Regret in decision making:

the cost of changing your mind

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Abstract

The main purpose of this thesis is to study the relationship between regret and changing your mind in decisions where there is a time period between the choice and when the outcome is revealed. Do people experience regret before as well as after the outcome is known? If so, do they experience more regret after the outcome if they have the option to change their mind, and do so? To answer these two questions three experiments were performed. In Study 1 and Study 2 the participants were given the impression that the result was at least partly based on their skill in offering money to a simulated opponent. Half the participants were given the opportunity to change their mind. In the first study the participants' reported regret before the outcome was significantly higher than the regret reported post-outcome, while in the second study it was equal. In both studies those who changed their choice before the outcome reported more regret both not only before, but also after the outcome, compared to those who did not change. To further explore the effect of changing your mind a third study was performed. Even when changing your mind was the best strategy those who did so reported a higher amount of regret than those who did not. Results indicate that there is a significant amount of regret before the outcome is known, and that the act of changing your mind has an effect on the amount of experienced post-outcome regret.

1   Introduction

Regret is an important factor in daily human life. We might make a promise that we know we'll have problems fulfilling, or we might spend or invest money unwisely. There is often a time period between when we make a decision and before the outcome is known where we might have a chance of changing our original decision. When studying regret the focus is on the emotional consequences of these kinds of experiences.

Regret has been studied both in the fields of economics and psychology. While the approaches might at times differ greatly between those fields, both psychology and economics try to study and explain the social behaviour of people, and how our judgement and decision making influence the choices we make both individually and in groups. There have been extensive studies on the processes and antecedents taking place before a decision in both economy and psychology (e.g.Kahneman & Tversky, 1979; Loomes & Sugden, 1982), as well as after the outcome (e.g. Connolly & Zeelenberg, 2002; Gilovich & Medvec, 1995), but not as much is known about the period after the decision but before the outcome is known (Kirkebøen & Teigen, 2008).

In economics most of the studies are normative "thought experiments", describing how one *should* act in a given situation, while in psychology many of the studies are introspective, asking how you *would* act in a given scenario. A third way of performing studies, which is used here, is to combine fields of economics and game theory with psychology, using the games defined through game theory to control the possible outcomes for the participant, and to give opportunities to make decisions with a real impact on the participants. This combination makes it possible to study regret, and the consequences of changing your mind, in situations closer to real-life, where the regret reported is the regret that the participants actually experience based on their earlier choices. As the participants take part in a game consisting of several stages, it becomes possible to measure regret at different points in time: The anticipated regret before the choice is made (1), during the period after the choice is made, but before the outcome is known (2), and after the outcome, when the consequences of the choice is known. The focus of this study will be on the second and third stages, in particular with regards to the effect of changing your choice on the amount of regret experienced after the outcome, and how individual traits influence the amount of regret reported by the participants.

1.1   Previous research on regret in decision making

The earliest approach to studying regret was philosophical, where the focus of the work was the internal state that accompanies regret, and how to distinguish regret from related emotional states such as disappointment, guilt, remorse and sadness. Gilovich and Medvec (1995) contains a brief overview of some of this research. According to Gilovich and Medvec there has been mixed success in these efforts. Regret is clearly an emotion, but it is an emotion which requires thinking and judgement about choices. On the other hand, is it possible to feel regret over actions that you know will be repeated in the future, such as smoking? To further explore regret it is important to first look at how regret itself is defined or operationalized. One popular definition of regret is from Landman (1993), a more philosophically aligned work:

> Regret is a more or less painful cognitive and emotional state of feeling sorry for misfortunes, limitations, losses, transgressions, shortcomings, or mistakes. It is an experience of felt-reason or reasoned-emotion. The regretted matters may be sins of commission, as well as sins of omission; they may range from the voluntary to the uncontrollable and accidental; they may be actually executed deeds or entirely mental ones committed by oneself or another person or group; they maybe moral or legal transgressions or morally and legally neutral. (p. 36)

In the early economic traditions of game theory and decision theory the definition of regret was purely based on the *utility* of outcomes: "Regret means the difference between the reward actually obtained and the reward that could have been obtained with perfect foresight" (Herbert A. Simon, 1959, p. 267). In later behavioural decision-making (DM) works regret is recognized as an emotion or sensation, and not just a purely quantifiable utility value: "Regret theory rests on two fundamental assumptions: first, that many people experience the sensations we call regret and rejoicing; and second, that in making decisions under uncertainty, they try to anticipate and take account of those sensations" (Loomes & Sugden, 1982, p. 820). This is still a much more narrow definition than Landman's (1993) definition above, and it still considers anticipated regret as a part of the utility of a possible outcome, so it might not cover common usages of the word. An example is that the definition of regret used by Lomes and Sugden does not take into consideration that a participant in a study might show more regret over an "almost chosen" alternative, than over one which was not an option at all. Another example where the economic definition of regret might not cover the actual feeling of regret is where there is not just the possible final states which might decide how

much regret you feel, but also the sequencing of the alternatives, such as in the so-called Isolation Effect (Kahneman & Tversky, 1979). Yet another example is the regret experienced when not all the possible outcomes are revealed. How do you measure regret over imagined consequences of choices not taken?

The many possible interpretations of the term regret makes it important to take great care when it comes to which definition of regret a participant in an experiment has in mind when asking "how much do you regret this choice?" Simon's (1959) economic definition above is clearly easier to operationalize than the philosophical or DM definitions, but as the word regret is the same, it is possible to confuse the *emotion of regret* as described in the philosophical traditions with the more narrow definition used in the economic research traditions.

1.1.1   Regret Theory and anticipated regret

Perhaps the most influential experimental approach to studying regret is the economic approach, where regret mainly is studied as part of Expected Utility Theory (EUT). There has been a large number of studies of regret in decision making following EUT, particularly from the late 1970's and forward. Even in the 1950s there were some empirical results (Simon, 1955) which indicated that people systematically act in ways which violated the assumption of rationality popular in economic theories of the time. In the early 1970s this became even more evident. One important article which highlighted the problems with the EUT was Kahneman and Tversky's (1979) article which introduced *prospect theory.* This theory was presented as an alternative to EUT for the range of choices people would make in situations with uncertainty and risk, such as when making financial decisions. A major change from EUT is that prospect theory started from empirical evidence, and building on such evidence the theory describes how individuals evaluate potential losses and gains. Kahneman and Tversky defined several effects based on their findings, such as the "reflection effect", which indicates that people have a tendency to be risk-aversive for gains, but risk-loving when it comes to losses. An example of one of their (later) experiments is the investment experiment (Kahneman & Tversky, 1982), where participants were asked to assess the regret experienced by two investors: One who lost $1200 as a result of buying a particular stock, and one who lost the same amount as a result of holding on to the same stock. 92% of participants indicated that the active buyer would feel more regret than the passive holder of the stock. While

prospect theory did not deal with emotions directly, and some later experimental findings weakened the prospect theory, Kahneman and Tversky's observations were used by Loomes and Sugden's more influential *Regret Theory* (Loomes & Sugden, 1982).

In Regret Theory (RT) the basic idea is that when choosing between two alternatives, individuals anticipate regret for missed opportunities. When looking at the consequences of individual choices the theory states that individuals look at utility as derived from the outcome of a chosen alternative, which might be influenced by the outcome of the alternative action that was not chosen. If the outcome of a chosen alternative is worse than the outcome that would have resulted from the alternative action, the individual is assumed to experience a sense of regret which detracts from the utility of the consequence. In other words, how you feel about what you have is affected by "what might have been". Lotteries are common examples used in both prospect and regret theory. Imagine that you play the same numbers in the national lottery every week. If the numbers don't come up you get nothing. If the numbers do come up, and you did not play them, you still get nothing, but would you feel the same as you did when you played and the numbers did not come up? (The example is based on Calow, 1998, p. 329.) In RT the answer to this question would be a "no", as the person might feel worse in the second case, experiencing a strong sense of regret from not winning the big prize. In other words, according to RT the *potential* for regret (anticipated regret) or rejoicing in the post-outcome period should be included into the outcome when decisions are made.

After Regret Theory was formulated there have been two distinct traditions that have developed the implications of those ideas. On the economist side there have been theoretical refinements, with the aim of improving the predictive validity of the standard Expected Utility theory by introducing consideration of anticipated emotions, such as regret and disappointment. The second tradition is the psychology regret tradition, which originated in psychological inquiry into the antecedents and consequences of experiencing or anticipating feelings such as regret in connection with choice, and often a sub-optimal choice. One characteristic of this research is the attempt to directly measure the emotional experience of regret using rating scales that rely on cognitive introspection (Connolly & Butler, 2006). An influential theory in this tradition is Zeelenberg and Pieters' (2007) *Theory of Regret Regulation 1.0*. This theory tries to incorporate the findings from psychology, economics, marketing and other disciplines in a single theory, including many of the theories mentioned in this paper. The core idea of Regret Regulation is that people are regret-averse, and that they

try to regulate their regrets, both before (trying to avoid anticipatory regret) and afterwards (retrospective or post-outcome regret).

1.1.2 *Post-outcome regret and counterfactual thinking*

Within the psychological originated regret tradition the focus is mostly on the feeling of regret we might have *after* an outcome is revealed (the post-outcome period), and we realize that we should have acted otherwise. This form of regret is usually labelled post-outcome regret. A recent theoretical framework where post-outcome regret is discussed is Decision Justification Theory (Connolly & Zeelenberg, 2002). This theory is linked to counterfactual thinking. An example of counterfactual thinking is thoughts which occur when a person thinks about an option that was not selected, usually with regret. As humans we can quite easily be influenced by events that never occurred, thinking "what if" or "what might have been" in certain circumstances even if that "what if" scenario never actually existed. Such thoughts were studied by Kahneman and Miller (1986). Counterfactual thinking is the tendency to think of events that could have happened given the chance and circumstances, even if that "what if" circumstance did not actually occur. Another way of looking at counterfactual thoughts is that we imagine the opposite of the event. In the counterfactual tradition the psychological impact of events, both positive and negative depends on the way we imagine the "what if" factor. I.e., if we think of a result which is better than the event that actually happened we might feel regret, but if we think of a result which is worse we might feel rejoicing.

According to the latest version of counterfactual thinking theory (Epstude & Roese, 2008) there are two "cognitive pathways" or "what if" frameworks. A content-specific pathway, which consists of intentions and casual inferences, and a content-neutral pathway, which involves indirect effects such as mind-sets, motives and perceived control. These two pathways are thought to influence both each other and the actual behaviour. In addition, when thinking about alternatives to events that have already occurred individuals tend to use one of two frameworks: They may imagine what would have happened if they had done a particular action, or they might imagine what would have happened if they had not done a particular action. These two frameworks are also present in Roese, Hur and Pennington (1999), which discusses counterfactual thoughts that may occur in two forms: Thoughts that alter a previous action ("if only I had not done that"), and thoughts that alter a previous inaction ("if only I

had done that"). Roese et al. also discuss how counterfactual thinking is related to promotion goals and prevention goals. In a promotion goal, individuals are concerned with acquisition of a desired goal, and are sensitive to omissions along the way to that goal. When promotion fails, they most commonly generate counterfactual thoughts concerning the addition of some action they did not do. For a prevention goal individuals are concerned with preserving the status quo, which makes them sensitive to actions or events that threaten it. Consequently, when prevention fails, people are more likely to generate counterfactual thoughts concerning the removal of an action that played a role in bringing about the presence of something negative. Promotion goals are associated with counterfactual thoughts centring on inactions, while prevention goals are associated with counterfactual thoughts focusing on actions.

Several experiments have shown that theoretical concepts such as anticipatory regret, post-outcome regret and counterfactual thoughts have value in explaining regret as an emotion, but do they cover all the situations where regret might be experienced?

1.1.3 Regret between choice and outcome

So far I've only discussed anticipated regret (regret before the choice is made), and regret after the outcome is known, but as mentioned earlier there is another phase where one might experience regret: The period after the decision is made, but before the outcome is known. In most situations there will be a time gap between when the choice is made and the outcome is known. An example is the investment example (Kahneman & Tversky, 1982) described earlier. This example shows the difference in expected regret due to commission (making and active choice) and omission (not making a choice), but, as anyone who has invested in the stock-market knows, the returns are never instant. From the moment you decide to buy a stock until you sell it again, realizing any losses or winnings there might be a considerable time period where the value of your investment has only the *potential* for loss or win, and where you can reverse your decision with little loss. Imagine that you buy shares in a stock just before the market closes, hoping that the stock will open higher the next day. You might feel anticipatory regret before buying the shares, and possibly post-outcome regret when you decide to sell it, but what form of regret is the feeling you might have the same evening, before you actually know the outcome of the investment? In this period we might feel a lot of uncertainty, worry and regret about the possible consequences of what we did. While most of the studies based on economic research have dealt with anticipatory regret,

most of the ones published in psychological journals have studied regret as a phenomenon which belongs to the post-outcome period, looking backward at the choices we've made, while from the economic side it has mainly been studied as a forward looking anticipatory phenomenon. That regret can be experienced both before and after the outcome is also reflected in the Theory of Regret Regulation 1.0 (Zeelenberg & Pieters, 2007, p. 4), where proposition 5 states that "Regret can be experienced about past ("retrospective regret") and future ("anticipated or prospective regret")". While the Theory of Regret Regulation 1.0 does not explicitly say anything about this period, there is nothing that says that regret cannot be experienced after the decision, but before the outcome is known.

1.1.4   Pre-outcome regret

As described earlier there are two main traditions in regret research, the psychological and the economical. In studies based on traditional decision theory the time period between when the decision is made and the outcome is revealed is either immediate or very short. E.g. in a study by Gilbert, Pinel, Wilson, Blumberg and Wheatley (1998) the longest period between the choice and when the outcome was revealed was 10 minutes. In most studies, the choices of the participants lead directly to well defined outcomes, which might not be very realistic compared to how it is in real-life.

An alternative way to look at regret, which also includes the aspect of time, is illustrated in the following model redrawn from Kirkebøen and Teigen (2008):
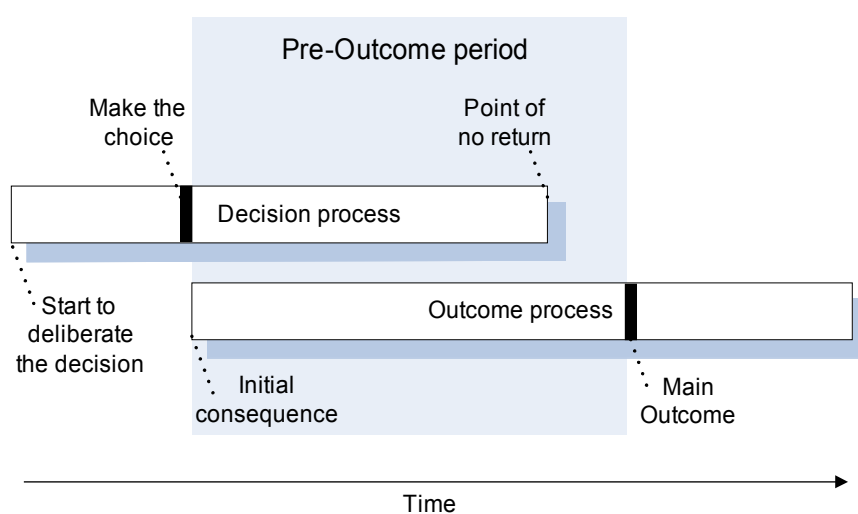

Figure 1: a "two process" model of regret which includes pre-outcome regret

In the two-process model there are three distinct phases of making a choice: (1) The pre-decision phase, before the choice is made; (2) after the choice is made, but before the outcome is known (the pre-outcome period); (3) after the outcome is known, or the post-outcome period (Kirkebøen & Teigen, 2008). An example of the pre-outcome period is the period after the stock market investment, but before the outcome is known, as described in the example used in the previous chapter. Studies of the first period, before the choice, are quite common, as well as the third period above, after the outcome. The period *between* the decision and the outcome is less studied however. In the model presented in Figure 1 there is time for second thoughts and regrets after the decision is made, but before the outcome is known.

The two-process model is based on a series of studies by Kirkebøen and Teigen where the main finding was that there is a significantly higher amount of regret after the initial decision, but before the outcome, than after the outcome. The amount of regret in the pre-outcome period was measured in three self-report studies, using two imagined scenarios, and in one study using remembered major life choices. These three studies suggest that there can be a stronger sense of regret in the pre-outcome period than in the post-outcome period, but as the measurement of regret was done at a single sitting using questionnaires it was not completely empirically validated.

1.2   Regret and changing your mind

A common advice when taking tests as a student is that the first thing you think of is usually the correct answer. That there is some kind of inherent problem in changing your mind is refuted by at least a large majority of the studies which have been done on the topic (Kruger, Wirtz, & Miller, 2005). In a meta-study of 33 studies not one was found were the median performance decreased when the participants changed their mind (Benjamin, Cavell, & Shallenberger, 1984). One explanation for the discrepancy between the outcome of changing your mind and the experienced regret is that it is a product of counterfactual thinking (Kruger et al., 2005). If you change your answer when you should have stuck with the original you would experience more "if only I had not.." self-recriminatory thoughts than if you had stuck to the first answer, therefore these cases become more memorable, and easier to access. In other words, there is a memory bias towards sticking with your original choice. Another theory which might be applied to explain that those who change their choice report

more regret than those who did not is Prospect Theory (Kahneman, Slovic, & Tversky, 1982, p. 142). While not discussed directly in Kahneman and Tversky (1979), later articles by Kahneman and Tversky state that there would be more regret from losing money based on an active choice (an omission) than not making a choice (a commission). This is illustrated in the investment example mentioned in chapter 1.1.1 (Kahneman & Tversky, 1982) as the investor who loses $1200 on an active investment (a commission) is expected to experience more regret than the investor who loses $1200 on not selling a stock at the right time (an omission). The tendency to frame regret in either omission or commission is quite common to many of the theories on regret.

Yet another way of explaining regret after changing your mind is used in the cognitive dissonance tradition, e.g. Festinger and Walster (1964). This study does not directly measure the experienced regret, instead it uses the number of participants who change their original choice as an indication of regret. In the experiment performed by Festinger and Walster, the regret is expressed as the tendency to change the choice of hair-cut, and was found to be strongest just after the decision is made. Regret is, according to Festinger, an expression of post-decision dissonance, which is strongest just after the choice is made.

1.3   Research topics and hypotheses

Based on the theories and studies presented above three possible research topics presents themselves:

Measuring pre-outcome, post-outcome and ad-post-outcome regret: There is some discussion regarding which is the stronger form of regret, anticipated or retrospective regret, and whether anticipated regret is an emotion or a prediction of an emotion. In a study by Van Boven and Ashworth (2007) it was found that people tend to report more intense emotions during anticipation than during retrospection, and that there is a slight tendency for people to expect future emotions to be more significant than they remembered past emotions to have been. Taking into account the two-process model of Kirkebøen and Teigen (2008), discussed in chapter 1.1.4, the regret can also be measured after the decision is made, but before the outcome is known. The effect of temporal distance on regret can also be studied further, by surveying the "ad-post" outcome regret one week after the original experiment.

Regret from commission versus omission: This was discussed in chapter 1.2 earlier.

One interesting experimental result is that people differ when it comes to what they assume they would regret compared to what they actually report in studies of life-time retrospective regret. An example is the investor experiment detailed earlier (Kahneman & Tversky, 1982), where it was found that people assumed they would regret a loss from an active choice more than a similar loss from not doing anything. This is different from what is found when one asks a large number of people "what do you regret in life?" According to Gilovich and Medvec (1995) people have in the long-term a strong tendency to regret the choices they did not make, such as not taking higher education, while in the short therm people regret their active choices. This ties in with the ad-post-outcome measurement from the first question.

Individual differences: One of the propositions in Zeelenberg and Pieters (2007, p. 4) is that "individual differences in the tendency to experience regret are reliably related to the tendency to maximize and compare one's outcomes". Maximization behaviour is the tendency to wish to maximize your choices. The tendency to maximize choices and to be sensitive to regret has been measured in a survey designed by Schwartz et al. (2002). It is also possible to measure maximization behaviour by how much the participant tries to find out more information about the experiment she is taking part of.

From the research questions above three sets of hypotheses were formulated:

H1a: Building on the model suggested by Kirkebøen and Teigen (2008), hypothesis H1a is that the participants would experience a considerable pre-outcome regret, and not just anticipate regret before they know the outcome of their offer.

H1b: Hypothesis H1b is a stronger definition of H1a, that the pre-outcome regret of the participants would be greater or equal to the post-outcome regret.

H2: As described in the paragraph about regret from commission and omission, hypothesis H2 is that those who had the opportunity to change their mind, and do so, would report a stronger pre-outcome regret than those who did not have the opportunity.

H3: In addition to the pre-outcome regret, hypothesis H3 states that those who had a chance to change their mind, and do so, also would experience more post-outcome regret.

H4: In order to explore the effect of individual differences, hypothesis H4 states that the size of the post-outcome regret would be influenced by individual differences, the outcome, if the participant has an opportunity to change their mind, and if the opportunity is

used.

These hypotheses were first tested in two studies. For the third and final study a fifth set of hypotheses was created to further explore the results of the two first studies. The third study will be discussed after the results of the two first studies.

Economic games were used for the three experiments designed to test the hypotheses. In order to provide some background information before describing the studies I'll first provide some brief theoretical background for how people are expected to act in economic games in general, then describe the theory behind the three games which were used to test the above hypotheses.

2   Economic games and behavioural game theory

As the majority of studies utilizing economic games are from fields other than psychology it is worthwhile to examine how those fields explain the actions of the participants. The earliest approach is from the field of *game theory*. This field has an extensive history, going back to the second world war, with the publication of *Theory of Games and Economic Behavior* (von Neumann & Morgenstern, 1944). Originally the focus of game theory was on the intersection of economics and mathematics, in particular analysing zero-sum games from the simple "matching pennies game" to more complicated multi-player games such as poker. The field was further extended in the 1950s, with the definition of Nash equilibriums. A set of strategies is in a Nash equilibrium if no player can do better by unilaterally changing his or her strategy. Imagine that each player is told the strategies of the other players. If any player would want to do something different after being informed about the others' strategies, then that set of strategies is not a Nash equilibrium. If, however, the player does not want to switch, or is indifferent to switching, then the set of strategies is a Nash equilibrium. Each strategy in a Nash equilibrium is a "best response" to all other strategies in that equilibrium, given the knowledge of the players (Nash, 1950). When the game is in a Nash equilibrium all the players choose a strategy which is the best, i.e. "utility maximizing" response to all the other players' strategies. In economics the Nash equilibrium and the concept of utility maximizing has become one of the most common theoretical constructs (Goeree & Holt, 2001), and has formed the basis for a large number of modern developments in the area of economics.

While the economic theories assume that actors are rational, the same might not be assumed for participants in psychology experiments. This has been known at least since Simon (1955, 1959), who was one of the first to criticise the "deductive approach" of game theory. While there seems to be a tendency among game theorists to assume that given the right kind of circumstances, behaviour will converge to Nash equilibriums, the support for this from actual experiments is not very strong. One example is a paper by Goeree and Holth (2001), where it was shown that for all the major types of game theory based games a change in the pay-off structure, which in itself should not change the Nash equilibriums, would in an experiment lead to the opposite of what was predicted in game theory.

One attempt at merging variables more often studied in psychology with game theory is *behavioural game theory* (Camerer, 1999b, 2003). The aim of behavioural game theory is to describe actual behaviour, usually by empirical observation (mostly experiments), and to "chart a middle course between over-rational equilibrium analyses and under-rational adaptive analyses" (Camerer, 1999b, p. 167). Camerer suggests using the following three steps: (1) First, start with a game or situation where standard game theory makes a prediction; (2) if actual behaviour differs from the prediction, think of plausible explanations, and (3) extend formal game theory to incorporate these explanations, as formally as possible. The modifier "behavioural" is intended to point out that the theory is intended to predict the behaviour of individuals and of groups such as firms (Camerer, 2003, p. 465).

2.1.1   The Ultimatum and Trust games

The game used in the first study is based on the Ultimatum game, an experimental economics game where two players interact to decide how to divide a sum of money given to them, in a two stage game. The game is based on classic game theory, and was first analysed by a Swedish researcher (Ståhl, 1972), but first tested experimentally by Güth, Schmittberger and Schwarze (1982). In the game the "proposer" proposes how to divide the sum between the participants, while the second player, the "responder" can either accept or reject the proposal. The Nash equilibrium would be that the responder should choose something over nothing, so the proposer should offer the smallest sum possible.

What surprised Güth et al. in 1982 was that a large majority of the offers was for an equal split. According to game theory the proposer, the player that makes the offer is strongly favoured. If the sum to be shared is $10, and the proposer offers $1 to the responder, the

responder should take the dollar, since $1 is better than nothing, assuming that both players are maximizing their outcomes. This result have been replicated a large number of times, with the mean offer of 40% and many proposing half, with the responders rejecting offers of less than 20% about half the time. (See Camerer, 1999a, Chapter 2, for a summarized list). Güth et al. theorised that the reasons for rejecting might have to do with the fairness of the offer; an unfair offer might be rejected, punishing the other player, even if that leads to no pay-off for the responder. Other social preferences, such as altruism or fair-mindedness might also explain the difference in offers by the proposer.

In the second study a different design based on the *dictator game* was used. In dictator games the first player "the proposer" determines the entire allocation of money. The second player's role is entirely passive; he simply receives what the first player does not allocate to himself, and has no strategic input into the outcome of the game. One of the dictator games variants is the *Trust game*, also known as the investment game (Berg, Dickhaut, & McCabe, 1995). In the Trust game the first player can invest money with a second player, a "trustee", who in most experimental designs receives the same initial amount as the first player. When the money is invested the invested sum is multiplied, usually by a factor of three. It is then up to the second player how much of the multiplied money to return. Here trust is the willingness to bet that another person will reciprocate, at a cost to themselves. If the players are only interested in maximizing their pay-offs the second player (the trustee) will keep all the money. An investor that realizes this should keep the money rather than investing it, so the single Nash equilibrium here is for the first player to invest nothing, leaving the second player nothing to keep. Since this is a one-shot game played with an anonymous trustee there is no relationship, social sanctions for greediness or communication between the players outside of the sum invested. This means that the game requires *pure* trust from the investor. Still, in an experiment run by Berg et al. (1995) the mean investment (out of $10) was 50%, with five of 32 investing everything and only two investing nothing. The mean amount repaid was about 95% of what was invested, with half repaying either nothing or $1. This experiment has been repeated a number of times, in different cultures. See Camerer (2003, p. 48) for an exhaustive overview.

2.1.2   The Monty Hall problem

The third study is based on the Monty Hall problem, a probability puzzle based on the American TV show "Let's Make a Deal", which was hosted by Monty Hall. Superficially the premise is simple: A contestant on a game show gets to pick one of three doors, one hiding a car, and two hiding goats. After the contestant has picked a door the host reveals that behind one of the two other doors there is a goat. He then asks if the contestant wants to switch to the other closed door. Should the contestant switch? There are several theoretical solutions to this puzzle, but the simplest explanation is that there is a 1/3 chance of picking the car on the first try. Switching from the car condition leads to a goat, but the reverse is also true: There is a 2/3 chance of picking a goat, and switching from a goat will always reveal the car after the other goat has been revealed. In summary, when given the chance to switch the chance is 1/3 for a goat, but 2/3 for picking a car, so you should always switch. (The description is based on Palacios-Huerta, 2003)

Perhaps the most interesting fact about the Monty Hall problem is how often people get it wrong. When the original problem was discussed in a Sunday newspaper magazine (vos Savant, 1990), it reportedly attracted hundreds of letters claiming that the (correct) solution was wrong. In later studies it was found that a large majority of people assume that each door has an equal probability, and therefore conclude that switching does not matter (Mueser & Granberg, 1999). In one study, out of 228 subjects only 13% chose to switch (Granberg & Brown, 1995). This makes the Monty Hall problem a good candidate for a "game" in which the participants can feel regret for their choice of switching or not switching. The number of times the experiment is repeated has also got an influence on the result. In Friedman (1998) the percentage of times the participants changed their mind increased from 10% to 40% from the first attempt to the sixth.

3   Method

Three studies were performed. The two first studies were designed to test the hypotheses listed in chapter 1.3, in other words whether there is a significant amount of pre-outcome regret (H1a, H1b), that those given the opportunity to change their choice would report more pre-outcome (H2) and post-outcome (H3) regret, and if there were any individual differences in the reported regret (H4). The third study was designed to further study the results from the first two studies, and will be discussed after Study 1 and 2.

Participants were recruited on three separate occasions, mainly using email to students attending classes at the Department of Psychology at the University of Oslo. There was also some recruitment using flyers, but to limit the number of participants the flyers were only distributed at the Psychology Department. The participants took part individually, by clicking on a link in the email or by typing in the address on the flyer. Using an on-line solution for gathering data lowered the threshold to participate, leading to a total of 377 participants for the three studies. As all three games had the possibility of winning a prize there were some basic mechanisms to detect cheating and attempts at taking part more than one time, which will be discussed briefly later. To keep the experimental constraints constant between the three studies the web pages were designed to appear to be part of an official University of Oslo research project, and there was no change in the layout between the three studies. The three experiments can (for the foreseeable future) be tested at http://wiki.kroyd.com/master. As there was some overlap between the participants in the three studies it is possible that repeated participation had an effect as well, since even with each of the three studies being fundamentally different, many of the same questions were repeated.

3.1 Study 1 and 2: The Ultimatum and Trust games

The first two studies are based on two economic games discussed in chapter 2, the Ultimatum game (Study 1), and the Trust game (Study 2). In both studies the participant had to decide how much to offer a simulated opponent, programmed to respond similar to participants in earlier studies. After making the offer the participants had the opportunity to explore how the computer reacted. Afterwards half the participants in both studies could change their offer. Regret was measured at three stages: (1) after exploring how the computer reacted but before the outcome was revealed (pre-outcome), (2) after an initial outcome (how much money you had a possibility of winning), (3) and up to one week later.

Design: Both the Ultimatum and Trust games were designed as both between-group and within group studies, where the participants were split into groups differing in how much information they were given about the opportunity to change their choice, and if they actually could change it. Because both the Ultimatum game and the Trust game followed nearly the same procedure they are discussed together, with only the individual differences pointed out.

Both studies were designed so that it was not obvious to the participants that the major factor being measured was the regret they experienced during the experiments. In order to test

if being informed about the possibility of changing one's mind would have an impact 50% of the participants were informed about the possibility of changing their mind, and 50% were not. The groups are summarized in Table 1 below. To explore possible individual differences the participants were polled both for scales having to do with maximization (Nenkov, Morrin, Ward, Schwartz, & Hulland, 2008), regret (Schwartz et al., 2002), and single-item questions. The Regret and Maximization scales, as well as the single-item questions are listed in the appendix, in respectively Table 8 and Table 7.

Table 1: Main categories of participants, and number of participants in the group

Label	Study	Description	N
A	Study 1	Informed about their possibility of changing their bid/offer and given the opportunity to do so	54
B1	Study 2	Informed about opportunity to change bid/offer, and given it	50
B2	Study 2	Informed about opportunity to change bid/offer, and not given it	50
C	Study 1	Not informed about opportunity to change bid/offer, and not given opportunity to do so	55

In addition to the categories for changing your mind or not the participants were split into two groups. In the within-group category (P1) the participants were polled for both pre-outcome regret and post-outcome regret (N=55 in Study 1 and N=51 in Study 2), while in the other group (P2) the participants were polled for post-outcome regret only (N=54 in Study 1 and N=49 in Study 2).

Motivation and reward structure: In order to motivate the participants they were given the impression that they could win up to 1500 Norwegian kroner (NOK) in Study 1, and up to 1200 NOK in Study 2. In Study 1, where the participant had to give an offer and the computer could either reject or accept it, the maximum possible reward was (500 NOK - the offer to the computer) x 3. The participants started with 1000 NOK, so if the computer
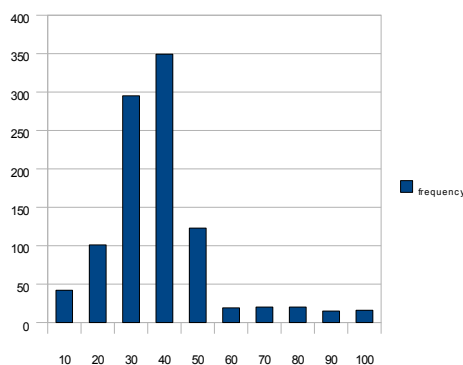

Figure 2: Return distribution of 1000 simulated offers, the formula is based on the distribution in Cesarini et al. (2008)

accepted an offer of zero the gift card would be 1500 NOK. There was also a consolidation prize of 100 NOK for those who did not get their offer accepted. For Study 2 the maximum gift-card the participants could win was the part of the (tripled) investment the computer decided to return + what the participant did not invest. The start sum was 400 NOK, so if a participant decided to invest the entire sum the total possible gift-card would be 1200 NOK. In Study 1 the formula for deciding if an offer was accepted or not was based on whether the sum of the amount offered plus a random number between 1 and 550 was larger than 550. In other words, an offer of 1 NOK would be accepted 1 out of 550 times, while an offer above 550 NOK would always be accepted. If the offer was not accepted the participant joined the draw of the 100 NOK consolation prize. In Study 2 the outcome (amount of money returned) was calculated to be close to the return distribution for Swedish participants in Cesarini et al. (2008), as shown in Figure 2. While the Swedish participants in the study by Cesarini et al. returned slightly more than the investment, the formula in Study 2 was modified so that the amount returned would average closer to the money invested.

Rationale for the participants: In both studies the participants were given the impression that they were taking part in an experiment studying behaviour during economic games.

Procedure: The participants were first explained the basics of the economic game they were going to take part in (1). The next page then explained the reward structure (2), in other words how their choices would impact on their chances of winning and the value of the gift-card they had a chance of winning. They were then asked to register with their email address, age and gender (3). In the next step the participants had to fill out the single-item questions in Table 7 in the appendix (4), before being asked to give an offer to the computer (5). In the next step the participants were split into tree categories: Those who were told that they would get a chance to change their offer (A, in Study 1), those who were told that they had a 50% chance to get an offer of changing their choice (B1 or B2, in Study 2), and those who were not informed about this opportunity (C, in Study 1) (6). The next step was an interactive try-out-period (7), where the participants had a maximum of ten attempts to get insight into how the computer, which was programmed to react as a typical person, reacted to their offers. Half the participants were then polled for their pre-outcome regret (8) with regards to either making a higher or lower offer than they did. In the next step (9) the participants in A (Study 1) and B1 (Study 2) got the opportunity to change their bid, while the participants in C (Study 1) did not

get a chance to change their mind, and were not told about the opportunity. The participants in the category B2 (Study 2) were told that they were not in the 50% who got a chance to change their bid. After repeating information about what kind of bid the participant made, the outcome (10) was displayed, as well as the amount of the gift-card the participant had an opportunity to win. The participants were then polled for post-outcome regret (11). Before the participant could finish the experiment they also had to fill out a questionnaire (12) from a scale intended to measure maximization behaviour (Nenkov et al., 2008), as well as a regret scale (Schwartz et al., 2002). The questions involved are listed in Table 8 of the appendix.

Up to one week after the participants took part in the experiment they received an email stating that the winners had been chosen, and that they could check if they were one of the winners on-line. Before getting the result the participants were polled for the ad-post-outcome regret (13). In the final part the participants had the opportunity to visit a debrief page, which gave information about the experiment they had taken part in. The entire procedure can be tested at http://wiki.kroyd.com/master.

The pre-outcome, post-outcome and ad-post-outcome regret in step 8, 11 and 13 above were surveyed by asking two questions: how much the participant regretted that she did not transfer *more* than the offer or bid, and how much the participant regretted not transferring *less* than the offer or bid. The amount of regret reported in the results for Study 1 and Study 2 is the maximum of these two questions, i.e. the maximum of the two scores. The exact questions are listed in the appendix, Table 11. Both scales were scored on a 7 item likert scale.

The first study had 109 participants (80 women and 29 men), with a mean age of 25.9 (SD=4.4). The second study had 100 participants (72 women and 28 men), with a mean age of 25.6 (SD=4.0). The students were mainly recruited by email, but some were also recruited from an introductory psychology class and by flyers passed out in the building used by the Psychology Department.
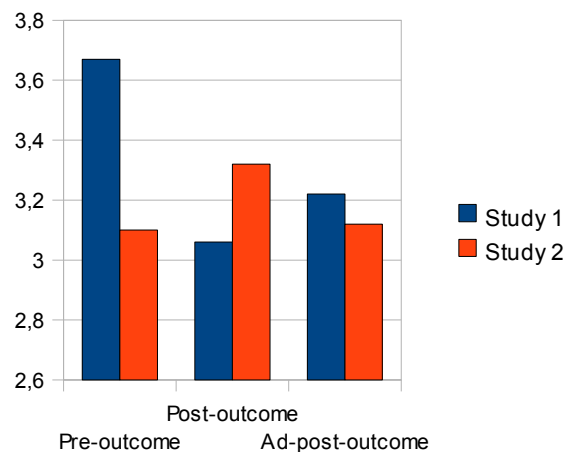
All survey questions were in Norwegian, and are presented here translated to English, with the original form in the appendix.

3.1.1   Results of Study 1 and 2

In the first study 55 participants were polled for pre-outcome regret, 109 (all the participants) were polled for post-outcome regret, while 100 participants reported their ad-

post-outcome regret when checking if they had won a prize. Correspondingly, in the second study 51 of the 100 participants were polled for the pre-outcome-regret, 100 were polled for post-outcome regret, and 98 reported their ad-post-outcome-regret when checking if they were one of the winners

The mean regret for the two studies is illustrated in Figure 3, which shows the mean maximum regret from the two questions for each of the participants at the three measurement points. A paired samples t-test of the result shows that the reported pre-outcome regret for all the participants polled on pre-outcome was significantly higher than post-outcome regret in Study 1 ($t(54)=2.014$, $p=.49$), and not significantly different in Study 2 ($t(50)=-1.33$, $p=.189$). Both the H1a hypothesis, that the participants would

Figure 3: Mean amount of regret in Study 1 and Study 2

experience a considerable pre-outcome regret, and the H1b hypothesis, that the pre-outcome regret of the participants would be greater or equal to the post-outcome regret, were found to be supported. There is a large amount of pre-outcome regret, and pre-outcome regret was found to be higher or equal to the post-outcome regret.

The second and third hypotheses concerned the possible consequences of having the chance to change the decision, and doing so. Hypothesis H2 stated that those who had the opportunity and used the chance to change their mind would report a stronger pre-outcome regret than those who did not have the opportunity, while H3 stated that those who had a chance to change their mind, and did so, would also report more post-outcome regret. According to Kruger et al. (2005) changing your mind has an effect in itself, and they theorise that by changing your mind you engage in more "what-if" thinking than if you do not. The results of an independent samples t-test comparing participants who changed their mind with those who got the chance, but did not do so, is displayed in Table 2. As can be seen from this table, with the exception of ad-post-outcome regret in the first study, there is a large and statistically significant differences between the groups for all three measurements of regret.

Table 2: Summary of t-tests between those who changed their mind and those who did not

	t	df	p
Study 1:			
Pre-outcome	-5.94	25	.000**
Post-outcome	-2.42	52	.019*
Ad-post-outcome	-1.31	47	.196
Study 2:			
Pre-outcome	-5.09	22	.000**
Post-outcome	-2.18	48	.035*
Ad-post-outcome	-2.74	47	.009**

The differences in mean reported regret are illustrated in Figure 4 and 5. The amount of regret is consistently lower for those who had the opportunity to change their mind but did not do so.
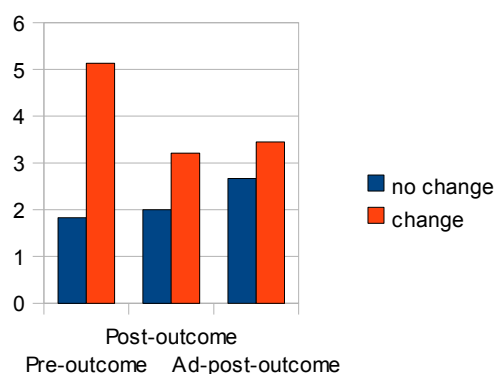
Figure 4: Regret in Study 1, for those who had the opportunity to change
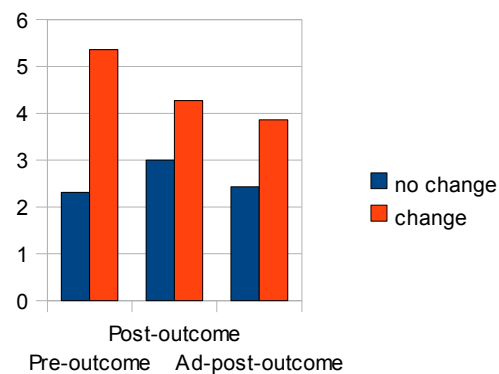
Figure 5: Regret in Study 2, for those who had the opportunity to change

Comparing Table 2 and Figure 5 and 6 it appears that much of the difference between pre-outcome regret and post-outcome regret shown in Figure 3 is actually a result of the regret from the participants who had a chance to change their mind, and used it. The difference between the two groups is not surprisingly much stronger in the pre-outcome period, as those who experienced the most regret were more likely to change as well, but the difference is still significant for the post-outcome regret. The results from both Study 1 and Study 2 support hypothesis H3, that those who had the chance to change their mind and used it would report

more post-outcome regret. There is less support for this being true for the ad-post outcome regret, as the difference in ad-post outcome regret between those who changed their mind and those who didn't is only significant in Study 2.

An interesting result is that the mean value of the potential gift-card was 39% higher in Study 1 for the participants who chose to change their bid, but they still reported more regret than those who didn't. This difference was not statistically significant, with M=463, SD=358 for those who changed their bid, M=333, SD=284 for those who did not with $t(52)$=-1.399, p=.168. In Study 2 the mean potential gift-card for those who changed their bid was slightly lower than for those who did not. (M=414, SD=126 for those who changed, M=477, SD=86 for those who did not $t(48)$=1.196, p=.237). The result from the first study indicates that even when the outcome is better after changing your decision, the experienced regret might be stronger after the outcome.

In Study 2 the participants were told that they had a 50% chance of changing their offer. The participants in category B1 got the opportunity to do so, and reported a pre-outcome regret of and 3.71 (SD=2.12, N=24), while the participants in category B2 didn't get the chance, and reported a pre-outcome regret of 2.56 (SD=1.97, N=27). This difference is significant, with $t(49)$=2.016, p=.049. For post-outcome and ad-post-outcome there was no statistically significant difference between B1 and B2.

Did it matter if the participants were told of the opportunity to change their mind or not? As there were methodological differences between the two studies which might have a confounding effect, such as the details of the reward structure, it is not possible to directly compare the measured regret between the two studies, but it is possible to compare the reported pre-outcome regret for A and C in Study 1. An independent samples t-test showed no difference in pre-outcome regret between the participants who knew they could change their bid (category A, M=3.67, SD=2.18) and those who did not know they would not get a chance to do so (category C, M=3.68, SD=3.68), with $t(53)$=-0.21, p=.321. Comparing between the two studies it is clear that the means for A (those who knew all along that they would get a chance to change, M=3.67) and B1 (those who knew that they might, and got the chance, M=3.71) are basically identical.

No significant differences in the amount of post-outcome regret was found between those who were polled for only post-outcome regret (P2) when compared to those polled for

both pre-outcome and post-outcome regret (P1).

Using an independent samples t-test it was established that there might be some gender differences in the amount of regret measured. In Study 1 there was a statistically significant difference in pre-outcome regret between men (M=4.67, SD=1.91, N=15) and women (M=3.30, SD=1.98, N=40), with $t(53)=2.302$, $p=.025$, and in Study 2 ad-post outcome was significantly different with $t(96)=-2.442$, $p=.16$. For the other measurements no significant gender differences was found. The mean regret reported was higher for men than for women in Study 1, and the reverse was the case in Study 2.

Hypothesis H4, which concerns the individual differences, will be discussed in the general discussion.

3.1.2   Some concerns with Study 1 and 2

There are several concerns that might be raised with regards to the studies. Perhaps the most important one is that they were somewhat intricate, and might have been somewhat demanding to follow. In the case of Study 2 the explanation of the reward structure alone took about one page of text, in a style similar to this page, and required the participant to follow the logic of how the money were transferred. Secondly, they are based on a perceived aspect of skill; the participant might get a feeling of insight into how the game is played, which might influence the amount of regret reported. A prediction is that participants feel much stronger for games where they believe that their actions have an influence on the outcome than in games where the outcome is (clearly) random or where the outcome is predetermined. This stronger feeling should be very evident in the amount of regret that the participants feel. To test this two new hypotheses were defined:

H5a: Participants who change their mind would report a higher amount of regret than the participants who stays with their original choice, even if the experiment is not based on a perceived skill or insight.

H5b: There is an effect of how the information about the choice the participant makes is revealed.

3.2 Study 3: The Wheel of Fortune

The third study was designed to mitigate the possible concerns with the two previous studies, and to isolate and further examine the causes and effects of the participants changing their mind, as this had such a strong effect in Study 1 and 2. The intention of Study 3 was to simplify the design, so pre-outcome regret was not measured, all participants were given the chance to change their mind, and the outcome was the same for all participants.

The experiment used in the study is based on the Monty Hall problem, as described in Chapter 2, but because the Monty Hall problem is somewhat well known, at least among college students, a variation of the problem was created, The Wheel of Fortune. In this game the participants had to choose a date from a year, with prizes given for correct month, correct day of the month, and for correct day of year. The months were represented on a Wheel of Fortune, illustrated in Figure 6. After picking a month, seven months are shown to not contain the correct date, corresponding to the door with the goat in the original problem. According to the mathematical foundations of the Monty Hall problem, the probability of picking the right month the first time is 1/12. After seven months were shown to not contain the date the chance of picking the correct month among the five remaining months would be 1/5.

3.2.1 Design and procedure

Design: The participants took part in what appeared to be a simple Wheel of Fortune game, as described above. The participants were split into two conditions (A and B) based on how the months were presented when revealing which months did not contain the correct date, with the majority of participants in condition A. All participants had the opportunity to change their mind. To keep things simpler the post-outcome result was the same for all the participants: they were told that they had picked the wrong month, and that they only later would be told if they had picked the right day. This

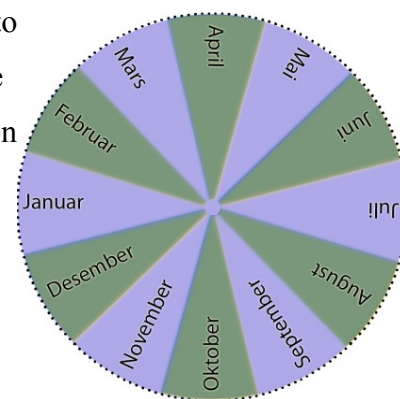*Figure 6: The Wheel of Fortune*

misinformation was explained in the debrief information after the ad-post-outcome regret was measured. Splitting the participants into condition A and B was inspired by an earlier study by Teigen, Evensen, Samoilow and Vatne (1999)*,* as the presentation (step 7 below) might lead to the perception of being more or less lucky, which could influence whether the participant

picked a new date, and the amount of regret experienced.

In order to motivate the participants to participate and to have a reason to regret the choices the participants had the opportunity to enter a draw of three gift-cards with values of 500 NOK for picking the right month, 500kr for picking the right day of the month, and 1000 NOK for picking both correctly. In theory, if winning all three draws, the maximum gift-card a participant could win had a value of 2000 NOK, or about equal to the income from almost two days of part-time work for most students. (That the possibility of being drawn as the winner in all three prize drawings was minute was not described in the flyer or email.) The participants were as in the two previous studies mainly recruited by email, and some by flyers, and they were able to access the experiment until a few hours before the winners were drawn. The number of participants in Study 3 reached 168, compared to 109 and 100 for the two previous studies. There difference in the number of participants between the three studies was probably an effect of the maximum possible reward and the simplicity of the task described in the email and flyers.

Rationale for the participants: There was no obvious rationale for the study presented to the participants; it was simply a possibility to "win up to 2000 NOK in 5 minutes by taking part in a simple psychological experiment".

Procedure: The web page first (1) explained the prizes, and that the task was to pick the correct date, unique to each participant, from a year consisting of 12 months of 30 days. 30 day months were chosen to avoid favouring months with 31 days, as the failure to do so might confound the amount of regret experienced by the participants, and the date was explicitly unique to avoid co-operation between participants. After registering their email address, age and gender (2) the participants first filled out a simple form (3) with the single-item questions listed in Table 7 of the appendix. They were then asked to pick a month, and a day in that month (4). In the next step the participants were shown information to "help them make a better choice" (5). This information consisted of an animation showing each of the seven months previous to the participant's choice (condition A) or seven months opposite to the choice (condition B) becoming grey, indicating that the correct date was not in these months. E.g., if the choice was April 15th, they would be shown either August-January and February-March, or June-January as months where the correct date was not located. To further increase their attention to the problem the participants were asked to closely observe how the

months were greyed out. After repeating the information shown in the animation in words (6) all participants were then given the opportunity to confirm their existing choice or to pick another date. Showing seven months and forcing the participants to confirm their choice using a new selection of day and month was decided on after it was found to be very hard to get pilot test participants to change their existing choice. In a pilot test with seven participants using five months directly before their choice and a "select yes if you want to change your choice" option none decided to change their choice. In order to isolate the effect of changing your mind everyone were then informed that their pick of month was wrong, regardless if they changed their date or not (7), but that they still were in the running for picking the correct day of month. Immediately following they were asked how much they regretted (not) changing their choice of date (8), using a variant of the two questions used in the previous studies. To identify the participants who understood the rationale behind the correct choice, and the reasoning of those who did not, the participants were then asked why they changed or did not change their mind (9). See the appendix, Table 11 for the questions. Finally, they were asked the questions from the Maximization scales and Regret scales used in the two previous studies, and one additional question (10). The procedure can be tested at http://wiki.kroyd.com/master.

One week later the participants received an email saying that the gift-card winners had been drawn, and that they now could check if they were one of the lucky winners. These pages first repeated the question about regret from step 8 above (11), then went on to explain that the result revealed in step 7 above was misleading, and informing the winners (12).

In Study 3 there was no measurement of the pre-outcome regret. The post-outcome and ad-post-outcome regret in steps 8 and 11 above were surveyed using the following questions: "To what degree would you now say that you regret your choice of day and month (date)?" and "To what degree would you now say that you regret that you did [not] change your mind?". Both questions were surveyed on a 7 item likert scale. The exact questions are listed in Table 11 in the appendix. These two questions differ from the ones used in Study 1 and Study 2; as they are not symmetrical each question had to be analysed by itself.

3.2.2   Results of Study 3

168 participants took part in the study. The mean age was 25 years (SD=4.868), 133 were female, and 35 were male. Of the 168 participants 148 also checked if they were one of the winners, and completed the form for ad-post-outcome regret.

The main hypothesis tested in Study 3 was that the participants who changed their mind would report a higher amount of regret than the participants who stayed with their original choice, even if the experiment is not based on a perceived skill or insight. (H5a). Figure 7 shows how the regret for the choice of date differed between just after being told the misleading outcome and when checking the final result up to one week later. Out of 168 participants 57 decided to change the original choice (33.9%). An independent samples t-test shows that there is a statistically significant difference in post-outcome regret on the date chosen between those who changed their mind (M=3.14, SD=1.875, N=57) and those who did not (M=2.40, SD=1.884, N=111), with $t(166)=2.427$, $p=.016$. In other words, those who made the correct choice to change their date reported a significantly higher amount of regret for the date chosen just after the outcome was known. This supports hypothesis H5a, that the participants who changed their mind, even in a luck based game would report a higher amount of regret than the participants who stayed with their original choice. T-tests for the amount of regret for the act of changing the date itself, and for the ad-post outcome survey found no significant differences between the two groups.

Did it matter how the information was presented? This was tested by how the months where the date was not located were excluded. In order to test hypothesis H5b, 144 of the participants were shown the months directly before the month the participant picked (condition A), while 24 of the participants saw the months shown on the opposite side of the wheel (condition B). A t-test of the two groups showed that there was no significant correlation between how the date was presented and

Figure 7: Regret from changing in Study 3

picking a new date or not, with $t(155)=-0.529$, $p=.597$ between the two conditions and picking a new date. The mean regret was slightly higher when the months were shown directly before the date (M=2.69, SD=1.87, N=144) than on the opposite side (M=2.42, SD=2.125, N=24), but this difference was not significant with $t(166)=0.643$, $p=.521$. There is no support for
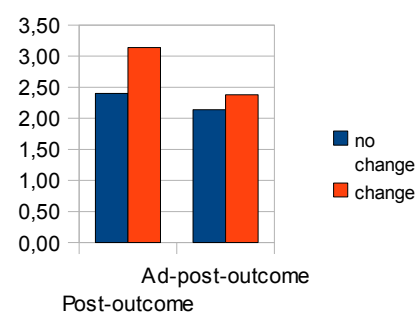
hypothesis H5b.

For the post-outcome period a paired samples t-test shows that there is a significant difference ($t(135)=3.35$, $p=.001$) between the amount of regret reported after the outcome and when checking the result, which indicates that there is significantly less regret after one week. The individual factors that influenced the amount of regret in the post-outcome period (H4) are discussed together with the factors from Study 1 and Study 2 in the general discussion below.

In step 9 of the procedure the participants were asked either why they changed their mind or why they did not. The results are summarised in Table 3 below.

Table 3: Reasons for changing the date, with percentage and average regret

		N	Percent	Regret (date)	Regret (change)
	Reasons for changing				
e1	I just felt like it	11	6.5	2.82	3.18
e2	I thought it would improve the probability of guessing correctly	35	20.8	3.2	2.71
e3	It was more exciting to try another date	3	1.8	3.67	2.67
e4	I asked and followed someone else's advice	-	-	-	-
e5	The new date I picked means something special for me	3	1.8	3.33	2.67
e6	No idea	5	3.0	3	3
	Reasons for not changing				
b1	I just did not feel like it	2	1.2	2.5	4.5
b2	I saw no reason to change	21	12.5	2.57	2.57
b3	I think one should keep one's first choice	9	5.4	2.22	3.11
b4	It would not change the probability of guessing correctly	64	38.1	2.33	2.58
b5	I asked and followed someone else's advice	-	-	-	-
b6	The date I picked means something special for me.	15	8.9	2.53	2.67
b7	No idea.	-	-	-	-

This table reveals that the post-outcome regret for the participants who changed their date for the correct statistical reason (e2) is higher than the post-outcome regret of the participants who did not change it, based on not understanding that doing so would increase the chances of winning (b4). This is a statistically significant difference, with $t(97)=2.136$, $p=0.035$. This indicates that the participants who correctly changed their date, based on a *correct* understanding of the statistics, felt significantly more regret than those who did not,

based on a *faulty* understanding of the statistics. This is quite surprising, and will be discussed further in the general discussion.

One interesting finding is that as many as 20.8% of the participants thought that changing the original choice would lead to improving the probability of guessing correctly (e2 above). This is a higher number than has been found in other studies, e.g. in Granberg and Brown (1995) where only 13% of the participants decided to switch at all. In the third study 33.9% decided to change, and of those more than half decided to change for the correct reason. One possible reason for the high percentage of participants deciding to change is suggested by the pilot tests. As mentioned in the method description, a pilot test with 7 participants found that none of them wanted to change their choice. This led to two crucial changes: The text was changed from asking if the participant wanted to change the original choice of <date>, to having the participant actively confirm the date by selecting both month and day again. A new pilot test showed that almost half the participants changed their choice with the new text. The tendency for people to rationalize their choices is a field that has been extensively studied, e.g. in the cognitive dissonance tradition (Aronson, 1997). That the new choice would lead to a better chance of winning might simply have been the most socially accepted justification of a choice which was already made.

When it comes to gender differences it was established using t-tests that there were no significant differences in the regret reported by males and females in Study 3.

4   General discussion

The results from the five main hypotheses were discussed in the results section after each study. The general discussion will follow the same sequence as the hypotheses. I will first discuss pre-outcome regret (H1a and H1b), then the effects of changing your mind on pre-outcome regret (H2) and post-outcome regret (H3). The last of the original main hypotheses, which concerned the effects of individual differences (H4) will then be covered, before I discuss how the design of the experiment might have influenced the reported regret (H5a). Finally I'll briefly discuss how the amount of time between the experiment and measurement of ad-post-outcome might have influenced the change in reported regret. I will end the general discussion with some possible methodological concerns and opportunities for future studies.

4.1   *Pre-outcome and post-outcome regret*

As shown in the results section for Study 1 and 2 there was a significant amount of pre-outcome regret. (Pre-outcome regret was not measured in Study 3) A paired samples t-test of the result revealed that the reported pre-outcome regret for all the participants polled on pre-outcome was significantly higher than post-outcome regret in Study 1 ($t(54)=2.014$, $p=.49$), and not significantly different in Study 2 ($t(50)=-1.33$, $p=.189$. This meant that both the H1a hypothesis, that the participants would experience a considerable pre-outcome regret, and the H1b hypothesis, that the pre-outcome regret of the participants would be greater or equal to the post-outcome regret, were found to be supported.

It is not surprising that the participants who later went on to change their choice also reported a higher amount of pre-outcome regret than those who had the chance to do so, but did not. As shown in Figure 4 and 5 in chapter 3.1.1 the amount of pre-outcome regret for those who later change their choice was more than twice as high as the pre-outcome regret for those who didn't (M=1.83, SD=1.333, N=12 vs. M=5.13, SD=1.506, N=15 for Study 1, while Study 2 had M=2.31, SD=1.843, N=13 vs M=5.36, SD=.809, N=11). It is more surprising how the difference in regret also continued until after the outcome. Possible reasons for this is discussed in chapter 4.3 about individual differences.

The motivation to examine pre-outcome regret as a part of the studies was the 2008 article by Kirkebøen and Teigen. In this article the thought experiments the participants took

part in, such as one examining their feelings about holding a speech at a wedding, can be said to contain a degree of worry for the (future) outcome of the decision, which is part of the "outcome process" of Figure 1. For the two first studies performed here it is hard to say how worry about the outcome might have been involved in the pre-outcome period. After all, what has the participant to lose, except for a few minutes of his or her time? An explanation is that the pre-outcome regret experienced by those who later changed their mind functioned as a form of signal, which indicated the intent to change the choice. The regret experienced in Study 1 and 2 is clearly different from "anticipatory regret", as there was no reason to feel worry about the possible outcome in the first two studies.

4.2   Regret from changing the choice

The most surprising result from the three studies was the amount of post-outcome regret experienced by the participants who changed their mind. There was a significant difference in the measured regret between the participants who changed their mind and those who did not. This difference, if less distinctive, and only statistically significant for Study 2, was still present at the ad-post-outcome survey, up to one week after the original experiment.

A natural question is why the participants who changed their mind felt so much more regret after the outcome was known. In the first two studies the participants had the impression that the outcome would at least in part depend on their understanding of the game, and the reward structure was constructed so that it always would appear that it would be possible to get a better outcome. They were also given ample opportunity to gain insight into the game during the interactive try-outs, where they could test how the computer was programmed to react. As the computer varied the result in a semi-random manner, it is possible that some of the participants got a very strong feeling of their first bid not being good enough, and that a different bid might give a better outcome. The number of try-outs and the information revealed after each attempt was designed so that the participants would not be able to figure out the underlying reward formula, which might have led to a feeling of perceived control, and a belief that their actions made a difference.

When it comes to the third study there are several factors which might explain the comparatively lower amount of post-outcome regret that was experienced by those who changed their mind (M=3.14, SD=1.875, N=57) and those who did not (M=2.40, SD=1.884, N=111). While this is still statistically different, with $t(166)=2.427$, $p=.016$, the difference in

mean post-outcome regret between those who decided to change and those who didn't is less in the third study than in Study 1 and 2. A possible explanation is that in the third study there was no interactive try-out period where the participants could make active attempts at getting a better result. Another possible reason, is that it was hard to get the pilot test participants to change their mind, which led to several rounds of trying different descriptions and ways of changing the choice before a variant where a significant number of participants actually changed their mind was settled on. It is possible that the missing interactive try-out period in the third Study, the change in how the choice was confirmed, and the fact that the third study used a game which appeared to be based on luck had an effect on the pressure the participants experienced.

As mentioned in the results of Study 3, the participants who changed their mind, claiming it was for the right statistical reason, experienced more regret than those who didn't change their regret based on a flawed understanding of statistics. While the studies and theories referenced in the introduction see regret in the post-decision period either as a result of commission or omission (or in the case of Festinger, cognitive dissonance), it is hard to say why the participants should feel more regret after making a rational and correct choice in Study 3. It is possible that the experienced post-outcome regret in Study 3 is better explained as a result of the *changing* the choice, and not as a result of an commission error. This might be linked to counterfactual thoughts (Kruger et al., 2005; Roese et al., 1999), as the participants might have generated more "if only I had not" thoughts after changing the choice.

4.3   *Individual differences*

There are several factors which might have influenced if the participant in the three Studies changed their mind or not. In order to test how individual differences might influence the amount of regret experienced, several single-item personality measurements and the Maximization and Regret scales were measured in each study. Using a bivariate correlation analysis none of the single-item questions had any significant correlations with whether the participant changed their mind or not. For the Regret and Maximization scale a bivariate regression analysis found only one weak significant correlation with the participant changing their mind: in the second study there was a correlation between the Regret scale score and whether the participant used the chance to change the offer or not ($r=.282$, N=50, $p=.047$). As the significance was quite weak and the explorative analysis quite extensive, it is possible that

this single significant correlation was due to chance.

One of the main hypotheses (H4) was that individual differences would influence the amount of post-outcome regret. Doing an explorative bivariate correlation analysis between both pre-outcome and post-outcome regret and variables with possible relevance for the experienced regret revealed, perhaps not surprisingly, that the strongest predictor for the post-outcome regret was the pre-outcome and ad-post-outcome regret. The difference in regret between those who changed their mind and those who did not was shown in Figure 4, 5 and 7 earlier. That the amount of post-outcome regret is influenced by the pre-outcome regret is not surprising for those who did not change their mind, but it is more surprising how consistent the regret was on the next measurements. The pre-outcome regret was in fact slightly more predictive for the post-outcome regret than the ad-post-outcome regret. In the tables below the significant variables are listed with the Pearson's correlation, significance (2-tailed) and number of participants for all three studies. Whether the correlation is significant at the .05 level or .001 level is signified by * or ** respectively.

Table 4: Significant correlations with pre-outcome regret in the three studies

	Study 1			Study 2		
	Correlation	Sig	N	Correlation	Sig	N
Number of interactive attempts	.480**	.000	55	.184	.268	24
Age	-.437**	.001	55	.149	.296	51
Gender	-.302*	.025	55	.071	.622	51
Regret scale	.254	.061	55	.277*	.049	51
Choice changed	.765	.000	27	.735	.000	24
Opportunity to change choice	.003	.983	55	.277*	49	51
Maximisation scale	.257	.058	55	.182	.201	51
(Post-outcome regret)	.626**	.000	55	.733**	.000	51
(Ad-post-outcome)	.485**	.000	49	.483**	.000	51

Note that only half of the participants were polled on pre-outcome, so the significances are weaker in Table 4 than in Table 5. Pre-outcome regret was not polled in Study 3. Perhaps not surprisingly, those who made a lot of interactive attempts (step 7 in the procedure) also experienced more regret.

Table 5: Significant correlations with post-outcome regret in the three studies

	Study 1			Study 2			Study 3		
	Correlation	Sig	N	Correlation	Sig	N	Correlation	Sig	N
Regret scale	.319**	.001	109	.255**	.010	100	.063	.420	168
Choice changed	.318*	.019	54	.300*	.035	50	-.185*	.016	168
Age	-.310**	.001	109	.001	.990	100	-.028	.719	168
Maximisation scale	.237**	.004	109	.284**	.004	100	-.024	.762	168
Value of gift-card	-.267**	.005	109	-.244*	.015	100	n/a	n/a	n/a
Bid accepted	-.235*	.014	109	n/a	n/a	n/a	n/a	n/a	n/a
Q1 single-item	-.227*	.018	109	-.120	.236	100	-.084	.281	168
Q7 single-item	-0.129	.182	109	.002	.983	100	-.155*	.044	168
Opportunity to change choice	-.166	.85	109	.115	.254	100	n/a	n/a	n/a
Pre-outcome regret	.626**	.000	55	.733**	.000	51	n/a	n/a	n/a
(Ad-post-outcome)	.643**	.000	100	.619**	.000	98	.570**	.000	148

In Study 1 the "Bid accepted" variable in Table 5 is either true or false, indicating whether the participant is in the draw for a gift-card based on the result, or for a consolatory 100 NOK gift-card. The Q1 single item is the question "generally speaking, how happy would you say that you are these days?", while the Q7 single item is "I often act on impulse." "Opportunity to change" indicates whether the participant had the opportunity to change the bid or offer, while "Choice changed" indicates whether the participant actually did so. In the table the ad-post-outcome is in parentheses, as it is measured up to one week after the post-outcome. The correlations for post-outcome regret were more significant than for pre-outcome regret, but this might be because half as many participants were polled for pre-outcome as compared to post-outcome. An interesting finding for post-outcome regret is that the scores on the Regret and Maximization scales correlate strongly with the amount of post-outcome regret for Study 1 and 2, but not for study 3. The Regret and Maximization scales will be discussed further in the next chapter.

One possible reason for the differences in significant correlations found in Study 1 and 2 is that these studies were performed within two weeks of each other. It took more work to recruit participants for the second study, so the two groups of participants might not be drawn from the same population of students. Study 3 was done some 3 months later, and it was significantly easier to recruit participants.

4.4   A further examination of the Maximization and Regret scales

The questions in the Shortened Maximization scale (Schwartz et al., 2002) can be split into three factors, or dimensions (Nenkov et al., 2008). The three dimensions found by Nenkov were labelled as follows: *Alternative search*, which measures the tendency to seek better options, *Decision difficulty*, representing the difficulty associated with choosing and making decisions and *High standards*, or the tendency to have high standards for themselves and things in general. The individual questions, their Norwegian translation and which dimension the questions belong to are listed in the appendix, Table 8. While the total scores have been used so far, it is worth examining, if as suggested by Nenkov et al. (2008), any of the dimensions of the Maximization scale have a higher correlation with the experienced regret than the total score on the Maximization scale. (Correlations marked with ** and * are significant at the 0.01 level, and at the 0.05 level respectively.)

Table 6: Correlated regret with the sub-scales of the Maximization scale and the Regret scale

Regret measured in	Alternative Search	Decision Difficulty	High Standards	Regret
Study1:				
Pre-outcome: (N=55)	.262	.161	.022	.254
Post-outcome: (N=109)	.260**	.124	.134	.319**
Ad-post-outcome: (N=100)	.024	.080	.061	.188
Study2:				
Pre-outcome: (N=51)	.232	.152	-.064	.277*
Post-outcome: (N=100)	.258**	.241*	.032*	.255*
Ad-post-outcome: (N=98)	.117	.152	.072	.299**
Study3:				
Post-outcome: (N=168)	.058	-.084	-.030	.063
Ad-post-outcome: (N=136)	.101	.068	.176*	.090

As can be seen from Table 6 it is the Alternative Search sub-scale which most strongly correlates with the amount of regret reported for the two first studies. The difference between the two first studies and the third study is also evident, as neither the Regret scale nor Maximisation scale correlated with the reported post-outcome regret in the third study. A possible explanation is that there was more room for maximization *behaviour* in Study 1 and 2. Maximisation behaviour might increase the amount of post-outcome regret experienced for the participants who also score highly on the Maximisation scale, leading to the correlation

between post-outcome regret and the Maximization and Regret scales for Study 1 and 2. That it is the Alternative search sub-scale which explains most of the variance in the Maximization score can perhaps be explained by interactive try-out period in Study 1 and 2. The interactive try-out period is a way of searching for alternatives, by trying to figure out which offer was most suitable.

That the Decision Difficulty dimension only correlated with regret for the second study might at least in part be explained by the complexity of the games used. The Trust game, which was used in the second study, might have been experienced as more demanding, as it required the participant to imagine how much the other part would transfer back of the tripled investment, while the Ultimatum game in the first study was a more simple judgement of fairness, and the result from the Wheel of Fortune in the third study appeared to be random.

The Maximization and the Regret scales have been found to be strongly correlated (Schwartz et al., 2002). In all three studies the correlations were significant on the 0.001 level (2-tailed), with Pearson correlations of .514, .553, and .573 respectively between the Regret and Maximisation scales for each of the three studies. It is likely that the scores on the Regret and Maximization scales should correlate with other factors besides the amount of regret reported by the participants. One possible hypothesis is that the score on the Maximization scale should correlate with the number of times the participant tried the interactive try-out in step 7 of Study 1 and 2. In Study 1 the number of attempts correlated strongly with the Regret Scale ($r=.289$, $p=.002$), while the Maximization Scale was correlated with only a 0.06 significance. No such significant correlations were found for Study 2. While the Maximization scale correlated well with the post-outcome regret in Study 1 and 2 it seems to be less able to predict actual maximization behaviour.

For the third study an additional question was added to further explore the reasons for changing the original choice. In addition to the 11 questions on the Regret and Maximization scales (see the appendix, Table 8) a 12th question was added, "I often change my mind without knowing entirely why". This question was added under the assumption that people (if any) who change their opinion without entirely knowing why in general, might also do so in the specific experiment they took part in. The question had a r of .181 ($p=.019$) with if the chosen date was changed. The question was also negatively correlated with single-item Q2, "How optimistic are you to your chances of winning in this game?" ($r=-.63$, $p=.020$, N=168), and

strongly correlated with Q3, "When I make plans I'm almost certain that I'll go through with them." (r=-.261, p=.001, N=168).

The 12th question did not correlate with the reported regret at either the post-outcome or the ad-post-outcome measurements of regret, but it did correlate strongly with the Regret Scale (r=.290, p=.000, N=168), and not quite as strongly with the Maximization Scale (r=.193, p=.012, N=168). It is interesting that neither the Regret nor the Maximization scales correlated with whether the participant changed the date or not in the third study, but the extra 12th question correlated with both scales, in addition to correlating with if the participant changed the date or not. While it is possible that the direct nature of the question ("I often change my mind without knowing entirely why") merely reveals that many participants didn't know why they changed their date, this was not evident when they were asked why they changed (see Table 3). Another possible explanation is that the question in part measures an underlying personality trait, separate from the Maximization and Regret scales, but which might lead to more maximization and regret inducing behaviour.

4.5   Effects of the experiment design on experienced regret

As mentioned in chapter 3.2.1 there were several possible concerns with regards to Study 1 and 2: The demanding nature of the games, the complicated pay-off structures, and finally that the games might have given the participants a feeling of control, and that their choices ("skill") had an effect on the outcome. These three factors might have influenced the amount of regret experienced. The third study was designed to mitigate these problems, by using a simpler design with a much less complicated pay-off-structure, and what at least appeared to be a "luck based" game.

The main differences between the two first studies and the third is that the Maximisation and Regret scales didn't correlate with the post-outcome regret in Study 3, while it correlated strongly in Study 1 and 2 (see chapter 4.4 for the discussion of this). The reason for this might be the design of the games. In the two first Studies the participants could express maximizing behaviour by using the interactive try-outs. In Study 1 the mean time spent on the interactive try-outs was 109 seconds (SD=116), while in Study 2 it was 142 seconds (SD=65). While there where no significant correlations between the Maximisation scale and time spent on the interactive try-outs in Study 1 or 2, it is possible that the opportunity to express maximisation behaviour in Study 1 and 2 might have caused some of

the participants to express both more post-outcome regret, and higher scores on the Maximisation scale.

Even with the changes, the post-outcome regret was significantly stronger for those who changed their mind than for those who didn't, even if they did so for the right reason. (See chapter 3.2.2 for the discussion of hypothesis H5a.) This supports the possibility that at least part of the post-outcome regret for those who change their mind is related to the action of changing their mind, and not a result of a commission error.

4.6   The effect of temporal distance between measurements

There is some support for the notion that regret has a tendency to fall over time (e.g. Gilovich & Medvec, 1995 for real-life regrets). While the mean level of regret either decreased between the post-outcome and ad-post outcome measurements or stayed the same for all three studies, the time period between the outcome measurement and the ad-post-outcome measurement allows for a more precise calculation of exactly how much the regret changed. As the participants took part in the experiments on-line, they were free to take part in the studies until the morning before the final draw. In Study 1 the mean number of hours between the first participant and the last was 122 (SD=90, min=23, max=339), in Study 2 the mean was 182 (SD=54, min=4, max=429), and for Study 3 the mean was 219 (SD=98, min=22, max=765). Is there a relation between how much time has passed and changes between the post-outcome and ad-post-outcome regret? This was explored using a regression analysis of correlation between the number of hours between finishing the first part of the experiment and the amount of change in the regret (calculated by taking ad-post-outcome regret minus the post-outcome regret). For Study 1 the result was $r=-.039$, $p=.701$, N=100, for Study 2 $r=.006$, $p=.951$, N=98 and for Study 3 $r=-.077$, $p=.354$, N=147. For Study 1 the mean change in regret was 0.150 (minimum -5, maximum 6 with a SD of 1.64), for Study 2 -.0176 (minimum -6, maximum 6, SD=1.76), and for Study 3 -.533 (minimum -6, maximum 4, SD=1.680).

In conclusion, there do not seem to be a strong correlation between the change in regret and the number of hours between the survey of post-outcome regret and ad-post-outcome regret. It is possible that the limited amount of time between the post-outcome regret measurement and the ad-post-outcome regret measurement was insufficient for any significant difference to appear.

4.7 Methodological concerns with using web-based experiments

A common concern with experiments is obtaining the required number of participants for getting significant results. To lower the effort required to take part in a study, the three experiments in this report were all performed on the web, where all a participant had to do to participate was to click on a link in an email, or type in the address from a flyer. Is it possible that the setting of the experiment have had an effect on the results? One possibility might be that by using a web page and invitations by email makes it likely that the participants are self-selected, and that some potential participants might feel too busy to participate. The importance of recruitment can be illustrated by the difference in the number of participants in the three studies: In the two first studies a lecturer for the largest psychology class did PR for the study and in addition to the first invitation the psychology students also received a reminder that they could participate in the study. For the third study it was much easier to recruit participants, which might be explained by two factors: The maximum possible gift-card value was considerably higher, and the invitations stated that the game was very simple and only would take 5 minutes. It is probable that this made participating much more of an impulse action, which in addition to the "pure luck" aspect might have influenced the amount of regret that the participants experienced in the third study.

There have been some studies comparing paper based questionnaires with web based versions (Gosling, Vazire, Srivastava, & John, 2004; Ritter, Lorig, Laurent, & Matthews, 2004), which have found that the results from web based questionnaires are consistent with those of paper based studies, if some steps are taken. Gosling et al. lists six preconceptions about internet methods (p.95). As participation in the three studies performed for this paper was limited to invited psychology students, and some basic protections from multiple submissions was in place, it is likely that at least the answers to the scales and individual questions are reliable.

The three studies presented would have had to be performed as laboratory experiments if they were not implemented on the web. It should still be mentioned that if the three studies were replicated in a more "serious" setting, such as in a traditional laboratory, there would be a different selection of students (those willing to make an appointment and actually go to the laboratory), as well as the participants perhaps taking the study more seriously during the experiment than when taking part on impulse. It is likely that these two factors would have had an effect on the results. Still, it appears that the participants took the study seriously, and

only a small number tried to cheat. In the third study, with 168 participants, 3 were "caught" in trying to going back to redo their choice. This was such a small number that it did not have any effect on the results presented here.

4.8   Possible future studies

The findings in the three studies lend themselves to a number of new possible research questions. One topic which hasn't been covered is if there is a connection between regret and memory. A common assumption (e.g. Miller & Taylor, 1995) is that there is a connection between a strong feeling of regret and the participants' memory of the situation. While how well the participants remember the experiment they took part in wasn't measured in any of the three studies, it would be fairly simple to do so, e.g. by polling the participants in one of the studies on how much their offer was, if they changed their mind or not, and perhaps ask again how much they regretted their (remembered or actual) choice. It is also possible that there is connection between the personality of the participant and the direction that the memory takes. Do people who score higher on the Regret scale remember the experiment differently than others? A prediction based on research on bias and memory (e.g. Levine & Safer, 2002) is that participants who scored strongly on the Regret scale would also remember their regret more strongly.

As mentioned earlier, a possible factor which might explain the difference in regret experienced by those who changed their mind versus those who did not between the two first studies and the third, is the amount of perceived control of the outcome experienced by the participants. It is possible that some of the perceived control comes from stable personality traits, such as Rotter's (1954) concept of locus of control. The Locus of Control concept was represented with the single-item question Q3 ("When I make plans I'm almost certain that I'll go through with them"), but this question did not correlate strongly with the amount of regret reported. Using a larger questionnaire which attempts to measure the general control felt by the participants might help explain more of the variance in the reported regret.

The 12th question introduced in Study 3 after the Regret and Maximization scales, "I often change my mind without knowing entirely why" raises questions which might be worth further investigation. The answers on the question correlated with the Maximization and Regret Scales and more importantly, it correlated with if the participant actually changed their mind, something the Maximization and Regret scales did not do for Study 3. The relationship,

if any, between often changing your mind without knowing why and experienced regret, both in the short and long term might be worth further exploration.

5 Conclusion

The main purpose of this paper was to examine regret in decision making, with a particular focus on the regret experienced when changing decisions. Study 1 and Study 2 strongly suggests that people regret their choices before the outcome is known, which lends some credibility to the two-stage model introduced by Kirkebøen and Teigen (2008). In fact, it might seem that people have stronger feelings of regret before the outcome is known than after. As I've shown, the amount of regret is influenced by the design of the experiment. If the participants take part in a game where they have a chance to practice and gain insight they seem to experience a larger amount of regret, in particular if the insight leads to the participant changing the original choice. In the two first studies the participants who changed their choices felt the most regret after the outcome. In the third study, where the game was based more on perceived luck than skill, the difference in regret for those who changed their choice was still significantly higher, even if doing so was the rational choice. This might indicate that the act of changing a decision in itself might increase the amount of regret experienced.

The three studies illustrate the possibility of using simple economic games to test psychological hypotheses. It might be appropriate to quote Reinhard Selten, one of the three game theorists to share the 1994 Nobel Prize together with Nash and Harsanyi, who said: "Game theory is for proving theorems, not for playing games" (Selten quoted in Goeree & Holt, 2001, p. 1419) , but that does not mean that the games used in economic theories, and the theories created to explain the results according to game theory, can't be combined with psychological theory.

6   References

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7   Appendix 1: Scales and single-item questions

Table 7: Single-item scales

	Norwegian (original)	English (translation)	Concept
Q1	Generelt sett, hvor fornøyd vil du si at du er for tiden?	Generally speaking, how happy would you say that you are these days?	Life satisfaction, similar to the question used in Inglehart (2000).
Q2	Hvor optimistisk er du til vinnersjansene dine i dette spillet?	How optimistic are you to your chances of winning in this game?	Optimism
Q3	Når jeg legger planer er jeg nesten sikker på at jeg vil gjennomføre dem	When I make plans I'm almost certain that I'll go through with them.	Locus of control, Rotter (1954)
Q4	Hvor ofte hjelper du andre selv om du ikke må?	How often do you help others even if you don't have to?	Altruism
Q5	Hvordan vurderer du dine ferdigheter til å forstå og regne med tall?	How do you estimate your skill in understanding and doing calculations?	Numeracy
Q6	En bør i størst mulig grad greie seg selv i livet	One should as much as possible manage on your own in life.	Individualism
Q7	Jeg gjør gjerne ting på impuls	I often act on impulse.	Low self control/Sensation seeking Zuckerman
Q8	En får som regel som en fortjener i livet	You usually get what you deserve in life.	Just world theory (Lerner, 1980)
Q9	I hvilken grad mener du selv at du er i stand til å ta andre menneskers perspektiv, altså se situasjoner fra andres ståsted?	To what degree do you think you are able to take other people's perspective, that is, see situations from another's point of view?	Empathy / taking other's perspective

All of the single-item questions were scored on a 7 item likert scale.

Table 8: Maximization and Regret scales

	Norwegian (translation)	English (original)	Scale
1	Når jeg hører på radio i bilen sjekker jeg ofte andre stasjoner for å se om de spiller noe bedre, selv om jeg er relativt fornøyd med det jeg hører på	When I am in the car listening to the radio, I often check other stations to see if someting better is playing, even if I am relatively satisfied with what I am listening to.	Max 2/AS
2	Når jeg gjør et valg er jeg alltid nysgjerrig på hva som hadde skjedd om jeg hadde valgt annerledes	Whenever I make a choice, I'm curious about what would have happened if I had chosen differently.	Reg
3	Uansett hvor fornøyd jeg er med jobb eller studier så er det riktig for meg å være på utkikk etter bedre muligheter	No matter how satisfied I am with my job, it is only right for me to be on the lookout for better opportunities.	Max 4/AS
4	Om jeg gjør et valg og det går bra føler jeg meg mislykket om jeg finner ut at et annet valg ville ha gått bedre	If I make a choice and it turns out well, I still feel like something of a failure if I find out that another choice would have turned out better.	Reg
5	Jeg finner det ofte vanskelig å handle en gave til en venn	I often find it difficult to shop for a gift for a friend.	Max 7/DD
6	Når jeg tenker på hvordan det går med meg i livet tenker jeg ofte på muligheter som jeg ikke benyttet meg av	When I think about how I'm doing in life, I often assess opportunities I have passed up.	Reg
7	Uansett hva jeg gjør så har jeg de høyeste standardene for meg selv	No matter what I do, I have the highest standards for myself.	Max 11/HS
8	Å leie filmer er veldig vanskelig. Jeg strever alltid med å finne den beste	Renting videos is really difficult. I'm always struggling to pick the best one.	Max 9/DD
9	Når jeg har tatt en beslutning så ombestemmer jeg meg ikke (R)	Once I make a decision, I don't look back. (R)	Reg
10	Jeg slår meg aldri til ro med det nest beste	No matter what I do, I have the highest standards for myself.	Max 12/HS
11	Når jeg gjør et valg prøver jeg alltid å skaffe informasjon om hvordan det gikk med de andre alternativene	Whenever I make a choice, I try to get information about how the other alternatives turned out.	Reg

The number in parentheses behind "Max" is the the question number from the 6 item shortened Maximization Scale from Nenkov, Morrin, Ward, Schwartz, & Hulland (2008). The

code following the number is the dimension the question belongs to, where AS=Alternative search, DD=Decision difficulty, and HS=High standards. The "Reg" (regret) questions are the 5 highest loading questions from the Regret Scale in Schwartz et al. (2002)

In the third study a 12th question was added: "I often change my mind without knowing entirely why" ("Det hender ofte jeg endrer mening uten helt å vite hvorfor").

Table 9: Possible reasons for changing your mind in the Wheel of Fortune if the participant changed their date:

	Norwegian	English
e1	Jeg bare følte for det	I just felt like it
e2	Jeg trodde det økte sannsynligheten for å gjette riktig	I thought it would improve the probability of guessing correctly
e3	Det var mer spennende å prøve en annen dato	It was more exciting to try another date
e4	Jeg spurte og fulgte andres råd	I asked and followed someone else's advice
e5	Den nye datoen jeg valgte betyr noe spesielt for meg	The new date I picked means something special for me
e6	Aner ikke	No idea

Table 10: Possible reasons for changing your mind in the Wheel of Fortune if the participant did not change their date:

	Norwegian	English
b1	Jeg bare følte ikke for det	I just did not feel like it
b2	Jeg så ingen grunn til å skifte	I saw no reason to change
b3	Jeg mener en bør holde på det første valget en tar	I think one should keep one's first choice
b4	Det ville ikke endret sannsynligheten for å gjette riktig	It would not change the probability of guessing correctly
b5	Jeg spurte og fulgte andres råd	I asked and followed someone else's advice
b6	Datoen jeg valgte betyr noe spesielt for meg	The date I picked means something special for me.
b7	Aner ikke	No idea.

Table 11: Questions for measuring regret

Study	Norwegian (original)	English (translation)
1	Forestill deg at du hadde muligheten til å prøve på nytt. Ville du ha ( ) øket budet ditt ( ) redusert budet ditt.	Imagine that you had a chance to try again, would you have ( ) increased your offer ( ) reduced your offer.
	I hvilken grad vil du nå si at du ..	To what degree would you now say that you..
	... angrer på at du ikke tilbød **mer** enn det tilbudet du ga på \<bud\> kroner?	… regret that you did not offer **more** than the offer you gave of \<offer\> kroner?
	... angrer på at du ikke tilbød **mindre** enn det tilbudet du ga på \<bud\> kroner?	… regret that you did not offer **less** than the offer you gave of \<offer\> kroner?
2	Forestill deg at du hadde muligheten til å prøve på nytt. Ville du ha ( ) øket overføringen din ( ) redusert overføringen din.	Imagine that you had a chance to try again, would you have ( ) increased your transfer ( ) reduced your trainsfer.
	I hvilken grad vil du nå si at du ..	To what degree would you now say that you..
	... angrer på at du ikke overførte **mer** enn \<bud\> kroner?	… regret that you did not transfer **more** than \<offer\> kroner?
	... angrer på at du ikke overførte **mindre** enn \<bud\> kroner?	… regret that you did not transfer **less** than \<offer\> kroner?
3	I hvilken grad vil du nå si at du ...	To what degree would you now say that you..
	... angrer på ditt valg av dag og måned (dato)?	... regret your choice of day and month (date)?
	.. angrer på at du [ikke] ombestemte deg?	... regret that you did [not] change your mind?

In Study 1 and 2 the first question was binary, while the next two questions were scored on a likert scale with 7 items from "do not regret" (angrer ikke) to "regret strongly" (angrer sterkt).