Erasmus University Rotterdam

# Reducing Loss Aversion

Master's Thesis Behavioural Economics

Author: V.W.B. Sloeserwij

Supervisor: Dr. C. Li

Co-reader: I. Aydogan

Date: 11 November 2016

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**Abstract**

This thesis investigates factors that may influence people's degree of loss aversion. Data obtained by an online survey with 108 respondents showed that aggregating risks with other individuals makes people less loss averse. However, providing information on the outcome of others' choices did not have an impact. When controlling this effect for other demographic covariates, it is found that men are more loss averse than women, older people are more loss averse than younger people, and happier people are more loss averse than less happy people. Future research could concern the underlying cause of the statistically significant effect and explore the possibilities of a nudge, based on this intervention.

# 1 INTRODUCTION

People make decisions all the time. For example, you have just made the decision to read this thesis. And currently, you are making the decision to read on, despite the fact that there are probably many other things you could be doing. When studying decisions, a distinction can be made between a normative analysis and a descriptive analysis (Kahneman & Tversky, 1984). This thesis firstly addresses the descriptive analysis, focusing on people's beliefs and preferences as they are, which may not correspond to what they should be from a normative perspective. Then, an intervention is proposed in order to guide people to a probably normatively more desirable position.

This study mainly focuses on risky choices. Consequences of decisions coming forth of risky choices depend on realisations of uncertain events, which implies that risky choices are made without prior knowledge of their consequences, but the probability for each possible outcome is known. In the hope to reveal basic attitudes of people towards risk and value, Kahneman and

Tversky (1984) indicate that the study of decision-making under risk has focused on choices between simple gambles with monetary outcomes and specified probabilities. However, account must be taken of the fact that people mostly do not evaluate prospects solely based on the expectation of their monetary outcomes. The concept of 'utility' implies that people attach a subjective value to monetary outcomes, which forms the leading determinant of their decision-making (Bernoulli, 1954).

When making risky decisions, people often require a premium to take risks, which shows they are risk averse. Moreover, it is found that people have the tendency to strongly prefer avoiding losses to acquiring gains. This phenomenon is called loss aversion. The intuition behind it is that outcomes below the reference state loom larger than corresponding outcomes above the reference state (Tversky & Kahneman, 1991).

Loss aversion can lead to choices that are not in the best interest of the decision maker: it does not produce "good" decision-making (Thaler et al., 1997). In this sense, it can be considered a wealth-maximising error (Kermer et al., 2006). This adresses the demand for a way in which decision-making might be improved in the favor of the decision maker. The underlying motive is not to support paternalism, but to reject one of the arguments commonly raised against it. The general assumption in economics that people generally know what is good for them and therefore should be left alone is found to be not so strong (Kahneman et al., 1997).

By using an experiment in which risks of other people are aggregated, a way is proposed in which the loss aversion of people can be reduced in order to let them make decisions that are more beneficial to them in terms of objective expected outcome. Also, the possible effect that providing different types of information has on the level of loss aversion is researched.

This paper is organised in the following way. In section 2, the existing literature is reviewed and theories on which this study is based are discussed. Section 3 provides a brief overview of the hypotheses that come forward of the theories. The methodology of the conducted experiment and the analysis are presented in section 4, and section 5 contains the results of this analysis. In the end, the hypotheses will be answered and evaluated in section 6, and in section 7, the limitations of this study and suggestions for future research are discussed.

# 2 LITERATURE REVIEW

In this section, the literature in which is tried to explain human behaviour is reviewed to form the theoretical background of this study. The section starts with a detailed explanation of the phenomenon of loss aversion. Thereafter, an aspect of loss aversion, the impact bias, is described. Consequently, two causes of the impact bias are mentioned, after which the law of large numbers and aggregating risks will come forth to possibly provide a solution for one of these causes. Finally, some attention is given to the phenomenon of "moral hazard".

## 2.1 LOSS AVERSION

As mentioned in the introduction, loss aversion implies that people prefer avoiding losses to acquiring equivalent gains, and can be formulated in practical situations using a coefficient. In order to get a better understanding of this phenomenon, an example of a loss averse utility function is provided below.

$$U(x) = \begin{cases} x, & x \geq 0 \\ 2.5x, & x < 0 \end{cases}$$

The "U" stands for utility, which is the subjective value that people attach to monetary amounts. The "x" stands for a change in wealth relative to the reference point, measured in monetary units. The utility function indicates that an increase in wealth leads to an equivalent increase in utility, and a decrease in wealth leads to a decrease in utility that is 2.5 times the monetary amount. The disutility of losing $100 is more than twice the utility of gaining $100 (Thaler et al.,1997). In several experiments that involved hypothetical choices regarding the acceptability of gambles, Tversky and Kahneman (1991) find loss aversion coefficients that are either 2 or 2.5.

The subjective value of objective losses is multiplied by the loss aversion coefficient, often denoted by "$\lambda$" (lambda), which is greater than 1 when a person is loss averse. In the given example, the value of $\lambda$ is 2.5. Absolute loss aversion means that if $0 < y < x$, then the bet in which there is a 50% probability to win x and a 50% probability to lose x is less attractive than the bet in which there is a 50% probability to win y and a 50% probability to lose y. Relative loss aversion implies that risk aversion is stronger when there is a probability to lose money than when there are only positive outcomes (Ert & Erev, 2013).

*Myopic loss aversion* assumes that people are more sensitive to losses than to gains, in combination with the tendency of people to evaluate outcomes myopically over time (Gneezy & Potters, 1997; Benartzi & Thaler, 1995). This means that outcomes are frequently evaluated, and even long-term investors might act accordingly. Research shows that investors who receive the most frequent feedback about their investments took the least risk, which was disadvantageous to the amount of money they earned. Investors who received less information did better in terms of outcome (Thaler et al., 1997).

## 2.2 IMPACT BIAS

When trying to explain the phenomenon of loss aversion, the impact bias can be mentioned as an underlying concept. The impact bias describes the tendency of people to overestimate the intensity and duration of emotional reactions to future events (Wilson & Gilbert, 2005). Many decisions that people make are based on affective forecasts. These forecasts are predictions about emotional reactions to events in the future. If you ask people to predict their feelings after losing their job or their life companion, they mostly overestimate both the intensity and the duration of negative feelings. Losses loom large in prospect but do not feel large in reality due to rationalisation or minimisation of losses by people, making loss aversion both a wealth-maximising error and an affect-maximising error (Kermer et al., 2006).

The impact bias can partly be explained by defensive processes in human brains that operate automatically without people even noticing the presence of these processes (Kermer et al., 2006). A result of these processes is that people fail to anticipate how capable they are in transforming a negative event psychologically. Two causes of the impact bias are focalism and the underappreciation of the emotional immune system. Those two causes are discussed in the next two subchapters.

### 2.2.1 FOCALISM

Focalism addresses two tendencies in people's behaviour. First, people mostly overestimate how much they will think about an event in the future and second, they underestimate the extent to which other events will influence their thoughts and feelings (Wilson & Gilbert, 2005).

Focalism can be seen as a focusing illusion. It is found in studies that there is a tendency to exaggerate the hedonic impact of any event on which one's attention is focused. One example can be obtained from a study by Schkade and Kahneman (1998). They observed that people overestimate the relative objective advantages of California, when they are asked to consider the possibility of living there. Most of the considerations concern only those aspects of life that are easily observable, such as climatic changes, yielding too much weight given to these aspects. When they are asked to answer a question regarding their own life satisfaction, they look at more central aspects of life, and not only at the aspects they focused on when answering the first question. There is a shift of attention when rating the place that one does not live in, followed by the place that one does live in. The failure to anticipate this shift of attention is a focusing illusion. It leads people to exaggerate the negative consequences of climatic changes between regions due to an underestimation of future generations to adapt to these changes.

It is also found that the focusing illusion is not restricted to the context of life satisfaction. This is because the underlying psychological explanation of the focusing illusion is that it is quite difficult or even impossible to consider multiple aspects to the same or comparable extent when one of these aspects is at the focus of attention and the other is at the background (Schkade & Kahneman, 1998).

### 2.2.2 UNDERAPPRECIATION OF "EMOTIONAL IMMUNE SYSTEM"

The second cause of the impact bias that is described in this study is the underappreciation of the capacity for emotional adaptation to negative events. A psychological immune system provides a way in which experiences of negative affect are ameliorated, and people are mostly unaware of this system (Gilbert et al., 1998). People therefore overestimate the duration of their affective reactions to negative events. Gilbert et al. (1998) provide evidence for the existence of this immune system by using six different experiments. Participants in all of these experiments overestimated the duration of their affective reactions when making affective forecasts about, for example, an electoral defeat or a rejection by a prospective employer. Another study even showed women feeling better than they expected after receiving the news from a pregnancy test that they were pregnant whilst they preferred not to be (Mellers & McGraw, 2001). People thus fail to anticipate how quickly they will recover psychologically from negative events.

Events that happen unexpectedly trigger four processes in sequence: attention, reaction, explanation and adaptation (Wilson & Gilbert, 2005). This is on itself not such a remarkable finding for psychologists, but what is interesting, is that people do not consciously take these processes into account when making predictions about their future feelings. People will underestimate how quickly their tendency to explain events will reduce the impact of these events due to the fact that the processes that let people explain or make sense of unexpected events happen quickly and unconsciously. Something that plays a role in the underappreciation of the capacity for emotional adaptation to negative events is the tendency of people to evaluate an entire extended future outcome by evaluating just the transition to it (Kahneman et al., 1997). An example that is commonly used to clarify this tendency is the fact that when asked to predict the well-being of paraplegics, people mostly focus on the event of *becoming* a paraplegic, largely neglecting the long-term state of *being* a paraplegic.

The tendency to underestimate the emotional immune system to negative events can be regulated (Sokol-Hessner et al., 2009). By letting people evaluate their position from another perspective, behaviour can be altered in an unconscious way. A seller might for example demonstrate loss averse behaviour when selling a product he owns, but when asked to focus on gaining revenue, he unconsciously pays less attention to the fact that he will lose his ownership, leading to a reduction of his negative feelings resulting from the unpleasant event (Ariely et al., 2005).

Kermer et al. (2006) find that in affective forecasts, people predict losing would have a greater emotional impact than winning, even when the losable amount was less than the winnable amount. No evidence was however found that losing actually had a larger emotional impact than winning. People failed to realise they have the unconscious capacity to reframe the loss positively, for example by realising that they could have lost more. Neither wealth nor happiness will be maximised by decisions that are the result of people erroneously believing that losses will have more impact than gains. Loss aversion is stronger in prospect than in actual experience, which could lead to a wealth-maximising error when making decisions about future outcomes.

## 2.3 The Law of Large Numbers

An observed phenomenon in human decision-making that might discourage the effect of the impact bias on the level of loss aversion is the law of large numbers. This law of large numbers is best explained by a short example. Imagine you are offered to take part in a bet in which you will have a 50% probability to earn $200 and a 50% probability to lose $100. You would probably not take part because you consider the risk of losing $100 to be too high and not compensated enough by the possible win of $200. Or, how Samuelson (1963) puts it: "I won't bet because I would feel the $100 loss more than the $200 gain." However, when repeatedly executing this bet, there is a greater approach towards certainty; when this bet will be executed 100 times, you can be virtually sure that the outcome is positive. There is, in some sense, safety in numbers. Samuelson (1963) indicates that, when executing the bet described above 100 times, the possibility of an outcome of minus $10,000 is less than one in a million, whereas the probability of getting 34 or more positive outcomes (which would be enough for the total outcome to be positive) is over 99%. It is mentioned in other studies that the attractiveness of multiple prospects increased with the number of repetitions, especially when the total distribution of outcomes is clearly mentioned (Redelmeier & Tversky, 1992).

What is important when trying to obtain the behaviour described above by offering multiple bets to people, is that they can be sure up front that they are going to take a certain amount of bets. When there is no certainty about the number of repetitions of the bet (even when the probability of repetition after a single bet is really high), people tend to ignore expectations about risky opportunities of the future (Kahneman & Lovallo, 1993), where they should not if their behaviour were to abide by certain rules of rationality.

## 2.4 AGGREGATING RISKS

When making decisions, considering each prospect as a separate event is called segregation. Evaluating the overall distribution of outcomes is known as aggregation, which accommodates the law of large numbers to affect behaviour. Most people choose differently when choosing by segregation than when choosing by aggregation, since they would reject a single gamble but accept a series of repetitions of this gamble. It is found that people tend to choose by segregation when a particular gamble is singled out and often fail to overview the broader picture, leading to segregation of multiple prospects that form a violation of the standard theory of rational choice (Redelmeier & Tversky, 1992).

The tendency of most people to consider problems in isolation and thus choose by segregation is commonly mentioned in scientific research. Kahneman and Lovallo (1993) show that statistics of the past and future opportunities are neglected when evaluating plans in the present. The effects of statistical aggregation are not taken into account when making choices, leading to overly cautious risk attitudes. People are overly timid because they neglect the possibilities of aggregating risks when evaluating single risky prospects instead of an aggregated amount of prospects. Finally, treating problems as unique and not taking the broader view into account can cause inferior decision-making. If people would be rational, they would consider the joint consequences of two or more concurrent decisions rather than treat each decision as a separate event (Redelmeier & Tversky, 1992).

As already mentioned in section 2.3, in order for the law of large numbers to work, it is necessary that the repetitions of a single bet are evaluated as one big gamble instead of a sequence of several small gambles. The following example clarifies this. Normally, the attractiveness of a series of gambles increases with the number of repetitions of this single gamble, which consists of a 50% probability to win $2,000 and a 50% probability to lose $500. So most people would prefer to play this gamble six times to playing it five times. However, when people are asked to play this bet a sixth time after they have played it five times and do not know yet the results of these five gambles, the number of people who reject the sixth gamble is about the same as the number of people who reject the single gamble in the first place (60%) (Redelmeier & Tversky, 1992). There is, in some sense, a reversal of preference when comparing the situation in which people consider the six gambles as a fixed series, to the situation in which people tend to segregate the sixth gamble from the rest of the series.

## 2.5 MYOPIC LOSS AVERSION

The phenomenon of segregation described in the previous chapter is also found when looking at a myopic decision maker. Consider a myopic decision maker with a utility function as provided in paragraph 2.1. This decision maker will probably reject a gamble in which he is offered a 50% probability to win $200 and a 50% probability to lose $100 because this would yield him a negative expected utility. When offered two of those bets, the distribution of outcomes will be a 25% probability to win $400, a 50% probability to win $100 and a 25% probability to lose $200, which would yield a positive expected utility. In principle, the decision maker should accept this repeated gamble, but since he is myopic, he will first conclude that he does not like the prospect of the first gamble, and consequently reject the whole series (Thaler et al., 1997).

For myopic loss averse investors who choose between risky stocks (high expected pay with a high standard deviation) and safe assets (small but certain expected pay), the investor’s time horizon is of interest to the attractiveness of the risky stocks. The longer an investor is prepared to wait and thus the less the outcomes of investments are evaluated, the more attractive the risky stocks become, relative to the safe assets (Thaler et al., 1997). Next to that, when investments are evaluated more frequently, the probability of observing a loss is higher.

Now, if it is true that losses loom larger than gains, more frequent feedback would cause a myopic investor to evaluate a series of investments as less attractive than a less myopic investor would do (Kahneman et al., 1997). When the evaluation period increases and the amount of feedback decreases, the experience of losses will be mostly eliminated due to statistical aggregation. In conclusion: a myopic, loss averse investor can be made less loss averse by reducing the amount of feedback and thus increasing the length of the evaluation period; the more frequently investments are evaluated, the more loss averse investors will be and thus the least they earn in terms of objective outcomes (Thaler et al., 1997; Gneezy & Potters, 1997).

## 2.6 Moral Hazard

Taking more risks because other people than you would bear the possible burden of those risks, is called moral hazard. In economics, this kind of situations is commonly researched. For example, in managerial behaviour, it is found that risks are partly taken because managers do not expect that they have to bear the consequences of those risks (March & Shapira, 1987).

When individual behaviour affects the distribution of an outcome that involves risk sharing of multiple individuals, it is possible that moral hazard arises (Hölmstrom, 1979). This tendency is likely to occur if no contingent contract can be made. This is the case when none of the contracting parties knows whether the specified contingency has occurred or not (Arrow, 1970). Thus, when there is no possibility to observe individual action and therefore it cannot be contractually agreed upon, moral hazard might come into play, yielding a lower level of loss aversion due to the fact that people expect not to bear the burden of the consequences of their decisions.

# 3 HYPOTHESES

This study examines loss aversion and how to let people make decisions that are less influenced by this wealth-maximising error. To do this, an intervention is proposed to reduce the impact of loss aversion on people's behaviour. Because the aggregation of multiple investment choices leads people to take more risks, and because of the phenomenon of moral hazard, a possible intervention that decreases loss aversion would be to aggregate one's risks with the risks of other individuals. By introducing this intervention, people might be derived of their tendency to underestimate their power to adapt to future losses because a negative outcome is less likely to occur, and might take higher risks because of the "safety in large numbers" by sharing the total outcome, resulting in more favorable decision making by avoiding loss aversion. Such an intervention in people's decisionframework leads to the first hypothesis of this study:

***H1****: "Aggregating one's risks with the risks of other individuals will decrease the level of loss aversion"*.

Secondly, when the evaluation periods of investments are shorter and people thus receive more feedback on the outcomes of their choices, people become more loss averse and choose options that are less wealth-maximising. Receiving information on the outcome of a person with whom the total outcome is shared, is comparable to this kind of feedback on outcomes of one's own choices, yielding possibly the same increase in loss aversion. The second hypothesis of this study is:

***H2****: "Receiving more information about the outcomes of choices of other individuals, increases the level of loss aversion"*.

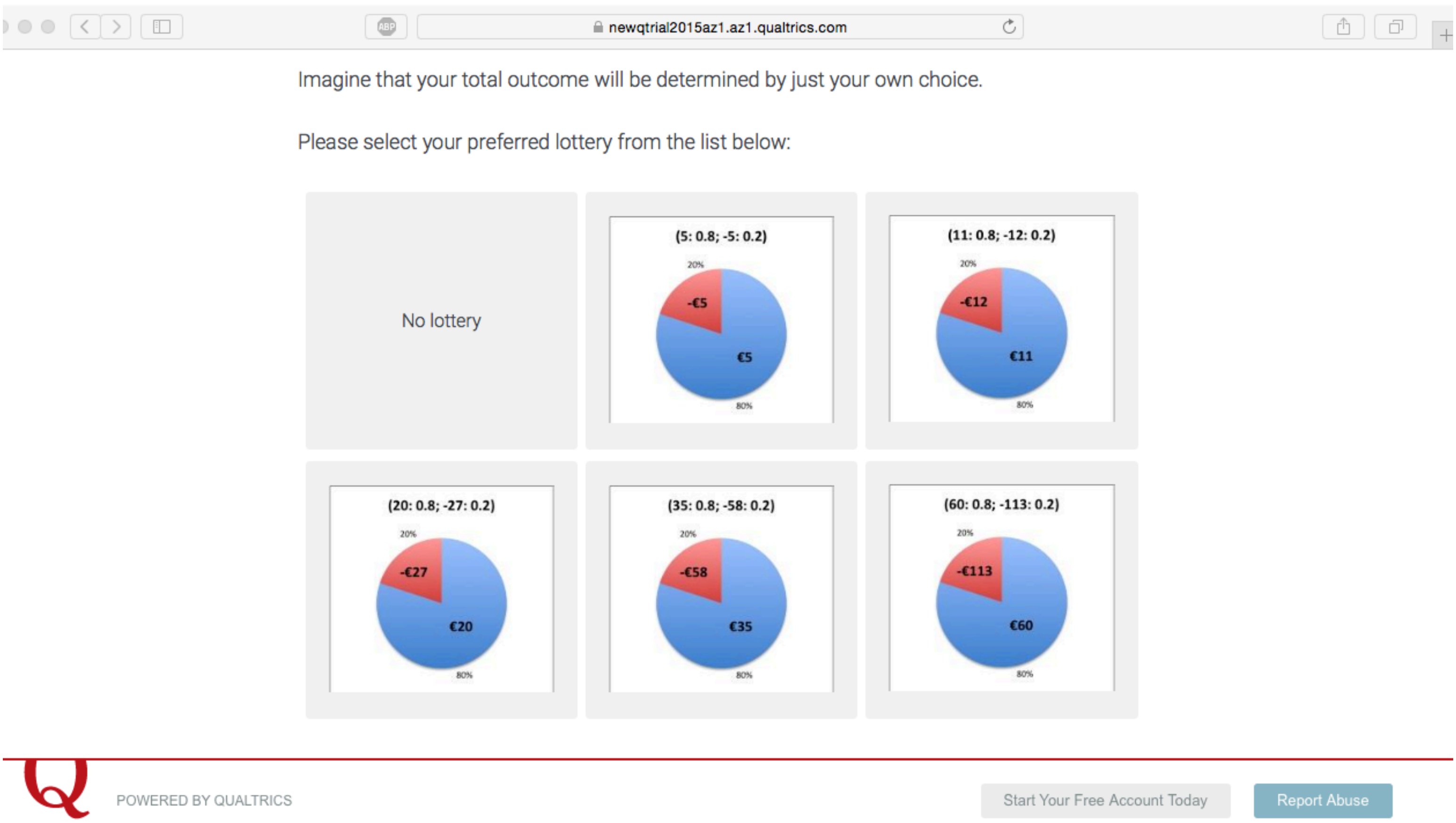
So, when supporting evidence is found for both hypotheses, a possible intervention to reduce loss aversion would be to propose people to aggregate their risk with other people, while not corresponding any information on the outcome of other people before making a decision, such that outcomes are not judged separately and considered in a less myopic way.

# 4 METHODOLOGY

An experiment was conducted to test the two hypotheses. The experiment takes the form of an online questionnaire, sorting people's level of loss aversion in different circumstances. Below, the experiment design with the experimental tasks and an overview of the analysis are described.

## 4.1 THE EXPERIMENTAL DESIGN

Participants have to choose their preferred lottery out of the following 5 lotteries, or to choose not to participate in any lottery at all. In the online survey, this looks as follows.




The appendix contains a full example of the online survey as presented to the respondents.

Table 1 provides some additional information on the options, in which option number 1 stands for choosing "No lottery".

**Table 1**

| Option Nr. | Lottery | Expected Value | Lambda minimum (loss aversion) | Lambda maximum (loss aversion) |
|---|---|---|---|---|
| 1: | No lottery | 0 | 4 | NA |
| 2: | (0.8: 5; 0.2: -5) | 3 | 3.428571429 | 4 |
| 3: | (0.8: 11; 0.2: -12) | 6.4 | 2.4 | 3.438571429 |
| 4: | (0.8: 20; 0.2: -27) | 10.6 | 1.935483871 | 2.4 |
| 5: | (0.8: 35; 0.2: -58) | 16.4 | 1.818181818 | 1.935483871 |
| 6: | (0.8: 60; 0.2: -113) | 25.4 | NA | 1.818181818 |

The lotteries are denoted in the following way: $(p_1: x_1; 1 - p_1: x_2)$. In this equation, $p_1$ stands for the probability to gain the amount $x_1$ (in euros), and $1 - p_1$ is the probability with which the amount $x_2$ (also in euros) is gained. Since $x_2$ is negative in all lottery options, gaining $x_2$ results in a loss. For example, choosing option number 5 leads to an 80% probability to win 35 euros, and a 20% probability to lose 58 euros.

The idea behind the different lotteries in the options is as follows. Choosing "no lottery" (option 1) yields the lowest possible loss (0 euros), option 6 is the lottery in which the amount that can be lost is the highest (113 euros). One amount involved exceeds 100 euros because, if only low amounts would be used, loss aversion would be less visible (Ert & Erev, 2013).

The probabilities of 80% and 20% are chosen to avoid a 50%-50% distribution of probabilities. It is possible that the gambles simply trigger more risk-taking behaviour than other gambles. Possible reasons for this tendency are overweighting of the probability of 50% or some yet unspecified framing effect (Ert & Erev, 2013; Battalio et al., 1990).

The level of loss aversion (lambda) corresponding with the different lotteries increases when the amount that can be lost decreases. So when you are less loss averse (corresponding with a lower lambda), you prefer a lottery in which the amount that can be lost is higher. The way these lambdas are calculated is by comparing the prospect theory value of one option with that of all other options. The value of lambda is the only unknown in the calculations (functioning as a multiplier of the negative values of $x$ in the utility function), yielding a value for loss aversion after solving the different equations. If option 4 is chosen, this implies that this person has a loss aversion level of between 1.94 and 2.4, since these levels of loss aversion would yield a lower level of utility when a different choice is made than option 4.

The *absolute* values of the lambdas do not indicate any significant result for the analysis. There is no universal value for lambda indicating a perfect loss aversion parameter (Wakker, 2010). This is, however, not a problem for the experiment setup of this thesis, since the loss aversion levels in different circumstances are compared, yielding only a measurement of the effect of a treatment on the loss aversion parameter of which the absolute value does not really matter in theory.

It is, however, important to notice the increase in lambda when the option number is decreasing. This has to hold for different utility functions and different probability weighting functions; otherwise, observed behaviour cannot be attributed to loss aversion. Also, the correct trend is important because not the exact values of loss aversion will be used in the analysis, but a range from a high level of loss aversion corresponding with option 1 to a low level of loss aversion corresponding with option 6. When the correct trend holds, the different utility functions and probability weighting functions of participants do not matter for the analysis of the level of loss aversion.

Hereafter, it is shown that in different circumstances it is still true that a lower lambda corresponds with a higher option number and vice versa. This is done by eliciting the levels of loss aversion ($\lambda$) in different prospect theory evaluations.

Those evaluations are generated using the utility functions:

$$U_1(x) = \begin{cases} x, & x \geq 0 \\ \lambda x, & x < 0 \end{cases}$$

$$U_2(x) = \begin{cases} x^{0.9}, & x \geq 0 \\ -\lambda(-x)^{0.9}, & x < 0 \end{cases}$$

The first utility function is piecewise linear function, with a kink at 0. The second utility function is concave for gains and convex for losses, indicating diminishing marginal utility for both gains and losses with their magnitude. This means, for example, that the difference in utility between a gain of 10 euros and a gain of 20 euros is greater than the difference in utility between a gain of 110 euros and a gain of 120 euros. The shape of the function also predicts risk-seeking behaviour in the domain of losses and risk-averse behaviour in the domain of gains (Thaler, 1980; Pennings & Smidts, 2003; Barberis, 2013). Loss aversion implies that the utility function is steeper for losses than for gains, since $\lambda > 1$. The utility function is however not the only aspect of the prospect theory evaluation and does not solely predict human behaviour. The probability weighting function also plays a role; these are the two functions that are used in this thesis:

$$w_1{}^{+}(p) = w_1{}^{-}(p) = p$$

$$w_2{}^{+}(p) = w_2{}^{-}(p) = \frac{p^{\beta}}{(p^{\beta} + (1-p)^{\beta})^{1/\beta}}$$

Kahneman & Tversky (1992) estimated $\beta$ in the second probability weighting function to be 0.61, which is used in the calculations of this thesis. This probability weighting function is an inverse-s-shaped probability weighting function that is concave for low probabilities and convex for high probabilities, capturing the idea that people overweight small probabilities and underweight moderate and high probabilities (Kahneman & Tversky, 1992; Wu & Gonzalez, 1996). Considering the second utility function and the second probability weighting function together implies the presency of risk aversion for losses of small probability and gains of high probability, and risk seeking for losses of high probability and gains of small probability.

The general prospect theory evaluation that is constructed looks as follows:

$$PT(p_1\colon x_1; 1-p_1\colon x_2) = w^{+}(p)U(x_1) + w^{-}(1-p)\,U(x_2)$$

Below, different combinations of the utility functions and probability weighting functions above are put into prospect theory evaluations. These evaluations are used to derive the lambdas by comparing the evaluation of one outcome with the others, since only the lambdas are unknown in the equations. In table 1, the prospect theory evaluation used to derive the lambda-values can be denoted as

$$PT(p_1\colon x_1; (1-p_1)\colon x_2) = {w_1}^{+}(p)U_1(x_1) + {w_1}^{-}(1-p)\,U_1(x_2)$$

Table 2:

$$PT(p_1\colon x_1; (1-p_1)\colon x_2) = {w_1}^{+}(p)U_2(x_1) + {w_1}^{-}(1-p)\,U_2(x_2)$$

Table 3:

$$PT(p_1\colon x_1; (1-p_1)\colon x_2) = {w_2}^{+}(p)U_1(x_1) + {w_2}^{-}(1-p)\,U_1(x_2)$$

Table 4:

$$PT(p_1\colon x_1; (1-p_1)\colon x_2) = {w_2}^{+}(p)U_2(x_1) + {w_2}^{-}(1-p)\,U_2(x_2)$$

It becomes clear that the correct trend of the levels of loss aversion holds in every situation.

**Table 2**

| Option Nr. | Lambda minimum | Lambda maximum |
|---|---|---|
| 1: | 4 | NA |
| 2: | 3.447388411 | 4 |
| 3: | 2.452640823 | 3.447388411 |
| 4: | 2.019273241 | 2.452640823 |
| 5: | 1.926976226 | 2.019273241 |
| 6: | NA | 1.926976226 |

**Table 3**

| Option Nr. | Lambda minimum | Lambda maximum |
|---|---|---|
| 1: | 2.329467179 | NA |
| 2: | 1.996686154 | 2.329467179 |
| 3: | 1.397680307 | 1.996686154 |
| 4: | 1.127161538 | 1.397680307 |
| 5: | 1.058848718 | 1.127161538 |
| 6: | NA | 1.058848718 |

**Table 4**

| Option Nr. | Lambda minimum | Lambda maximum |
|---|---|---|
| 1: | 2.329467178 | NA |
| 2: | 2.00764454 | 2.329467178 |
| 3: | 1.428336575 | 2.00764454 |
| 4: | 1.175957684 | 1.428336575 |
| 5: | 1.122206968 | 1.175957684 |
| 6: | NA | 1.122206968 |

Participants make their decisions in three different situations. In one situation, the outcome of the participant is only dependant of his own choice. Another situation asks participants to imagine their outcome is shared with nine other participants who, according to their preferences, make a choice out of the same list of options. This situation makes sure that the risk of the participant is aggregated with other participants, trying to create the same effect as the law of large numbers has when a single gamble is offered with repetition. The third situation also includes the presence of nine other participants, but furthermore provides the information of the outcome of one of those nine other participants. Participants are randomly assigned to one of three different possibilities (treatment groups) in this question: one of the nine other participants chose “no lottery”, he won 60 euros or he lost 113 euros. This situation mimics the situation in which there is more feedback for decision-making. The order of the three questions regarding the situations is randomised to avoid a learning bias. In table 5, the three different situations and three different treatment groups in the third situation are described in an orderly manner, using labels for the different situations that are used in the remainder of this thesis.

**Table 5**

| Situation | Description |
|---|---|
| 1 | The outcome is only dependent on one's own lottery-choice. |
| 2 | The outcome is shared with 9 other fictional participants. |
| 3N | The outcome is shared with 9 other fictional participants, and the information is provided that one of these participants chose option number 1 (No lottery). |
| 3W | The outcome is shared with 9 other fictional participants, and the information is provided that one of these participants chose option number 6 and the outcome was "winning 60 euros". |
| 3L | The outcome is shared with 9 other fictional participants, and the information is provided that one of these participants chose option number 6 and the outcome was "losing 113 euros". |

When we look at the three questions that are asked about the different situations, the following applies. By asking participants to choose one option and making their outcome solely dependent of their own choice, an initial level of loss aversion is derived. A higher option number corresponds with a lower level of loss aversion. This yields a control condition, with which the situations in the other questions can be compared. The effect of the different situation-questions will thus be a within-subject design, comparing the same people in different situations. This setup avoids possible effects of different characteristics amongst participants on the effect of the different situations.

After the three choice questions, survey questions are asked to indicate the respondent's self-assessed level of optimism, anxiety and happiness. Finally, questions about the demographic situation of the participants are asked. These questions are asked to enable the possibility to check whether the main effects derived from the two hypotheses, are robust when adding this information as control variables.

With the abovementioned experiment setup it is possible to study:

- the possible effect of aggregating a risk with other people's risks on the level of loss aversion,
- the possible effect of providing information about the outcome of one other person on the level of loss aversion.
- the possible effect of the type of information that is provided on the level of loss aversion

The next section explains how this can be done.

## 4.2 ANALYSIS

To test the hypotheses, a number of tests has to be performed. The chosen significance level in all performed analyses is 5%.

The **first hypothesis** concerns the possible difference between the level of loss aversion when a respondent's outcome is only affected by its own choice and the level of loss aversion when a respondent's outcome is the result of an equally divided outcome of a group. Considering the experimental design, this possible effect of aggregating risks would result in a difference between the options that respondents choose in situation "1" and situation "2". Since these two variables are not normally distributed, they have to be compared by using a non-parametric test. A parametric test would have been preferred if this assumption of normality could have been justified, but this is not the case. This is explained in detail in the "Results"-section.

Every respondent answers the questions that generate the variables;

the questions are equal over all respondents, so a possible variation between those two answers is called a within-subject variation. The variables are paired, not independent as they are derived from the same group of respondents.

Lastly, the scale of the variables is of importance when choosing the correct test. In this case, the two variables of interest have an ordinal scale, since option number 1 (choosing the option "no lottery") corresponds with the highest level of loss aversion, and with every outcome, the level of loss aversion decreases towards option number 6, which corresponds with the lowest level of loss aversion.

Knowing these characteristics of the variables of interest, the conclusion can be drawn that the Wilcoxon signed rank test has to be performed in order to analyse the variance between the variables (McCrum-Gardner, 2008). The null-hypothesis being tested, is that the positive and negative differences between the variables are distributed normally about zero (Wilcoxon, 1945).

The **second hypothesis** concerns the variables that are generated by the choices made by the respondents in the situations "two" and "three". Despite the fact that in the third situation not all respondents received the same question due to the three treatment groups, the third situation can be distinguished easily from the second situation. Even though the content of the information differed, there could be an effect of the information that is provided on one other fictional outcome that affects the outcome of the respondent in the third situation. In the second situation, no information on any outcome is given, which leaves the respondent with a longer "evaluation period" than in the third situation.

Since every respondent answered both the questions in situation 2 and situation 3, the possible variation between the two can, despite the different treatment groups, again be considered as within-subject variation. Next to that, the variables are not normally distributed, paired and not independent, and have an ordinal scale. The correct test to analyse a possible difference between the variables is, once again, the Wilcoxon signed rank test.

To analyse a possible difference  between different treatment groups, a different test has to be performed. Possible differences in the choices respondents make in the third situation across the treatment groups are a form of between-subject variation. Regarding the question that concerns this third situation, there can not be a difference *within* a respondent's answer, since he or she is only put into *one* treatment group and thus only answers *one* question in the third situation; there can only be a difference *between* the answers of multiple respondents, put into different treatment groups.

The variables regarding the choices respondents make in the third situation (including both 3N, 3L and 3W) are not normally distributed (so parametric assumptions are not satisfied), unpaired and independent, and have an ordinal scale. The Kruskal-Wallis test that tests whether the distributions are equal or not, is the correct test to analyse a possible difference between the treatment groups, that would indicate an effect of the type of information received on the level of loss aversion. The Mann-Whitney U-test can subsequently be used as a *post hoc* test for the Kruskal-Wallis test, to analyse differences between only two of the three treatment groups at the same time.

So far, only the variables that result from the choices regarding different lottery-options are considered in the analysis. These variables form the baseline of the analysis, and should reflect the core-effects that are of interest in this thesis. The variables that describe a respondent's self-assessed level of optimism, anxiety and happiness, and the demographic variables are used to control these effects on robustness. Will they still hold when these control variables are added to the model? To analyse this, a regression model will be constructed, making use of the panel structure of the data. This way, all usable and possibly relevant data that is collected of one respondent, explains the level of loss aversion of that respondent by giving insight in the underlying motives that explain the chosen options.

This regression model can be constructed in a few different ways, none of which is better than the other. The three ways in which the regression models are constructed in this thesis, are as follows.

1. First, a model without any control variables is estimated. The only explanatory variables in this model will be the variables that directly concern the hypotheses, such that only the different situations and the treatment groups explain the choices of the respondent.
2. Next, a model is estimated including all information that is collected from the respondents. There will probably be a lot of insignificant variables in this model, but not showing them at any point might lead to the misinterpretation that they are not considered at all, which could be reason to believe there might be an existing effect. To avoid this misconception, a full model including all variables possible will be presented.
3. Finally, a model is estimated that includes only the most significant variables, and probably explains the choices respondents make concerning the different lotteries the best. The level of loss aversion is probably largely explained by the variables that are included in this model. This model is constructed by leaving out the most insignificant variables of the second model one by one, until almost all variables have a significant effect at the 5%-level.

# 5 RESULTS

This section starts with a list of the variables that are used to perform the tests, and their descriptions. Thereafter, a few characteristics of some of the variables are summarized. Then, a short clarification on the non-normality of the outcome variables is given. Afterwards, the results on the executed tests that regard the hypotheses are given and explained, and finally, the constructed regression models are shown.

## 5.1 LIST OF VARIABLES

| **Variable name** | **Variable description** |
| --- | --- |
| Lot_Choice | Categorical variable indicating the choice a respondent makes concerning the different lottery options, including all situations and treatment groups (for panel analysis). |
| Situation | Categorical variable indicating the different hypothetical situations respondents are in: 1 = outcome determined solely by own choice, 2 = outcome shared with 9 other fictional people that also make a decision, 3 = outcome shared with 9 other fictional people and knowing the outcome of one of these people. |
| TreatmentGroup | Categorical variable indicating the treatment group a respondent is in. 1 = the learned outcome at the third situation is "no lottery" (3N), 2 = the learned outcome at the third situation is "winning 60 euros" (3W), 3 = the learned outcome at the third situation is "losing 113 euros" (3L). |
| Age | Age in years. |

| | |
|---|---|
| Anxiety | Categorical variable indicating the level of anxiety, ranging from -9 (very anxious) to 9 (very relaxed), deduced from a series of questions regarding anxiety. |
| Educ | Categorical variable indicating the respondents highest attained level of education. 1 = No education, 2 = Elementary school, 3 = High school, 4 = Intermediate Vocational Education, 5 = Higher Vocational Education, 6 = University or above. |
| Happy | Categorical variable indicating the self-assessed level of happiness on a scale from 0 to 10. |
| Language | Dummy variable indicating the language in which the survey has been completed. 0 = Dutch, 1 = English. |
| Languagedif | Dummy variable indicating whether a respondent chose to answer the survey in his/her mothertongue (0) or not (1). |
| Male | Dummy variable indicating whether the respondent is a male (1) or a female (0). |
| Mothertongue | Dummy variable indicating whether a respondents mothertongue is Dutch (0) or a different language (1). |
| Optimism | Categorical variable indicating the level of optimism, ranging from -16 (very pessimistic) to 16 (very optimistic), deduced from a series of questions regarding optimism. |
| Resp_Nr | Number that identifies all observations of the same individual. |
| Siblings | Continuous variable indicating the number of brothers and sisters of a respondent. |
| Single | Dummy variable indicating whether a respondent is single (1) or not (0). |
| Student | Dummy variable indicating whether a respondent is a student (1) or not (0). |
| Working | Dummy variable indicating whether a respondent is employed for wages (1) or not (0). |

## 5.2 SUMMARY OF THE VARIABLES

The total number of respondents that completed the survey is 108. In order to have an overview of the contents of some of the variables listed above, a few characteristics per variable are summed up below:

**Table 6**

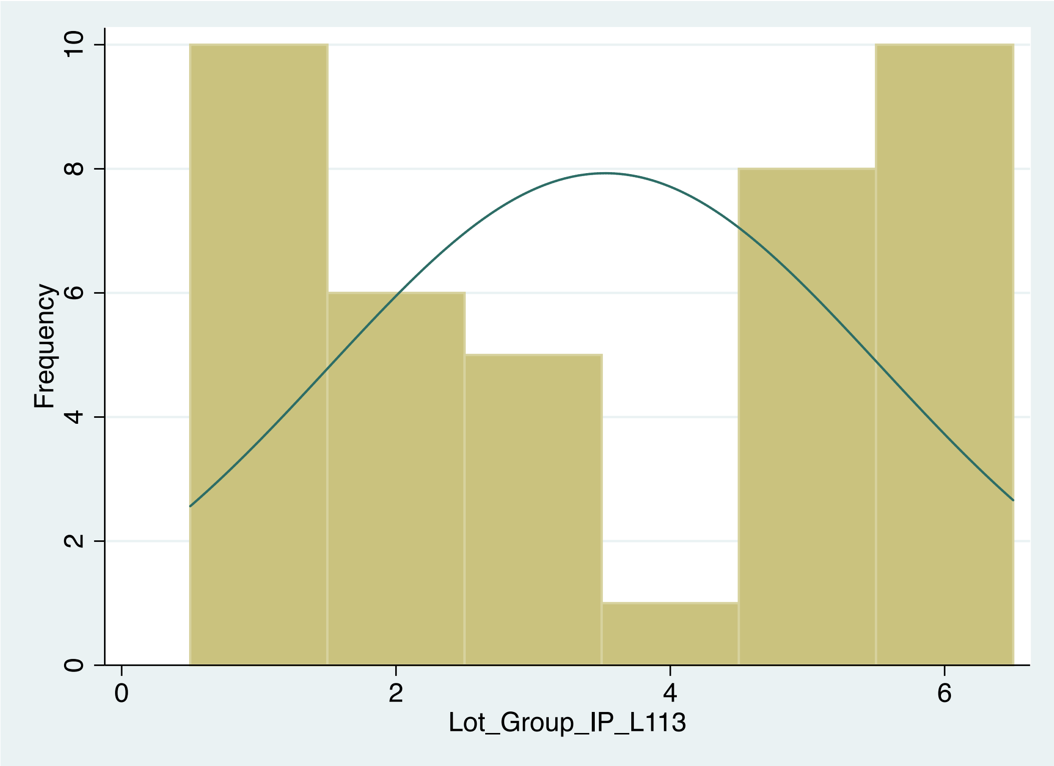
| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Age | 108 | 37.94444 | 16.14296 | 18 | 76 |
| Happy | 108 | 7.851852 | 0.9049688 | 4 | 10 |
| Male | 108 | 0.4074074 | 0.4936425 | 0 | 1 |
| Student | 108 | 0.3703704 | 0.4851552 | 0 | 1 |
| Lot_Choice | 324 | 3.290123 | 1.827489 | 1 | 6 |

## 5.3 NON-NORMALITY OF THE DATA

To test the normality of the outcome variables that are in the tests that regard the hypotheses, a Shapiro-Wilk test is performed and a histogram of the separate variables is analysed.

The Shapiro-Wilk test for normality tests the null-hypothesis that the data of a variable are normally distributed. The test is performed for all situations, including all treatment groups, on the choices respondents make regarding the lottery-options. None of the tests yielded a p-value lower than 5%, so all tests supported the conclusion that the null-hypothesis of normality could not be rejected. The p-values for the variables that correspond with the situations 1, 2, 3N, 3W and 3L are respectively 0.13347, 0.30167, 0.40533, 0.85288, and 0.25016, which are all higher than 0.05, so the null-hypothesis of normality can not be rejected.

However, when making histograms of these variables, it appears that the shapes of these figures does not quite resemble the shape of the bell-curve that is typical of a normal distribution. Based on these histograms, I concluded that the data that form these variables are not normally distributed, and therefore non-parametric tests have to be performed in order to test the hypotheses of this thesis. As an example, the histogram of the variable indicating situation 3L is shown below. It becomes clear that the data do not correspond with the bell-curve.




## 5.4 TESTING THE HYPOTHESES

The Wilcoxon signed rank test that is performed to test the **first hypothesis**, tests whether the positive and negative differences between the variables that regard situations 1 and 2 are normally distributed about zero or not. The null-hypothesis is that aggregating risks, and thus making the outcome of a respondent dependent on other fictional individuals, does not influence the level of loss aversion of a respondent. The alternative hypothesis is that the variable regarding situation 2 contains higher values than the variable regarding situation 1.

The test results report that the level of loss aversion is significantly lower when sharing outcomes with others compared to not sharing with others. The obtained test statistic is $z$ = -2.573, yielding a p-value of 0.0101, which is smaller than 0.05. The effect size is $r$ = -0.18, indicating a small to medium effect (Cohen, 1988). The effect size is calculated by the following equation (Rosenthal, 1993):

$$r = \frac{Z}{\sqrt{N}}$$

in which $Z$ is the z-statistic, produced by the Wilcoxon signed rank test, and $N$ is the total number of observations. The relatively low value of the effect size is mostly because of the high number of people not changing their choice between the two situations, causing them to not be taken into account in the Wilcoxon signed rank test, but reducing the effect size in its role as a (large) denominator in the equation above.

The Wilcoxon signed rank test regarding the **second hypothesis** did not yield any significant results. When performing this test to compare the variables concerning situation 2 and 3 (including 3N, 3W, and 3L), to analyse a possible difference between the two, the $z$-statistic is 0.706, yielding a p-value of 0.4802, which is larger than 0.05. The null-hypothesis that the positive and negative differences between the variables are distributed around zero, can not be rejected. The results of the variable regarding situation 3 do however significantly differ from the variable regarding situation 1 (Wilcoxon signed rank test, $z$-statistic = 2.237 and p-value = 0.0253), there is a significant lower level of loss aversion in the former variable. This is most likely because of the effect of being in a group, since this effect is shown to be significant in the first hypothesis.

The results of the tests that test the two hypotheses of this thesis mean that the data form sufficient evidence to suggest that the first hypothesis can be validated and the second hypothesis can be rejected. So, the data support the statement that aggregating one's risks with the risks of other individuals will decrease the level of loss aversion, and the data do not significantly support the statement that providing information on the outcome of another person positively affects the level of loss aversion.

To analyse the possible effect of the different treatment groups, the Kruskal-Wallis test is performed. This test yields a test-statistic of $H(2) = 1.092$ with a corresponding p-value of 0.5792. Since the p-value is larger than 0.05, we can not reject the hypothesis that the level of loss aversion is not affected by any of the treatment groups. The Mann Whitney U-tests that are performed to follow up the finding of the Kruskal-Wallis test, do not yield any significant results either. There is no significant difference in the choices in the third situation between any of the two treatment groups. The test results are as follows:

- between the variables of situation 3N and situation 3W:
  - $z$-statistic: -0.618
  - p-value: $0.5367 > 0.05$
- between the variables of situation 3W and situation 3L:
  - $z$-statistic: -0.398
  - p-value: $0.6903 > 0.05$
- between the variables of situation 3N and situation 3L:
  - $z$-statistic: -1.047
  - p-value: $0.2951 > 0.05$

All p-values are larger than 0.05, so the choices respondents make in the treatment do not significantly differ between any pair of treatment groups.

## 5.5 REGRESSION MODELS

The three regression models that are estimated are listed in table 7. The first column represents the model with only the variables that directly concern the hypotheses as explanatory variables. The second column represents the model that includes all information collected from the respondents. The third column represents the model that only includes the most significant explanatory variables. The values without brackets indicate the coefficients of the explanatory variables, the values between brackets reflect the *z*-statistics corresponding with the different variables.

**Table 7**

| | Lot_Choice | Lot_Choice | Lot_Choice |
|---|---|---|---|
| 2nd Situation | 0.426 | 0.426 | 0.426 |
| | (2.95)** | (2.95)** | (2.95)** |
| 3rd Situation | 0.278 | 0.278 | 0.278 |
| | (1.93) | (1.93) | (1.93) |
| 2nd TreatmentGroup | 0.203 | 0.087 | |
| | (0.52) | (0.22) | |
| 3rd TreatmentGroup | 0.489 | 0.269 | |
| | (1.34) | (0.76) | |
| Happy | | -0.508 | -0.460 |
| | | (2.64)** | (2.91)** |
| Male | | 0.732 | 0.718 |
| | | (2.33)* | (2.48)* |
| Age | | -0.011 | -0.025 |
| | | (0.76) | (2.84)** |
| 4.Educ | | 1.166 | |
| | | (1.11) | |
| 5.Educ | | 0.580 | |
| | | (0.58) | |
| 6.Educ | | 0.526 | |
| | | (0.56) | |
| Single | | -0.155 | |
| | | (0.38) | |
| Student | | 0.822 | |
| | | (1.34) | |
| Working | | 0.046 | |
| | | (0.09) | |
| Siblings | | -0.045 | |
| | | (0.43) | |
| Optimism | | 0.022 | |
| | | (0.56) | |
| Anxiety | | 0.056 | |
| | | (1.01) | |
| _cons | 2.818 | 5.928 | 7.325 |
| | (10.29)** | (2.92)** | (5.72)** |
| *N* | 324 | 324 | 324 |

* $p$<0.05; ** $p$<0.01

For the categorical variables, one of the categories is left out of the model to serve as the reference category. So, the interpretation of the effect of the second situation is as follows: being in the second situation increases the option number chosen by a respondent by 0.426 compared to being in the first situation, ceteris paribus. This effect is significant at the 1%-level.

The results from the regression models show a lot of similarities with the results of the non-parametric tests that concern the hypotheses directly. The second situation significantly lowers the level of loss aversion compared to the first situation, indicating a clear effect of aggregating risks with other individuals on the choice a respondent makes. Also, none of the treatment groups significantly affects the outcome variable in the regression models, which confirms the results of the non-parametric tests. The results of these tests are thus robust when controlling for other explanatory variables.

There is, however, also a slight difference between the regression models and the results of the non-parametric tests. The difference between the third situation and the first situation was considered to be significant in the non-parametric test at a 5%-level, whereas the regression models show a non-significant effect, although the sign of the effect corresponds with the finding of the non-parametric test. Because of this difference in results between the regression and the non-parametric tests, the effect of situation 3 is less robust than the effect of situation 2. Leaving the third situation out of the regression models to improve the percentage of significant explanatory variables is however not improving the model, since the variable does show valuable information. In the third situation, the level of loss aversion is higher than in the second situation, and although this difference is not significant, this might give a hint for the validation of the second hypothesis.

To interpret the results of the regression model that fits the data the best (column three), some attention is given to the coefficients of the explanatory variables concerning demographics in this model and their explanation.

- Male are less loss averse. This gender difference is consistent with the literature (Rau, 2014; Booij & van de Kuilen, 2009; Brooks & Zank, 2005; Rieger et al., 2011). This phenomenon is due to both a more frequent occurrence and a higher extent of loss aversion (Schmidt & Traub, 2002), and can be examined in both riskless and risky choices (Gächter et al., 2007). Gächter et al. (2007) however did not find this phenomenon to be significant when conditioning on other covariates, but Brooks and Zank (2005) did find this effect to be significant at a 1%-level in their regression model.

- For every year that a person becomes older, the option number that is expectedly chosen decreases by 0.025, ceteris paribus. This effect is statistically significant at a 1%-level. Hence, age has a positive effect on the level of loss aversion. This phenomenon is also found in other studies regarding loss aversion (Gächter et al., 2007; Hjorth & Fosgerau, 2011), but not in every study (Wood et al., 2005; Li et al., 2013). A possible explanation for this phenomenon can be the a decrease in cognitive abilities (Gächter et al., 2007), such as memory performance (Weber & Johnson, 2006). Another explanation could be that older people are presumed to be more conservative, and therefore less likely to choose options involving high possible losses (Kovalchik et al., 2005). Older people are also found to be more *risk* averse because their household financial security is decreased, compared to younger people, since they experience less job security (Jianakoplos & Bernasek, 2006). This effect can be an underlying cause of the effect of age on the level of loss aversion.
- Having a self-assessed level of happiness that is 1 point higher on a scale from 0 to 10 decreases the chosen option number by 0.460, ceteris paribus. This effect is statistically significant at a 1%-level. Assessing oneself a higher level of happiness thus yields a higher level of loss aversion. Although this phenomenon nor its explicit absence is often encountered in existing literature, two possible explanations are provided (Kliger & Levy, 2003). Corroborating the existence of the phenomenon, Kliger and Levy (2003) state that a good mood leads to both a raise in people’s reference state and more cautious behaviour. Having a high reference point leads to more aversion to a possible loss, whereas hasty behaviour is entailed by a bad mood. The dislike of happy people to gamble is consistent with the

mood-maintenance theory, indicating the aversion of happy people to high-risk bets (Isen & Patrick, 1983). It is also shown that, parallel to the aversion to high-risk bets, happy people reported more thoughts about losing when contemplating a high-risk bet than when contemplating a low-risk bet, and also more thoughts about losing when comparing their thought-reports in the four minutes after filling out their preferences with the reports of a control group (Isen & Geva, 1987).

The coefficients of the different situations do not differ between the different regression models. This is because the situations concern a within-variation, and the rest of the variables concern between-variations. Within-variation means that the variation is caused by a difference within the same respondent, so the change between one situation to the other for one individual. Between-variation means that the variation is between different respondents. For the analysis in this thesis, a random-effects estimator is used to construct the regression models.

Because both a between-effects estimator (regarding only between-variation) and a fixed-effects estimator (regarding only within-variation) would leave out a lot of information and therefore do not give a good overview of the explanatory variables that fit in the model, the choice for the random-effects estimator is made. The random-effects estimator includes both effects and the coefficients in this model do not seem to be systematically different from the coefficients in the other models.

# 6 DISCUSSION

One main shortcoming of this research is the fact that no real monetary incentives were used to differentiate between the situations. The introduction of fictional other people did however have a significant effect, but it is hard to say whether this effect would be the same in a real-life situation. Furthermore, a larger sample size is needed for better statistical power. For example, providing information in the third situation did have the expected effect, but it was not statistically significant. Also, the effect size of the statistically significant effect found at the first hypothesis is "small" to "medium", which is a drawback of the practical impact of the intervention. Lastly, the age of a large part of the respondents was clustered around both the age of 20 and the age of 50. A more representative distribution of the society would have been preferred.

As underlying causes for the phenomenon observed concerning the first hypothesis, both moral hazard and the effect of the securing of a positive outcome by the law of large numbers are put forward. Clearly, there is an effect of aggregating risks, but the exact cause of this effect remains unclear. Future research could focus on the possible causes, trying to apprehend the motivations of the effects observed in this study.

Aggregating risks with other individuals did significantly decrease the level of loss aversion. The intervention has an effect, but what does this imply for a possible nudge? A nudge can be described as "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2008). The mechanisms causing the intervention to have an effect, might also work on a nudge that avails these underlying causes by creating awareness of the situation. A nudge might be introduced by informing individuals on the situation that risks are aggregated, if risks are indeed aggregated in a certain situation. This last condition is added to avoid changing economic incentives, which is a prerequisite of a nudge. Making people aware of an already existing situation, in which the underlying effects that cause the intervention to have an effect are present, might reduce loss aversion compared to the situation in which this information is not explicitly provided. The possible nudge thus functions as a mere informationprovider, but must affect the actual choice situation in order to be distinguished from an advertisement (Bovens, 2009). Future research could focus on whether or not a nudge would yield results that are compatible with the results of the intervention in this study.

# 7 CONCLUSIONS

Despite the small sample size, a few conclusions can be drawn based on statistically significant results of the performed experiment. Firstly, the results support the first hypothesis, stating that aggregating one's risks with the risks of other individuals will decrease the level of loss aversion. The intervention embodying this aggregation that was applied in the experiment resulted in a decrease in the level of loss aversion. It has to be noted, however, that the effect size of this statistically significant effect has to be considered "small" to "medium". No statistically significant evidence was found to support the second hypothesis; based on the results of this study, providing information on the outcome of another person has no significant effect on the level of loss aversion. Next to that, different types of information received (no lottery chosen, win or loss) did not yield a significant difference.

As regards the demographic characteristics influencing the level of loss aversion, a few interesting effects are evinced as well. In accordance with the existing literature, male respondents had a lower level of loss aversion than female respondents, and for age and the self-assessed level of happiness, a positive effect on the level of loss aversion was found.

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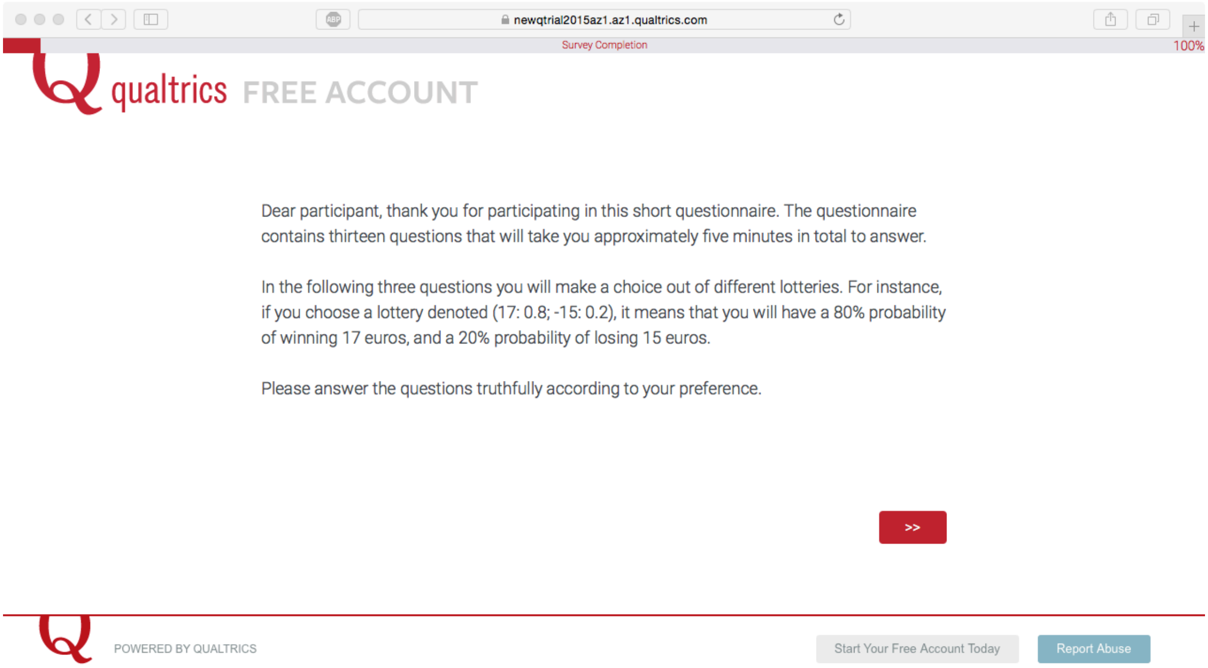
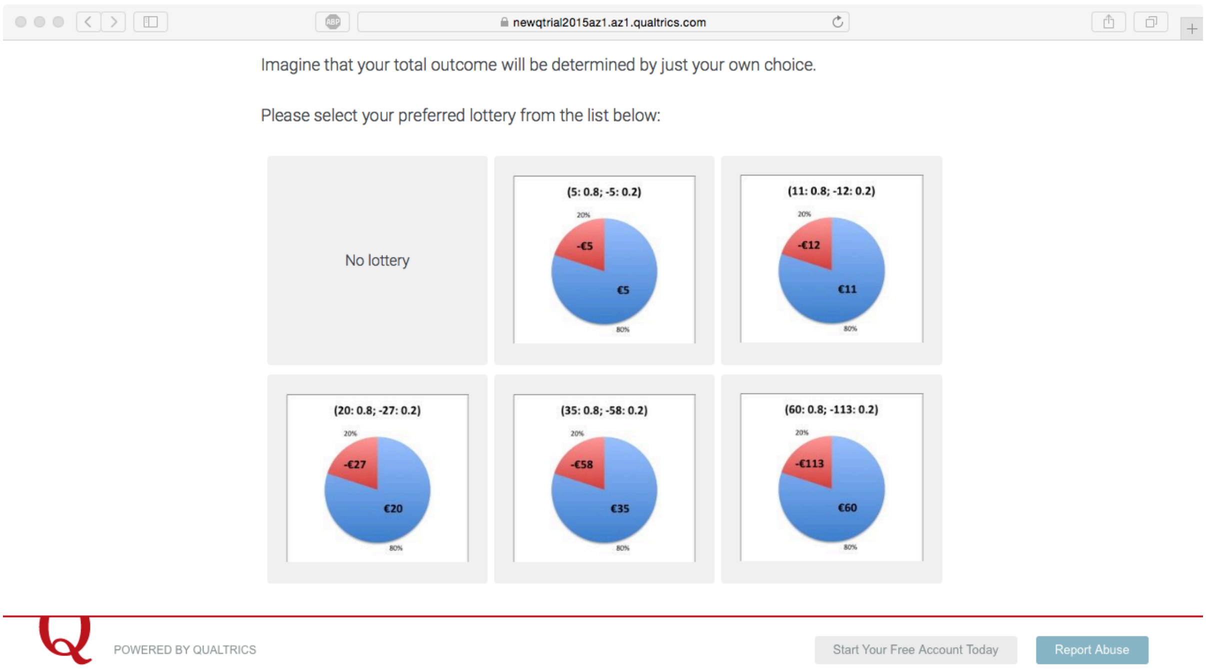
# Appendix

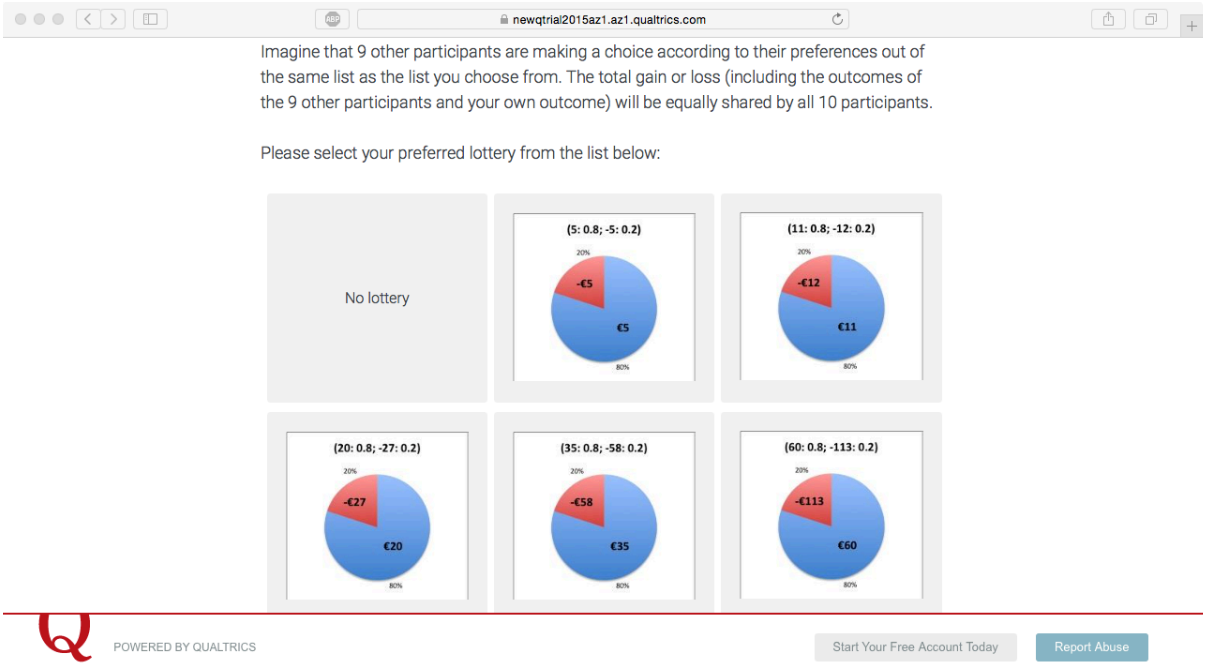
In this appendix, the survey that was presented to the respondents, will be displayed. After having chosen his or her preferred language (English or Dutch), the respondent receives a short explanation on lotteries in general.



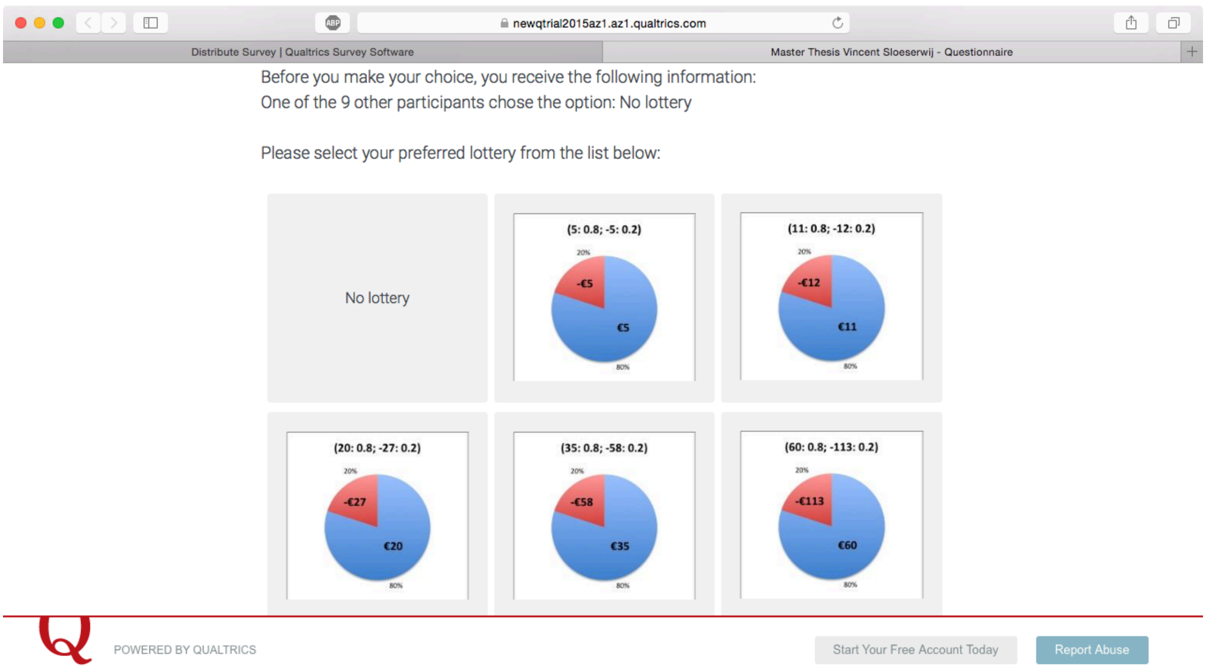

Next, the respondent has to choose one option out of six, regarding risky lotteries.



The question regarding the second situation is as follows:

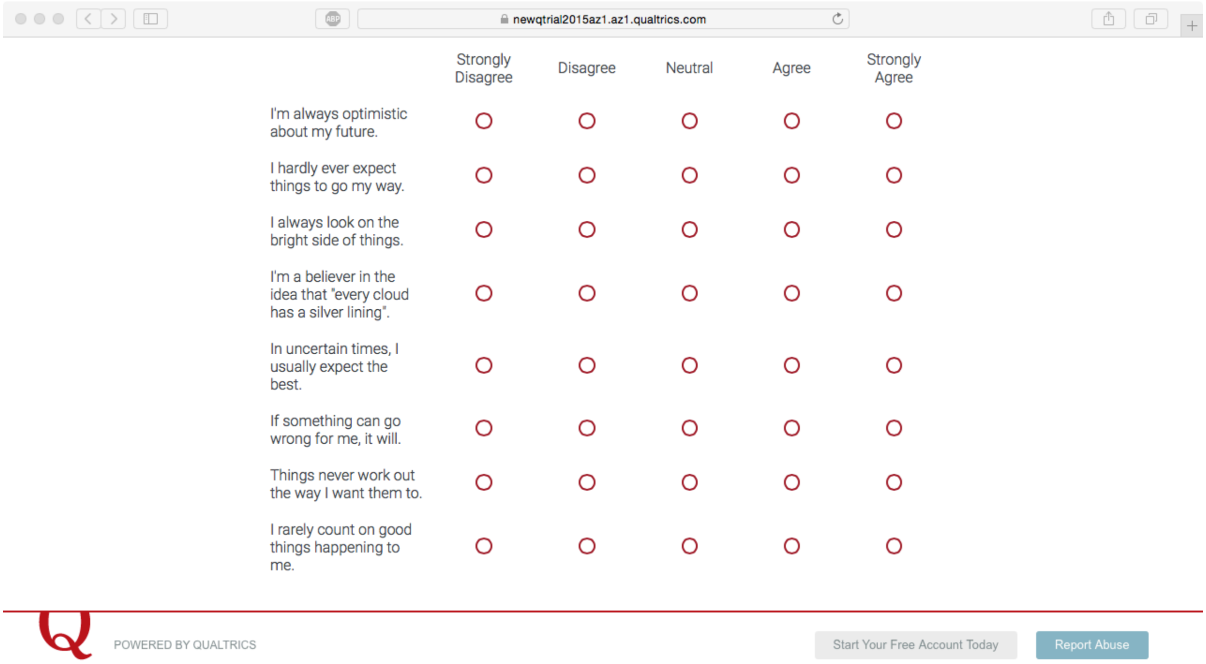



The choice respondents have to make considering the third situation is presented as follows. The question below is identical to the second situation, but two extra lines including the information on one other outcome are shown. In this case, the question considers the first treatment group. The three questions are shown in a random order to avoid a learning bias.



Next, the questions regarding the respondents' self-assessed level of optimism, anxiety and happiness are shown as follows:

Optimism: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| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I'm always optimistic about my future. | ○ | ○ | ○ | ○ | ○ |
| I hardly ever expect things to go my way. | ○ | ○ | ○ | ○ | ○ |
| I always look on the bright side of things. | ○ | ○ | ○ | ○ | ○ |
| I'm a believer in the idea that "every cloud has a silver lining". | ○ | ○ | ○ | ○ | ○ |
| In uncertain times, I usually expect the best. | ○ | ○ | ○ | ○ | ○ |
| If something can go wrong for me, it will. | ○ | ○ | ○ | ○ | ○ |
| Things never work out the way I want them to. | ○ | ○ | ○ | ○ | ○ |
| I rarely count on good things happening to me. | ○ | ○ | ○ | ○ | ○ |

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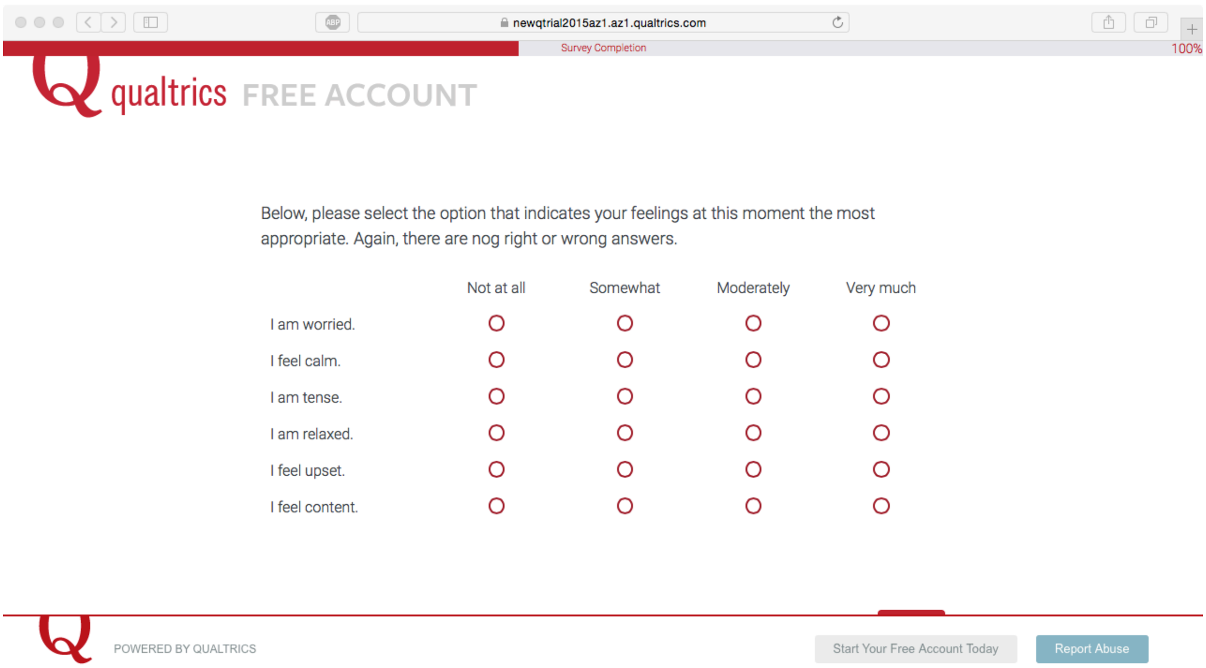
Anxiety: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Below, please select the option that indicates your feelings at this moment the most appropriate. Again, there are nog right or wrong answers.

| | Not at all | Somewhat | Moderately | Very much |
|---|---|---|---|---|
| I am worried. | ○ | ○ | ○ | ○ |
| I feel calm. | ○ | ○ | ○ | ○ |
| I am tense. | ○ | ○ | ○ | ○ |
| I am relaxed. | ○ | ○ | ○ | ○ |
| I feel upset. | ○ | ○ | ○ | ○ |
| I feel content. | ○ | ○ | ○ | ○ |

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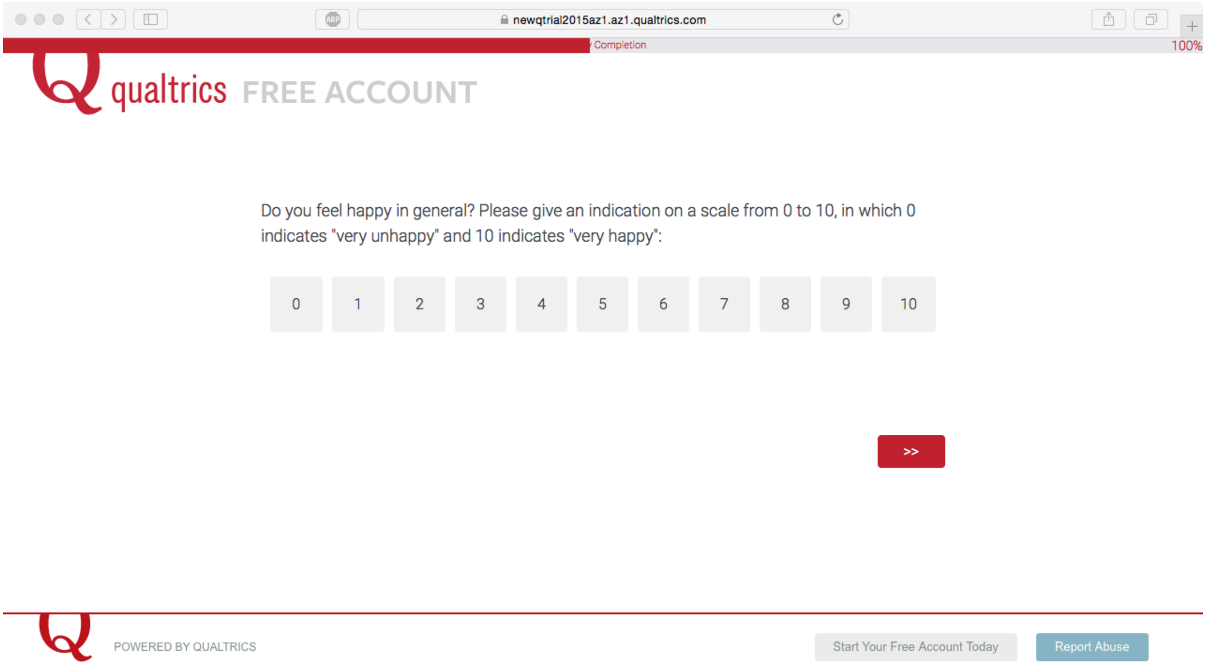
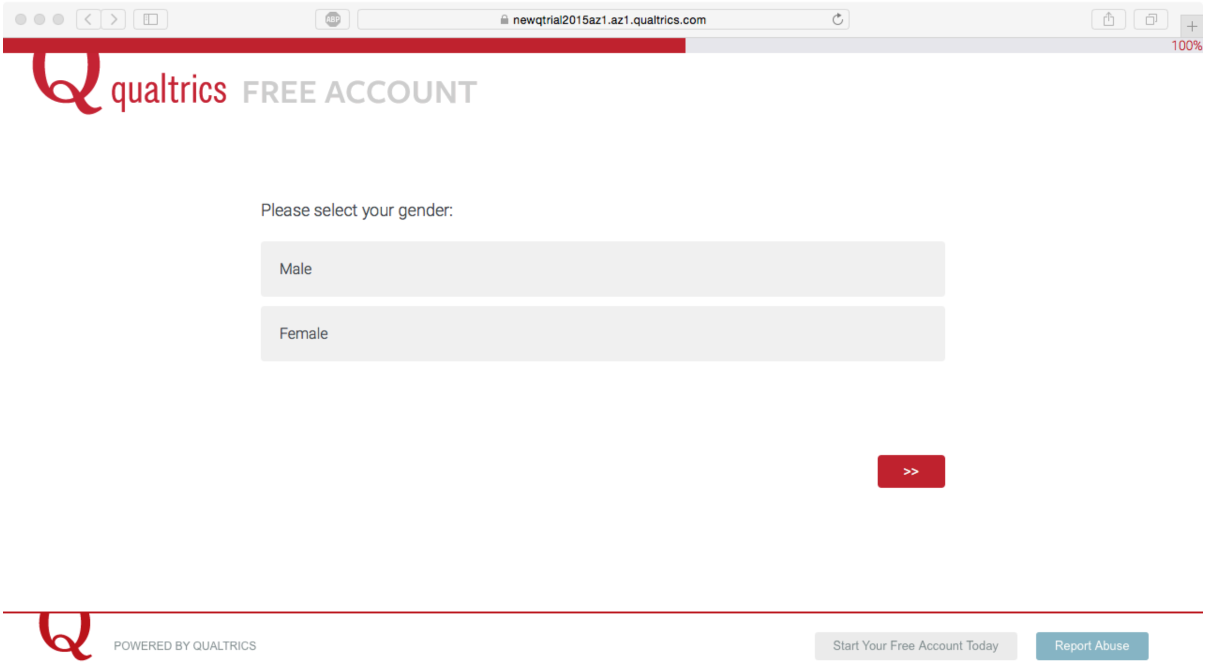
Happiness:

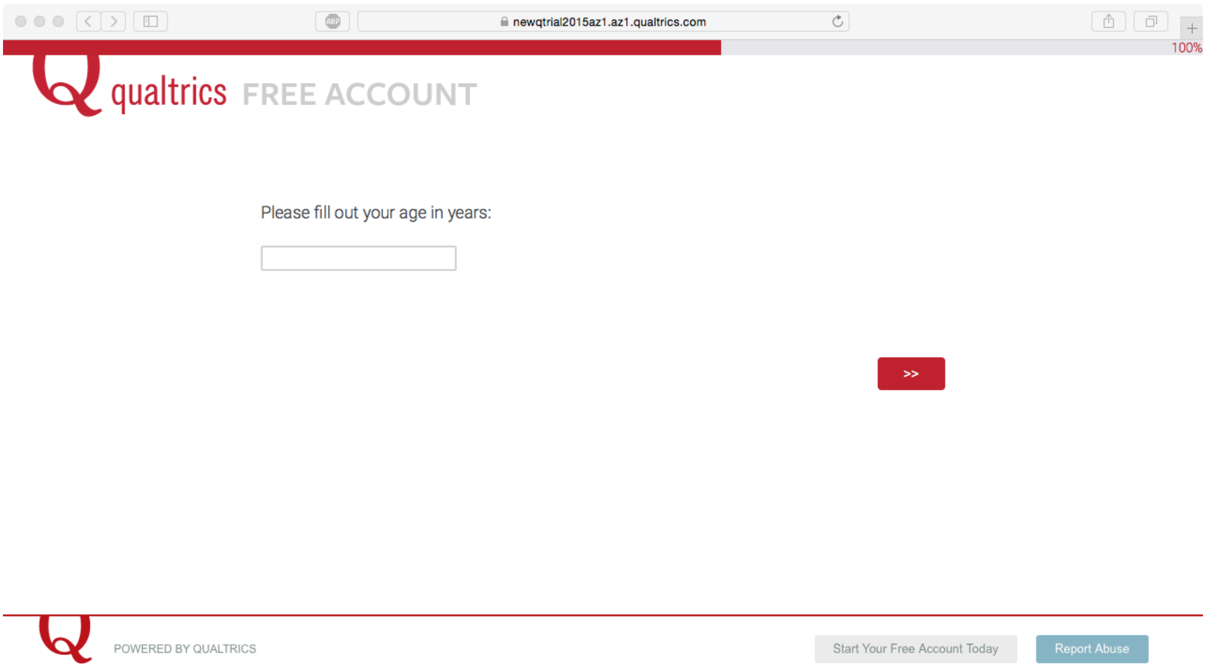



The last few questions concern the respondents' demographic situation:

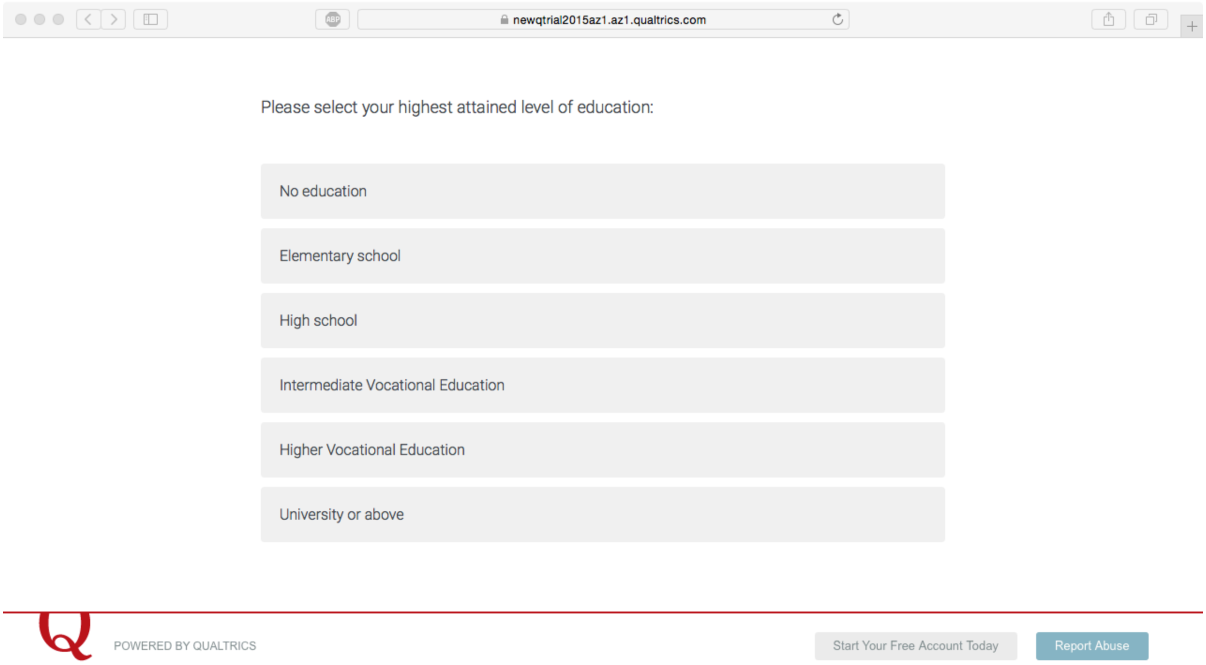
Gender:




Age:




Education:



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Please select your highest attained level of education:

No education

Elementary school

High school

Intermediate Vocational Education

Higher Vocational Education

University or above

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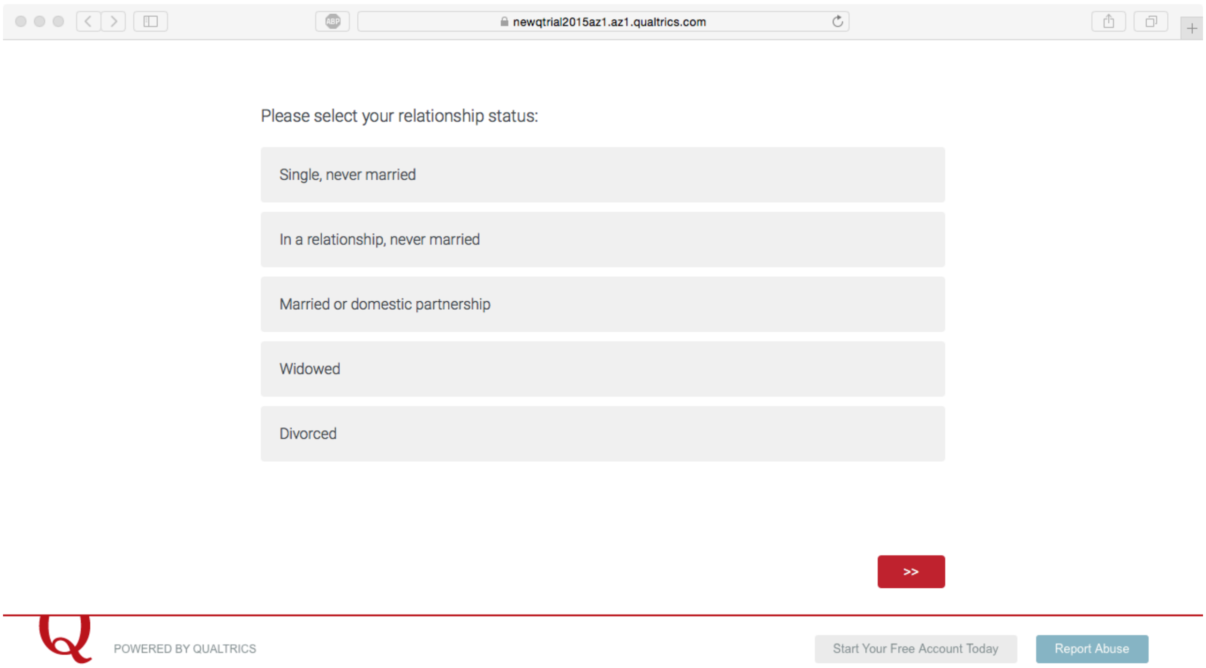
Relationship status:



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Please select your relationship status:

Single, never married

In a relationship, never married

Married or domestic partnership

Widowed

Divorced

>>

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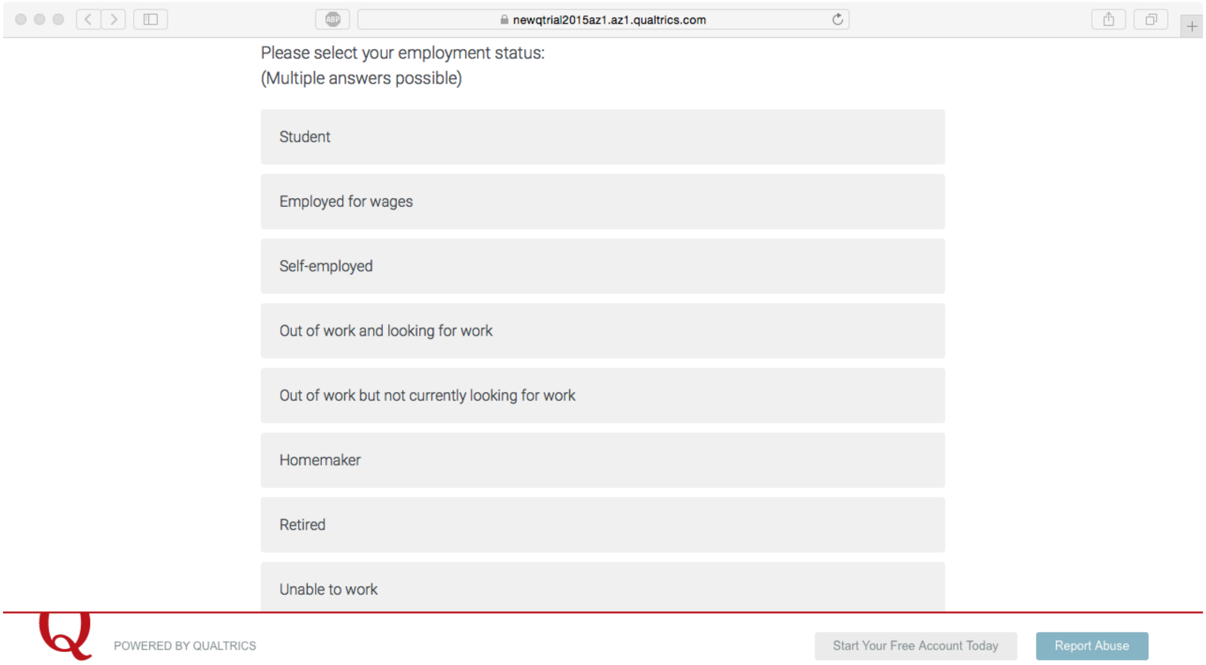
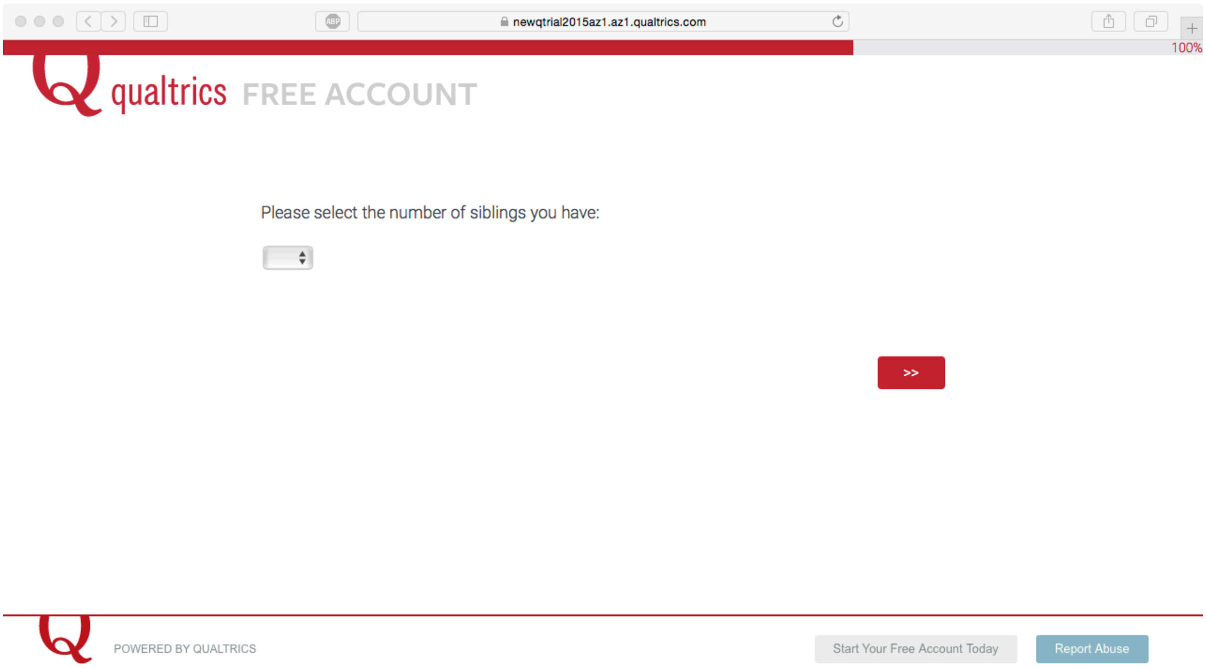
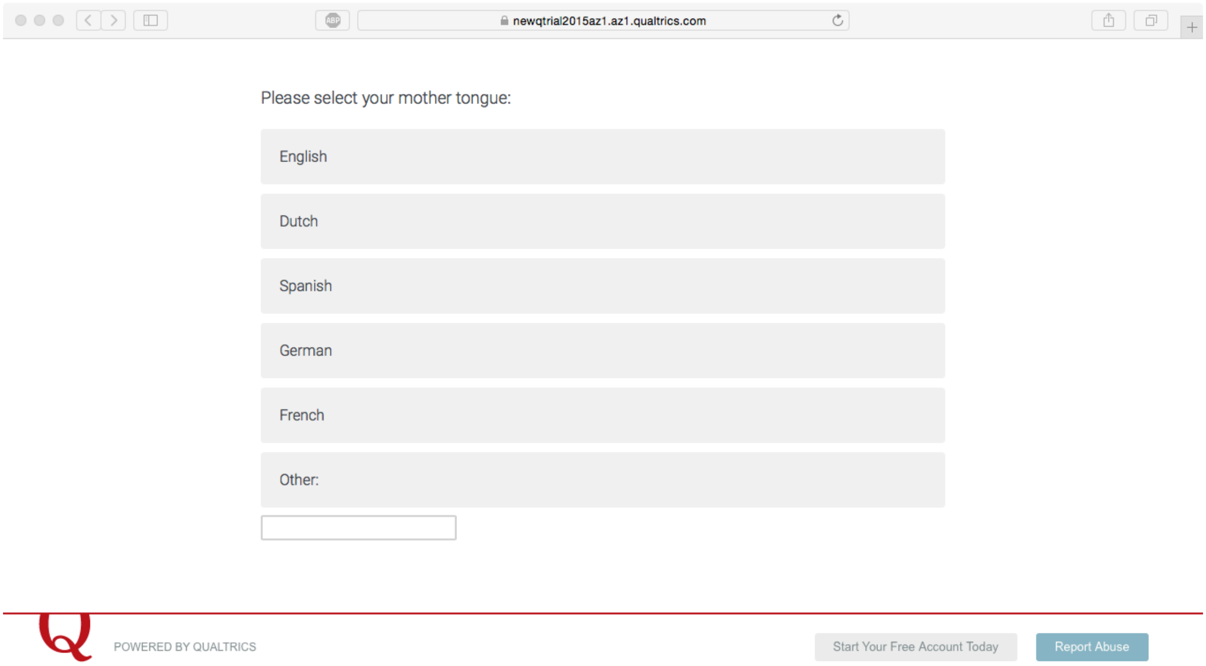
Employment status:




Siblings:




Mother tongue: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Dutch
Spanish
German
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