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Feeling overconfident today:

Does mood affect a person's level of overconfidence?

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Abstract:

Moore and Healy (2008) distinguish 3 sub categories of overconfidence: (1) overestimation of one's actual performance, (2) over-placement of one's performance relative to others and (3) excessive precision in one's belief (over-precision). This paper examined to what extend a person's mood influences these 3 types of overconfidence. To do so, a survey was conducted. The 131 respondents were allocated between two treatment groups and a control group. In one treatment a sad mood was induced within the participants and in the other treatment a joyful mood. These mood induction procedures were used as the primary proxy for the subjects' mood. In addition, the participants had to provide their current mood on a 1 to 7 Likert-scale. This scale was used as an auxiliary proxy for mood. The results of the non-parametric tests revealed a significant correlation between the reported mood of participants and their level of overestimation and overplacement. This implies that when participants stated that they felt more joyful they also tended to overestimate and overplace themselves more. There was however insufficient evidence to conclude that participants who participated in the sad group were less overconfident than participants in the neutral group or the joyful group.

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Chapter 1 Introduction.

An expending body of literature, both theoretical and empiric, has linked moods and emotions to cognitive decision making. It is quite straightforward that mood affects behaviour and the outcome of certain behaviour in turn influences mood. However, to what extend and through which channels mood affects decision making processes is more complex and abstract (Schwarz, 2000). Baillon, Koellinger, & Treffers (2015) have shown that mood can influence people's attitude towards ambiguity. In their paper sad subjects showed more ambiguity-neutral behaviour than non-sad participants. Being ambiguity-neutral was considered rational, as the research was held under circumstances were being ambiguity-neutral led to a higher pay-off than being ambiguity-averse or ambiguity-seeking.

Overconfidence is a widely debated bias which causes people to overestimate their abilities, knowledge and influence over certain events. Overconfidence has both its positive and negative sides, as (over)confident people on average are more pro-social, happier and, have better job prospect. At the same time overconfidence causes people to ignore or overlook information and take more risk, it causes entrepreneurs to start businesses in saturated markets. According to Moore & Healy (2008) overconfidence is often used as an umbrella term for three different forms of persons overestimating themselves, namely overestimation, over-placement and over-precision. The first term refers to overestimating your own abilities. The second term implies people have the tendency overestimate themselves compared to others. The third definition of overconfidence implies that people tend to overestimate the precision of their probabilistic judgements. This thesis aims to shed some light on how moods interact with the level of the three the definitions of overconfidence. To do so I formulate the following research question:

Does mood affect a person's level of overconfidence?

In order to answer the research-question a survey has been conducted for this paper. The design of the questionnaire was based on the experiment that was run by Moore and Healy (2008). In addition to their design mood induction procedures were added in order to be better able to measure the correlation between moods and overconfidence.

The structure of this paper is as follows: *chapter 2* discusses relevant literature, focusing on overconfidence, its subcategories and the effect of mood on cognitive decision-making. Subsequently, *chapter 3* outlines the conceptual framework. Next, *chapter 4* formulates an ideal experimental which would be desirable if more resources were available. *Chapter 5* describes the actual study design used for this paper and *chapter 6* outlines and discusses the results.Finally, *chapter 6* discusses and concludes this paper.

Chapter 2 Literature Review.

2.1 Overconfidence

Overconfidence is the tendency to overestimate one's own abilities and knowledge. Furthermore, it describes people's propensity to have an illusion of control - in situations in which they do not - and underestimate risk. Although confidence in general is a desired quality, overconfidence can lead to detrimental and unfavourable results. Previous studies found correlations between overconfidence and excessive trading, high frequencies of entrepreneurship despite the large probability of failure, and the relatively large amount of mergers and acquisitions (Koelinger, Minniti & Schade, 2007; Cooper et al., 1988; Moore & Healy, 2008). In certain circumstances overconfidence can also be beneficial for a person (Adams & Finn, 2006). For instance, someone's overconfidence can be seen as a signal of competence, which may lead to better jobs, collaboration prospects and social status (Anderson et al., 2012).

The classic economical paradigm describes humans as individuals who update their belief about their abilities in a Bayesian manner. However, studies in the field of social psychology have shown that in reality agents deviate from this model and update their beliefs asymmetrical. People tend to focus rather on their successes and disregard their failures, when they recollect their past. This phenomenon is called the confirmation bias and causes a skewed perception of their skills and attributes. Humans therefore tend to believe they perform above average and regard their chances in life as more favourable than they really are (Mobius et al., 2011). Weinstein (1980) discovered that people tend to underestimate risks in situations where they have a certain level of control. They therefore underestimate the likelihood of getting into a car crash or become addicted. Another example is when investors and managers believe that their stocks, or the stocks they intend to buy, are going to outperform other stocks Although this optimism leads to biased decision making, it also generates happiness and productivity. Barber & Odean (2001) show that an individual's overconfidence can differ depending on features of tasks to be completed. One's overconfidence tends to increase when an objective involves more uncertainty, complexity or has a higher difficulty. It also increases based on the perceived lack of skill of the competition and/or the lack of a decent feedback mechanism.

2.1.1 Types of overconfidence

Moore & Healy (2008) argue that, before their paper was published, overconfidence was studied in inconsistent ways. They distinguish 3 subcategories of overconfidence: *overestimation, over-placement* and *over-precision* in order to make overconfidence better measurable and interpretable.

Overestimation refers to people overestimating their own abilities, knowledge, level of control level and performance. Their subjective probability of a positive (negative) outcome is often higher (lower) than the actual probability. Previous research found numerous situations in which overestimation occurs. For example, many investors overestimate their ability to select well-performing stock. They consequently engage into excessive trading, which causes them to underperform due to transaction costs (Gervais & Odean, 2001). Langer (1975) revealed that people often think they can exert control in situations where they cannot. This bias is called the *illusion of control* and causes people to become inappropriately confident. Also people tend to overestimate the extend and relevance of their knowledge (Hall, Ariss & Todorov, 2007). We often assume we have a deep understanding of concepts and theories, while actually our knowledge only scratches the surface. Theories, that often seem crystal clear in our heads, become fragmented and inconsistent once we have to explain them to others or write them down (Rozenbit & Keil, 2002). Furthermore, persons in the possession of irrelevant information tend to be too confident in their ability to forecast outcomes. But in reality, they lose precision by focussing on the irrelevant information, meanwhile neglecting statistical information. For example, sports fanatics who know the names and birth data of athletes think this information gives them the upper hand when predicting the outcome of a match. This phenomenon is called the *illusion of knowledge* (Hall, Ariss & Todorov, 2007). Another example of overestimation is the *planning fallacy*. People tend to systematically underestimate the time they will need to complete a task. While planning the timeline of a task, they rarely consider their past experiences with similar tasks and rather focus on optimistic plan-based scenarios. As a result, they do not start on time (Buehler, Griffin & Ross, 1994).

Over-placement means that people tend to think they perform above average in their reference group. This subcategory of overconfidence is highly affected by the perceived difficulty of the involved tasks and the perceived skill of the reference group. One of the main reasons Moore & Healy (2008) make this explicit distinction between overestimation and over-placement is that they do not always move in the same direction. This means that persons who overestimate (underestimate) themselves can still under-place (over-place) themselves. For example, the perceived difficulty of a task tends to affect over-placement in a different way than overestimation. When performing easy tasks humans have a propensity to underestimate themselves, as their ability to assess themselves is imperfect. However, their ability to assess others is even more biased. In other words, while executing easy tasks, individuals underestimate themselves, but they underestimate others even more. Hence, they simultaneously tend to over-place and underestimate themselves. The opposite happens when a task is perceived as difficult to perform. This phenomenon is called *the hard-easy effect* (Moore & Healy, 2008; Suantak, Bolger & Ferrell, 1996; Moore & Small, 2007).

A well-known example of over-placement is the study by Svenson (1981). He asked American and Swedish students if they believed they were better than the median driver. 69% of the Swedish and 93% of the American participants answered yes. This is obviously not possible, as only less than 50% can be better than the median. A more recent example is the study done by Montier (2006). He surveyed 300 fund managers, asking them whether they believed to perform above average. 74% of the sample believed to perform above average, the remaining 26% believed to be average. Noteworthy is that – an impossible – nearly 100% of the sample believed to be average or better. However, Zábojník (2004) argues that these studies are too eager to conclude that people are overconfident, when more than 50% of the samples states they are above the average or median. In reality the true distribution of drivers may be skewed in such a way that more than 50% of the population does perform above the average, making the median hard to identify. He gives an example where biased information updating can still be considered rational. For example, there is a situation containing an equal number of safe and unsafe drivers. If we distinguish the bad drivers from the good drivers when they cause an accident, the majority of the drivers – both the good drivers and the bad drivers who have not yet caused an accident – will report themselves as a good and above average driver. Zábojník (2004) therefore cautions researchers to interpret over-placement data with care.

In practise over-placement is a possible explanation why we observe such a high number of people becoming entrepreneur, despite the fact that only 25% of them end up earning more through their own company than they would with a normal job and salary. This phenomenon is mostly observed in crafts that are easy to learn - such as opening a bar - as easy tasks induce over-placement (Camerer & Lovallo, 1999: Koellinger, Minniti & Schade, 2007: Fischhoff et al., 1977)

The third type is *over-precision.* This is the phenomenon where people overestimate the precision of their probabilistic judgements. For example, when persons are asked to provide a lower- and upper-bound for the length of the Nile, they tend to give too narrow an interval. The combination of overestimation and over-precision causes CEOs & CFOs to overestimate the yearly return of their firm and underestimate the volatility of the firm's stocks and cash flow.

These three constructs of overconfidence are measured differently and cause different detrimental effects. It is therefore important to treat them as different entities, especially since overestimation and over-placement tend to move in opposite direction in certain circumstances (Moore & Healy, 2008)

2.1.2 The causes of overconfidence

Barberis and Thaler (2003) distinguish two sub-biases – the *hindsight bias* and the *self-attribution bias* – that affect the level of overconfidence. Adams & Finn (2006) introduce two more decision-making biases that affect the level of overconfidence: The *confirmation bias* and the *over-valuation bias*. Above mentioned biases, that cause persons to have a better feeling about their skills in order to provide cognitive ease, are called *self-serving biases.*

The *hindsight bias* refers to people's tendency to believe that they were able to predict past events. For example, very few people did actually foresee the bust of the Dotcom bubble, but many said -in hindsight- that they did. Because people think they were able to predict those events, they also tend to overestimate their ability to forecast future events. CEOs, CFOs, managers and other investors suffering from this bias are likely to take more risk (Rizzi, 2008).

The *self-attribution* biases refer to people's tendency to attribute successes in life to their own skills and effort and failures to external forces. This causes people to update their beliefs about their own skills in a biased manner. Consequently, they become overconfident, as they do not obtain a realistic perception of their own abilities by focusing solely on their achievements (Miller & Ross, 1975). According to Koriat, Lichtenstein & Fischhoff (1980) people do not only underweight their own influence on their failures, but frequently ignore their missteps altogether. This is caused by a phenomenon called the *confirmation bias*, which refers to people's tendency to recollect the successes and failures of their past in such a way that is the most gratifying. By subconsciously reshaping the perception of their successes in life, their level of overconfidence tends to increase.

Mobius et al. (2011) show that individuals do not only tend to update asymmetrically, but are also conservative in updating their beliefs. This implies that an individual – in contrary to a perfect Bayesian - only partially adjusts the perception of his skills, when confronted with a negative or positive signal. In their experiment subjects incorporated on average only 35 % of the information of a given signal in their adjustment whereas a perfect Bayesian would incorporate100%. Subjects who received positive feedback were more willing to incorporate the information than those who received negative feedback. On average those who received positive feedback incorporated 15% more information in their next decision than those who received negative feedback of the same magnitude. This phenomenon is likely the result of the self-serving bias.

Biases that mainly enhance over-placement are the *over-valuation* bias and the *base-rate fallacy*. The over-valuation bias is similar to the illusion of knowledge and one of the main reasons why people are willing to bet on sports and stock. Someone affected by the over-valuation bias believes that he is in possession of a unique piece of information or talent that gives an edge over the competition. Affected gamblers base their bet on this piece of assumed information, instead of betting on the line. According to Adams & Finn (2006) this deviation from the line is also a deviation from rationality as the line represents the collective average of the information of all betters.

While making a decision, people often do not use all the available information. Instead they base their decisions on the information that is the easiest to be retrieved from memory and thus the most salient. This is often information based on own experiences, retrieved from friends or made very salient by media. People often rely too much on this information and tend to neglect the base-rate altogether (Russo & Schoemaker, 1992: Bar-Hillel, 1980)

According to Russo & Schoemaker (1992) the cognitive bias that is the most associated with over-precision is *anchoring*. Anchoring refers to the tendency to stick with a previous given piece of information while making a subsequent judgement. For example, when asked to estimate a confidence interval, people tend to base their numbers on a previous given but not necessary relevant anchor. In order to explain how anchoring affects over-precision, Soll & Klayman (2004) propose a model with three different entities. The first entity is a perfectly calibrated and non-existing person. If this person sets a confidence interval $A \pm D$ (where A is his point estimate and D the adjustment from this point estimate to set a upper- and lower bound), with for example 90% certainty, the interval will always contain the true value of the object 90% of the time. The second entity is a perfectly rational person (Econ). Although he is perfectly rational, the econ is less knowledgeable, more prone to error and will therefore provide a confidence interval $A \pm D + \mathcal{E}$. The noise term ($\mathcal{E}$) has mean zero and is not correlated with A & D. Because of the shape of the normal distribution – where the density is the largest in the middle and decreases towards the tails - an inward error due to $\mathcal{E}$ will lead to more overconfidence than an outward error will lead to underconfidence. The third example entails a peasant who is the most relatable to humans in general. This peasant suffers in addition to the noise ($\mathcal{E}$) from a narrowing factor (b). The peasant therefore has the following subjective probability distribution function $A \pm bD + \mathcal{E}$, where ($0 < b < 1$). The lower the value of b, the narrower the set confidence interval, thus the more the displayed over-precision. Narrowing is a result of adjusting too little from the point estimate (A) due to anchoring.

2.1.3 The effect of demographics on overconfidence

Previous studies have found links between overconfidence and gender and age (Benington et al, 2002). Barber & Odean (2001) argue that overconfidence is a trait that is more observed among men than women. For example, overconfident male portfolio managers tend to trade more than their female counterparts. Due to transaction costs and a better calibrated perception of their skills, female investors tend to outperform their male counterparts. Other studies have shown that overconfidence is also predominant in males in other fields than finance (Mobius et al, 2011). Gervais & Odean (2001) introduce a model that shows that financial traders overconfidence peaks shortly after the start of their career. At the start they are moderately overconfident, but once they start trading the self-attribution bias causes them to become more overconfident. As they age they learn to better assess their own skills which will lead to a reduction in overconfidence. According to Gervais & Odean (2001) age has a non-linear relation with overconfidence. Positive at first and negative once an individual learns to update his beliefs less asymmetrically.

2.1.4 Overconfidence in finance

According to Barberis & Thaler (2003) overconfidence is one of the most important components of behavioural finance. This trait is frequently observed in CEOs, CFOs and other key figures in the financial sector. Goel & Thakor (2008) show that overconfident managers are more likely to become CEO than their risk neutral or risk-averse colleagues. This implies that overconfidence is a trait observed more frequently among CEOs than among the general population. Furthermore, they argue that a moderate overconfident CEO outperforms a rational and risk-averse CEO under the optimal contract with regards to maximizing shareholder value. Risk-averse CEOs tend to underinvest, when the optimal contract is in place, where moderately overconfident CEOs invest sufficiently to meet the shareholders' expectancies. Mildly overconfident CEOs have the best chance to flourish in innovative sectors, as their propensity to excessively innovate, invest and acquire patents has the highest probability to lead to success in innovative sectors (Hirshleifer, Low & Teoh, 2012)

Ben-David, Graham & Harvey (2010) show many CFOs are miss-calibrated and therefore use too narrow intervals to forecast future returns. This causes them to overinvest in projects using higher debt leverage than would be considered rational. Malmendier & Tate (2008) investigated why mergers and acquisitions are so frequent, while they on average rather destroy value than create it. They discovered that an overconfident CEO has a 65% higher probability to engage in an acquisition, as they overestimate their ability to create value in both their own firm and potentially acquired firms. Both CEOs and CFOs often think that external parties undervalue their firm. The probability of an acquisition increases if they have the means to finance the takeover with cash flows or debt-financed money instead of equity.

2.2 Moods

Emotions are the body's response to events, thoughts and other stimuli. Usually emotions are an unconscious process. When emotions turn into a conscious process they are called feelings. Basically emotions have two dimensions: arousal and valence. The term arousal is used to describe general excitement, accompanied with the bodily response, ranging from low to high. Valence describes the hedonic value of an emotion ranging from negative through neutral to positive (Zamsoy, 2015). Moods can be described as "temporary states of mind", which are more persistent than emotions and feelings (Schwartz, 2000). This part of the literature review starts with a brief summary of previous research on the relations between mood, emotions and cognitive decision-making. Thereafter, factors that affect mood and mood inducing procedures will be discussed.

2.2.1 Moods & cognitive decision making

Loewenstein (2000) argues that emotions and moods affect a person's decision-making behaviour in a substantial way. Emotions tend to drive choices into a direction that deviates from the long-term optimum. When making decisions under uncertainty people do not solely rely on logic. In order to conserve energy, they use heuristics to quickly decide which option to choose. Heuristics however are biased and prone to error. One of these heuristics is called the *affect heuristic,* a mental shortcut based on emotions. People link words and events to emotions, based on previous experiences. Depending on whether previous experiences invoke a positive or negative emotion people are able to decide whether they like the option within a second and without logical evaluation (Tversky & Kahneman, 1974). Lucey & Dowling (2005) showed that investors often incorporate the affect heuristic in their decision-making process, which can be an efficient tool. However, their mood is easily influenced by irrelevant factors, such as the personal circumstances or the weather. Good weather for could cause them to become over-optimistic about a buying a certain stock. This will result in a judgement error, as the weather and the stock are not connected. Furthermore, Lucey & Dowling (2005) argue that investors also buy equity based on whether they like the company or not. Their sentiment regarding the company is however not related to the stock's performance and therefore should not influence their decision. This phenomenon where mood negatively influences the outcome of choices under uncertainty is called *mood-misattribution.*

There is a substantial amount of literature that ties moods and emotions to cognitive processes. For instance, people are more likely to remember a certain event if the mood at the time was congruent with their current feelings. People experiencing a sad episode are said to be more conservative than people experiencing felicity. Happy and content people are in turn more sure about their own ideas and opinions (Schwarz, 2000). Lichtenstein, Fischhoff & Phillips (1977) found that in general people suffer from an *optimism bias*. This refers to people's habit to overestimate the probabilities of positive outcomes. Alloy & Abramson (1979) argue that being in a depressed state reduces overconfidence. Individuals influenced by a depressed mood therefore have a reduced bias toward optimism and make better-calibrated choices. In a recent experiment Baillon, Koellinger & Treffers (2015) found that sad people display more ambiguity-neutral and payoff-maximizing behaviour while making choices under uncertainty.

Lyubomirsky, King & Diener (2005) argue that positive affectivity induces confidence, optimism and pro-social behaviour. Well-tempered people are more likely to pursue goals and engage in activities. When confronted with choices they tend to be more creative and make better use of heuristics. Furthermore, happy people tend to have more energy and are better able to channel their energy in positive and productive directions (Staw & Barsade, 1993). Currently there is a discussion going on about which states of mind cause a person to make the best choices, known as the "sadder but wiser vs. happier and smarter debate "(Staw & Barsade, 1993; Kuvaas & Kaufmann, 2004).

2.2.2 Factors affecting mood

Lucey & Dowling (2005) found that moods are affected by factors such as a person's biorhythm, social events and the weather. Howarth & Hoffman (1984) found correlations between a person's mood and the weather. The level of humidity and the hours of sunshine within a day positively affect a person's optimism. Scepticism is positively correlated with the amount of rain per day and temperatures and, negatively correlated with the hours of sunshine per day. Saunders (1993) examined how the weather affects New York City's stock traders. He discovered that returns were significantly higher if the cloud coverage was between 0 – 20%, which is considered a sunny day, instead of near 100%, which indicates a gloomy and rainy day. These results were robust against the January- and weekend effect and, infer that weather affects mood, which tends to affect stock returns.

2.2.3 Mood inducing procedures

Moods can also be induced within subjects on purpose for scientific research, in order to test how this affects decision-making behaviour. Mayer et al. (1995) summarize mood inducing procedures (MIPs) developed in social psychology and cognitive sciences. To induce moods within a subject one can use the van *Velten mood induction method*, *music induction*, *facial expression*, *social interaction*, *solitary recollection*, *film clips* and *feedback methods* (see appendix B for a brief description of these methods). They found out that combining various methods have the largest impact on a subject's mood. For example, a combination of methods that focus on active cognitive processes and another method that sets a background atmosphere. Westermann et al. (1996) found that negative MIPs on average have a stronger impact on mood than positive MIPs. They compared 11 MIPs and concluded that the presentation of a story or movie in general has the largest impact on a subject's emotional state. The greatest effect was achieved when they instructed subjects beforehand to enter a specific mood.

Not all the procedures have the same success rate in affecting a subject's mood. In her paper Martin (1990) provides a rough success rate for several techniques. She argues that music, autobiographical recall, solitary recollection and presenting a film all have a success rate above 75%. Other procedures such as self-statement, social recollection, facial expression and social feedback have a success rate of approximately 50% to induce the desired mood within a participant.

Mood is not perfectly tangible and is therefore hard to measure. In previous studies social psychologist tested how MIPs affected subjects by looking at changes in physical expressions and relying on self-reported information of the subject. The problem with self-reported information is that it is hard to verify if the subject is (willingly) telling the truth. Another serious problem with MIPs is that it is possible subjects do not enter the desired mood but pretend to do so, as this is expected from them. This phenomenon is called the *demand effect* and causes biases in the obtained data. This effect is most often observed when subjects are explicitly instructed beforehand to enter a specific mood (Westermann et al., 1996).

Chapter 3 Framework.

In order to measure how mood affects overconfidence, I propose the following framework; Mood influences peoples' perception of themselves and their abilities. A person influenced by positive affectivity has a more optimistic view of his abilities. As opposed to a person influenced by negative affectivity. Mood is a latent variable, as it is not directly observable. Although different types of mood can often be recognized through observing body language, tone of voice and the way they express their self it hard to measure it. This thesis however, is based on an online survey and therefore lacks the means to directly observe participants' expressions or measure their mood through previously mentioned equipment. Instead it relies on 2 proxies for mood to measure its influence on overconfidence: Mood induction treatments as main proxy and self-reported mood as an auxiliary proxy. The figure below visualizes the framework.

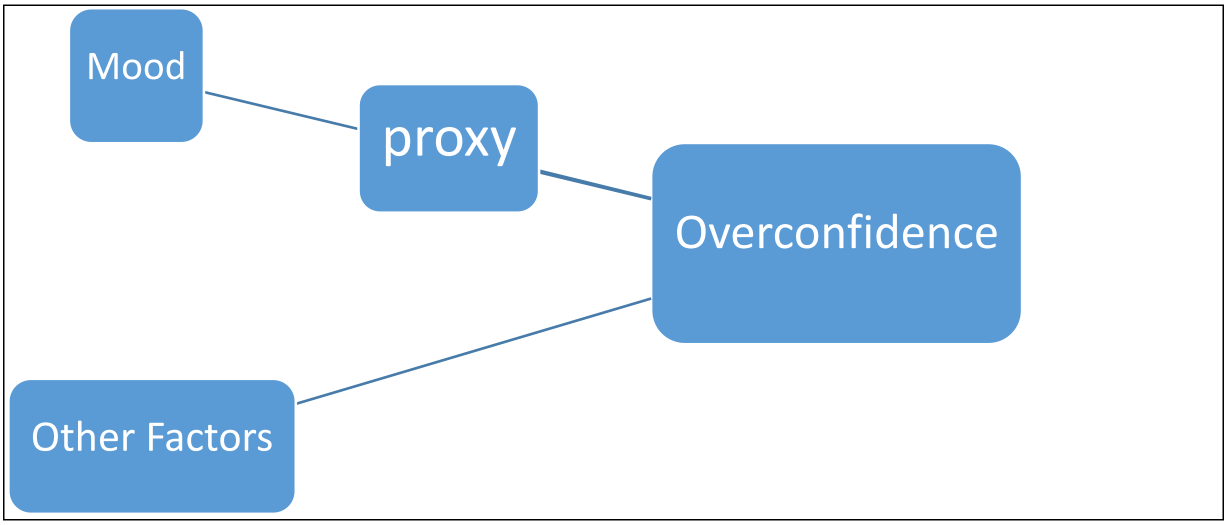

Figure 1. Conceptual Framework

Chapter 4 Hypothetical experimental design.

This section outlines a hypothetical experiment that could be implemented - when having sufficient resources - to test the effect of mood inductions on the level of overconfidence. The resources for this paper were however limited. The experimental design that was actually used - and tries to approximate the hypothetical experimental design as much as possible - is described in chapter five.

The hypothetical experimental design will be a combination of Moore and Healy's (2008) method and two mood induction procedures. The study will use a between-subject design, which entails that each subject only participates once in either the control group or one of the two treatment groups. The between-subject design prevents the learning effect, but increases the variance of the error term, as different subjects have different characteristics. This can be partially compensated by increasing the subject pool.

4.1 Procedure.

The mood induction procedure will be partially based on the experimental design of Baillon, Koelinger & Treffers (2015). At the beginning of the experiment subjects will be randomly allocated to one of the three groups. The three groups consist out of a joyful group, a sad group and a control group. Once subjects are randomly allocated to one of the three groups they will be induced with either a joyful or sad emotional state using emotionally charged film clips. Using emotionally charged film clips has proved to be very effective in inducing an either negative of positive mood within a subject (Westermann, 1996). Before and after subjects undergo the MIP they are asked to fill in the Positive And Negative Affect Schedule (PANAS-X) (see appendix C for the PANAS-X form). The PANAS-X can be used to examine whether subjects experienced a change in their respective mood, due to the MIP. The control group fills in the PANAS-X only once, as they are expected not to undergo sudden mood changes while participating in the experiment. The MIPs are the independent variables in this experimental design.

After the MIP part of the experiment has been completed the eliciting of the different levels of overconfidence between groups starts. In order to prevent information spill overs, all three sessions should be held simultaneously. The mood eliciting part contains one round per participant as opposed to Moore & Healy's design, which contained 18 rounds per participant. Reason for this is that the effect of the mood induction might wear of over time. The round will exist out of 18 questions, divided over six categories. The categories are “science & nature”, “literature & art”, “geography”, “entertainment” and “sports” based on Trivial Pursuit. Every category will contain an easy, normal and hard question to moderate the “hard-easy” effect. To prevent an “order effect” the sequence of questions will be randomly distributed among subjects. Before and after answering the 18 questions, subjects have to predict the probability (p) that they would obtain each of the 19 possible scores, in such a manner that the sum of the probabilities add up to 100%. For example, a participant can predict she will answer 10 questions correctly with 40%, 11 questions with 40% and 12 questions with 20% probability, which sums up to 100% probability. They have to do the same estimation for a randomly selected previous participant (RSPP).

4.2 Dependent variables and hypotheses

Overestimation will be modelled as follows: Participant i estimates how many of the 18 questions she thinks she will or has answer(ed) correctly and assigns a probability to each possible score, as explained in the example above. This elicits her subjective probability distribution $p = (p_0, p_1, \dots, p_{18})$ for each possible score. Her estimation $E(x_i)$ is computed by multiplying each of the nineteen possible scores by its reported probability, and summing these products. For instance, the estimation of the participant in the above mentioned example would be $0.4 * 10 + 0.4 * 11 + 0.2 * 12 = 10.8$. This construct will be compared to the number of questions she actually answered correctly x_i. Her overconfidence will be identified as $E(x_i) - x_i$. When $E(x_i) > x_i$; i has overestimated herself by $E(x_i) - x_i$. When $\mathrm{E}(x_i) < x_i$; i has underestimated herself by $x_i - E(x_i)$. Participant i estimated her score correctly in case $E(x_i) = x_i$. The corresponding hypothesis for this dependent variable is:

H1: The level of overestimation is different between mood treatments

Over-placement will be modelled as follows: In addition to her beliefs about herself, participant i will be asked to estimate the score of her assigned RSPP $\mathrm{E}(x_j)$. Similar to $E(x_i)$, $E(x_j)$ is constructed by multiplying each of the nineteen possible scores by its reported subjective probability, and summing these products. The level of over-placement can be identified as $(E(x_i) - x_i)) - (E(x_j) - x_j)$. This is participant i’s miss-estimation of herself ($\mathrm{E}(x_i)$- x_i)) subtracted by her miss-estimation of her assigned RSPP ($\mathrm{E}(x_j)$ - x_j). Each participant will be randomly allocated to another using the random- and sorting functions of Excel. The random allocation is done in order to examine to what extent participants overplace themselves with respect to the RSPP. The accompanied hypothesis for this dependent variable is:

H2: The level of over-placement is different between different mood treatments

Over-precision is measured by looking at the subjective probability distribution obtained from the probabilities provided for each possible score. This will be compared to the actual probability distribution of the scores. Furthermore, estimated probabilities of obtained scores will be compared with the actual probabilities of scores. The following hypothesis is formulated for this dependent variable:

H3: The level of over-precision is different between different mood treatments

4.3 Statistical analysis

H1 and H2 can be tested by comparing the median of a treatment group to the medians of the other treatment groups. The Jonckheere-Terpstra is the most suited for this examination. The obtained data is categorical and there is a prior expected order between treatments. The expected level of overconfidence should on average be the highest for the happy group and the lowest for the sad group. Therefore, the Jonckheere-Terpstra test is preferred over the Kruskal-Wallis test and parametric tests. H3 can be tested using the Levene variance test, the Brown-Forsythe test or the F-test for equal variances. Finally, the Wilcoxon signed-rank test can be used to examine if participants update their estimations after answering the trivia.

4.4 Payment scheme.

This paragraph will outline and discuss the payment scheme used by Moore & Healy (2008) and propose a payment scheme for the desired experimental design.

Participants in the experiment of Moore & Healy (2008) had three opportunities to earn rewards:

(1) They were paid $25r$ euro's (where r is their percentile rank compared to all other subjects that completed the quiz) for their score in the trivia quiz.

(2) Before starting the quiz, participants were asked to predict the probability (p) that they or their assigned RSPP would realize each of the possible scores. The subjects provided their subjective probability distribution $p = (p_0, p_1, \dots, p_{10})$ where p_i ($i \leq 1$) refers to the probability that a particular score is realized. For providing correct estimations participants were paid according to the *quadratic scoring rule*: Participants received $1 + 2p_j - \sum_{i=1}^{n} p_i^2$

euro's, where j is the actual score participants or their RSPP obtained. For example: A participant answered 6 questions correctly and she estimated that she would answer 5 questions correctly with 30%, 6 questions with 40% and 7 questions with 30 % certainty. She then would have received $1 + 2 * 0.40 - 0.30^2 - 0.40^2 - 0.30^2$ euro's for estimating her own score correctly with 40% certainty. The payoff for her estimation part would be the highest if she correctly estimated her own or her RSPP's score with a 100% certainty, as $2p_j \ = 2$ and $\sum_{i=1}^{n} p_i^2 \ = 1$. She consequently will receive €2 for the estimation. Should she have incorrectly estimated the scores with a 100% certainty, she would not receive money for her estimation, as $2p_j \ = \ 0$ and $\sum_{i=1}^{n} p_i^2 \ = 1$.

(3) After finishing the trivia questions, participants were once again asked to estimate the probability (p) that they or their RSPP would realize each of the possible scores. They consequently were paid according to the quadratic scoring rule as explained above.

From an economic point of view, the payment scheme used by Moore and Healy may cause a discrepancy with regards to the participants' incentives and their desired behaviour. The first problem that could occur is that participants, who think they are not good in answering trivia questions, will falsely estimate that they will answer all questions wrong. They subsequently will deliberately answer all trivia questions incorrectly, such that their estimations of their own scores are 100% accurate. However, this is only a dominant strategy if they are very certain that they are not able to answer more than a few trivia questions correctly, as this strategy will yield 4 euro's at most (this strategy does not affect their accuracy regarding their estimations of their RSPP's score). Nonetheless it reduces the validity of the research.

The second problem with this payment scheme is that it does not account for *diminishing marginal utility*. This implies that each new euro brings in less utility than the prior one, as people tend to view monetary consequences in terms of changes from a reference point. The reference point is their initial wealth at the start of the experiment. The further an additional gain is from this reference point the less they are willing to invest effort in difficult tasks. (Kahneman & Tversky, 1979). Participants that have scored high on the trivia questions are substantially rewarded. This reward may decrease their motivation to optimally perform in the next task, which is the post-trivia estimations. This problem is likely to occur because the possible reward for the post-trivia estimations is relatively low. Especially since the quadratic scoring rule is complicated and therefore often not fully comprehended or partially ignored by subjects (Artinger, Exadaktylos, Koppel, & Sääksvuori 2010).

In cognitive psychology there is a distinction between *declarative knowledge* – subjects' knowledge of the world – and *procedural knowledg*e – the skills needed and strategies involved to utilize declarative knowledge in solving problems (Camerer & Hogarth, 1999). In this case, participants will use their declarative knowledge to solve the trivia questions and their procedural knowledge to estimate the score. In this paper, we are particularly interested in the participants' abilities to correctly estimate their own abilities and those of others. However, to properly measure the participants' true level of overconfidence, it is utterly important they answer both the trivia and estimate the scores to the best of their abilities.

Implementing a *random lottery incentive system (*RLIS) could be a way to reduce the diminishing marginal utility problem. RLIS implies that participants perform multiple tasks, of which only one randomly chosen task is actually paid for. This prevents participants from accumulating wealth during the experiment, which could change their reference point (Starmer & Sugden 1991)

The pay-off for the post-trivia estimations should be increased in such a way that it matches the pay-off for answering the trivia questions correctly, since only one of the tasks will be randomly selected and paid for. To prevent participants form manipulating their answers, they are not told about the post-trivia estimations beforehand. Instead they will be instructed that they will either be paid for correct answers or for another yet to be revealed cognitive task.

In this situation the pre-trivia estimations are still a problem, since participants can still decide to faulty answer the trivia in order to increase the pay-off of these estimations. A necessary trade-off is not paying subjects for their pre-trivia estimations and instead rely on their intrinsic motivation to provide estimations to the best of their abilities. This negates their motivation to deliberately manipulate their trivia question answers. This decreases the validity of the pre-trivia estimations since participants are not rewarded for their effort but at the same time increases their validity since participants are no longer tempted to manipulate the experiment. This way the validity of the trivia questions and post-trivia estimations are preserved.

Summarizing, participants will not be paid for their pre-trivia estimations. Instead they will either be paid for their score on the trivia questions or their post-trivia estimations. A possible payment scheme that incorporates the random lottery incentive system can be as follows: Participants receive a 5 euro show up fee. Subsequently, they will either receive 1 euro for each correctly answered question or $4.5 + 9p_j - 4.5\sum_{i=1}^{n} p_i^2$ for estimating[1] their own score and their RSSP's score, depending on outcome of the RLIS. There is a small chance that some subjects will predict that they must estimate their scores again after the test, based on having to do a pre-estimation. This could be an incentive to answer all trivia incorrectly and afterwards make them estimate that they incorrectly answered all their questions in order to have a 50% chance to get a maximum payoff for estimating their own score. This is however a risky, ambiguous and unlikely strategy, since they have no way of knowing what the second task involves. Nonetheless it would be wise to first test this payment scheme, before applying it on a large scale.

[1] ($p = (p_0, p_1, \dots, p_{18})$ where p_i ($i \leq 1$) and j is the actual score participants or their RSPP obtained)

Chapter 5 Applied experimental design.

Due to a lack of resources the design described in the previous section cannot be executed. This chapter will outline the experimental design that approximates the desired design as much as possible without having to pay the participants. A cheap and easy way to gather data is to use an online questionnaire. The survey used for this paper was made with the software from Survey Monkey (surveymonkey.nl). In total three versions of the online questionnaire were made:

- A version containing a joyful MIP (As proxy for a happy mood)
- A version containing a sad MIP (As proxy for a sad mood)
- A control version without a MIP (As control group)

Appendix D contains a copy of the used survey and the different mood inducing procedures.

5.1 Survey and method

The methodology of using the MIP's to measure how mood affects cognitive decision-making is partially based on the method used by Baillon, Koellinger & Treffers (2015). In their paper they investigated whether different emotional states – sadness, fear, felicity and neutral – had an effect on peoples' attitude towards ambiguity. In order to measure the effect of mood on ambiguity, they used MIPs as proxies. In this case emotionally charged film clips (frightening, sad or happy, depending on the treatment).

The MIPS used for this paper – a music procedure and a solitary recollection MIP – are selected from the list of MIPS described in Martin's (1990) paper. According to Mayer (1995) both procedures have an above 75% probability to induce the desired mood within a subject, especially when used simultaneously. The combined effect of the solitary recollection- and music MIP is arguably weaker than a procedure using film clips (Westerman et al., 1996). However, asking voluntary participants to watch a film clip of 5 to 10 minutes would be a bit too much, as they did not get paid. Film clips shorter than 5 minutes are unlikely to induce the desired mood.

5.1.1 The survey

The moment a participant opened the survey, emotionally charged music automatically started to play. In the opening statement of the survey participants were explicitly asked not to turn down/off the music while filling in the survey. In addition, they were asked to think for the duration of 3 minutes about two moments in their life that made them feel:

- Happy and loved (in case of the happy treatment)
- Sad and alone (in case of the sad treatment)

For control and internal validity purposes subjects were asked to briefly describe the two events. The advantage of this method is that it requires less time than film clips. A possible disadvantage is that they can be more volatile. This is due to the fact that some participants may have experienced happier or sadder events in their life than others. It is also likely that some of the participants are reluctant to think about their sadder moments. Film clips should give a less volatile effect as everyone experiences the exact same event.

The survey contained 4 pages. When a participant went on to the next page a new song started to play, in order to maintain the emotional state of the participant. After writing down their emotional experiences, participants were asked to state their current mood on a 1 to 7 Likert-scale. On this scale 1 corresponds with very sad and 7 with very happy. Using the PANAS-X would give richer information regarding the participants' emotional state. However, including PANAS-X would require too much time of the participants. The survey was already very long and therefore it was decided to use a simple Likert scale in order to examine mood. Respondents also had to fill in their perception of the weather, while they filled in the survey (sunny, cloudy or rainy).

The second and main part of the questionnaire is based on the study design used by Moore & Healy (2008). After the MIP and the mood assessment, the subjects were asked to answer 18 pop quiz questions. The pop quiz questions were based on Trivial Pursuit and divided in 6 categories (Sports, History, Entertainment, Arts/ Literature, Geography and Science). In order to moderate the hard-easy effect each category contained a hard-, neutral- and easy question. The hard-easy effect entails that people on average underestimate themselves when asked easy questions. They are well-calibrated for neutral questions and overestimate themselves for hard questions. Furthermore, people generally tend to under-place themselves with easy tasks and over-place themselves while executing difficult tasks. All questions are open and based on - but not identical to- the questions previously used by Moore & Healy (2008).

Before participants answered the pop quiz questions, they were asked to predict scores in a number of ways (see figure 2). First, they had to estimate how many of the 18 questions they expected to answer correctly. They subsequently were asked to estimate a *range* of correct answers they expected to give with a 90 % certainty in order to provide a confidence interval. Finally, they were asked to estimate the score of a RSPP.

3) Next you have to answer 18 general knowledge pop quiz questions. It is important you answer them using your own knowledge. Please do not look for the answers on the internet.

Before you look at the questions, can you estimate how many of the 18 questions you'll answer correctly?

I think I will answer __ out of the 18 questions correctly.

4) Can you provide an interval, such that you are 90% certain that it will contain the correct answer?
I am 90% sure that I will answer between __ and __ questions out of the 18 correctly

5) How many of the 18 questions do you think a randomly selected previous participant will answer correctly?

I think he will answer __ out of the 18 questions correctly

Figure 2. Estimation Questions

Notes: Question 3 is used to elicit overestimation, question 4 to elicit overprecision and question 5 to elicit overplacement.

In order to examine if participants adjusted their beliefs after having completed the trivia test, they were asked to provide the same three estimations again, immediately after they finished this part of the questionnaire. The emphasis of this paper will be on the after estimations, as it impossible for participants to adequately estimate their scores before they see the trivia questions. This will likely cause the before estimations to be more random and contain more variance and therefore it will be less likely that significant results will be found.

The last part of the questionnaire contained questions about demographics and personality traits, in order to get more information on other variables that might affect the level of overconfidence, such as age, gender, education, religion, level of conservatism, level of competiveness, self-image and sibling information.

5.1.2 Auxiliary proxy: Self-reported mood

One of the questions participants were asked is to state their mood on a scale of 1 to 7. This paper will use self-reported mood as an auxiliary proxy in order to determine whether mood has an influence on levels of overconfidence.

Self-reported data through surveys is a very popular method in both behavioural and marketing science, as it is an easy and cheap way to identify relations between scores and behaviour. The use of self-reported data however has some limitations that can threaten the internal validation of the research and is therefore often debated. The self-reported data were therefore tested for consistency, before using it as an independent variable. This was done by examining whether the self-reported data can consistently forecast other variables, that should be highly correlated or causal in this case the MIPs and the weather. Unfortunately, the weather turned out to be consistently sunny, so there is not much variance in the weather that can explain mood (Austin et al., 1998).

There are several reasons why self-reported scale data can be biased. Self-reported data faces honesty issues, since participants may be not completely honest while providing self-reported data. The level of dishonesty can increase when the information is more personal and when the level of privacy decreases. Subsequently, the data also relies on the introspective ability of the subject. Even if participants are completely honest, they may fail to accurately estimate their current mood. The third problem is the interpretation of the scale. The perception of which number on the scale corresponds with what mood may differ amongst participants. Therefore, even if subjects are honest and are able to accurately evaluate their own mood, they can still provide information that causes biases in the data (Austin et al., 1998).

5.1.3 Dependent variables and hypotheses

The dependent variables are constructed slightly different as described in the hypothetical experimental design. Overestimation, over-placement and over-precision are constructed as described below. This paper will examine whether the level of overestimation, over-placement and over-precision is different for different moods.

Overestimation will be modelled as follows: Participant i estimates how many of the 18 questions she will answer or has answered correctly $E(x_i)$. This will be compared to her actual score x_i. Her overconfidence will be identified as $E(x_i) - x_i$. When $E(x_i) > x_i$; she has overestimated herself by $E(x_i) - x_i$. When $E(x_i) < x_i$; she has underestimated themselves by $x_i - \mathrm{E}(x_i)$. In case $E(x_i) = x_i$ she estimated her score correctly. The accompanying hypothesis for this dependent variable is:

H1: The level of overestimation is different in different treatments

Over-placement will be modelled as follows: In addition to her beliefs about herself, participant i will be asked to state her beliefs about the score of a random selected previous participant $E(x_j)$. The level of over-placement can be identified as $(E(x_i) - x_i)) - (E(x_j) - x_j)$. This is the participant's over- or underestimation of herself, subtracted by her under- or overestimation of the RSPP. All participants will be randomly paired to a RSPP using the random- and sorting functions in Excel, in order to examine to what extent participants over-placed themselves with respect to the RSPP. The second hypothesis of this paper is:

H2: The level of over-placement is different in different treatments

Over-precision is often measured by asking the participants to provide an interval $[E(x_i^-), E(x_i^+)]$, that contains the true value of the objective with 90% certainty. If they provide a too small interval they are over-precise. Their answers are considered over-precise if $x_i < E(x_i^-) < E(x_i^+)$ or $E(x_i^-) < E(x_i^+) < x_i$. They are well-calibrated if $E(x_i^-) < x_i < E(x_i^+)$. In this thesis over-precision is measured by asking participants to estimate a *range* of correct answers they expect to give with a 90 % certainty in order to provide a confidence interval. The third hypothesis of this paper is:

H3: The level of over-precision is different in different treatments.

Besides the effect of the MIPs on levels of overconfidence, this paper will also examine whether the level of overconfidence varies amongst levels of self-reported mood. To do so, this paper tests the same three dependent variables. The last three hypotheses of this paper are:

H4: The level of overestimation varies amongst levels of self-reported mood

H5: The level of over-placement varies amongst levels of self-reported mood

H6: The level of over-precision varies amongst levels of self-reported mood

5.1.4 Statistical analysis

This paragraph outlines which statistical tests are used to analyse the hypotheses. Hypotheses 1 and 2 will be tested by comparing the medians of all three treatment groups. Three non-parametric tests are used to analyse the results of the questionnaire:

1. The Jonckheere-Terpstra test (When groups have a ranked order)
2. The Kruskal-Wallis test (In case groups do not have a ranked order)
3. The Fisher-exact test (In case there are many ties)

The Jonckheere-Terpstra test is preferred over the Kruskal-Wallis, as there is an expected prior ordering of the outcome of the treatments: Sad MIP subjects will be less overconfident than those in the neutral group and neutral group subjects are expected to be less overconfident than the respondents in the happy MIP group. For control purposes the Kruskal-Wallis test is applied. The dependent variables overestimation and overplacement are discrete and have limited outcomes, which could result in a high number of ties between treatment groups. Since both the Jonckheere-Terpstra and the Kruskal-Wallis test are not good in dealing with ties, a 3x3 Fisher-Exact test will also be executed. Furthermore, the Mann-Whitney-U (MWU) test is used to examine whether the level of overconfidence is different between two out of three groups.

Hypothesis 3 will be tested using a 2 x 3 Fisher-exact test. The dependent variable "over-precision" is either 0 (not over-precise) or 1 (over-precise). The independent variables are the 3 different treatments.

The Wilcoxon signed-rank test is used to examine if the level of overestimation and overplacement for participants was different before and after answering the trivia-questions. Over-precision is a binary variable, and is therefore examined using the McNemar test. In addition, the interaction between the treatments and how participants adjusted their estimations is examined, by looking at the difference in overconfidence between the pre-trivia estimations and the post-trivia estimations. The significance of this difference is tested using the Kruskal-Wallis test for overestimation and overplacement. The Fisher-Exact was used to test if there is an interaction between the three groups and the difference in overprecision before and after the trivia questions.

Hypotheses 4 to 6 are tested using the same three tests as were used for testing H1 - H3. The Jonckheere-Terpstra test will be used to examine if the level of overestimation and overplacement is different between the 7 scales of self-reported mood. The Jonckheere-test is preferred, since prior ordering is to be expected. In addition, the Kruskal-Wallis test and the Fisher-exact test are used to get a more complete picture of the data. Mood, overestimation and over-placement were divided in 3 categories in order to use the Fisher-Exact test properly. The variables are transformed in 3 categories because there are not enough observations to do a Fisher-Exact (Chi-Squared) test with 7 self-reported mood levels and all possible outcomes of overestimation and overplacement. The mood categories are also used to examine the difference in overconfidence between the before and after trivia question estimations, as there are too few observations to apply the signed-rank test and McNemar test on each of the 7 scales of self-reported mood.

In appendix A Table 1.1a and Table 1.1b is shown how the mood and overconfidence variables are divided amongst the categories. Overestimation and over-placement will be tested using a 2x3 test and over-precision using a 2x3 Chi-squared test.

Chapter 6 Results

In this chapter the experiment's results are outlined. Paragraph 1 describes the features of the used sample. Subsequently the results of the non-parametric test are shown and discussed. Finally, different models using OLS-regressions are presented and discussed.

6.1 Sample and descriptive statistics

Sample collection

In an ideal research situation subjects would have been randomly assigned to each treatment, which would have prevented over- or underrepresentation of certain characteristics in various treatments, as this could cause demographic interference. Another way to obtain more significant test results is to collect a sample as homogenous as possible. This would minimalize the variance of the error term, by reducing different characteristics of respondents to a minimum. A group consisting of only Dutch students aged between 20 and 25 for instance would have been optimal. However, using such a homogenous sample would cause the results to be only externally valid for this specific group.

However, the means to collect a sample that meets the above mentioned criteria were not available. During the data gathering process it became clear that some subjects were reluctant to participate in the sad treatment. Although the versions of the survey were randomly distributed, the response rate for the control group was larger than the sad treatment group. At some point there were only 11 responses for the sad treatment while the neutral group contained 32 responses. Unfortunately, the survey program "Survey Monkey" only registered replies if at least the first page was filled in completely. This made it impossible to examine how many participants decided not to continue with the questionnaire due to their reluctance against the sad MIP. To meet the criteria of a minimum of 30 subjects per treatment the sad treatment version was then also distributed through another channel. The average age of respondents that were collected through this channel was significantly higher than the original channel. This may have affected the outcome of this research. Only after receiving the required minimum of 30 observations for the sad MIP and neutral group, the happy MIP version of the questionnaire was distributed.

The sample used for this thesis consists out of 131 observations: 46 in the sad MIP group, 49 in the neutral group and 36 in the joyful MIP group. The gender distribution entailed 54 males and 77 females. The percentage of males: females for each treatments is as follows: 41:59 in the sad MIP group, 37:63 in the neutral group, 47:53 in the happy MIP group. So each group has more female than male respondents. The age variable is not evenly distributed, as the mean age in the sad group is 46.7, while the mean age of the neutral and happy group are 22.8 and 26.7 respectively. The mean age of the total sample is 30.57 and the median is 25.

The weather during the sample collection period was almost consistently sunny. Table 1 displays the number of weather observations for each treatment group and table 2 displays the average and median mood amongst treatment groups.

Table 1 - Weather Types Frequencies per Treatment

Weather / Group	Neutral	Sad	Happy	Total
Rainy	0	2	2	4
Cloudy	12	6	4	22
Sunny	37	38	40	107

Table 2 – Average and Median Mood per Treatment

Treatment group	Median Mood	Average Mood
Neutral	5	4.67
Sad	4	3.91
Happy	5	4.89

Notable is that there is not a substantial difference in mood between the neutral group and the happy group. The mood of the sad group is approximately .75 point lower than the mood in the neutral group and almost 1 point lower than the happy group. A possible explanation for these small differences can be the almost consistently sunny weather at the time of the sample collection. The uplifting influence of the weather may have nullified a portion of the effect of the MIP in the sad group. It is also possible that participants were already in an uplifted mood because of the weather and therefore the happy MIP may have had less effect. Table 3 below provides an overview of the participants' average score, their estimations of their own score and the RSPP's score per treatment.

Table 3 - Average Estimations and Scores per Treatment

	Neutral group	Sad group	Happy group
Actual score	8.81	9.82	10.18
Own score estimation before	10.22	10.85	11.31
Own score estimation after	8.49	9.07	9.33
Estimation score of the RSPP before	10.27	10.91	10.86
Estimation score of the RSPP after	8.92	9.63	9.31

The average score as the highest in the happy group and the lowest in the neutral group. The Kruskal-Wallis-test found evidence that scores differed slightly between treatments (P-value 0.0835). However, the MWU test showed that the scores of the sad group did not significantly differ from the happy group ($p = 0.346$) and the neutral group ($p = 0.162$). The scores of the neutral group were however significantly lower than those of the happy group ($p = 0.032$). Participants on average overestimated themselves before answering the questions in all three treatments. Participant on average underestimated themselves in all groups after answering the questions. Both the Jonckheere-Terpstra test and the Kruskal-Wallis test found no evidence that respondents' estimations differed between treatment ($p = 0.34$ & $p = 0.11$ before) and ($p = 0.46$ & $p = 0.39$ after). The Wilcoxon Signed-rank test revealed that participants' estimations of both their own score and the RSPP's score were significantly higher before than after the trivia test ($p < 0.001$ own & $p < 0.001$ other RSPP).

The mean of correctly answered questions was 9.5 in total. The average score of male participants was 10.5 and females scored on average 8.85. This could indicate that the topics of the trivia questions were more within the interest sphere of men. The MWU test confirmed that the scores of men where significantly higher ($p = 0.0014$). On average participants displayed more underconfidence than overconfidence. This is with the exception of over-placement among men, which is moderately positive. Table 4 contains the average level of overconfidence and table 5 contains summary statistics of the most important variables. Table 5 shows that women on average are less confident than men. They on average underestimate themselves by 0.87 compared to men and under-place themselves by 1.19 compared to men.

Table 4 – average overconfidence per gender

After	Overestimation	Over-placement
Total	-0.62	-0.36
Male	-0.18	0.31
Female	-1.03	-0.88

Table 5 – Summary Statistics

Variable	Mean	Median	Std. deviation	Min	Max
x_i	9.55	10	2.96	3	17
Mood	4.47	5	1.17	1	7
Male	0.41	0	0.49	0	1
Age	30.89	25	14.65	15	70
Estimations Before Trivia Questions					
$E[x_i]$	10.74	10	3.34	3	18
$E[x_j]$	10.66	10	2.58	4	16
$E[x_i^-]$	6.94	7	3.85	0	17
$E[x_i^+]$	13.21	14	3.82	3	18
Overestimation	1.19	1	3.86	-10	12
Overplacement	0.07	0	4.87	-15	17
Overprecision	0.36	0	0.48	0	1
Estimations After Trivia Questions					
$E[x_i]$	8.92	9	3.53	2	16
$E[x_j]$	9.27	9	2.55	4	16
$E[x_i^-]$	6.35	6	3.74	0	16
$E[x_i^+]$	10.69	10	4.00	3	18
Overestimation	-0.62	-1	2.63	-6	8
Over-placement	-0.36	0	4.24	-12	8
Overprecision	0.38	0	0.49	0	1

6.2 Differences between treatment groups

This paragraph will test if participants' level of overconfidence changes when they are subject to a mood induction procedure. Before running non-parametric tests, a manipulation check was done in order to examine if the MIPs indeed affected the participants' mood as intended. The Jonckheere-test determined that the MIPs significantly affected their moods in the expected direction $J(131) = 4.033$, ($p < 0.001$). The MWU test showed that mood levels in the sad group were significantly lower than in the neutral group ($p < 0.001$) and in the happy group ($p < 0.001$). It was however not significantly different between the neutral- and happy group ($p = 0.723$). The results from the MWU test imply that the sad treatment had the desired effect. The happy treatment in turn did not significantly affect the mood of participants. This was to be expected, since the difference in average mood was only 0.22 between the happy and neutral group.

Overestimation is the first component that will be tested, subsequently over-placement and lastly over-precision. For overestimation and over-placement, the results are based on the Jonckheere-test. The results of the Kruskal-Wallis test and the Fisher-Exact test can be found in Appendix A table 1.3 - 1.6. The tables contain p-values for the total sample and the male- and the female portion of the sample.

Hypothesis 1: The level of overestimation is different between different treatments

No evidence was found by the Jonckheere-test that different treatments caused different levels of overestimation. Table 6 below shows the median level of overestimation before and after the trivia questions per treatment. Surprisingly the median of the sad treatment is the highest, both before and after answering the trivia. This may be a result of the significant age difference between the sad treatment and the other two groups. In paragraph 4 of this chapter the combined effect of age and the treatments on overestimation will be examined in order to establish to what extend the skewedness of the age variable has affected the test results. The Mann-Whitney-U test was used to examine whether the level of overconfidence is different between two out of three groups. The p-values of this test are displayed in table 7. The MWU-test results found no evidence that the level of overestimation was different between the groups. Based on the results of the non-parametric tests there is insufficient evidence to assume the level of overestimation is different between different MIP groups. Furthermore, the Wilcoxon-signed-rank test found sufficient evidence that the participants' level of overestimation was significantly higher before finishing the trivia questionnaire than afterwards. Lastly, the Kruskal-Wallis test concluded there is no difference in the adjustments of participants believes between treatments ($p = 0.99$).

Table 6 – Median Overestimation per Treatment

Overestimation	**Control group**: Median	**Sad group**: Median	**Happy group:** Median	**P-values:** Jonckheere-test
Before the quiz	1	2	0	0.638
After the quiz	-1	0	-1	0.703
P-values: Wilcoxon signed-rank test	0.0023***	0.0010***	0.0063***	

*** significant at the 1% level

Table 7 –Results MWU-test for Overestimation

Overestimation	**P-value:** Before	**P-value**: After
Treatment 1 & 2	0.80	0.88
Treatment 1 & 3	0.56	0.61
Treatment 2 & 3	0.42	0.81

Hypothesis 2: The level of over-placement is different between treatments

Table 8 below shows the median level of over-placement for every treatment group, the corresponding p-value of the Jonckheere-Terpstra test and the results of the Wilcoxon-signed-rank test. Subsequently, table 9 shows the results of the MWU-test. Since none of the p-values in both tables are below 0.10, there is not enough evidence to infer that the level of over-placement is different between treatments. Furthermore, the Wilcoxon signed-rank test does not find significantly different levels of over-placement before and after the quiz. Noteworthy is that the level of over-placement of the joyful group increases after the quizzes, while it decreases for the sad and neutral group. The Kruskal-Wallis test concluded there is no difference in the adjustments of participants believes between treatments ($p = 0.89$).

Table 8 – Median Overplacement per Treatment

Over-placement	**Control group**: Median	**Sad group**: Median	**Happy group:** Median	**P-values:** Jonckheere-test
Before the quiz	1	0.5	0	0.349
After the quiz	0	0	1	0.245
P-values: Wilcoxon signed-rank test	0.42	0.22	0.73	

Table 9 –Results MWU-test for Overplacement

Over-placement	**P-value:** Before	**P-value**: After
Treatment 1 & 2	0.82	0.46
Treatment 1 &3	0.67	0.51
Treatment 2 & 3	0.89	0.95

Hypothesis 3: The level of over-precision is different between treatments

In order to test whether the level of over-precision is different between different treatments a 2x3 Fisher-exact test was executed. Table 10 below shows the percentage of participants that was over-precise per treatment and the p-values of the corresponding McNemar test. The 2x3 Fisher exact test concluded there is not sufficient evidence that the level of over-precision differs significantly between treatments. Before answering the trivia questions approximately one-third of the participants did not estimate their interval correctly. The average participants in both the sad and happy groups became even more over-precise after answering the trivia questions. The control group became slightly less over-precise after answering the questions. Furthermore, the McNemar test implies there is no significant change between the level of over-precision before and after the participants answered the trivia questions for each treatment group. Lastly, the fisher exact test found insufficient evidence to support that the difference in overprecision before and after the trivia is significantly different between treatments ($p = 0.54$) .

Table 10 – Overprecision per Treatment

Over-precision	**Control:** Percentage	**Sad:** Percentage	**Happy:** Percentage	**P-values:** Fisher-exact test
Before	0.39	0.37	0.31	0.76
After	0.29	0.46	0.42	0.21
P-values: McNemar test	0.51	0.38	0.42	

Notes: This table outlines what portion of the participants was over-precise per treatment

6.3 Differences between self-reported mood and levels of overconfidence

This thesis uses self-reported mood as an auxiliary proxy to determine if mood affects overconfidence. This section will test the last three hypotheses in a similar fashion as the first three have been tested. For overestimation and over-placement, the results are based on the Jonckheere-test. The results of the Jonckheere test, Kruskal-Wallis test and the Fisher-Exact test can be found in Appendix A table 1.7 - 1.10. The tables contain p-values for the total sample and the male- and the female portion of the sample.

Hypothesis 4: The level of overestimation varies between levels of self-reported mood

The median overestimation for each treatment and the results of the Jonckheere-test are displayed in table 11. The Jonckheere test concludes that there is sufficient evidence to assume that over-estimation is different for different levels of self-reported mood ($p = 0.0016$), for the post trivia estimations. This implies that when participants stated that they felt more joyful they also tended to overestimate themselves more. The Jonckheere-test was also conducted independently on the male and female portion of the sample. The test concluded that for males, overestimation was significantly different for different levels of mood ($p = 0.0009$). However, there was insufficient evidence to conclude that women are affected by mood. In addition, both the Kruskal-Wallis test and the Fisher-exact test only found significant results for the total and male portion of the sample (Appendix A table 1.8). This may suggest that the level of overestimation in men is more affected by mood than in women.

With regards to the pre-trivia estimations, there is only sufficient evidence that the level of overestimation is different for different levels of mood in males ($p = 0.067$). There is not enough evidence to infer the same for total sample and the female segment. Furthermore, the

Wilcoxon rank test shows there is sufficient evidence that participants are less confident after answering the questions for each mood category. Based on the data hypothesis 4 is accepted.

Table 11 – Overestimation per Self-Reported Mood Category

Overestimation	**Mood: 1-3** (N= 19) [a] median	**Mood: 4** (N= 43) Median	**Mood: 5-7** (N= 70) Median	**p-values:** Jonckheere-test
Before the quiz	0	2	1	0.511
After the quiz	-2	-1	0	0.002**
P-values: Wilcoxon signed-rank test	0.041*	0.000**	0.0053**	

Notes: [a] The Jonckheere-test examined if the level of overestimation is different between the 7 scales of self-reported mood, not the 3 groups reported in this table.
* significant at the 5 percent level
** significant at the 1 percent level

Hypothesis 5: The level of overplacement varies between levels of self-reported mood

The median overplacement for each treatment and the results of the Jonckheere-test are displayed in table 12. The Jonckheere-test concluded there is sufficient evidence to assume that the level of over-placement for post trivia estimations is different for different self-reported mood levels (p= 0.025). Furthermore, the test concluded that the effect of mood is significant for the male portion of the sample ($p = 0.0046$) but not for female portion (see Appendix A table 1.10). The results for the pre-trivia estimations are only significant for the male portion of the sample ($p = 0.046$). This was also the case with overestimation. This may infer that men are responsible for most of the variance in overconfidence between different levels of self-reported mood. Based on the data there is enough evidence supporting hypothesis 5. Lastly, the Wilcoxon signed rank test found no evidence that levels of overplacement are different between pre- and post-triva estimations.

Table 12 – Overplacement per Self-Reported Mood Category

Over-placement	**Mood: 1-3** Median	**Mood: 4** Median	**Mood: 5-7** Median	**p-values:** Jonckheere-test [a]
Before the quiz	-1	1	0	0.24
After the quiz	-1	0	1	0.025**
P-values: Wilcoxon signed-rank test	1.00	0.15	0.36	

Notes: [a] The Jonckheere-test examined if the level of overestimation is different between the 7 scales of self-reported mood, not the 3 groups reported in this table.
* significant at the 10 percent level
** significant at the 5 percent level

Hypothesis 6: The level of over-precision varies between levels of self-reported mood

Table 13 shows the percentage of over-precise participants for each mood category. The Fisher-exact test concluded there is no significant difference in over-precision between different levels of self-reported mood. The McNemar test concluded there was no significant difference in over-placement between pre- and post-trivia estimations. Based on the data, there is insufficient evidence to support that the level of overprecision is different between levels of mood.

Table 13 – Over-precision per Self-Reported Mood Category

Over-precision	**Mood: 1-3** percentage	**Mood: 4** percentage	**Mood: 5-7** percentage	**p-values:** Fisher Exact test
Before the quiz	0.42	0.40	0.32	0.574
After the quiz	0.53	0.42	0.32	0.208
P-values: McNemar test	0.72	1.00	1.00	

6.4 Regressions

In order to obtain more knowledge about how self-reported mood and MIPs affect overconfidence in combination with other variables, several models have been tested using OLS- and Logit regressions. A perquisite for the OLS-regression is normality of the dependent variables. The Shapiro-Wilk test showed there is insufficient evidence to conclude that overestimation and over-placement are non-normal distributed (see Appendix A table 1.11 for Shapiro-Wilk test results). Therefore, it is possible to use the OLS-regression to gain a better understanding of the data.

Three regression models have been used to explain the 3 dependent variables, which resulted in 9 regression outputs for the post-trivia estimations, the pooled estimations (both pre- and post-trivia estimations in one regression) and pre-trivia estimations.

Starting with the post-trivia regressions, table 14 below outlines the results of the 6 regressions concerning overestimation and overplacement. Table 15 outlines the regression outputs of overplacement. Note that the first two regression tables show the results for the estimations after answering the trivia questions. The results for the pooled estimations are displayed in table 16 and table 17 and will be discussed after the post-trivia estimations. The results for the pre-estimation regressions can be found in the appendix A table 1.12 and table 1.13. None of the variables were able to explain the level of overconfidence for the pre-trivia questions estimations. A possible cause could be that participants had no way of knowing the difficulty of the questions beforehand, which likely resulted in less calculated estimations of their own and their RSPP's scores and more variance.

The first regression model uses the happy and the sad treatment and age as independent variables. Where happy and sad are binary variables and age a discrete variable.

(1) $Overconfindence = \alpha + \beta 1 Happy + \beta 2 Sad + \beta 3 Age$

The second model uses happy and sad treatment, gender and the interaction term Sad*Age as explanatory variables to explain the level of overconfidence.

(2) $Overconfidence = \alpha + \beta 1 Happy + \beta 2 Sad + \beta 3 Male + \beta 4 Age * Sad$

The third model uses mood and gender as explanatory variables. Where mood is an ordinal and categorical variable and gender is 1 if the participant was a male.

(3) $Overconfidence = \alpha + \beta 1 Mood + \beta 2 Male$

Note that overestimation and overplacement are analysed using an OLS-regression and overprecision using a Logit regression.

Results post-trivia estimations

Table 14 - Level of Overconfidence **post-trivia estimations**, by Mood and Treatments. Regression Analysis

	Dependent variable					
	Overestimation			Over-placement		
	(1)	(2)	(3)	(4)	(5)	(6)
Happy	-0.64 (0.58)	-0.61 (0.56)		-0.18 (0.94)	-0.19 (0.92)	
Sad	-1.11* (0.67)	-2.63** (1.06)		-1.51 (1.08)	-4.02** (1.74)	
Male		1.00** (0.46)	0.92** (0.44)		1.13 (0.75)	1.09 (0.74)
Age	0.033* (0.020)			0.028 (0.032)		
Age*Sad		0.050** (0.022)			0.071** (0.035)	
Mood			0.62*** (0.19)			0.69** (0.31)
Observations	131	131	131	131	131	131

Notes: OLS regression in columns 1-6. Standard errors in parentheses. The variable Age*Sad estimates the effect of age for subjects that participated in the sad treatment. Information regarding the R^2 and F-statistics of the models can be examined in appendix A table 1.14
* significant at the 10 percent level
** significant at the 5 percent level
*** significant at the 1 percent level

Overestimation

One of the main objectives of the regression is to examine whether the insignificant results for hypotheses 1-3 were (partially) caused by the large age difference between the sad MIP group and the two other groups. The most variance regarding age was within the sad group. The standard deviation of age was 17.57 in the sad group, 3.67 in the neutral group and 9.33 (3.10 without two over-60-year-old outliers) in the happy group. Including age as an estimator led to one marginally significant result. However, an estimator that only accounted for the variance of age within the sad group (Sad*Age) was found to be highly significant.

Regression 1 examines the combined effect of the treatments and age on the level of overestimation. Both the sad treatment $p = 0.099$ and the age estimators $p = 0.090$ are significant at the 10% level, but only marginally. Nonetheless this result indicates that the sad treatment probably does affect the level of overestimation to some extend when controlled for age and that the treatment's effect would probably be more defined in a better randomized sample.

Regression 2 shows that sad treatment does significantly affect overestimation when included in a model together with the estimators of the male, happy and the interaction term "$Age * Sad$" variables. The significance of the sad treatment estimator, when inserted together with the interaction term, implies that older people within the sad treatment tend to overestimate themselves more than younger participants in the same group. This can be a result of older participants reacting milder on the treatment. The coefficients predict that participants younger than 52 in the sad treatment are less confident than in the other two groups. Since the median age in this treatment is 46.5 it is likely that the effect of the sad treatment is (partially) nullified due to demographic interference. The estimator "male" is also significant and implies that men tend to overestimate themselves by one question more than their female counter parts. The happy treatment estimator is not significant and has an unexpected negative sign in this model. As can be seen in the regression table, the happy treatment is not significant in any of the models. The insignificance of the happy treatment estimator does not depend on the choice of the reported models. Numerous models have been tried for this thesis, but in none of them the p-value of the happy treatment estimator was below 0.2. The manipulation checks in paragraph 6.2 revealed that the level of mood was not significantly affected by the happy treatment. Consequently, it is no surprise that the happy treatment did not affect the level of any type of overconfidence.

Regression 3 measures the combined effect of mood and gender on overestimation. Both estimators are significant at the 5% level. Self-reported mood has a rather large impact on overestimation. According to the regression an increase on the scale corresponds with an increase in overestimation of 0.62. This confirms that participants who stated that they were very happy had a bigger chance to overestimate themselves. The opposite holds for participants who indicated that they felt sad. The effect of gender is roughly the same as in model 2.

Over-placement

Regression 4 does not contain significant estimators. The combination of the treatments and the participants' age cannot explain a participant's level of overplacement.

Regression 5 illustrates that the sad treatment is a significant estimator for the level of overplacement when put in a model with the estimators of the happy treatment, male and the interaction term. Older participants in the sad treatment group tend to overplace themselves more than younger subjects. The coefficients of the estimators predict that participants in the sad group younger than 57 tend to overplace themselves less than participants in the neutral and happy group. Both the gender and the happy treatment estimators are not significant.

Regression 6 shows that the level of overplacement is significantly different for different levels of self-reported mood. The estimator for gender however is insignificant. It is strange the male estimator is not significant in both model 3 and 4, since the difference in overplacement between women and men is more than 1 question on average. However, the non-parametric test in paragraph 6.3 showed that especially men display different levels of overplacement for different levels of self-reported mood. It is possible that the mood estimator captured most of the difference in overplacement between men and women, rendering the male estimator to be insignificant.

Over-precision

Table 15 - Level of Overprecision **Post-Trivia Estimations**, by Mood & Treatments. Regression Analysis

Over-precision	(7)	(8)	(9)
Happy	0.15 (0.11)	0.14 (0.11)	
Sad	0.26** (0.12)	0.47** (0.20)	
Male		-0.055 (0.089)	-0.043 (0.087)
Age	-0.0048 (0.0037)		
Age*Sad		-0.070* (0.042)	
Mood			-0.057 (0.039)
Observations	131	131	131

Notes: Logit regression, marginal effect (dY/dx) at means in columns 7-9, robust standard errors in parentheses.
* significant at the 10 percent level
** significant at the 5 percent level

In **regression** 7 the sad treatment is a significant predictor to determine if a participant is over-precise or not. The regression implies that someone who participated in the sad treatment is more likely to be over-precise than someone in the other groups. According to **regression 8** over-precision and the sad mood treatment are positively correlated and the interaction term and over-precision are negatively correlated. This implies that people affected by the MIP were more likely to provide too small intervals. This tendency reduces as participants within this treatment get older. This results of regressions 7 and 8 are in contrast to expectations, as it is assumed that sadness reduces overprecision. It is likely not every participant in this thesis understood how a 90% confidence is constructed. A large number of participants used their point estimation as lower- or upper-bound of the interval and some participants provided an interval consisting out of only 2 or 3 numbers, which is rather small for a 90% confidence level. **regression 9** has no significant estimators. It appears that self-reported mood and gender do not have any explanatory power in determining whether someone is over-precise or not.

Results pooled estimations

This paragraph outlines and discusses the results for the pooled estimations, which include both the pre- and post-trivia question estimations. For these regressions the models are moderately adjusted. The variable "*after*" is included to estimate the difference in overconfidence between the pre- and post-trivia question estimations. The models are now formulated as follows:

(1) $Overconfindence = \alpha + \beta 1 Happy + \beta 2 Sad + \beta 3 Age + \beta 4 After$

(2) $Overconfidence = \alpha + \beta 1 Happy + \beta 2 Sad + \beta 3 Male + \beta 4 Age * Sad + \beta 5 After$

(3) $Overconfidence = \alpha + \beta 1 Mood + \beta 2 Male + \beta 3 After$

Table 16- Level of Overconfidence **Pooled-Estimations**, by Mood, Male, Age and Treatment. Regression Analysis

	Dependent variable					
	Overestimation			Overplacement		
	(1)	(2)	(3)	(4)	(5)	(6)
Happy	-0.46	-0.33		-0.13	-0.083	
	(0.52)	(0.56)		(0.71)	(0.727)	
Sad	-1.03	-2.21**		-1.43	-3.63***	
	(0.64)	(1.06)		(0.91)	(1.40)	
Male		-0.03	-0.06		0.62	0.60
		(0.02)	(0.41)		(0.58)	(0.55)
After	-1.76***	-1.76***	-1.76***	-0.38	-0.38	-0.38
	(0.41)	(0.41)	(0.41)	(0.57)	(0.56)	(0.56)
Age	0.035**			0.030		
	(0.017)			(0.027)		
Age*Sad		0.043**			0.065**	
		(0.018)			(0.028)	
Mood			0.41**			0.60**
			(0.17)			(0.26)
Observations	131	131	131	131	131	131

Notes: OLS regression in columns 1-6. Robust standard errors in parentheses. Information regarding R^2 and F-statistic of the models can be examined in appendix A table 1.14

The results for the pooled estimations are similar to the post-trivia estimation results. Table 16 shows that the happy treatment is not a significant estimator for the level of overconfidence in any model and the sad treatment estimator is only significant when inserted together with the Sad*Age interaction term. Which mainly indicates that older participants in the sad treatment tend to overestimate and overplace themselves more than younger participants in the same treatment. Furthermore, self-reported mood is significantly correlated with both the level of overestimation and overplacement. The "after" estimator is significant for overestimation but not for overplacement. This indicates that people consistently lowered their believes about their own score after answering the trivia. There is however no clear pattern in how they adjusted their estimations about their own score compared to their assigned RSPP's score.

Table 17 - Level of Overprecision **Pooled-Estimations**, by Mood and Treatment. Regression Analysis

Over-precision	(7)	(8)	(9)
Happy	-0.413 (0.076)	0.033 (0.077)	
Sad	0.163* (0.187)	0.31** (0.14)	
Male		-0.100 (0.088)	-0.073 (0.061)
Age	-0.0044 (0.0026)		
Age*Sad		-0.005* (0.003)	
After	0.023 (0.060)	0.023 (0.060)	0.023 (0.060)
Mood			-0.041 (0.027)
Observations	131	131	131

Notes: Logit regression, marginal effect (dY/dx) at means in columns 7-9, robust standard errors in parentheses.
* significant at the 10 percent level
** significant at the 5 percent level

Lastly the results in table 17 show that people in the sad treatment were more likely to be overprecise in both periods. **Regression 8** shows that this tendency declines with age within this treatment.

Non-significant variables

Other variables that were tested but were not significant in the models are: The self-reported scale (1 to 7) of self-love, conservatism and competitiveness. Lastly, also the following variables were found to be non-significant estimators: happy treatment, whether someone was religious or not, level of education and one's position in the family with regards to siblings.

Chapter 7 Discussion and Conclusion

This chapter outlines the discussion and conclusion. The first part will provide a brief summary of the thesis and discuss the most important results. The second part will review the experimental design as compared to the desired experimental design.

Summary and results

This study's goal was to examine how mood effects the level of overconfidence. Moore and Healy's framework (2008) was used for defining overconfidence. They mention that overconfidence can be divided into three components: overestimation, over-placement and over-precision. Overconfidence has been studied extensively in the past. The used methods measured different aspects of overconfidence and cannot be compared to each other. Each component of overconfidence is caused by different biases. Therefore, certain situations may cause an increase in one component while causing a decrease in another component. For example, the hard-easy effect causes people to underestimate themselves while performing easy tasks and simultaneously overestimate themselves compared to others. Because of these discrepancies, one must measure all three types of overconfidence to get a complete picture. This thesis examined how mood influences all three types of overconfidence. Managers and policy makers for instance can use the results of this research as a basis for decision-making, especially when the decisions could have large consequences. In order for them to make the right choices, it is essential that they do not overestimate themselves and therefore take into account their current state of mind.

Results

The first result that this paper revealed was that the level of overestimation was different for different levels of self-reported mood. The Jonckheere test concluded that the happier participants felt the more they overestimated themselves after answering the trivia questions. This is an indication that people's perception about their own skills and knowledge indeed changes while being in a certain state of mind (ranging from sad to happy). This feature proved to be especially present within males. In addition, the male portion of the sample showed a correlation between self-reported mood and overestimation for pre-trivia estimations. These findings build on previous research by Alloy & Abrahamson (1989) who found that a depressed state of mind reduces overconfidence and the research by Lyubomirsky, King & Diener (2005) who argue that a positive mood induces (over)confidence.

These findings can be applied to many situations involving risk. For instance, when someone's profession involves high-risk decision-making it advisable to reflect on the state of mind before and while making important choices. Or, if someone experienced an uplifting event it is not recommendable for him visit a casino. His positive mood could cause him to take a higher risk than he would have in a neutral state of mind.

The second significant result found in this paper, by the non-parametric tests, is that the level of overplacement for post-trivia estimations was different for different levels of self-reported mood. In addition, mood also significantly affected men's level of overplacement for pre-trivia questions. Self-reported mood significantly affects both the level of overestimation and overplacement for men for both pre and post-trivia estimations. Meanwhile the total sample is only significantly affected for post-trivia estimations and the female portion in isolation is not significantly affected by mood in any situation. This may infer that the differences in overconfidence between levels of self-reported mood are largely driven by males.

Furthermore, significant results have been obtained from the regressions. In both the post-trivia and pooled estimations regressions the sad treatment variable was highly significant in models that included the "SAD*AGE" interaction term. This indicates that older participants in the sad treatment group significantly overestimated and over-placed themselves more than younger participants in the same treatment group. Since the vast majority of participants in the sad group was notably older than participants in the other two groups, it is possible that the results of the non-parametric tests were insignificant, due to demographic interference. However, this can only be thoroughly tested when a sample is available where participants are better randomly assigned between treatments.

Self-reported mood was a significant estimator in determining the level of overestimation and overplacement in both the post-trivia- and the pooled estimations regressions. Gender was found to be a significant estimator for overestimation in the post-trivia regressions. This outcome supports previous findings regarding gender and overconfidence. For example, Barber & Odean (2001) also showed that males tend to be more overconfident than females.

Review of the experimental design

The main complication for the research was the large age difference between the sad group and the other groups. This age discrepancy was caused by multiple factors. First, it was discovered at an early stage, during the data gathering process, that respondents were reluctant to fill in the survey version containing the sad MIP. The sad MIP version was distributed again, but was then mainly filled in by older participants. In hindsight it may have been better to gather a smaller but more homogenous sample, which likely would have produced better results. Carrying out the experiment in a lab instead of by means of a survey, would improve this research in several ways. Allocating subjects randomly between treatments could have prevented the large differences in characteristics between groups. Furthermore, using the lab should reduce the loss of internal validity. Participants answering an online questionnaire cannot be monitored. Therefore, it can only be assumed that they properly executed the mood induction procedures. Having participants write down their saddest and happiest memories, as means of control, reduced this problem. However, there is no way of knowing if they spend enough time to acquire the desired state of mind, which could be better monitored if done in the lab. The lab would also ensure that participants do not look up the answers of the trivia questions on the internet. Lastly, the lab prevents the effect of external factors on the mood of participants, such as persons in the room or background music.

The budget for this paper was a limitation. No money was available to carry out the desired design. Consequently, subjects did not get paid for their participation. Offering participants, a show up fee reduces selection bias and increases external validity. In this thesis mostly older participants took the time to participate in the sad treatment group, which had a severe impact on the data. In addition, participants also did not get paid for their performance. This lack of monetary incentives may have caused a certain number of participants to perform sub-optimally. Especially the confidence interval was often not constructed carefully. For example, a lot of participants used their point estimation as lower bound or upper bound instead of constructing their interval around the point estimation. Payment could have made them put more effort in their estimations. However, finding a proper payment scheme to incentivize participants will prove to be difficult, as participants are paid both for their score and their estimations of this score. Paying participants for providing accurate pre-trivia estimations may provide them with a direct incentive to answer trivia questions incorrectly on purpose.

Another limitation of this research compared to the desired design, is the construction of the 3 dependent variables. Due to limitations in the software used to gather the sample, it was not possible to replicate Moore and Healy's (2008) method. They constructed overestimation and over-placement by summing the participants' subjective probabilities for their own score and their RSPP's score. For this paper participants were asked to provide a point estimate of their own score and their RSPP's score in order to calculate their overestimation and over-placement. Moore & Healy (2008) examined over-precision by looking at the shape and magnitude of their participants' subjective probability functions. This paper had participants construct a 90% confidence interval around their point estimates instead.

The songs used for the Mood Induction Procedure and the trivia questions have not been used in previous research. The sad MIP existed out of a solitary recollection exercise with sad background music. The Likert-scale showed that subjects who underwent the sad treatment were indeed sadder than subjects in the two other groups. The subjects who received the happy treatment were only marginal happier than those in the other groups. The manipulation check found no evidence that participants in the happy treatment were significantly happier than participants in the control group. This can imply that the happy solitary recollection treatment combined with the selected music does not have a large impact on subject's state of mind. Another explanation may be that most participants were already in a positive mood due to the weather. It is possible the happy MIP did not uplift their mood even further.
The questions invoked underestimation and under-placement on average and participants adjusted their estimations downwards after answering the trivia. This could be because the participants underestimated the difficulty of the questions beforehand. It is possible they adjusted their estimations afterwards more than would be considered rational, as a result of underconfidence, caused by the difference between the anticipated difficulty and the actual difficulty of the trivia.

Future research

To conclude, future research can extend knowledge on this topic, by repeating this research with a proper random allocated sample to examine the effect of the mood induction procedures on overconfidence without demographic interference. Subsequently it can explore the effect mood has on overconfidence through different MIPs, for example emotionally charged film clips. By using different MIPs, the efficiency of an individual MIP can be tested. The effect of other mood dimensions -such as fear for example- on overconfidence can also be examined by including the PANAS-X. Lastly, it might also be interesting to replicate Moore and Healy's research (2008) but use analytical tasks instead of trivia questions to elicit the participant's level of overconfidence.

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Appendices

Appendix A: tables

Table 1.1a – Mood and Overconfidence Categories

	Mood		Overestimation
Sad	1-3	Underestimation	$E(x_i) - x_i < 0$
Neutral	4	Well estimated	$E(x_i) - x_i = 0$
Happy	5-7	Overestimation	$E(x_i) - x_i > 0$

Notes: overplacement is also divided in three categories. In case $(E(x_i) - x_i)) - (E(x_j) - x_j) < 0$ it is under-placement, well estimated if $(E(x_i) - x_i)) - (E(x_j) - x_j) = 0$ and over-placement in case $(E(x_i) - x_i)) - (E(x_j) - x_j) > 0$.

Table 1.1b – Mood and Overconfidence Category Frequencies

Mood	Sad	Neutral	Happy
	19	43	70
	Underconfidence	Well Calibrated	Overconfidence
Overestimation Before	41	17	74
Overestimation After	67	22	43
Overplacement Before	58	9	65
Overplacement After	58	10	64

Table 1.2 - Frequencies of Self-Reported Mood per Treatment

Treatment/mood	1	2	3	4	5	6	7
Sad	0	7	3	23	13	0	0
Neutral	1	4	0	13	18	13	0
Happy	0	0	4	7	17	5	3

Table 1.3 - test results overestimation between treatments. (before)

	Kruskal-Wallis	*Jonkcheere*	*Fisher -Exactt*
Total sample	0.815	0.724	0.185
Male	0.664	0.641	0.735
Female	0.462	0.887	0.191

Table 1.4 - test results overestimation between treatments. (after)

	Kruskal-Wallis	*Jonckheere*	*Fisher -Exactt*
Total sample	0.741	0.703	0.470
Male	0.454	0.646	0.484
Female	0.936	0.653	0.796

Table 1.5 - test results over-placement between treatments. (before)

	Kruskal-wallis	*Jonkcheere*	*Fisher –Exact*
Total sample	0.922	0.807	0.809
Male	0.866	0.933	0521
Female	0.304	0.635	0.557

Table 1.6 - test results over-placement between treatments. (after)

	Kruskal-wallis	*Jonckheere*	*Fisher –Exact*
Total sample	0.712	0.384	0.201
Male	0.432	0.185	0.552
Female	1.00	0.413	0.217

Table 1.7 - test result overestimation between mood levels. (Before)

	Kruskal-wallis	*Jonckheere*	*Fisher –Exact*
Total sample	0.323	0.511	0.462
Male	0.339	0.0674*	0.242
Female	0.285	0.907	0.765

* significant at the 10% level

Table 1.8 - test result overestimation between mood levels. (after)

	Kruskal-wallis	*Jonkheere*	*Fisher –Exact*
Total sample	0.086*	0.002***	0.019**
Male	0.042**	0.001***	0.028**
Female	0.671	0.132	0.645

* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

Table 1.9 - test result overplacement between mood levels. (Before)

	Kruskal-wallis	*Jonkheere*	*Fisher –Exact*
Total sample	0.646	0.235	0.346
Male	0.222	0.043**	0.201
Female	0.454	0.657	0.493

* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

Table 1.10- test result overplacement between mood levels. (After)

	Kruskal-wallis	*Jonckheere*	*Fisher –Exact*
Total sample	0.445	0.025**	0.616
Male	0.171	0.0046***	0.065*
Female	0.859	0.285	1.00

* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

Table 1.11 - Test of normality: Shapiro-Wilk test

Dependent variables	P-values
overestimation before the quiz	0.850
over-placement before the quiz	0.440
over-precision before the quiz	0.522
overestimation after the quiz	0.376
over-placement after the quiz	0.220
over-precision after the quiz	0.767
Independent variables	
Mood	0.036**
Age	0.000***

* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

Table 1.12 - Level of Overconfidence **pre-estimations**, by Mood and Treatment. Regression Analysis

	Dependent variable					
	Overestimation			Over-placement		
	(1)	(2)	(3)	(4)	(5)	(6)
Happy	-0.43 (0.86)	1.03 (0.73)		-0.16 (1.09)	-0.049 (1.081)	
Sad	-1.07 (0.99)	-1.14 (0.73)		-1.43 (1.25)	-3.35 (2.05)	
Male		0.45 (0.59)	-1.14* (0.68)		0.075 (0.876)	0.067 (0.869)
Age	0.034 (0.029)			0.030 (0.037)		
Age*Sad		0.041 (0.028)			0.059 (0.042)	
Mood			0.19 (0.29)			0.49 (0.37)
Observations	131	131	131	131	131	131

Notes: OLS regression in columns 1-6. Standard errors in parentheses. Information regarding R^2 and F-statistic of the models can be examined in appendix A table 1.11

Table 1.13 - Level of Overprecision **pre-trivia estimations**, by Mood and Treatment. Regression Analysis

Over-precision	(7)	(8)	(9)
Happy	-0.068 (0.107)	0.074 (0.107)	
Sad	0.066 (0.12)	0.154 (0.198)	
Male		-0.100 (0.088)	-0.043 (0.087)
Age	-0.0044 (0.0037)		
Age*Sad		-0.004 (0.004)	
Mood			-0.057 (0.037)
Observations	131	131	131

Notes: Logit regression, marginal effect (dY/dx) at means in columns 1-3, standard errors in parentheses.

Table 1.14 – Regression Model Information

Post-Trivia Estimations						
	Overestimation			Over-placement		
	(1)	(2)	(3)	(4)	(5)	(6)
R^2		0.086	0.112		0.096	0.055
aR^2		0.057	0.098		0.060	0.040
$p > F$		0.022	0.000		0.030	0.026
Pooled-Estimations						
	Overestimation			overplacement		
	1	2	3	4	500	6
R^2	0.016	0.0866	0.0867	0.009	0.036	0.0867
$p > F$	0.234	0.000	0.000	0.537	0.095	0.000
Pre-Trivia Estimations						
	Overestimation			overplacement		
	1	2	3	4	500	6
R^2	0.013	0.021	0.024	0.012	0.022	0.014
aR^2	-0.011	-0.003	0.008	-0.012	-0.009	-0.001
$p > F$	0653	0.445	0.217	0.688	0.588	0.403

Appendix B: Mood Induction Procedures

Songs used for the sad treatment

Artist	Song
Jorge Mendez	Cold
Venetian Snares	I´m sorry I failed you
Baths	Departure
Stendeck	A perfect Place To Say Goodbye

Songs used for the happy treatment

Artist	Song
Cool And The Gang	Get Down On It
Earth, Wind And Fire	Let's Groove
Bob Sinclair	Love Generation
Crowded House	Weather With You

Mood induction procedure list:

Facial expression MIP

In this exercise the experimenter tells the subject to relax or contract certain muscles in the face, such as for instance frowning. The facial expression of the subject might induce the desired mood as a result. To reduce the demand effect, participants are often told that the experiment involves muscle measurement.

Feedback MIP

This exercise lets subjects perform a cognitive or motoric task. After the task participants are given (false) negative or positive feedback on their performance in order to induce the desired mood.

Film Clips

Subjects are asked to watch a heavy emotionally charged film fragment to induce the desired mood within a subject

Music Induction MIP

During or before the experiment emotionally charged music is played to induce the desired mood within a subject.

Social interaction MIP.

The experimenter exposes subjects to prearranged social interaction, which are either negative or positive. The behaviour of the other subjects should influence the state of mind of the subject of interest.

Solitary recollection.

This exercise asks a participant to think and write about pleasant or unpleasant events to induce the desired mood within the subject.

Van Velten mood induction procedure

An exercise invented by Theodore van Velten. During approximately 10 minutes, a subjects read 58 positive affirmations out loud. The success rate of the exercise depends largely on the subjects' willingness to accept and respond to the idea in each statement and allow each statement to act upon them.

Appendix C: PANAS-X

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. *Indicate to what extent you have felt this way today*. Use the following scale to record your answers:

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

______ cheerful ______ sad ______ active ______ angry at self

_______ disgusted	_______ calm	_______ guilty	_______ enthusiastic
_______ attentive	_______ afraid	_______ joyful	_______ downhearted
_______ bashful	_______ tired	_______ nervous	_______ sheepish
_______ sluggish	_______ amazed	_______ lonely	_______ distressed
_______ daring	_______ shaky	_______ sleepy	_______ blameworthy
_______ surprised	_______ happy	_______ excited	_______ determined
_______ strong	_______ timid	_______ hostile	_______ frightened
_______ scornful	_______ alone	_______ proud	_______ astonished
_______ relaxed	_______ alert	_______ jittery	_______ interested
_______ irritable	_______ upset	_______ lively	_______ loathing
_______ delighted	_______ angry	_______ ashamed	_______ confident
_______ inspired	_______ bold	_______ at ease	_______ energetic
_______ fearless	_______ blue	_______ scared	_______ concentrating
_______ disgusted with self	_______ shy	_______ drowsy	_______ dissatisfied with self

Appendix D: The survey

Sad Mood Induction Procedure

Thank you for helping with my master thesis survey. The data gathering process is anonymous and takes less than 10 minutes

An essential part of this survey is the mood induction procedure. It is very important that you execute this procedure before you start the survey.

Procedure:
Let the music play in the background while performing the procedure and filling in this survey. **Please do not turn it off.**

Important:
Before you start the survey, please think for 3 minutes of 2 events that made you feel sad or lonely, while listening to the music.

1) Before you started the survey, you thought for 3 minutes of 2 events that made you feel sad and lonely. Please provide a brief description of the 2 events

……………………………………………………………………

Happy Mood Induction Procedure

Thank you for helping with my master thesis survey. The data gathering process is anonymous and takes less than 10 minutes

An essential part of this survey is the mood induction procedure. It is very important that you execute this procedure before you start the survey.

Procedure:
Let the music play in the background while performing the procedure and filling in this survey. **Please do not turn it off.**

Important:
Before you start the survey, please think for 3 minutes of 2 events that made you feel happy, optimistic and loved, while listening to the music.

1) Before you started the survey, you thought for 3 minutes of 2 events that made you feel happy and loved. Please provide a brief description of the 2 events

…………………………………………………………………………………

Page One – Mood Questions

1. What is the weather today like?

Sunny/ Cloudy / Rainy

*2. How do you feel at the moment?

Very sad / Sad / Somewhat sad / Neutral / Somewhat happy / Happy / Very happy

Page Two – Before Trivia Estimations

*3. Next you have to answer 18 general knowledge pop quiz questions. It is important you answer them using your own knowledge. Please do not look for the answers on the internet.

Before you look at the questions, can you estimate how many of the 18 questions you'll answer correctly?

*4. Can you provide an interval, such that you are 90% certain that it will contain the correct answer?
Example: I am 90% sure that I will answer between X and Y questions out of the 18 correctly

X

Y

*5. How many of the 18 questions do you think a randomly selected previous participant will answer correctly?

Page Three – Trivia Questions

Next are 18 trivia questions, please do not look them up on the internet

*6. Which tennis player has won the most men's singles grand slams?
*7. Who is currently known as the fastest man alive?
*8. Who was the first female aviator to fly solo across the Atlantic Ocean?
*9. In which year did the second World War end?
*10. Which country donated the statue of liberty to America?
*11. Which friend of Julius Caesar later married Cleopatra?
*12. Who invented the formula E = MC^2
*13. Who is known for inventing the lightbulb?
*14. What is the name of the process where light is being used, by plants and bacteria, to turn carbon dioxide into different carbons, like glucose?
*15. Which movie made actor Leonardo DiCaprio famous?
*16. Which actor plays Tyler Durden in the movie 'Fight club'?
*17. Who is the director of the movie "Full-Metal Jacket"?
*18. Which country is containing the most land?
*19. In which continent is Guyana situated?
*20. What is the capital of Saudi-Arabia?
*21. Who painted the 'Mona Lisa'?
*22. Who wrote the book "The Animal Farm"?
*23. Who lived for 969 years according to the bible?

Page four – After Trivia Estimations

*24. How many of the 18 questions do you think you answered correctly?

*25. Can you provide an interval, such that you are 90% certain that it will contain the correct answer?
I am 90% sure that I have answered between X and Y questions out of the 18 correctly

x

y

*26. How many of the 18 questions do you think a randomly selected previous participant has answered correctly?

*27. What is your education level?

VMVO| MBO// HAVO| HBO / VWO |Universitair | bachelor

*28. What your age?

*29. What is your gender

Male/ Female

*30 Are you religious? If yes, which religion?

No / Yes:

*31 To what extend do you agree with the following statements?

I like myself:

Not at all / strongly disagree/ disagree neutral / agree / strongly agree / very strongly agree

I am conservative and don’t like change:

Not at all / strongly disagree/ disagree neutral / agree / strongly agree / very strongly agree

I am competitive and like to be the best:

Not at all / strongly disagree/ disagree neutral / agree / strongly agree / very strongly agree

*32. Do you have any siblings? If yes, are you the oldest, in the middle or the youngest?

No siblings / Youngest / In the middle / Oldest

Thank you very much for your time!