Increasing the willingness to pay and non-monetary subjective valuation for a solution to the pollution in Rotterdam*; the anchoring effect.*

Bachelor Thesis in Behavioural Economics

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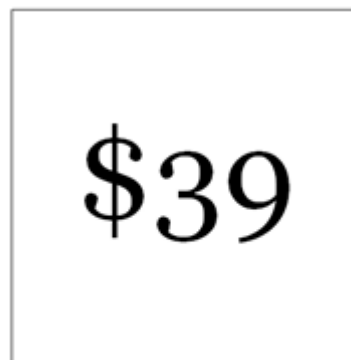
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Abstract

This paper focuses on the anchoring and adjustment bias, and its use in the valuation of environmental issues. Specifically, it will focus on people's willingness to pay as well as their non-monetary subjective valuation for a solution to the pollution problem and how this can be affected by the anchoring and adjustment bias. Then, it investigates which of the two is more prone to the anchoring and adjustment bias. Although much research is done about the effect of the anchoring bias on consumers' Willingness to Pay (WTP) only little research is done about the effect on people's WTP of environmental issues. Even fewer research is done about the anchoring effect on the non-monetary value people place on solutions to environmental issues. This research could be used by environmental organizations to increase their donations, and to attract people's attention to the significance of the problem by using the anchoring effect in the most effective way. This report is an attempt to extend the current research field and open a new research field by comparing the anchoring effects on different ways to measure people's involvement in environmental issues.

I Introduction

Imagine yourself in a shop, seeing these two price cards.

Which one would you choose? Chose the left one? Surprisingly, most people do. This is indeed a common trick in which consumers are primed by a higher price first so that they perceive the target price more reasonable than it really is.

A simple experiment that illustrates the anchoring bias that you could do at home is as follows. Get 3 bowls. Fill one with cold water, one with hot water and one with lukewarm water. Now stick one hand in the cold water bowl and the other in the hot water bowl. Keep them there for 30 seconds and put both of your hands in the lukewarm water. One hand will feel the water is warm, the other one that it's cold (Laya, 2013). This shows contrast plays a crucial role and explains partially why people would choose the left price card over the right one. This effect is also explained by Kahneman and Tversky who introduced the anchoring-and-adjustment heuristic. They found that there is a relationship between subject's estimates and the random starting points they received (Tversky & Kahneman, 1974). This relationship suggest that subjects anchor on the random starting point and base their final answer upon the starting point. This bias is called 'anchoring and adjustment' and is often used by marketers in the private sector to increase consumers' willingness to pay (WTP) and the value people place on products. It can also occur when people are unsure of the true value they place on goods (Kahneman & Sugden, 2005). The bias is often used in the private sector by marketers, for example by using the left price tag in the experiment above. However, the bias is not only being exploited in the private sector but it also holds in the public sector. One specific application is environmental issues.

Over the past couple of years, pollution has been increasing. This is caused by multiple factors such as car traffic, the industry as well as natural sources. The pollution increased the risk of underweight new-borns and the risk of asthma. It is estimated that urban outdoor air

pollution causes 1.3 million deaths worldwide per year (World Health Organisation, 2013). Rotterdam as a city is also coping with increasing air pollution. From the 20 streets that have most air pollution in the Netherlands, eight of them are in Rotterdam (RtvRijnmond, 2013). . Although Rotterdam is decreasing the air pollution by reducing the maximum speed on the highway around the city, it is not enough (Klompenhouwer, 2014). Now say a hypothetical new environmental organisation is starting an initiative. This will consist of multiple actions, for example more electric car charging places to stimulate electrical driving but also protesting and forcing Rotterdam to make new rules about the maximum of carbon dioxide emission. To research in what way this new organisation can best use the anchoring bias to increase donations and value placed on a solution the research question is as follows.

"In what way can the anchoring and adjustment effect be used to increase the willingness to pay and or value placed on a solution for the pollution in Rotterdam?"

This paper mainly uses the anchoring and adjustment bias. This report will focus on people's willingness to pay as well as their non-monetary subjective valuation for a solution to the pollution problem and how this can be affected by the anchoring and adjustment bias. The metric used for evaluating people's Willingness to pay is the amount of money they are willing to spend, and subjective assessments will be measured on a scale from on 1 to 9 in terms of the significance of the environmental problem. Then, it will focus on which of the two will be more affected by the anchoring and adjustment bias. Although much research is done about the effect of the anchoring bias on consumers' WTP, only little research is done about the effect on people's WTP of environmental issues. Even less research is done about the anchoring effect on the non-monetary value people place on solutions to environmental issues. This research could be used by environmental organizations to increase their donations, and to attract people's attention to the significance of the problem by using the anchoring effect in the most effective way.

This report is an attempt to extend the current research field and open a new research field by comparing the anchoring effects in different ways to measure people's involvement in environmental issues.

In the following part of this report the theoretical framework of this research will be elaborated. There will be a further elaboration of the anchoring and adjustment bias and the

hypotheses will be explained. In section II theoretical background of the anchoring bias is provided. First, the bias is explained and different measurements are mentioned. The relevant moderating factors and ways of influencing participants through anchors and through participants are explained. Finally the anchoring effect in Willingness to pay (Money) for public goods and the anchoring effect in judgement is elaborated. Section III will explain the possible research design which could be implemented in the future and consist of the survey design and data analysis. Section IV will consist of the research expectations and the conclusion is mentioned in section V followed by the appendix in section VI.

II. Theoretical framework

1. The anchoring effect

1.1 Definition

"The use of irrelevant information as a reference for evaluating or estimating some unknown value or information. When anchoring, people base decisions or estimates on events or values known to them, even though these facts may have no bearing on the actual event or value."

(Investopedia, 2011)

In 1974, Kahneman and Tversky introduced the anchoring-and-adjustment heuristic. They found that there is a relationship between subject's estimates and the random starting points they received (Tversky & Kahneman, 1974). In an experiment, participants were asked to spin a wheel which had numbers on it from 0 to 100, but was modified so it could only end on 10 or 65. Participants were asked to answer the question if the percentage of African countries in the United Nations was higher or lower than the number they had just spinned. Finally they were asked to give their estimation *of the percentage of African Countries in the United Nations.* Participants that had to estimate if the percentage was lower than 10 estimated the percentage on average on 25, while participants who spinned the wheel and spinned 65 estimated on average the percentage of African countries in the United Nations as 65 percent. This relationship suggests that subjects anchor on the random starting point and base their final answer upon the starting point. This bias is called anchoring and adjustment.

1.2 Explaining the bias

Kahneman (2011) states that our thinking system can be divided in two systems; system 1 and system 2. System 1 is automatic, unconscious and quick. This type of thinking involves simple mental rules called heuristics and resulting cognitive biases. The question '2+2=?' or driving a car on an empty road is done automatically by system 1. It is constantly monitoring the environment and processing information retrieved from our senses. System 2 thinking, on the other hand, is rational thinking. It is done deliberately and consciously. Focusing and concentrating are for example done by this system. System 2 works on information that System 1 automatically and unconsciously retrieves from the memory. This is why system 2 has no knowledge of the anchoring bias (Kahneman, 2011)

1.3 Measurement

1.3.1 The standard anchoring experiment

To research whether an anchoring effect occurs in a specific situation, researchers use a standard anchoring experiment. First, participants are exposed to give a comparative judgement by a dichotomous question with options higher or lower. This means participants need to indicate if something is higher or lower than the given number. This given number is the anchor in this experiment. After this, participants will be asked for an absolute judgement by an open ended question. They will be asked for an estimation. This is seen in the experiment above from Kahneman and Tversky. In this research, the dichotomous question was whether *the percentage of African Countries in the United Nations* was higher or lower than the spinned number, where the spinned number is the anchor. The open-ended question was what t*he percentage of African Countries in the United Nations was,* and participants were asked for an estimation/absolute judgement

Although there are many variations to this standard experiment, common anchoring research is rather standard. Participants are usually divided into two groups. The first group is a calibration group, it only answers the open-ended question without being exposed to an anchor. The second group will do the standard anchoring experiment. The results of both groups will be compared. If the answers of the open-ended question of group 2 match the calibration group, no anchoring effect has occurred. The most common variation of this

standard experiment is adding more experimental conditions by introducing different anchors, high and low anchors.

1.3.2 The anchoring index

Kahneman (2011) introduces a way to measure the anchoring effect. A standard anchoring experiment first asks participants if they believe something is higher or lower than the anchor After that, participants give an estimation to the question. First a group is divided in two and two anchors are set: a "high anchor" and a "low anchor". One group is exposed to the "high anchor" and the other to the "low anchor". After this, respondents are asked to give their estimate of the answer. Now the anchoring effect is measured as follows:

$$x = \frac{EstHa - EstLa}{Ha - La}$$

Where 0 is 0 % and 1 is 100 %

EstHa = Average estimation of group exposed to High anchor

EstLa = Average estimation of group exposed to Low anchor

Ha = High anchor

La= Low anchor

The anchoring index indicates, how much a valuation will increase if the anchor is increased by a unit. For example, participants in an experiment were asked what their willingness-to-pay an annual contribution to save 50,000 offshore Pacific Coast seabirds from small off shore oil spills was until ways are found to prevent spills or require owners of tankers to pay for the operation. Some of the participants were exposed to an anchor by the question if they were willing to pay more or less than a specific amount. Without an anchor, participants were willing to pay $64 on average. When the anchoring amount was $5, participants were willing to pay $20. But when the anchoring amount was $400, they were willing to pay on average $143. When we fill in the formula mentioned above, the anchoring index is approximately 30%. This means that when we increase the anchor with $100, the average willingness-to-pay will increase with $30. Therefore, outcome would be 100% for people who adopt the anchor as an estimate, and zero for people who can ignore the anchor completely (Kahneman D. , Thinking Fast and Slow, 2011).

2. Moderating factors

There are different factors that can affect the strength of the anchoring effect. These factors can be divided into two groups. The first group of factors are all affecting the anchoring effect by influencing the anchor. The second group of factors are influencing the anchoring effect by influencing the subjects/participants.

2.1 Influencing through the anchor

2.1.1 Informative vs Uninformative

Although multiple researchers argue that the bias only occurs when there is a relevant starting point, some findings show that the anchoring effect also occurs with an anchor that contains irrelevant or random information. In previously shown research, Kahneman and Tversky show that when the anchor is purely random, the anchoring effect still holds. This idea is also supported by multiple researches (Englich, Mussweiler, & Strack, 2006; Critcher & Gilovich, 2008).

For example, Englich et al. (2006) wanted to examine whether an irrelevant anchor influences the sentencing decisions of legal professionals. He took multiple legal experts such as junior lawyers, and he had them read an alleged rape case. After reading this, participants were asked to throw a pair of dice and indicate if the sentencing demand should be higher or lower than the number indicated on the dice. After this, participants were asked what the sentence would be for the case. They found that the sentencing decisions were influenced by the uninformative anchors (Englich, Mussweiler, & Strack, 2006).

2.2.2 Low vs High and Plausible vs Implausible Anchors

Strack (1997) asked 28 participants to fill in a questionnaire and used the standard anchoring experiment. The questions were about the width and height of the Brandenburg Gate and the length and height of the Cathedral of Cologne were randomly given. To set anchors, a calibration group was asked to give estimates about all the questions. The low anchors were set at the 15th percentile of the calibration group estimates, the high anchors were set at the 85th percentile. He found that high anchors led to higher estimates than did a low anchor value (Strack, 1997).

Wegener (2001) wondered if this effect would diminish if the anchor would become extreme or implausible. An *implausible anchor* is an anchor that is illogical, and in no way

exists. For example, an implausible anchor is 25,000 miles in the question whether the Mississippi River is longer or shorter than 25,000 miles. It is expected that every person knows that there is no river that long, therefore it is illogical and non-existent. 296 participants were asked to make eight estimates, after indicating whether the true answer was higher or lower than an anchor. The estimates were for example about the hottest temperature for a day in Seattle and the age of George Washington when he died. The anchors were random and either relatively high or low, or either moderate or extreme. The participants were divided in two groups. The only difference between the groups was that the extreme anchors from the first group were replaced with even more extreme anchors for the second group. For example, the first group got an anchor of 285°F (≈140.5 ºC) with the question about the hottest temperature for a day in Seattle, which was unrealistic. The second group got an anchor of 8905°F (≈5000 ºC) which was clearly impossible. Firstly he found that high anchors led to higher estimates than low anchors. But he also found that the anchoring effect was smaller when extreme anchors were used than when moderate anchors were used. The implausible anchors have less influence on judgements than more moderate anchors. This result was found in both groups (Wegener, 2001)

To decide whether Gandhi was older or younger than 140 years, a person needs to have more information and knowledge about him than to decide whether he was older or younger than 61 years. Implausible anchors are primarily based on knowledge about a general subject or category rather than a specific example. To decide whether Gandhi was older or younger than 140 years, a person may only use knowledge about humans in general instead of Gandhi specifically. (Mussweiler T. S., 2001). To investigate whether extreme anchors resulted in a larger anchoring effect than plausible anchors, Mussweiler conducted a similar research as Wegener in 2001. Low plausible anchors were set 1 standard deviation below the mean estimate of the calibration group, plausible high anchors were set about 1 standard deviation above this mean. Low implausible anchors were about 56 standard deviations below the mean estimate of the calibration group, the high implausible anchors were set at about 72 standard deviations above this mean. He found that the difference in anchoring effect between high and low anchors were only significant for the plausible anchors. Therefore he concludes that the anchoring effect is influenced by whether the anchor is high or low within a plausible range, but not for implausible anchors (Mussweiler T. S., 2001).

2.2 Influencing through participants

Besides the kind of anchor used in the researches, there are also human factors that contribute to the anchoring effect. For example, Wilson researched whether the knowledge of people affected their susceptibility to the anchoring effect. He let participants draw a random number and asked them to compare this number to a target question. He used for example the number of countries in the United Nations. After that, people had to rate how knowledgeable they were about the countries in the United States and how confident they were about the given answer on a scale of 1 to 9. Knowledge was therefore self-rated. Whether knowledge had an effect on the anchoring effect was measured by seeing if the level of knowledge of participants would moderate the anchoring effect. Wilson found that people that are knowledgeable are less likely to be influenced by being exposed to an anchor because they obtain the answer directly from long-term memory. (Wilson, 1996).

Mussweiler (2000) assumes that people test whether the anchor value might be equal to the target's value. For example, people were asked to estimate whether the average price for a German car was lower or higher than 40.000 German Marks. People are now triggered to selectively retrieve knowledge from their memory to test whether this is true. But Mussweiler was triggered to test the opposite. He took 60 male car experts with more than 5 years of experience. They were asked to judge how much a 10-year old car was worth. First they were given the major facts about the car. Half of the group was asked if the car was worth more or less than 2.800, the other half was exposed to an anchor of 5.000 marks. By doing this research, Mussweiler found that the car experts valued the car on the presented anchors (Mussweiler T. S., 2000).

Based on previous research, Englich and Solder conclude that a non-experts mood can influence the magnitude of anchoring. They assumed that sad non-experts would adjust their estimates to an anchor more than happy non-experts. To test this they did a standard anchoring test with first a comparative question and then an absolute judgement question. The mood of participants was measured as follows. Participants were asked to describe an incident from their life and to remember how they felt during this incident. Half of the group was asked to describe a happy incident, the other half a sad one. After this description, participants were asked to indicate how they felt on a scale from 1 to 9 (1 is a bad mood, 9 is a good mood). English and Soder found that people who were in a sad mood thought more

thoroughly about the comparative question than people who were in a happy mood. Therefore people in a happy mood are more susceptible to anchors (Englich & Soder, 2009). The anchoring effect even gets stronger the higher the ambiguity, the lower the familiarity, relevance or personal involvement with the problem or with a more trustworthy source or plausible bid (Van Van Exel, 2006).

3. Anchoring effect in Willingness to pay (Money) for public goods

3.1 Public goods

Green, Jacowitz, Kahneman and McFadden (1998) did an experiment to find if the anchoring effect had an effect on the willingness-to-pay of people specifically for public goods. They asked 370 volunteers to participate in an experiment. A calibration group of 121 people was asked in an open-ended format for WTP for two public goods and for estimates of three objective quantities. The two public goods were the willingness-to-pay per year for California highway improvements and enforcement of traffic laws that in five years will reduce the number of traffic accidents by 20% and the willingness-to-pay per year to save 50,000 offshore Pacific Coast seabirds from small offshore oil spills, until ways are found to prevent spills or require owners of tankers to pay for the operation. For these two willingness-to-pay questions, participants were first asked if they would vote in favour if there was a referendum and whether they would pay the anchor amount of money per year if the referendum was approved and implemented. The anchor values were set at 25, 50, 75, 90 and 95 percentiles of the calibration group distribution. After this, they were asked to state the maximum amount were they would still vote in favour of the cause. For this estimation question, participants were first asked to indicate whether the maximum amount was higher or lower than the anchor value (Green, Jacowitz, Kahneman, & McFadden, 1998). They found that the willingness-to-pay of participants was systematically higher when participants were asked dichotomous questions in comparison with open-ended questions and that the anchoring effect had an influence on the willingness-to-pay of people. To measure this effect they also used the anchoring index introduced by Kahneman, which was mentioned above. They found that for the first question, the anchoring index was 27,3%. This means that an increase of the anchor with $100 would increase the willingness to pay with 27,3$. For the second

willingness-to pay question the anchoring index was 49% (Green, Jacowitz, Kahneman, & McFadden, 1998).

3.2 Environmental issues

As seen in the research of Green, Jacowitz, Kahneman and McFadden, the anchoring effect can also specifically be used to increase the willingness to pay for environmental issues/public goods. The anchoring index of the willingness-to-pay per year to save 50,000 offshore Pacific Coast seabirds from small off shore oil spills, until ways are found to prevent spills or require owners of tankers to pay for the operation was 49% (Green, Jacowitz, Kahneman, & McFadden, 1998). This is also seen in the research of Kahneman. He did a standard anchoring experiment where participants were asked to find a suitable donation for the damage caused by oil tankers in the Pacific Ocean. When no anchor was mentioned, participants were willing to donate $64 on average. When an anchor of $5 was mentioned, the average donation was $20 and with an anchor of $400 it was $143 (Kahneman D. , Thinking Fast and Slow, 2011).

This effect was also shown in the research where French residents of the heavily polluted Marseilles region were asked what would be an acceptable increase of their living costs if the pollution would decrease. The willingness to pay for these French residents was higher when exposed to an anchor (Kahneman D. , Thinking Fast and Slow, 2011). The first hypothesis can be derived from these findings.

Hypothesis 1   The anchoring and adjustment bias can be used to increase the willingness to pay for environmental issues.

1.   Measuring the willingness to pay

Multiple questions and methods are used to measure the willingness to pay of people.

1)   To measure the willingness to pay of people for environmental issues open-ended questions are used. For example, Kahneman (2011) used the question "What do you believe is a suitable donation for the damage caused by oil tankers in the pacific ocean?". In the research of Green, Jacowitz, Kahneman and McFadden (1998) where the willingness-to-pay per year to save 50,000 offshore Pacific Coast seabirds from small offshore oil spills was measured, people were first asked if they would vote in favour if there was a referendum. To

measure the willingness to pay they asked to state the maximum amount were they would still vote in favour of the cause (Green, Jacowitz, Kahneman, & McFadden, 1998).

2) In the research of Hanley et al. a valuation ladder is used to find the willingness to pay of people to maintain the coastal water quality in one area of Scotland. :

"Starting with the smallest value, each respondent considers each value in turn, ticking amounts they would definitely pay, crossing off amounts they would definitely not pay, and leaving blank those values for which they cannot say either ''definitely yes'' or ''definitely no.'' The Willingness-to-pay is between the highest ticked value and the lowest crossed value. Hanley concludes that the uncertainty gap for a person might be caused by an anchoring effect (Hanley, Kriström, & Shogren).

4. Anchoring in non-monetary valuation

T. Thorsteinson et al. (2007) researched whether anchors that are clearly irrelevant to performance would affect performance judgement. 112 students participated in an experiment. Participants rated an employee on four performance dimensions and overall performance on a scale from 1 to 9. Participants were presented with different scenarios and performance information. After the information, participants were exposed to an anchor by asking whether the employee would be rated a score of 9, or a score of 1. If participants would say no, they were asked which number they would give to the employee. Participants who were exposed to a lower anchor, rated the performance on average lower than the participants in higher conditions. The researchers conclude that participants may be effected by irrelevant information when making performance judgements (Thorsteinson, Breier, Atwell, Hamilton, & Privette, 2007).

This shows that the anchoring effect is also applicable to situations where participants are asked to judge something and rate it on scale instead of how much they are willing to pay. Although there is some research about anchoring in judgement on a rating scale, there is little research about anchoring effect in valuation. Therefore the second hypothesis is

hypothesis 2: The anchoring and adjustment bias can be used to increase the non-monetary value people place on a solution for environmental issues.

To further answer the research question, the following hypothesis is stated.

hypothesis **3**: The anchoring and adjustment bias has the same effect on the willingness to pay as the non-monetary value people place on a solution for environmental issues.

III. Research design

This research is designed to test the above-mentioned hypotheses. This will be done by analysing the results of multiple surveys. In all surveys, participants are asked to answer questions about the following information.

Over the past couple of years, pollution has been increasing. This is caused by multiple factors such as car traffic, the industry as well as natural sources. The pollution increased the risk of underweight new-borns and the risk of asthma. It is estimated that urban outdoor air pollution causes 1.3 million deaths worldwide per year (World Health Organisation, 2013). Rotterdam as a city is also coping with increasing air pollution. From the 20 streets that have most air pollution in the Netherlands, eight of them are in Rotterdam (RtvRijnmond, 2013). Although Rotterdam is decreasing the air pollution by reducing the maximum speed on the highway around the city, it is not enough (Klompenhouwer, 2014). Now say a hypothetical new environmental organisation is starting an initiative. This will consist of multiple actions, for example more electric car charging places to stimulate electrical driving but also protesting and forcing Rotterdam to make new rules about the maximum of carbon dioxide emission.

This research will consist of two studies, study A and study B, to answer hypotheses 1 and 2, respectively. Thus, surveys in study A are intended to investigate the influence of the anchoring effect on willingness to pay whereas surveys in study B are intended to investigate the influence of the anchoring effect on subjective non-monetary valuation of people. Hypothesis 3 will be answered by comparing these two studies. Both studies will have the same background information, only the questions are different. To collect data for hypothesis 1, study A will be done. Study A will consist of survey 1 and survey 3. A calibration group will fill in survey 1 without an anchor to get a starting point and to set anchors for the survey 3.
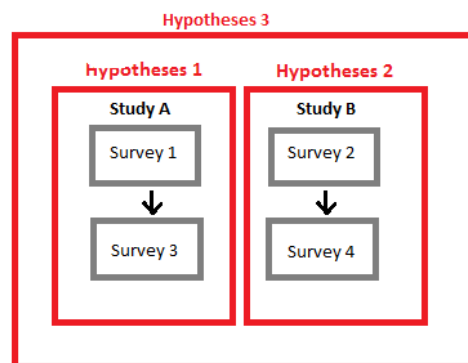
Similarly, to collect data for hypothesis 2, a calibration group will fill in survey 2 first, without any anchor. Then the results from this survey will be used to set anchors for Survey 4 which will be the main survey for Hypothesis 2.

1. Survey designs

	Calibration	General information and questions	Open-ended question	Dichotomous question	Willingness to pay	Rating
Survey 1	x	X	x		x	
Survey 2	x	X	x			X
Survey 3		X	x	x	x	
Survey 4		X	x	x		X

1.1 Survey 1

Survey 1 is part of Study A and is used as a calibration for survey 3. The survey consists of general questions about age and gender and general information about the pollution in Rotterdam. To measure the willingness to pay the survey consist of the open ended question "How much would you be willing to pay for a solution to this problem?" The outcome of this open ended question will be used to set anchors for survey 3.

1.1.1 Participants
The calibration group for study A will consist of 25 residents of Rotterdam

1.1.2 Method
Participants are asked to fill the survey in online. The data is collected through Qualtrics. Participants are approached through social media, email and personally. Participants are first asked to fill out the general questions and then to read to information about pollution in Rotterdam. After reading the information carefully, participants are asked to indicate how much they agree with the statement "I feel personally involved with the issue". After that they are asked to answer the question "How much would you be willing to pay for a solution to this problem?" This question asks for an answer in monetary terms from 0 to infinity.

1.2 Survey 2

Survey 2 is part of Study B and is used as a calibration for survey 4. The survey consists of general questions about age and gender and general information about the pollution. To measure the non-monetary value people place on a solution to the pollution in Rotterdam the survey consists of the open ended question "How much do you value a solution for this problem?" The outcome of this open ended question will be used to set anchors for survey 3.

1.2.1 Participants

The calibration group for study A will consist of 25 Rotterdam residents.

1.2.2 Method

Participants are asked to fill the survey in online with Qualtrics. The data is collected through Qualtrics. Participants are approached through social media, email and personally. Survey 2 follows the same procedure as survey 1, only the open-ended question is different. Participants are asked to answer the following question on a scale from 1 to 9: "How much do you value a solution for this problem?" The 1 on the scale of 1 to 9 refers to an extreme negative rating meaning not valuing a solution for the problem at al. The 9 on the scale of 1 to 9 refers to an extremely positive rating meaning the participant extremely values a solution to the problem.

1.3 Survey 3

This survey is part of Study A. The data of survey 1 will be used to set the anchors for this survey. The survey consists of general questions about age, gender, and general information about the pollution in Rotterdam and it contains a dichotomous question and an open ended question. The dichotomous question will contain an anchor, which will have 2 values as there will be 2 different anchors, a high and a low anchor. The anchors are set at 25th and 75th percentiles of the calibration distribution of survey 1.

1.3.1 Participants

The participants will consist of 100 (n=100) Rotterdam residents. Because there will be 2 anchors, participants are divided in 2 groups and asked to fill out survey 3.

1.3.2 Method

The survey is filled in online with Qualtrics and participants will be approached as in survey 1 and 2 through email, social media and personally. Participants are first asked to fill in the

general questions and read the general information. After reading the general information carefully, participants are asked to give a comparative judgement by telling if they are willing to pay more or less than the anchor exposed. Participants will be exposed to the anchor by the following statement "A suitable donation for this cause is x". The x will be filled out by anchor values and are set at 25th and 75th percentiles of the calibration distribution of survey 1. After this, the willingness to pay of participants will be measured by an absolute judgement. This will be done by asking the question "How much would you be willing to pay for a solution to this problem?". Participants will answer this question on a monetary scale with no limit. This is done to not limit the anchoring effect.

1.4 Survey 4

This survey is part of Study B. The data of survey 2 will be used to set the anchors for this survey. The survey consists of the same general questions and information as survey 3. The dichotomous question and open-ended question are different. The dichotomous question will contain the anchor in this survey and will have 2 values as there will be 2 different anchors, a high and a low anchor. The anchors are set at 25th and 75th percentiles of the calibration distribution of survey 1.

1.4.1 Participants

The participants will consist of 100 (n=100) Rotterdam residents. Because there will be 2 anchors, participants are divided in 2 groups and asked to fill out survey 4.

1.4.2 Method

The survey is filled in online with Qualtrics and participants will be approached as in survey 1 and 2 through email, social media and personally. Participants are first asked to fill in the general questions and read the general information. After reading the general information carefully, participants are asked to give a comparative judgement by telling if they are willing to pay more or less than the anchor exposed. Participants will be exposed to the anchor by the following statement "I value a solution to this problem at x". The x will be filled out by anchor values and are set at 25th and 75th percentiles of the calibration distribution of survey 2. After this, participants will be asked for an absolute judgement by the question "How much do you value a solution for this problem?". Participants are asked to answer this question on a scale from 1 to 9. The 1 on the scale of 1 to 9 refers to an extreme negative

rating meaning not valuing a solution for the problem at al. The 9 on the scale of 1 to 9 refers to an extremely positive rating meaning the participant extremely value a solution to the problem.

See the appendix for the complete survey

2. Analysing data

2.1 Hypothesis 1

The anchoring and adjustment bias can be used to increase the willingness to pay for environmental issues.

For this hypothesis the collected data from study A (survey 1 and 3) will be used. The collected data will be analysed using the anchoring index created by Kahneman (Kahneman D. , 2011).

$$Anchoring\ index = \frac{EstHa - EstLa}{Ha - La}$$

The *EstHa* will be filled in with the average willingness to pay of the group exposed to the high anchor and the *EstLa* will be filled in with the willingness to pay of the group exposed to the low anchor. The *Ha* and *La* will be the x used in the survey and set at 25 and 75 percentiles of the calibration group 1 distribution. We can calculate the Anchoring index for all respondents to the survey. Under the assumption that an anchoring index larger than zero implies that a person's judgement is affected by the presented anchor, we can model this according to a binomial distribution, where a 'success' is a person being influenced by the anchor. Our hypothesis can then be reduced to testing whether p is significantly larger than 0.5 in the binomial distribution, where n is our number of trials.

2.2 Hypotheses 2

The anchoring and adjustment bias can be used to increase the non-monetary value people place on environmental issues.

For this hypotheses, the collected data from study B (survey 2 and 4) will be used. The collected data will be analysed using the anchoring index created by Kahneman (Kahneman D. , 2011).

$$Anchoring\ index = \frac{EstHa - EstLa}{Ha - La}$$

The *EstHa* will be filled in with the average value participants place on a solution of group exposed to High anchor and the *EstLa* will be filled in with the value participants place on a solution of the group exposed to Low anchor. The *Ha* and *La* will be the x used in the survey and set at 25 and 75 percentiles of the calibration group 1 distribution.

We can use the same method as in testing hypothesis 1 to validate hypothesis 2.

2.3 Hypotheses 3

The anchoring and adjustment bias has the same effect on the willingness to pay as the non-monetary value people place on a solution for environmental issues.

This will be measured by comparing the outcome of study A and B. The data has both been transformed to percentage by the anchoring index and can now be compared. The anchoring index does this by setting the 1 of the valuating scale equal to the lowest willingness to pay, and the 9 in the valuating scale to the highest willingness to pay.

Again, we can use the binomial distribution to assess our hypothesis. In this case, we have paired data and our hypothesis can be reduced to testing whether $p_1 = p_2$, where p_1 is the probability that a person's willingness to pay is influenced by the anchor, and p_2 is the probability that a person's non-monetary value is influenced by the anchor.

IV. Discussion

1. Expectations

1.1 Hypotheses 1

The anchoring and adjustment bias can be used to increase the willingness to pay for environmental issues.

In research of Kahneman (2011) participants in an experiment were asked what their willingness-to-pay an annual contribution to save 50,000 offshore Pacific Coast seabirds from small off shore oil spills was until ways are found to prevent spills or require owners of tankers to pay for the operation. Some of the participants were exposed to an anchor by the question if they were willing to pay more or less than a specific amount. Without an anchor, participants were willing to pay $64 on average. When the anchoring amount was $5, participants were willing to pay $20. But when the anchoring amount was $400, they were willing to pay on average $143. When this data is used in the anchoring index, the anchoring index is approximately 30%. This means that when we increase the anchor with $100, the average willingness-to-pay will increase with $30 (Kahneman D. , Thinking Fast and Slow, 2011).This research is similar to Study A, therefor the expectations are that the data from study A will lead to a positive anchoring index and the hypotheses will be accepted.

1.2 Hypotheses 2

The anchoring and adjustment bias can be used to increase the non-monetary value people place on a solution for environmental issues.

Research of T. Thorsteinson et al. (2007) showed that anchors that are clearly irrelevant to performance would affect performance judgement. Students rated an employee on four performance dimensions and overall performance on a scale from 1 to 9. Participants were presented with different scenarios and performance information. After the information, participants were exposed to an anchor by asking whether the employee would be rated a score of 9, or a score of 1. If participants would say no, they were asked which number they would give to the employee. Participants who were exposed to a lower anchor, rated the performance on average lower than the participants in higher conditions. The researchers conclude that participants may be affected by irrelevant information when making performance judgements (Thorsteinson, Breier, Atwell, Hamilton, & Privette, 2007).

This shows that the anchoring effect is also applicable to situations where participants are asked to judge something and rate it on scale instead of how much they are willing to pay. Therefor the expectations are that this hypothesis will be accepted.

1.3 Hypotheses 3

The anchoring and adjustment bias has the same effect on the willingness to pay as the non-monetary value people place on a solution for environmental issues.

In hypotheses 1, it is expected that the anchoring and adjustment bias has a significant effect on the willingness to pay for a solution to the pollution in Rotterdam. In hypotheses 2, it is expected that the anchoring and adjustment bias has a significant effect on the non-monetary value people place on a solution for the pollution in Rotterdam. So in both hypotheses, it is expected that the anchoring and adjustment bias has a significant effect. There is no research that could argue that there would be a difference between those effects. Therefore, we expect that the hypotheses will be accepted.

1.4 Research question

"In what way can the anchoring and adjustment effect be used to increase the willingness to pay and or value placed on a solution for the pollution in Rotterdam?"

If all hypotheses would be accepted, the anchoring and adjustment bias could be used to increase donations and non-monetary value people place on a solution for environmental issues. When hypotheses 3 is accepted, which means that there is no difference in the effect between hypotheses 1 and 2, there is no clear better way to use the anchoring and adjustment bias. However, when hypotheses 3 would be rejected, it would be clear through which way the anchoring and adjustment bias could best be used.

2. Possible limitations

Because of limited time doing this research, it is expected that only a limited sample of the population can be included in the research. Therefore, the research might not be representable for the entire population.

3. Further research options

It would be interesting to investigate if an anchoring effect would still occur when the dichotomous question would be asked for the willingness to pay and with an anchor in monetary terms, and the open ended question would be about the value placed on the solution in ratings. So for example in this research the dichotomous questions would be: "A suitable donation for this cause is x" with options higher or lower followed with the open-ended question ""On a scale of 1 to 9, how much do you value a solution for this problem?". This could also be the other way around setting an anchor in value placed on a solution and asking an open ended question in monetary terms. Exel (2006) showed that the anchoring effect gets stronger the higher the ambiguity, the lower the personal involvement with the problem (Van Van Exel, 2006). It could be interesting to research whether this still holds for environmental issues. Although the questions to measure this are asked in the survey, to focus on the main research question this is ot further elaborated. The data from this research could be used to investigate this.

V. Conclusion

Kahneman and Tversky (1974) introduced the anchoring-and-adjustment heuristic. They found that there is a relationship between subject's estimates and the random starting points they received (Tversky & Kahneman, 1974). This relationship suggests that subjects anchor on the random starting point and base their final answer upon the starting point. This bias is called 'anchoring and adjustment' is not only being exploited in the private sector but it also holds in the public sector. One specific application is environmental issues.   Over   the past couple of years, pollution has been increasing. This is caused by multiple factors such as car traffic, the industry as well as natural sources. The pollution increased the risk of underweight new-borns and the risk of asthma. It is estimated that urban outdoor air pollution causes 1.3 million deaths worldwide per year (World Health Organisation, 2013). Rotterdam as a city is also coping with increasing air pollution. From the 20 streets that have most air pollution in the Netherlands, eight of them are in Rotterdam (RtvRijnmond, 2013). . Although Rotterdam is decreasing the air pollution by reducing the maximum speed on the highway around the city, it is not enough (Klompenhouwer, 2014). Now say a hypothetical new environmental organisation is starting an initiative. This will consist of multiple actions,

for example more electric car charging places to stimulate electrical driving but also protesting and forcing Rotterdam to make new rules about the maximum of carbon dioxide emission. To research in what way this new organisation can best use the anchoring bias to increase donations and value placed on a solution the research question is as follows.

"In what way can the anchoring and adjustment effect be used to increase the willingness to pay and or value placed on a solution for the pollution in Rotterdam?"

Three hypotheses will help answer this research question. The first was to investigate whether the anchoring effect would increase the willingness to pay for environmental issues. The second hypotheses was to investigate the relationship between anchoring and adjustment bias and the non-monetary value people place on a solution for environmental issues. Finally the last hypotheses was to investigate whether the anchoring effect would have a bigger effect on the willingness to pay or the non-monetary value people place on a solution for environmental issues.

Finally, a research design was created to investigate the research question by means of the three hypotheses. Surveys 1 and 3 in study A are intended to investigate anchoring effect on willingness to pay whereas surveys 2 and 4 in study B are intended to investigate anchoring effect on subjective non-monetary valuation of people. Hypotheses 3 will be answered by comparing these two studies. The collected data will from Study A and B will be analysed using the anchoring index created by Kahneman (Kahneman D. , 2011) to answer hypotheses 1 and 2. These both anchoring indexes will be compared to answer hypotheses 3.

VI. APPENDIX

Survey 1

What is your gender?

Male

Female

What is your age?

Please read the followig text and answer the questions

Over the past couple of years, pollution has been increasing. This is caused by multiple factors such as car traffic, the industry as well as natural sources. The pollution increased the risk of underweight new-borns and the risk of asthma. It is estimated that urban outdoor air pollution causes 1.3 million deaths worldwide per year (World Health Organisation, 2013). Rotterdam as a city is also coping with increasing air pollution. From the 20 streets that have most air pollution in the Netherlands, eight of them are in Rotterdam (RtvRijnmond, 2013). Although Rotterdam is a city is decreasing the air pollution by reducing the maximum speed on the highway around the city, it is not enough (Klompenhouwer, 2014). Now say a hypothetical new environmental organisation is starting a initiative. This will consist of multiple actions, for example more electric car charging places to stimulate electrical driving but also protesting and forcing Rotterdam to make new rules about the maximum of carbon dioxide emission.

How much do you agree with the following statement?
"I feel personally involved with this issue"

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

How much would you be willing to pay for a solution to this problem?

€

https://az1.qualtrics.com/jfe3/preview/SV_6gHD0bnEFrSSKW1

Survey 2

What is your gender?

Male

Female

|◄   III   ►|

What is your age?

Please read the followig text and answer the questions

Over the past couple of years, pollution has been increasing. This is caused by multiple factors such as car traffic, the industry but alsoas well as natural sources[IA1] . The pollution increased the risk of underweight newborns and the risk of asthma. Rotterdam as a city is also coping with increasing air pollution. Although Rotterdam is a city is doing something, it is not enough. To decrease the pollution, a new hypothetical environment organization is starting a initiative. This will consist of multiple actions, for example more electric car charging places to stimulate electrical driving but also protesting and forcing Rotterdam to make new rules about the maximum of carbon dioxide emission (Klompenhouwer, 2014).

How much do you agree with the following statement?
"I feel personally involved with this issue"

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

|◄   III   ►|

On a scale of 1 (not at all) to 9 (a lot) how much do you value a solution for this problem?

https://az1.qualtrics.com/jfe3/preview/SV_eULL5zlnzkELci1

Survey 3

What is your gender?

Male

Female

◄   III   ►

What is your age?

[   ]

Please read the followig text and answer the questions
Over the past couple of years, pollution has been increasing. This is caused by multiple factors such as car traffic, the industry as well as natural sources. The pollution increased the risk of underweight new-borns and the risk of asthma. It is estimated that urban outdoor air pollution causes 1.3 million deaths worldwide per year (World Health Organisation, 2013). Rotterdam as a city is also coping with increasing air pollution. From the 20 streets that have most air pollution in the Netherlands, eight of them are in Rotterdam (RtvRijnmond, 2013). Although Rotterdam is a city is decreasing the air pollution by reducing the maximum speed on the highway around the city,, it is not enough (Klompenhouwer, 2014). Now say a hypothetical new environmental organisation is starting a initiative. This will consist of multiple actions, for example more electric car charging places to stimulate electrical driving but also protesting and forcing Rotterdam to make new rules about the maximum of carbon dioxide emission.

How much do you agree with the following statement?
"I feel personally involved with this issue"

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

◄   III   ►

A suitable donation for this cause is x

Higher

Lower

◄   III   ►

How much would you be willing to pay for a solution to this problem?

[   ]

https://az1.qualtrics.com/jfe3/preview/SV_eP5rDRooXKPJUMd

Survey 4

What is your gender?

Male

Female

What is your age?

[   ]

Please read the follicwig text and answer the questions

Over the past couple of years, pollution has been increasing. This is caused by multiple factors such as car traffic, the industry as well as natural sources. The pollution increased the risk of underweight new-borns and the risk of asthma. It is estimated that urban outdoor air pollution causes 1.3 million deaths worldwide per year (World Health Organisation, 2013). Rotterdam as a city is also coping with increasing air pollution. From the 20 streets that have most air pollution in the Netherlands, eight of them are in Rotterdam (RtvRijnmond, 2013). Although Rotterdam is a city is decreasing the air pollution by reducing the maximum speed on the highway around the city,. it is not enough (Klompenhouwer, 2014). Now say a hypothetical new environmental organisation is starting a initiative. This will consist of multiple actions, for example more electric car charging places to stimulate electrical driving but also protesting and forcing Rotterdam to make new rules about the maximum of carbon dioxide emission.

How much do you agree with the following statement?
"I feel personally involved with this issue"

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

Please answer the following questions on a scale of 1 to 9 , where 1 on the scale of 1 to 9 refers to an extreme negative rating meaning not valuing a solution for the problem at al and 9 on the scale of 1 to 9 refers to an extremely positive rating extremely valuing a solution to the problem.
"On a scale of 1 to 9, I value a solution to this problem at x".

Higher

Lower

"On a scale of 1 to 9 how much do you value a solution for this problem?"

[   ]

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