 500 euros	0.1	0.152	1.577	0.137
Information costs 1500 euros	0.3	0.377	2.379	0.032
Information costs 2500 euros	0.5	0.498	-0.103	0.919
Information costs 3500 euros	0.7	0.613	-2.116	0.053
Information costs 4500 euros	0.9	0.878	-1.057	0.309

As can be seen, for information costs of 1500 euros the results are significant. This means, participants are risk prone. They are only willing to pay the amount of money for the information if the probability of making the wrong decision is higher than according to normative decision theory can be expected.

For the high cost condition the same method is used to examine risk behavior. In this condition, the difference between the information costs is the same and therefore every

pair can be compared. It is quite clear that the difference between 1500-2500 euros and 2500-3500 euros is the same, and the difference between 500-1500 euros and 3500-4500 also shows a similar pattern. Therefore, participants seem to value the information costs quite equally in the midsection, and experience a larger difference when information costs are very low or high.

Table 19

Indifference method in the high cost condition

Information costs	Indifference probability	Difference
500	0.15	
1500	0.38	0.23
2500	0.50	0.12
3500	0.61	0.11
4500	0.88	0.25

Also in the high cost condition, H2 is confirmed. Participants overall are risk neutral. H3 and H4 are examined in the next section by comparing the two conditions. First, the results for the variable certainty equivalent method are compared.

Also for the high cost condition, the variable certainty equivalent method was used to compare the results of the variable probability method. In the graph below, the results for this method are shown in comparison with the results of the variable probability method.

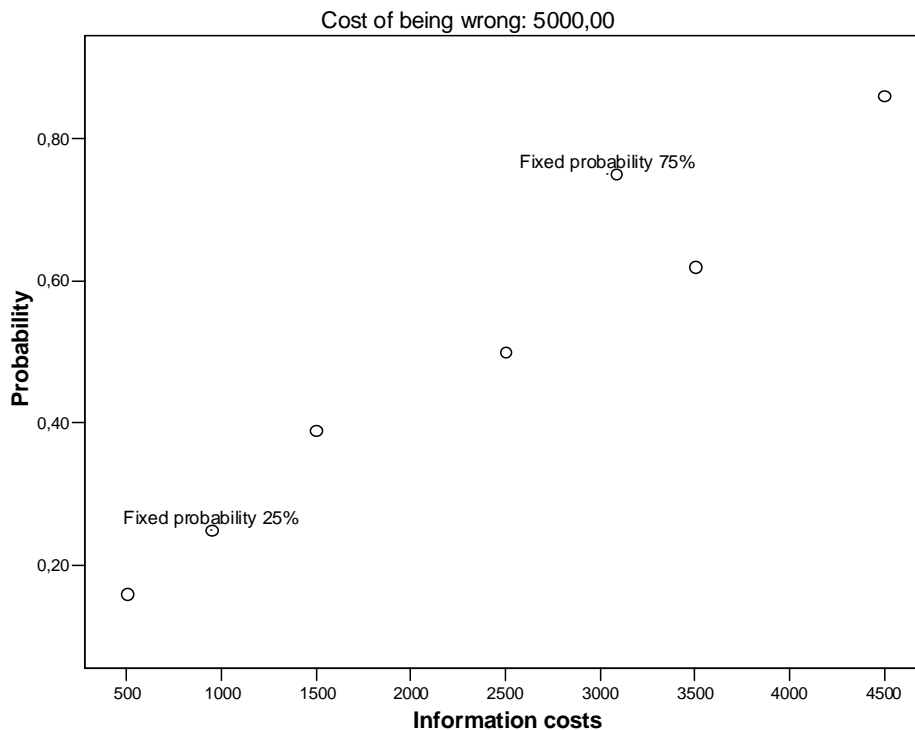


Figure 5. Mean scores for the variable certainty equivalent method in the high cost condition

For the high fixed probability, results are again quite different than the results for the variable certainty equivalent method. The low fixed probability also shows a risk prone result. In the table below, the significance of the results is tested.

Table 20

Results and expected values compared for variable certainty equivalent method in the high cost condition

Probability of being wrong	Expected value	Value	T	Significance
25%	1250 euros	945 euros	-2.787	0.014
75%	3750 euros	3083 euros	-3.480	0.004

The results in the table show that for both situations, participants are risk prone and the results are significant. They are willing to pay less for the information than the expected value. Thus, in the high cost condition risk proneness is not only found in the case of a high probability of being wrong, but also in the case of a lower probability of being wrong. It is difficult to explain how this effect emerges. People seem to react different if the probabilities are fixed. It can be that actually working with larger amounts of money a participant is willing to pay is more confronting and leads to smaller amounts of money. If a participant is literally asked to pay an amount of money, it is easier to realize how much money this. On the other hand, when asked for probabilities, this effect is smaller. Participants can more easily imagine amounts of money than probabilities and are more aware when dealing with the actual amounts. Of course, only two variables are used and further research is needed to investigate these results.

It seems that overall behavior is more risk neutral in the numerical conditions than in the non-numerical condition. Therefore, H1 and H2 are confirmed by combining the results of the non-numerical condition with the numerical conditions. In the variable certainty equivalent method, the results even show risk prone behavior. Further research is needed to investigate the results. In the next section, H3 and H4 are examined.

Comparison between the low and high cost condition

The results found in the previous sections on experiment 2 already show that for both conditions the overall behavior is risk neutral. Therefore, it is expected that no difference is found between the low and high cost condition. In this section, these results are compared more thoroughly.

In Figure 6, the values for the low and high cost condition are presented in one graph. Since the information values for both conditions are different, the expected probabilities are used to compare the results. These probabilities are found in table 12 and 18, in the second column.

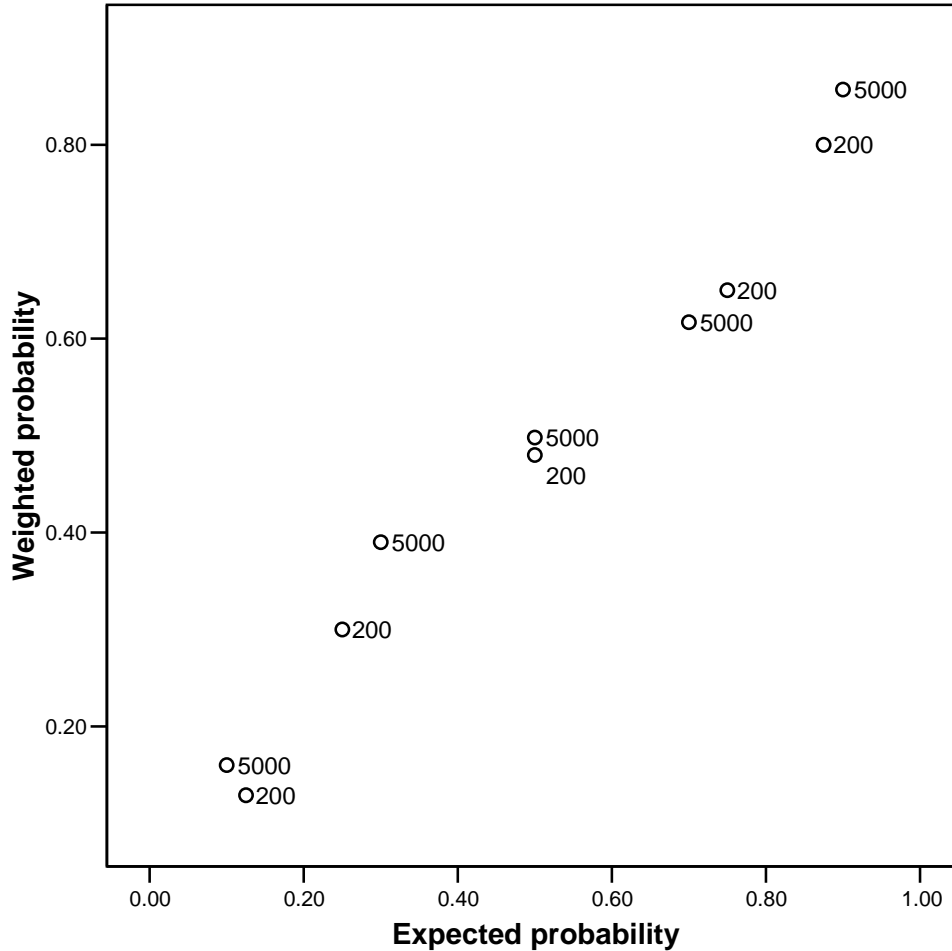


Figure 6. Mean values in the low and high cost condition

It is clear from the graph that the difference between the two conditions is very small. The scores for both of the conditions are on or around risk neutrality. Unfortunately, for methodical reasons, the expected probabilities are different for the two different conditions. It is decided to offer the participants information costs in a way it is easiest to picture the situation. This led to differences in information costs for both conditions. Therefore, conducting a T-test cannot compare the mean scores. Only the decision situation in which the expected probability is 0.5 can be compared, because in both conditions this was the case: in the low cost condition with information costs of 100 euros ($100 / 200 = 0.5$) and in the high cost condition with information costs of 2500 euros ($2500 / 5000 = 0.5$).

In order to compare the two numerical conditions, the differences between the conditions have to be controlled. Therefore, a formula is used:

$$(Cost\ of\ being\ wrong \times (probability\ wrong\ decision) - information\ costs) / cost\ of\ being\ wrong$$

Thus, if the decision costs are 5000 and the probability to make a wrong decision is 0.50 and the information costs are 2500, the result of the formula is 0. This also means that the combination is risk neutral. But, when the information costs are higher, for example 4000, the result of the formula is -0.6. Which means the answer is below 0 and thus risk averse. In the exactly the same situation for the low cost condition, the decision costs are 200, the chance of making a wrong decision is 0.5 and the information costs are 100. In this case, the result of the formula also is 0. Unfortunately, the results of this formula can only be compared for the medium decision situation, as mentioned above, and the results of the variable certainty equivalent method.

For the medium information costs, respectively 100 euros and 2500 euros, conducting a T-test compares the results of the formula. The result is not significant ($T = -0.387$, $P = 0.702$), this means there is no significant difference between the two values.

Furthermore, using the individual results in table 11 and 17 can compare the results. In both the conditions, ten participants are risk neutral or show no distinctive pattern. This means that for both conditions about two-third of the participants is risk neutral. According to these results and the results mentioned above, no difference between the conditions is found and H3 and H4 are rejected.

In table 22, the scores are compared for the variable certainty equivalent method. Also in this case, the formula presented above is used to compare the scores.

Table 22

Comparison of low and high cost condition for variable certainty equivalent method

Probability of wrong decision	T	Significance
Low	-2.175	0.038
High	-1.493	0.147

In the variable certainty equivalent method, for both conditions the behavior found was risk prone overall. But, in the low cost condition with a low probability of being wrong, behavior was risk neutral. This way, the significant difference between the two low probabilities is explained. Since only two variables are used for this method, it is difficult to draw conclusions from the results. More research is needed to explain the risk prone scores for this method.

4. Discussion

The answer on the research question shows that extending the questionnaire does not lead to a change in risk behavior. There is a very small difference between the results of this study and those of De Hoog & Kookken (2006). It is clear that four questions are enough to examine the trade-off between the cost of not knowing and the cost of finding out.

Overall it can be said that the first two hypotheses are confirmed and the third and the fourth are rejected. This means that for framing, only one effect is found.

The difference between the holistic processing style and analytical processing style, influenced by the non-numerical or numerical way of questioning, is confirmed. Participants are risk averse in the non-numerical condition and are risk neutral in the numerical conditions.

Effects of the size of the costs are not found. The results for 200 and 5000 euros are quite the same and higher costs do not lead to more risk averseness. Of course, the question is if the effects are the same if even more extreme costs are chosen. For example, what will happen if the cost of not knowing is 100,000 euros?

Other limitations of the research are the use of hypothetical situations, the use of quite 'technical questions' and the difference in research methods for both studies.

In the case of hypothetical situations, Kühberger et al. (2002) shows that hypothetical situations in decision making show the same results as real situations. Therefore, it is possible to use hypothetical decision making situations; these results are valid for examine risk behavior in decision making.

Because of the difficult questions, especially in the second study, results can be influenced. In the second study, participants did receive some information about the situation, which made it easier for them, but it remained difficult for the participants to imagine the situation.

Furthermore, the research methods are very different for both experiments. It is possible that results are different because participants fill in the questionnaire on a computer screen and the other group is interviewed and had immediate contact with the experimenter. It is possible that the direct contact with the experimenter influenced the results. Also, the two different methods presented by Von Winterfeldt & Edwards (1986) show distinct results. It is important to understand these differences by examining the results more thoroughly.

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