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MASTER'S THESIS BEHAVIORAL ECONOMICS

Over-confidence and learning about yourself:

Does priming for diseases affect an individual's level of overconfidence?

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Abstract

Moore and Healy (2008), defined over-confidence as a multifaceted concept with three main domains: over-estimation, over-placement and over-precision. This paper studies if priming people with information on potential diseases they may develop can affect individuals' level of over-estimation, over-placement and over-precision. Results show that individuals' levels of over-estimation and over-placement are significantly affected when subjects are primed for diseases. This implies that when participants belong to the treatment group they tend to over-estimate and over-place less; while if they belong to the control group they tend to over-estimate and over-place more. However, there was insufficient evidence to conclude that participants were affected by priming techniques when measuring over-precision.

Keywords over-confidence, over-estimation, over-placement, over-precision, priming, diseases

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1 Introduction

Have you ever noticed that individuals who suffered from a chronic illness change their confidence in life? Have you ever seen people, whose close friends or relatives suffered from highly death probability diseases, act unusually self-confident?

According to medical research, people who undergo invasive illnesses need not only clinical care, but also psychological support (Wagner et al., 2001). Among others, these people are prone to anxiety disorders, which may further provoke unusual self-confident issues.

This thesis investigates whether reminding people of the possibilities of developing certain diseases would have an impact on their over-confidence. It has been found that priming (in general) can induce changes in confidence (Fast et al., 2012; Lechuga & Wiebe, 2011; Sieck, 2000). Further the link between diseases, anxiety disorders and confidence issues has been established (Mathews & MacLeod, 2002). Though an abundance of research has been conducted on these factors, they have never been studied jointly. Hence, the aim of this paper is to fill the gap displayed by the literature answering the following research question:

Does priming for diseases affect an individual's level of over-confidence?

According to the notion provided by Moore and Healy (2008), over-confidence can be classified in three categories: over-estimation, over-placement and over-precision. The first element of novelty of this thesis is the investigation of priming effects on all three types of over-confidence. In fact, priming techniques have not been applied on the totality of over-confidence domains before. Secondly, the objective of priming is a novelty. In the literature, when over-confidence was measured through the application of priming techniques, participants were not primed for diseases. Lastly, this research aims to stimulate an immediate reaction that, through the ease of fear and consequently anxiety, should affect general knowledge. The conceptual framework presented in this thesis proposes a new approach for the assessment of over-confidence. The elements of novelty previously mentioned represent the contribution that this paper brings to the research, which could be used by people for better understanding the phenomenon of overconfidence in general.

2 Related Literature

In this section of the paper, I will present findings in the literature on the main concepts covered in this thesis. Firstly, I will discuss the concept of over-confidence and its main domains (over-estimation, over-placement and over-precision). Subsequently, I will discuss demographics' impact on over-confidence. Secondly, I will outline the concept of priming and its implications in this paper. Lastly, I will introduce the causes of deaths and injuries that globally affect human species. To better clarify how these concepts are interlaced, I will present a conceptual framework at the end of the section.

Over-confidence

Researchers proposed over-confidence as an explanation for numerous factors and events such as strikes (Singh et al., 2015), wars (Arreguin-Toft, 2001) or business failure (Camerer & Lovallo, 1999). Almost everyone thinks that his or her chances of getting fired from a job, being involved in a terroristic attack or missing a train are significantly lower than the chances of others to experience these misfortunes (Jolls, 1998).

In the literature several findings are summarized with over-confidence and accumulating evidence shows that people exhibit over-confidence in three key domains (Johnson, 2009): (a) they over-estimate their actual abilities, (b) they believe to be "better-than-average" meaning that they over-place their performances relative to others, and finally (c) they estimate their own precision in higher intervals when asked questions on numerical tasks (Moore & Healy, 2008). These three aspects of over-confidence are defined respectively as over-estimation, over-placement and over-precision.

Over-estimation

The great majority (around 64%) of studies conducted on over-confidence regard over-estimation (Moore & Healy, 2008). In this case, over-confidence is meant as the over-estimation of personal actual abilities, performances, level of control as well as chances of success (Moore & Healy, 2008). In general, people might overestimate or underestimate the probability that an event will occur (Kunreuther, 1989). Under-estimation may take place in events that are common in people's life such as it happens for stokes or car accidents (Viscusi, 1992), but also for events that are considered long-term risks such as osteoporotic fractures (Kanis et al, 2000). Over-estimation might be present when risks are salient or highly visible to individuals (Viscusi, 1992).

Over-placement

Over-placement occurs when people rate themselves better than average in terms of median. Over-placement is the least studied of the three faces of over-confidence with 5% of empirical studies (Moore & Healy, 2008). The better-than-average effect, as a common social comparison bias, reflects the same psychological implications of the individual level judgment (Larrick et al., 2007). However, the "hard-easy" effect sways over-placement's valence. In fact, if tasks are believed to be easy, subjects tend to over-place their performance thinking to be better than average. On the other side, if tasks are believed to be hard, subjects tend to under-place their performance thinking to be worse-than-average (Larrick et al., 2007). According to Moore and Healy, over-placement might not reflect individual's self-estimation. This is the reason why over-placement and over-estimation are considered as separate domains. In fact, people who over-place (under-place) themselves might under-estimate (over-estimate) themselves.

Over-precision

Over-precision is the phenomenon that expresses people's over-confidence in determining the accuracy of their own probabilistic judgments. In other words, it can be defined as the excessive certainty that someone knows the truth. Generally, over-precision is measured by drawing out a confidence interval, which is formalized as a range of values the judge is confident will include the true objective asked by an experimenter (Alpert & Raiffa, 1982). Therefore, over-precision is also pointed to as over-confidence presented in interval estimates (Soll & Klayman, 2004). Previous studies proved that people confidence in their knowledge outdoes their accuracy (Haran et al., 2010). For instance, providing too narrow intervals is an indicator of over-precision; whereas providing too wide intervals is an indicator of under-precision.

Many strategies have been applied in order to reduce over-precision: asking to determine top and bottom ends of an interval considering that there is a 90% chance the true answer is below or above it respectively (Soll & Klayman, 2004); or focusing on the way questions were formulated (Teigen & Jørgensen, 2005); or forcing the judge to take into account the entire range of possible answers applying SPIES-Subjective Probability Interval Estimates (Haran et al., 2010). In this paper, candidates are asked to provide top and bottom values of an interval where the true objective falls, with 90% certainty.

Over-confidence: underlying causes

The magnitude of over-confidence varies depending on questions asked, topics debated and the way in which confidence judgments are elicited (Klayman et al., 1999; Juslin et al., 1999). It is intricate to understand what are the driving causes of both over- and under-confidence. Initial research ascribed phenomena to cognitive biases. Thus, insufficient adjustment, anchoring as well as biased information retrieval and biased confirmation of interpreting information were involved (Hoch, 1985; Koriat et al., 1980).

Secondly, the concept of "over-confidence bias" was studied. It is entitled as the systematic discrepancy between people's confidence and relative frequency. It can be explained through the use of deeper mental flaws: when an alternative is chosen the mind searches for information that can confirm, not falsify, the answer provided (Koriat et al., 1980). Based on Koriat findings, Gigerenzer defines over-confidence as a cognitive illusion and states that it can disappear if subjects assess relative frequencies instead of single event probabilities (Gigerenzer, 1991). However, Gigerenzer findings are not confirmed in the literature. In fact, Brenner affirms that over-confidence is not eliminated by estimates of relative frequencies (Brenner et al, 1996). Additionally, Brenner's findings are consistent with Griffin and Tversky's. If based on the same evidence, judgments of confidence and estimates of relative frequencies lead subjects to make the same judgments (Griffin & Tversky, 1992). Consequently, over-confidence bias is not eliminated.

More recent studies focused on the effects of unbiased imperfections and the influence of information and judgments divergences (Soll & Klayman, 2004). As a result, it was proved that biased outcomes could be produced by unbiased judgments if they create "noise" (Erev et al., 1994). Even though the role of noise may explain many cases of over-confidence, the degree of influence of noise on over-confidence remains unclear (Brenner, 2000).

Lastly, unrealistic optimism can be a driver of over-confidence, and it is viewed as part of the self-enhancement phenomena (Weinstein, 1980). Over-confidence has been considered as a manifestation of self- enhancement interchangeable with over-placement (Kwan et al, 2004). Unrealistic optimism can reflect an high probability that negative phenomena can happen to others, whereas can reflect a low probability that the same phenomena could happen to oneself (Jolls, 1998).

The impact of demographics on over-confidence

In the following section are investigated possible consequences of age and gender on one's over-confidence level. A growing literature indicates that males are more confident than females, for instance when it comes to trade (Barber & Odean, 2001); or to make career-relevant decisions (Correll, 2001). Different social pressures among men and women have always been ascribed as main cause of distinct levels of over-confidence between genders (Ronay & Kim, 2006). Although, narrow down gender differences only to social pressures may lead to incomplete conclusions. Students at the Stockholm University (Bengtsson et al., 2005) or Swedish high-school students (Dahlbom et al., 2011), who were born and raised in a country with one of the highest degree of gender-equality, still showed gender differences in over-confidence. Consequently, despite the presence of social pressure phenomena, there are other factors when determining over-confidence. On the other hand, females who self-select into a predominantly male-dominated environment tend to be as over-confident as males (Nekby et al., 2008).

Findings on the relationship between age and over-confidence are mixed in the literature.

Pliske et al., (1996) found that older subjects tend to predict the correctness of their responses in a more accurate way than younger subjects. Crawford and Stankov (1996) found that older subjects tend to be more over-confident compared to younger subjects (Crawford & Stankov, 1996), and at the same time their confidence judgments are less able to discriminate between correct and incorrect answers. On the contrary, Bruine de Bruin (2012) found that older subjects perceive their competence of making decision to be lower than the one of younger subjects. These previous researches do not clarify what we can expect from differences in age and level of over-confidence in this study. Nevertheless, it will be interesting to investigate further.

Priming

Priming is defined as the effect that arouses *'changes in the standards'* that people adopt to fulfill evaluations (Iyengar, & Kinder, 1987). Priming occurs when a specific content suggests to the related-content audience that individuals *'ought to use specific issues as benchmark for evaluating the performance'* of the task (Scheufele & Tewksbury, 2007). Priming can also be seen as *'the difference in reaction time (RT) between a treatment condition in which a stimulus is repeated and a control condition in which stimuli are not repeated'* (Stadler & Hogan, 1996). Priming can be positive or negative, and the main distinction between the two is given by the speed of processing information (Mayr & Buchner, 2007).

Positive priming

Positive priming is faster than negative priming (Mayr & Buchner, 2007). When people are experiencing a stimulus and this stimulus has an effect on their decisions or preferences, positive priming is present (Reisberg, 1997). To experience a positive priming individuals do not need to be conscious, in fact the phenomenon can have consequences on subjects either if they are conscious or unconscious (Reisberg, 1997). Considering positive priming in terms of reaction time (RT), it may also take place when stimuli are repeated in two successive displays (Scarborough et al., 1977). Hence, it is also thought to cause an extensive activation. According to Reisberg, the process of positive priming starts when a first stimulus activates memories or a connection to them, right before being asked to perform a task. To complete the awareness process, individuals need to face a second stimulus. This second stimulus does not require the same level of activation that characterized the first one, because the first stimulus has already been activated (Reisberg, 1997). In this study, a positive priming approach is used.

Negative priming

Many studies have been conducted and models have been proposed to investigate negative priming. Herein, are proposed two models: distractor inhibition and episodic retrieval. The first model speculates that the brain inhibits the activation of received stimuli (Mayr & Buchner, 2007). The second model implies that after some time the brain decides to activate the previously ignored stimuli. The time taken to resolve this brain conflict causes the delay of activation (Mayr & Buchner, 2007). Considering priming in terms of reaction time (RT), when negative priming occurs the stimulus is at first inhibited and then activated (Stadler & Hogan, 1996). This means that with negative priming RT is slower than with positive priming, relative to control (Park & Kanwisher, 1994).

The top ten causes of death

Nowadays mortality data do not offer and exhaustive overview of reality, thus estimations are preferred in terms of Global Burden of Disease (GBD).[1] The concept appeared in 1996, and includes estimates of mortality as well as morbidity produced (Murray & Lopez, 1996). *'GDB analysis provides a comprehensive and comparable assessment of mortality and loss of health due to diseases, injuries and risk factors for all regions of the world'. 'The overall burden of disease is assessed using the disability-adjusted life year (DALY), a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health'* (Murray et al., 2013).

The World Health Organization (WHO) develops GBD estimates for more than 135 causes of disease and injury, globally and locally (Liu et al., 2015). According to the WHO, of the 56,4 millions of deaths worldwide in 2015 more than half of them (54%) were ascribable to "top ten causes".[2] Particularly, stroke and ischaemic heart disease are the world's leading causes, and they have been leaders in the category for the last 15 years. Together with these two, the other causes of death worldwide are:

- Lower respiratory infections
- Chronic obstructive pulmonary disease
- Trachea, bronchus, lung cancers
- Diabetes mellitus
- Alzheimer disease and other dementias
- Diarrhoeal diseases
- Tuberculosis
- Road injury

The following graph (Figure 1) visualizes the relation between the ten most frequent causes of

[1] Source: WHO, The Global Burden of Disease Concept.
http://www.who.int/quantifying_ehimpacts/publications/en/9241546204chap3.pdf

[2] http://www.who.int/mediacentre/factsheets/fs310/en/

death and the relative deaths in millions regarding the year 2015 (source, WHO).

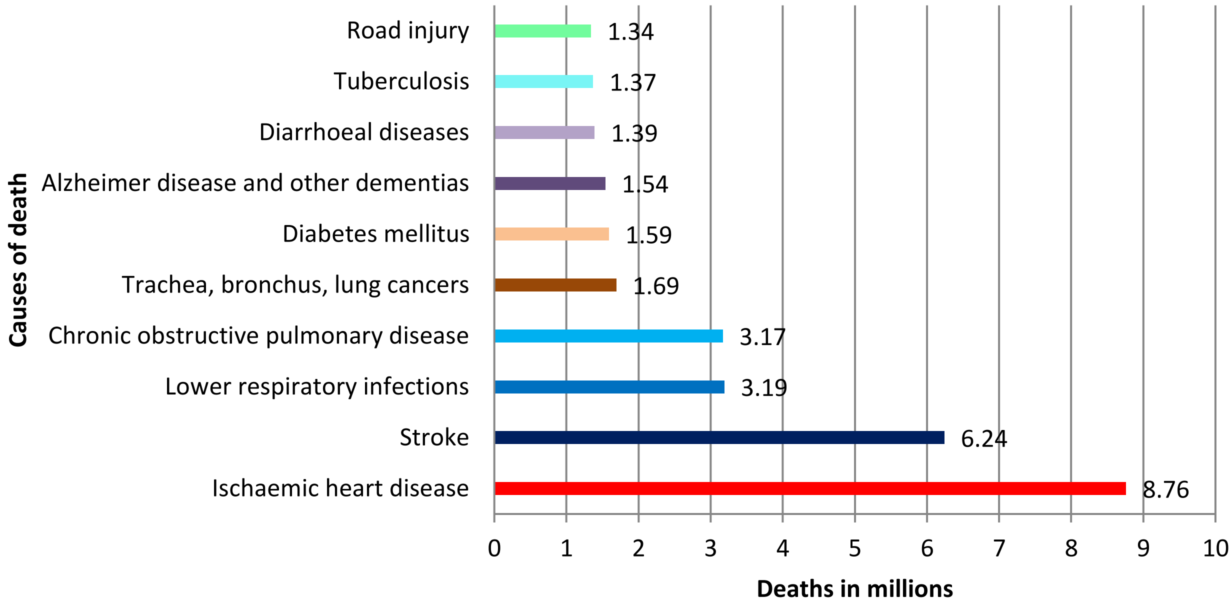


Figure 1: Top ten causes of death globally, (source: WHO, 2015).

Global projections for selected causes such as cancer, ischaemic heart disease or strokes show that these three diseases are going to be by far the most widespread killing diseases by 2030 (Appendix B: Exhibit 2) (Mathers & Loncar, 2006). As opposite phenomenon will be recorded a decrease in terms of millions of deaths of: acute respiratory infections, road traffic accident and HIV/AIDS[3] (Mathers & Loncar, 2006).

However, different causes are registered if we look more in detail to specific world areas. Hence, geographical and economic factors play a role. For instance, in low-income economies low respiratory infections are the first cause of death. To this disease are ascribed 84,9 deaths per 100.000 population. On the other side, in high-income economies low respiratory infections are the sixth cause of death with 38,2 deaths per 100.000 population (Appendix B: Exhibit 1).[4]

In this study are considered the world leading causes. Even though the sample is mostly composed of European citizens, some of the subjects are not European. Consequently, to detect the impact of diseases is necessary to consider those that can affect a multiethnic sample and not focusing exclusively on typical diseases of high-income economies.

[3] For more details see Appendix B: Global projections for selected causes, 2004 to 2030 (source: Mathers and Loncar, PLoS Medicine, 2006).

[4] http://www.who.int/mediacentre/factsheets/fs310/en/index1.html

Priming for diseases and relative effects on confidence

Priming affects confidence

Different studies explained the effects of priming on confidence. For instance, confidence is affected when people are primed for power (Fast et al., 2012), language (Lechuga & Wiebe, 2011) or when they are asked to determine diseases (Sieck, 2000). Additionally, awareness and over-confidence are affected when researchers prime for ambiguity through attributive inferences (Trope & Gaunt, 1999).

Anxiety as collateral effect widespread among the top ten causes of death worldwide

Among the main collateral effects of suffering from one of the top ten causes of death worldwide there are anxiety disorders. Anxiety symptoms are common in cancer patients (Stark et al., 2002), they are seen as psychological and social effects of cancer and they are usually associated with depression and other stress symptoms (Link & Phelan, 2006). In general, depression and anxiety improve over the 12 months after a road accident (Mayou et al., 1993). Studies have also shown that anxiety disorders can be driven by distorted beliefs regarding the danger of specific situations, such as driving or being passengers on a car (Taylor & Koch, 1995), or they can be driven by internal stimuli (Clark, 1999). Mansell and Clark demonstrated through an experiment how memory is affected by anxiety disorders in patients that experienced a road accident. High socially anxious patients recall mostly negative information, whereas low socially anxious individuals recall more positive information compared to high socially anxious patients (Mansell & Clark, 1999). In both cases, people who suffered from road injuries have distorted view of themselves and their general abilities and knowledge (Clark, 1999). The state of self-esteem influences the functional abilities of patients at 3 months after a stroke (Chang & Mackenzie, 1998). According to Strauss, patients who suffer from a stroke undergo dehumanization, onset of senescence and decline of intelligence (Strauss, 1997). As a consequence of hippocampal involvement, subjects endure memory loss and it can affect their general knowledge (Strauss, 1997). When people suffer from Alzheimer's disease or other dementias, priming shows a delay in response on general knowledge questions (Nebes, 1989). However, the slowing effect cannot be simply caused by an increase in the priming effect but it is due to the disease itself. Hyperpriming reflects a deterioration of a semantic memory and a storage deficit affecting the preservation of general knowledge (Giffard et al., 2001). Anxiety as collateral effect can be observed in patients that are afflicted with ischaemic hearth disease (Haines et al., 1987), diabetes mellitus (Li et al., 2008) (Smith et al., 2013), diarrohoeal diseases (Esler & Goulston, 1973), lower respiratory infections (Coughlin, 2012)., tuberculosis (Aydin & Uluşahin, 2001) and COPD (de Godoy & de Godoy, 2003; Aydin & Uluşahin, 2001).

Priming people for diseases may make them anxious

Several experiments have been conducted in order to test whether the development of anxiety behaviour may be caused by priming techniques. From a medical point of view, 14 corticotrophin-releasing factor (CRT) acts as a neurotransmitter or neuromodulator and it regulates anxiety when subjects are primed (Sajdyk et al., 1999; Dunn & Berridge, 1990). CRT reactions are observed in various contexts and they may be studied when subjects are primed for general knowledge (Risbrough & Stein, 2006). From a psychological point of view, attention-seeking and interpretative bias in anxiety can be induced through priming and these biases may influence one's tendency to anxiety (Mathews & MacLeod, 2002). Individuals experience anxiety disorders when reading words closely associated with their fears (Watson et al., 1988). Specific words may instantly '*evoke previous memories, images or bodily sensations that match events previously associated with fear*' (Mathews & MacLeod, 2002). Literature shows how stress and fear are likely to increase when people think of diseases they might suffer from (Furedi, 2006; Caiger, 1940). Besides that, general anxiety disorders can be inherited (Hettema et al., 2005). Therefore, genetic factors play a role especially with phenomena that may generate panic attacks (Torgersen, 1983). Hence, priming subjects to remind them of diseases they might suffer from, activates fear. Fear may lead to anxiety which may affect self-confidence on general knowledge.

Conceptual framework

In the literature review three main topics are discussed: over-confidence, priming and the major causes of death worldwide. To better clarify how these concepts are connected I will present a conceptual framework. In the figure (Figure 2) are outlined the relationships that logically follow-on one another. Firstly, priming for diseases can induce a feeling of fear in people that are scared to suffer from the same diseases they were primed for. According to the literature, fear may ease the development of anxious behaviours. It has been studied that if people are anxious their confidence is affected and might be altered. Lastly, over-confidence influences behaviour, habitual thinking and consequently one's own general knowledge.

Figure 2: Conceptual framework

3 Data and Methodology

In order to test whether over-confidence is affected when subjects are primed with information regarding the ten most common causes of death worldwide, I conducted a survey. Data were collected online and mainly through social media. The survey involved 144 respondents. In the following section, I will describe the methodology used.

The survey

For the purpose of verifying if the conceptual framework provided subsists, the survey consisted of two questionnaires: one with positive priming information (treatment group) and one with no priming information (control group).

Measurement of over-confidence

Both questionnaires were composed of ten questions testing respondents' general knowledge on various issues. In the literature questions regarding over-confidence are asked in different formats, for instance: true-false type, multiple-choice type etc. These methods differ in relationships between difficulty level and discrimination power (Silberman & Biech, 2015). Multiple-choice questions are generally used to identify strengths and weaknesses of candidates or to test one's progresses, while the format of true/false is designed to assess knowledge with the main advantage of applicability to broad domains in efficient and reliable ways (Rasiah & Isaiah, 2006). In this study, whose aim is to assess people's general knowledge, questions were asked in the form of true or false. Questions were selected among the ones proposed by Michael Mauboussin, author of "The success equation" (2012), who posted an online test that allows readers to assess their own level of over-confidence. One example question is:

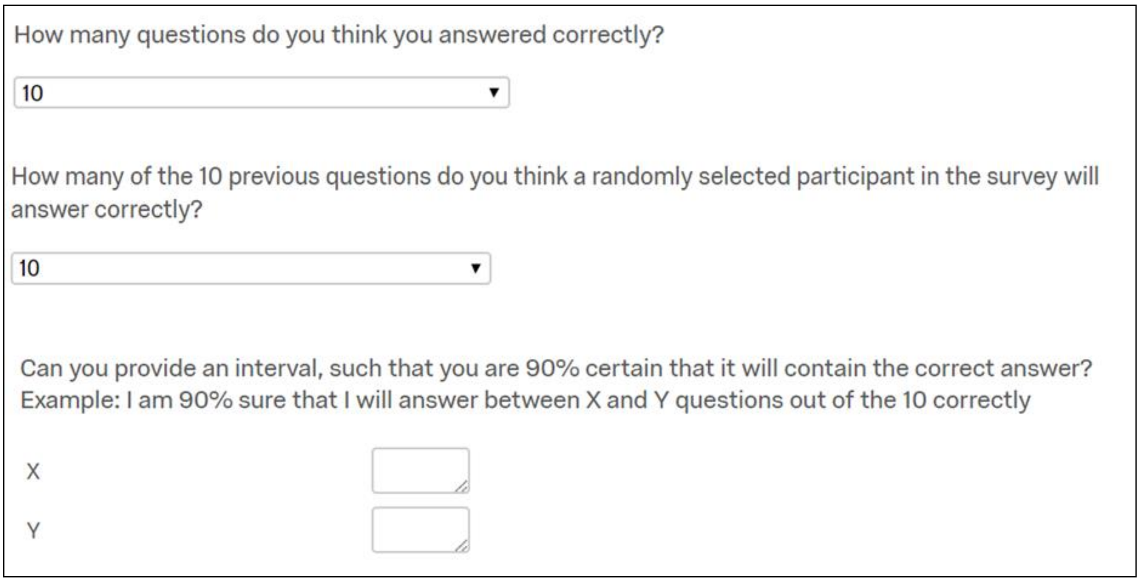
"Helen Clark is the prime minister of New Zealand"[5]*. True or False.*

The complete questionnaires can be found in Appendix A.

Participants in this study were not asked to report their confidence in terms of probability ("probability of correctness") on the truthfulness and falsity of assumptions made on arguments of general culture.

After the ten mandatory questions to assess candidates general knowledge, in both questionnaires participants were asked to fill in three additional questions. These have the purpose of estimating over-confidence in the entirety of its domains.

[5] Sample of question to detect over-confidence.


How many questions do you think you answered correctly?

10 ▼

How many of the 10 previous questions do you think a randomly selected participant in the survey will answer correctly?

10 ▼

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 10 correctly

X

Y

Figure 1: Test of over-confidence

The three questions correspond respectively to the three over-confidence domains as follows (Figure 3):

- The first one measures over-estimation
- The second one measures over-placement
- The third one measures over-precision

Priming

In the positive priming questionnaire (treatment group), before respondents judged the falsity of a statement, they were presented a factual statement of one widespread disease. For instance:

"About half of the people with COPD do not know to have it. Even though they present the symptoms, such as: shortness of breath, ongoing caught, chest tightness and wheezing"[6].

The information given regards COPD (chronic obstructive pulmonary disease), and its aim was to activate a stimulus in order to induce positive priming. In the treatment group, respondents answered the general knowledge questions without any priming.

Before the end of the survey participants were asked some demographics: age, gender and nationality. According to the literature, age plays a role in the definition of over-confidence, even though it is not clear in which direction its influence drives over-confidence. Previous studies gauge the difference males and females have in evaluating their over-confidence. Therefore, participants were requested to provide their gender. Lastly, WHO provides different causes of death relative to different regions of the world. In this paper, the causes of death taken into account are the worldwide ones. However, it may be that people from low-income countries completed the survey. These subjects may be primed with causes of death

[6] http://www.webmd.com/lung/video/diagnosing-copd

that are not as common as for citizens of high-income countries. Consequently, priming might affect differently participants. For this reason, nationality was asked. A complete overview of countries' distinctive diseases can be found in Appendix B (Exhibit 1).

Dependent variables and hypotheses

In this section I will discuss the dependent variables used and the relative hypotheses formulated for the three over-confidence domains. This paper examines whether the level of over-estimation, over-precision and over-placement differs when subjects are primed for diseases. Hypotheses were formulated in a way that foresees different outcomes for the two different treatments. Particularly, the treatment group is expected to provide lower over-confidence estimations, due to priming techniques applied, compared to the control group.
Over-estimation is generally measured comparing a person's performance with the person's belief of his or her own performance (Olsson, 2014). In this paper, over-estimation is measured comparing the number of correct answers x_i of a candidate *i,* with the number of answers the candidate thinks answered correctly $E(x_i)$. If $E(x_i) > x_i$, there is over-estimation. If $E(x_i) < x_i$, there is underestimation. Lastly, the estimation is provided correctly if it corresponds to the actual score $E(x_i) = x_i$. In order to test over-estimation the following hypothesis was defined:

H1: Priming affects the level of over-estimation

In order to test over-placement, over-estimation needs to be taken into account. In fact a participant *i* is asked to state the estimation of his or her own score $E(x_i)$ as well as to estimate the score of a randomly selected previous participant $E(x_j)$. Thereupon, the two estimations are contrasted with the two actual scores as it follows: $[E(x_i) - x_i] - [E(x_j) - x_j]$. Where $E(x_j)$ is the estimation of the number of questions answered correctly by a randomly selected participant in the survey, and x_j is the actual score of a randomly selected participant. If $[E(x_i) - x_i] < [E(x_j) - x_j]$, there is under-placement. If $[E(x_i) - x_i] > [E(x_j) - x_j]$, there is over-placement. The hypothesis formulated to test over-placement is:

H2: Priming affects the level of over-placement

To measure over-precision candidates are generally asked to provide an interval of confidence $[E(x_i -), E(x_i +)]$ which contains the value of the objective. If the estimations are well calibrated the actual score is enclosed in the interval provided $E(x_i -) < x_i < E(x_i +)$. Over-precision is present if the actual score x_i is smaller or bigger than both maximum and minimum estimations of x_i; so that: $x_i < E(x_i -) < E(x_i +)$ or $E(x_i -) < E(x_i +) < x_i$. In other words, participants are challenged to allocate intervals that are not too narrow (over-confidence) nor too wide (under-confidence) (Russo & Schoemaker, 1989). Candidates were asked to provide a low and high guess such that they are 90 percent sure the correct answer falls between the two. The hypothesis formulated to test over-precision is:

H3: Priming affects the level of over-precision

Statistical analysis

In order to analyze the hypotheses proposed in the previous section different statistical tests were applied. Tests were selected among the literature considering that the analysis is carried out with two independent samples. Furthermore, tests were selected considering that the main aim of this research is to study differences between groups. Every candidate took the test only once because candidates did not have any interests or incentives in repeating the test. Lastly, participants were randomly assigned to the treatments. Taken into account these features, design and application of the tests will be presented in the following paragraphs.

The most powerful techniques to learn about causal relationships are parametric tests. To properly conduct a parametric test four assumptions need to hold:

- The observations are independent
- The observations must be drawn from a normally distributed population
- In case two groups are analyzed with some ANOVA tests, they must have the same variance
- In order to interpret results, variables must be measured in an 'interval scale'

The data analysed in this study present independent observations and variables can be measured in 'interval scale' because the difference between values is meaningful. For instance, adding one unit to a value belonging to the dependent variable over-estimation means that a participant scored one additional correct answer. To test whether observations are drawn from a normally distributed population a Shapiro-Wilk test for normality was conducted. The null hypothesis of the test is that the population is normally distributed. The test was run for over-estimation and over-placement, not for over-precision because this dependent variable is binary, thus it is not normally distributed by definition. Results can be seen in the following table (Table 1).

Table 1 – Results of Shapiro-Wilk test (in p-value)

	Shapiro-Wilk test
Over-estimation	0.99745
Over-placement	0.96467

Over-estimation and over-placement are not significant (p-value=0.99745 and W=0.99742, p-value=0.96467 and W=0.99600 respectively). Since both p-values are greater than 0.05 there is no evidence to reject the hypothesis that data come from a normally distributed population. Hence, we fail to reject the assumption of normal distribution for over-estimation and over-placement.

F-tests were conducted to test whether variances of over-estimation and over-placement are the same in the two treatments. The results obtained while testing for over-estimation show a two sided p-value equal to 0.0450, which is significant at a 5 percent significance level. It means that we reject the null hypothesis that variances are equal in treatment and control groups. Over-placement's f-test results show a not significant two sided p-value (0.5642), which means that we fail to reject the null hypothesis of equal variances in treatment and control groups. Equality of variances is a requirement for some of the ANOVA tests, however not for all of them. Additionally, t-test can deal with unequal variances applying the unequal variance t-test, also called Welch t-test.

The following table summarizes the test conducted per hypothesis (Table 2).

Table 2 – Tests conducted per each hypothesis

	Tests			
Hypothesis	T-test	Mann-Whitney U	Pearson's Chi-square	Fisher Exact 2x2
H1	x*	x	x	x
H2	x**	x	x	x
H3			x	x

*T-test assuming equality of variances
**T-test assuming inequality of variances

In order to have a more complete analysis, all the hypotheses were tested with a t-test assuming equality (hypothesis 1) and inequality (hypotheses 2) of variances. The Student's t-test assuming equality of variances is a test in which the test statistic follows a Student's t-distribution under the null hypothesis. The t-test assuming inequality of variances, also known as Welch's t-test, is a two samples location test that is applied in order to test the hypothesis that two populations present equal means.

Furthermore, hypotheses 1 and 2 were tested by comparing treatments to each other. Results of the questionnaires are tested through the Mann-Whitney U test. The Mann-Whitney U test detects whether two independent samples present different distributions by comparing the mean ranks of each distribution of scores. Thus, the test suits the analysis because between-subjects samples are present. Nevertheless, the dependent variables of over-estimation and over-placement are expected to generate discrete and limited outcomes. These types of outcomes may yield many ties and the Mann-Whitney U test is not advisable to deal with them. Hence, a 2x2 Fisher Exact test was likewise conducted. The 2x2 Fisher Exact test is applied when two independent samples consist of two classes each. Dependent variables "over-estimation" and "over-placement" assume value 0 (in case of under-estimation or under-placement) and 1 (in case of over-estimation or over-placement). The independent variable is 'Treatment', by which is meant whether subjects undertook or not the treatment. Lastly, a Pearson's chi-square test was conducted for both hypotheses to determine if there is a particular difference between observed outcomes in a category and expected outcomes in a category. Chi-square is a popular non-parametric test applied when a population consists of two or more classes. As for 2x2 Fisher Exact test, the dependent variables "over-estimation" and "over-placement" assume value 0 (in case of under-estimation or under-placement) and 1 (in case of over-estimation or over-placement). The independent variable is 'Treatment'. Over-precision can be defined as a binary dependent variable 'over-precision', that assumes value 0 (in case of under-precision) and 1 (in case of over-precision), whereas the independent variable is given by the different treatments. Hypothesis 3 was tested using a 2x2 Fisher Exact test and a Chi-square test.

4 Results

In this section, I will describe results obtained through the survey. Firstly, I will identify the characteristics of the sample. Secondly, I will display the results acquired through the use of parametric and non-parametric tests. Lastly, I will outline OLS and logistic regressions' results.

An overview of the sample

Subjects were randomly assigned to each treatment. Therefore, differences in results are claimed to be outcomes of the experimental procedure instead of preexisting attributes of participants. The random assignment of subjects to treatments was possible due to Qualtrics' "survey flow" function. Besides random assignment, a further method to minimize the variance of the sample and increase its statistical power is to collect data that are as homogeneous as possible. For instance, the sample could have been composed only by Erasmus University's students that present similar intellectual abilities, whose age is comprehended between 18 and 25 years old, and whose nationality is identical (for example only Dutch or only Indonesian students). However, it appeared clear from the beginning of the collection that such data would have been hard to obtain due to time and network limitations.

In total, 144 participants completed the survey. 8 candidates tried to fill in the survey when it was already closed. From the numbers provided by Qualtrics, it is possible to observe that some subjects started the survey but they abandoned it. Particularly, 10 subjects abandoned the control group questionnaire, whereas 24 subjects abandoned the treatment group questionnaire. The difference in completion rates may be attributed to the negative impact of diseases' information on candidates in the treatment group. Additionally, one of questionnaires' feedback concerned the difficulty of questions, which might had induced subjects to give up. Eventually, there were 79 subjects in the control group and 65 subjects in the treatment group. Data consists of 83 males and 61 females, distributed respectively as 45 and 34 for the control group and 38 and 27 for the treatment group. As it is possible to observe, the sample is composed more by males (83) than females (61) (Table 3).

Table 3 – Gender distribution

	Males	Females
Control group	45	34
Treatment group	38	27
Total	83	61

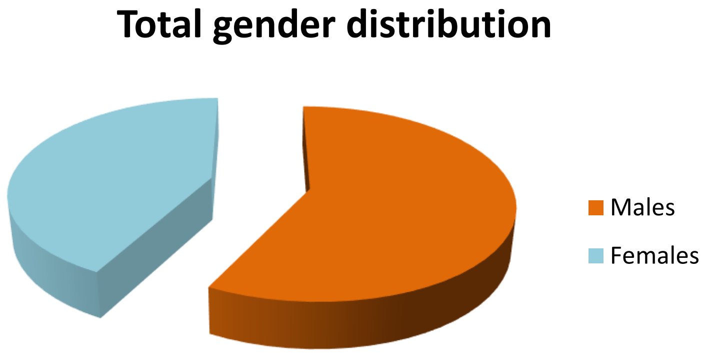


Figure 2: Total gender distribution

The age variable is not evenly distributed, in fact 40.28% of participants belong to class 18-24 years old; 25.69% belong to 25-34; 9.03% belong to 35-44; 15.28% of participants belong to 45-54 and 9.72% of subjects are 55-64 years old.

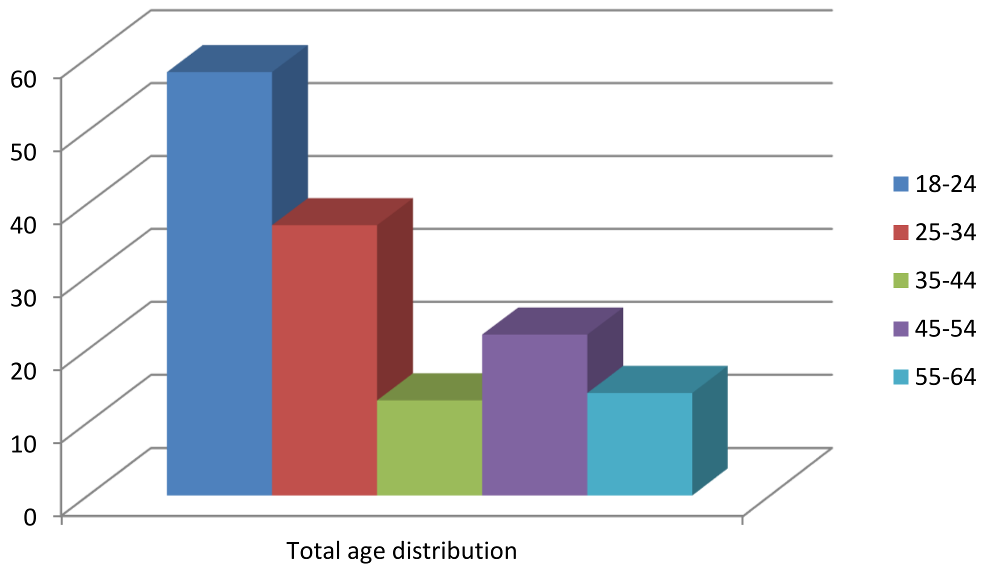


Figure 5: Total age distribution

Table 4 – Age distribution

	18-24	25-34	35-44	45-54	55-64
Control group	40.5% (32)	26,58% (21)	8,86% (7)	19% (15)	5,06% (4)
Treatment group	40% (26)	24,62% (16)	9,23% (6)	10,77% (7)	15,38% (10)
Total	40,25% (58)	25,6% (37)	9,05% (13)	14,88%(22)	10,22% (14)

The most widespread nationality is Italian (77,34%), as it was easy to predict due to my personal network. Other nationalities present are: Dutch (6.25%), German (3.75%), Greek (3.75%), Chinese (2.5%) etc.

Table 5 – Nationality distribution

	Italian	Others
Control group	74,68% (59)	25,32% (20)
Treatment group	80% (52)	20% (13)
Total	77,09% (111)	22,91% (33)

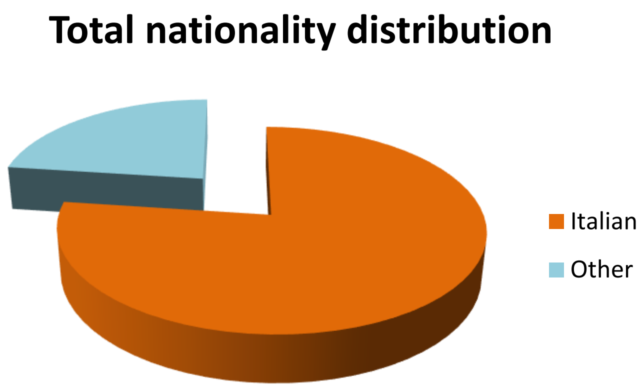


Figure 6: Total nationality distribution

In the following two tables (Table 6 and Table 7) are outlined the summary statistics for both control and treatment groups. Descriptive statistics of treatment and control groups, jointly, can be found in Appendix C (Table 20).

Table 6 – Summary statistics: control group

	Mean	**Median**	**Std. Deviation**	**Min**	**Max**
Gender	1.43038	1	.4982931	1	2
Age	3.21519	0	1.29764	2	6
Nationality	.2531646	0	.4376029	0	1
$E[x_i]$	6.177215	6	1.722844	1	10
$E[x_j]$	6.227848	6	1.584778	1	9
$E[x_i^-]$	3	3	1.88108	0	10
$E[x_i^+]$	6.708861	7	2.167072	1	10
Over-estimation	.4683544	1	1.998945	-3	7
Over-placement	.1155063	0.875	2.403071	-5.125	6.875

Table 7 – Summary statistics: treatment group

	Mean	**Median**	**Std. deviation**	**Min**	**Max**
Gender	1.415385	1	.4966232	1	2
Age	3.369231	3	1.485021	2	6
Nationality	.2	0	.4031129	0	1
$E[x_i]$	5.492308	5	2.054896	1	10
$E[x_j]$	6.030769	6	1.776313	1	10
$E[x_i^{-}]$	3.492308	3	2.085089	0	10
$E[x_i^{+}]$	6.753846	7	2.150805	1	10
Over-estimation	-.5846154	-1	2.53656	-6	5
Over-placement	-.7403846	-1.125	2.572039	-6.125	3.875

According to the analysis of descriptive statistics, subjects present similar actual scores in the two treatments. In fact, control group presents an average score of 5.71, while treatment group has an average score of 6.08 and in total the average score of the sample is 5.87. However, subjects who answered to the control group's questionnaire estimated a higher score on average (6.177215) compared to those who answered to the treatment group's questionnaire (5.49) and, considering both groups together, subjects estimated their own score at 5.87. Thus, even though treatment group's participants performed slightly better compared to control group's participants (delta=0.37), they estimated their scores lower than the one's of control group's participants (delta=-0.69). This difference in results may be ascribed to priming for diseases techniques, however the hypotheses testing section will define in details if there is a causal effect. Lastly, the score of a randomly selected participant is estimated at 6.23 by control group's members and at 6.03 by treatment group's members. Considering both groups together, subjects estimated a randomly selected participant score at 6.11. A possible explanation for this estimation's difference can be given by a higher perceived difficulty of treatment group's questionnaire due to diseases insights.

Table 8 – Average estimations and scores per treatment

	Control group	**Treatment group**	**Total**
Actual score	5.71	6.08	5.87
Estimated score	6.18	5.49	5.49
Estimated score of a random selected participant	6.23	6.03	6.11

Note: with 'Total' is meant as the union of control and treatment group.

Differences between treatment groups

This paragraph tests if the level of participants' over-confidence is affected when they are exposed to the ten most frequent causes of death. First of all, I will test over-estimation, followed by over-placement and over-precision. For every hypothesis, I will present the results obtained on the entirety of tests conducted.

H1: Priming affects the level of over-estimation

In order to test the first hypothesis (H1), a Student's t-test was conducted. The t-test provides a two sided p-value equal to 0.0061, which means that we reject the null hypothesis and conclude that the two populations' means are different at the 0.05 significance level.
Secondly, a Mann-Whitney U test was conducted. The test presents a p-value equal to 0.0077, thus we reject that the distribution of over-estimation for control and treatment group is equal. Moreover, the first hypothesis was tested by the Pearson's Chi-square test. The result provided by the Chi-square test is significant at 0.05 significance level (p-value=0.011), hence we can reject the null hypothesis. The last test conducted on H1 is the Fisher Exact test 2x2. Results show that there is significant evidence to reject that treatment and control group are evenly distributed over the two classes of under-estimation and over-estimation (p-value=0.012).
According to the results obtained, evidence is found that priming with information on diseases affects the level of over-estimation. Subjects belonging to the treatment group over-estimate less compared to subjects belonging to the control group. The results obtained through the analysis of the first hypothesis (H1) are summarized in the following table (Table 9).

Table 9 – Results of the tests on H1

	T-test	**Mann-Whitney U test**	**Pearson's Chi-square test**	**Fisher Exact test 2x2**
p-value	0.0061	0.0077	0.011	0.012

H2: Priming affects the level of over-placement

Similarly to H1, four tests were conducted to test the second hypothesis. The Student's t-test presents a two sided p-value of 0.0427, which is significant at a 0.05 significance level. We reject the null hypothesis and conclude that the two population means are different. Secondly, the Mann-Whitney U test presents a p-value equal to 0.0914, which means that there is mild evidence that the distributions of the two groups differ. Hence, we reject the null hypothesis that the distribution of over-placement for control and treatment group is equal. The Pearson's Chi-square test concluded that there is significant evidence to support H2 (p-value=0.043). The p-value is significant at a 0.05 significance level and we can reject the null hypothesis. Eventually, the Fisher Exact test 2x2 confirmed the presence of a mild evidence to conclude that levels of over-placement are affected by priming for diseases (p-value=0.062).

Results show that there is significant evidence to reject that treatment and control group are evenly distributed over the two classes of under-placement and over-placement. To conclude, there is sufficient evidence that priming affects the level of over-placement. Subjects belonging to the treatment group over-place less compared to subjects belonging to the control group. The results obtained through the analysis of the second hypothesis (H2) are summarized in the following table (Table 10).

Table 10 – Results of the tests on H2

	T-test	**Mann-Whitney U test**	**Pearson's Chi-square test**	**Fisher Exact test 2x2**
p-value	0.0427	0.0914	0.043	0.062

H3: Priming affects the level of over-precision

With the purpose of testing the third hypothesis a Pearson's Chi-square test was run. The test present a p-value equal to 0.105, which is not significant and therefore we fail to reject the null hypothesis. Moreover, a Fisher Exact test 2x2 was run. Similarly to the Pearson's Chi-square test results are not significant (p-value=0.125). We fail to reject the null hypothesis that treatment and control group are evenly distributed over the under-precision and over-precision classes. To conclude, it is possible to affirm that priming for diseases does not affect the level of over-precision. The results obtained through the analysis of the third hypothesis (H3) are summarized in the following table (Table 11).

Table 11 – Results of the tests on H3

	Pearson's Chi-square test	**Fisher Exact test 2x2**
p-value	0.105	0.125

Additional models

After having conducted the tests outlined in the previous section, in this paragraph I will define the statistical tests run in order to gain more information on the sample. At first, I will outline the OLS regressions examined for over-estimation and over-placement; then I will describe the logistic regression run for the binary variable over-precision.

OLS regressions

Before running an OLS regression is necessary to verify the normality of the dependent variables. Based on the results obtained through the Shapiro-Wilk test for normality (Table 1), over-estimation and over-placement show a normal distribution with p-value=0.99745 and p-value=0.96467 respectively. With the purpose of having a deeper insight on the sample, it is advisable to run OLS regressions for over-estimation and over-placement. The two regressions are robust which helps when data are contaminated with outliers and it may detect influential observations. The first regression presents as dependent variable over-estimation and as independent variables: age, nationality, gender and treatment. Independent variables are categorical (age) and binary (nationality, gender and treatment).

$$\text{Over-estimation} = \alpha + \beta 1 \text{age} + \beta 2 \text{dummynationality} + \beta 3 \text{gender} + \beta 4 \text{Treatment}$$

The results obtained can be observed in the following table (Table 12).

Table 12 – Results of the first regression: over-estimation

	coefficients	p-value
Age	-.4137158	0.002***
Nationality	-.047846	0.918
Gender	.2734215	0.453
Treatment	.9876844	0.010***

*** significant at a 1% significance level

Regressions coefficients represent the mean change in the response variable for one unit of change in the predictor variable while keeping other conditions constant. The coefficient of 'Age' indicates that, for every additional unit of over-estimation, is expected a decrease in age by an average of 0.4 (-.4137158) units, ceteris paribus. Since 'Nationality' is coded 0/1 (where 0=Italian and 1=others), for other nationalities the predicted over-estimation score is -.047846 points higher than for Italians, ceteris paribus. The coefficient of 'Gender' (1=males and 2=females) predicts a .2734215 higher score on over-estimation for females than for males, ceteris paribus. Lastly, if individuals belong to the control group they have a .9876844 higher score on over-estimation than subjects who belong to the treatment group (where 'Treatment' is 0 for treatment group and 1 for control group). The independent variables 'Age' and 'Treatment' result significant at a 1 percent significance level (p-value=0.002 and p-value=0.010, respectively), whereas 'Nationality' and 'Gender' result not significant (p-value=0.918 and p-value=0.453, respectively).

The second regression presents as dependent variable over-placement and as independent variables the same ones proposed for the first model: age, nationality, gender and treatment.

$$\text{Over-placement} = \alpha + \beta 1 \text{age} + \beta 2 \text{dummynationality} + \beta 3 \text{gender} + \beta 4 \text{Treatment}$$

The results obtained can be observed in the following table (Table 13).

Table 13 – Results of the second regression: over-placement

	coefficients	p-value
Age	-.3656292	0.012**
Nationality	.2255453	0.669
Gender	.0667452	0.872
Treatment	.7865772	0.061***

** significant at a 5% significance level
* significant at a 10% significance level

The coefficient of 'Age' indicates that for every additional unit of over-placement it is expected a decrease in age of -.3656292 units, ceteris paribus. For other nationalities the predicted over-placement score is .2255453 points higher than for Italians, ceteris paribus. The coefficient of 'Gender' predicts a .0667452 higher score on over-estimation for females than for males, ceteris paribus. Lastly, if subjects belong to the control group they present a .7865772 higher score on over-estimation than subjects who belong to the treatment group. The independent variable 'Age' results significant at a 5 percent significance level (p-value=0.012), 'Treatment' results significant at a 10 percent significance level (p-value=0.061); whereas 'Nationality' and 'Gender' result not significant (p-value=0.669, p-value=0.872, respectively).

Logistic regression

The binary variable over-precision will be analysed in this section with a logistic regression. In particular, the logit model will predict whether a participant is over or under-precise based on the treatment group he or she belongs to. The results obtained can be observed in the following table (Table 14).

Table 14 – Results of the logistic regression: over-precision

	p-value	coefficients
Age	1.000	.000024
Nationality	0.711	.164184
Gender	0.164	.5047684
Treatment	0.096*	-.5868754

* significant at a 10% significance level

Keeping everything else fixed, participants are more over-precise when they get older. Candidates, whose nationality is not Italian, are more likely to score higher in over-precision, ceteris paribus. Female participants are more likely to score higher in over-precision, keeping everything else fixed. An individual who belongs to the control group is less likely to obtain a high level of over-precision compared to an individual who belongs to the treatment group, ceteris paribus.

The independent variable 'Treatment' results significant at a 10 percent significance level (p-value=0.096), whereas 'Age', 'Gender' and 'Nationality' result not significant (p-value=1.000, p-value=0.164 and p-value=0.711, respectively).

A post-hoc power analysis

Power analysis is a key component in designing a statistical study. It investigates the optimal allocation of study resources to increase the likelihood of the successful achievement of a study objective. There are several types of power analysis: a priori, post-hoc, sensitivity or criterion. In this paper a post-hoc analysis was conducted with the aim of understanding if the sample size and effect size were sufficient to have a powerful study. The application of a post-hoc power analysis is believed to be controversial and it is not unanimously accepted by the scientific community (Thomas, 1997).

The first post-hoc analysis presented regards the power of Pearson's chi-square test. The analysis takes into account the degrees of freedom (over and under confidence), the proportion of population elements that do not have a particular attribute (Q=1-P), and the critical value under the bill given by the combination of degrees of freedom and confidence interval (in this case 2 and 0.95 respectively). The Pearson's power test was run for every hypothesis and results are summarized in the following table (Table 15). Pearson's chi-square test finds its most powerful analysis in over-estimation (roughly 0.62), followed by over-placement (roughly 0.42) and over-precision (roughly 0.28).

Table 15 – Results of the Pearson's chi-square power analysis

	Power
Over-estimation	0.62211554
Over-placement	0.42442451
Over-precision	0.28529209

Secondly, Fisher Exact test 2x2 power was analysed. In this case the power is examined in two proportions, according to both the different treatment and the over-confidence domain. For instance, to examine the power of over-estimation a 2x2 table is designed. Rows are given by treatments values, whereas columns represent the binary variable indicating over- and under-estimation. Results of the power test were obtained per each hypothesis and they are summarized in the following table (Table 16). Fisher Exact test 2x2 finds its most powerful analysis in over-precision (roughly 0.65), followed by over-placement (roughly 0.32) and over-estimation (roughly 0.26). On average, Fisher Exact test 2x2 has more power than Pearson's chi-square test when testing H3 and less power when testing H1.

Table 16 – Results of the Fisher exact test 2x2 power analysis

	Power
Over-estimation	0.2652
Over-placement	0.3221
Over-precision	0.6489

Thirdly, Student's T-test power was analysed. In this situation, a one sided analysis is conducted and means, standard deviations as well as group sizes are needed. The estimated power for a two sample means test is 0.8560 for over-estimation and 0.6523 for over-placement. Results of the power test obtained for H1 and H2 are summarized in the table below (Table 17). Student's T-test finds its most powerful analysis in over-estimation (roughly 0.85), followed by over-placement (roughly 0.65).

Table 17 – Results of the Student's T-test power analysis

	Power
Over-estimation	0.8560
Over-placement	0.6523

Lastly, the power analysis of Mann Whitney U test is outlined. The analysis of over-estimation and over-placement powers was conducted through the software GPower. Specifying means and standard deviations the software calculates the effect size (*d*), which corresponds to 0.4610951 for over-estimation and to 0.3438709 for over-placement. Given the effect size, the sample sizes of both groups and defined the alpha error probability as 0.05; GPower calculates the power of the test. For Mann Whitney U test over-estimation presents a power of 0.8490515, while over-placement presents a power of 0.6374894. Results of the power test obtained for H1 and H2 are summarized in the table below (Table 18). Mann Whitney U test finds its most powerful analysis in over-estimation (roughly 0.85), followed by over-placement (roughly 0.64).

Table 18 – Results of the Mann Whitney U test power analysis

	Power
Over-estimation	0.8490515
Over-placement	0.6374894

To conclude, power analyses are proposed per each hypotheses and per each test conducted (see Table 19). For over-estimation the most powerful tests are Mann Whitney U and Student's T-test (both circa 0.85), followed by Pearson's chi-square (about 0.62) and Fisher exact test 2x2 (about 0.26). For over-placement the most powerful tests are Mann Whitney U (about 0.64) and Student's T-test (about 0.65), followed by Pearson's chi-square (about 0.42), while Fisher exact test 2x2 presents the least powerful test (about 0.32). Lastly, for over-precision the most powerful between the two tests conducted is Fisher exact test 2x2 (about 0.65), while Pearson's chi-square presents a power around 0.28.

Table 19 – Power analysis (in power)

	Pearson's chi-square	Fisher exact test 2x2	Mann Whitney U	T-test
Over-estimation	0.62211554	0.2652	0.8490515	0.8560
Over-placement	0.42442451	0.3221	0.6374894	0.6523
Over-precision	0.28529209	0.6489	-	-

5 Discussion and Conclusions

In this last section of the paper I will present an overview of the study conducted summarizing the main concepts of the literature review and the development of the study up until the results gained. I will dedicate a separate paragraph to the overview of results and their relation to the findings in the literature. Moreover, in this section I will discuss the main limitations found during the study advancement and how they could be improved in future researches. Eventually, I will propose suggestions for future studies with the aim of deepening the knowledge on the topic discussed in this paper.

An overview of the study

The notion of over-confidence has been widely elaborated in the literature and it has been applied to numerous fields. This research bases its structure on the findings generated by Moore and Healy (2008), which states that over-confidence presents different domains whose limits have been blurred for long time making distinctions between them harder to be identified. In the section of related literature, these domains are outlined as over-estimation, over-placement and over-precision. In this paper, over-confidence is studied while positive priming techniques are applied. When people are positively primed they perceive stimuli that are immediately activated. Stimuli activation might provoke a reaction in individuals. In particular, individuals' over-confidence is primed for the most widespread and deadly diseases and injuries worldwide. The aim of the research is to prove that over-confidence is affected when one is primed for diseases. In order to verify the research question a survey was conducted. Two questionnaires were allocated in order to investigate the three hypotheses defined, one per each over-confidence domain: over-estimation, over-placement and over-precision. Hypotheses were formulated to investigate if there are significant differences in over-confidence level between the two treatments proposed (control and treatment group).

An overview of the results

Results show that individuals' levels of over-estimation and over-placement are significantly affected when subjects are primed for diseases. This implies that when participants belong to the treatment group they tend to over-estimate and over-place less; while if they belong to the control group they tend to over-estimate and over-place more. However, there was insufficient evidence to conclude that participants were affected by priming techniques when measuring over-precision.

The results obtained confirm that events that are common in people's life, such as diseases, are generally under or over estimated (Viscusi, 1992). This research widens the discoveries made by Kanis et al. (2000) confirming that over-estimation is affected when involves events that are considered long-term risks and suggesting that diseases can be categorized as long-term risks. Subjects thought their task was hard to be solved and therefore they estimated the score of a random selected participant higher than theirs. This confirms the theory of "hard-easy" effect (Larrick et al., 2007), which implies that with hard tasks individuals tend to under-place themselves thinking to be worse than average. The results obtained confirm the effectiveness of positive priming: the stimulus given by the information on diseases was experienced by participants and it influenced their decisions (Mayr & Buchner, 2007).

The fact that over-precision was not affected by priming techniques is a further confirmation that over-confidence domains are distinctive aspects of the same phenomenon and they need to be considered separately. More in general over-confidence is analysed through the manipulation of information and the results obtained show how general knowledge can be biased. The first element of novelty in this thesis is the investigation of priming effects on all three types of over-confidence. In fact, priming techniques have not been applied on the totality of over-confidence domains before. Secondly, the objective of priming is a novelty. There is not previous research that supports the investigation of priming techniques effects when applied to diseases. Lastly, this research aims to stimulate an immediate reaction that, through the ease of fear and consequently anxiety, should affect general knowledge. The conceptual framework presented in this thesis proposes a new approach for the assessment of over-confidence. The elements of novelty previously mentioned represent the contribution that this paper brings to the research, which could be used by people for better understanding the phenomenon of overconfidence in general.

Limitations

While developing the study design some limitations became clear. Mainly, limitations regard subjects involved in the survey. Indeed, the samples do not present homogenous subjects. This lack of homogeneity is due to differences in age and nationality. Even though participants were principally from Italy, a rough 23% of them comes from other countries. Nationality is investigated for its importance related to the spread of diseases. Every region of the world has characteristic diseases and injuries that affect the population and whose presence is caused by different reasons worldwide (e.g. economy, health system etc.). Linked to the Italian nationality a second limitation may be present: English is not subjects' native language. Therefore, participants could have misunderstood or misinterpreted the content of the questionnaires. Demographics play a role also in terms of age: older subjects could have perceived the topic regarding death in a different way compared to younger subjects. For instance, they could have attributed less weight to priming if they were randomly assigned to the treatment group. According to Grossman and Owens (2012), success depend on both personal skills and chance. Results may be altered by subjects feelings: for instance, if they felt "lucky" while answering the survey they could have been more over-confident on their performance. Participants feelings are not a controlled variable in this study, thus their influence is not measured.

Future research

Future research can investigate the effects of diseases on the over-confidence level of primed subjects avoiding the presence of demographics interferences. Doing so, researchers could obtain an homogeneous sample that would help better identifying the differences of over-confidence levels in different treatments. Another possibility for future research could be to differentiate diseases according to participants' country of origin. In this case, it would be possible to analyse the influence of specific diseases expecting them to produce even more effective and powerful results. Lastly, future research could reproduce the study introducing a new dependent variable whose aim would be to identify participants' mental state. In this case, subjects would be asked to indicate their psychological condition right before answering the survey. This procedure could help recognizing estimations biased by personal feelings and temporary mental states.

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Appendix A: the surveys

Questionnaire - CONTROL GROUP

Welcome,
Thank you for helping me with my master thesis survey. The data gathering process is anonymous and it takes few minutes.
In this survey you are asked to answer general knowledge questions.
Please, answer the questions without consulting any external sources of information.

Neutrons are the particles in an atom that have positive charge

- True
- False

Helen Clark is the Prime Minister of New Zealand

- True
- False

Marie Antoinette was executed in the 1700's

- True
- False

In sailing 'leeward' means toward the wind

- True
- False

China won the most gold medals in the 2008 Summer Olympics

- True
- False

All plants need sunlight to live

- True
- False

In poker, a full house beats a flush

- True
- False

Atlanta had the busiest airport in the world from 2010 through 2013

- True
- False

The capital of New Mexico is Albuquerque

- True
- False

Boltzmann formulated the equations to describe electricity, magnetism and optics as part of the electromagnetic field

- True
- False

How many questions do you think you answered correctly?

How many of the 10 previous questions do you think a randomly selected participant in the survey will answer correctly?

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 10 correctly

X

Y

Where are you from?

What is your gender?

- Male
- Female

What is your age?

- Under 18
- 18 - 24
- 25 - 34
- 35 - 44
- 45 - 54
- 55 - 64
- 65 - 74
- 75 - 84
- 85 or older

Questionnaire -TREATMENT GROUP

Welcome,
Thank you for helping me with my master thesis survey. The data gathering process is anonymous and it takes few minutes.
In this survey you will learn about 10 facts and, after each fact, you will answer a general knowledge question.
Please, answer the questions without consulting any external sources of information.

Did you know that Cardiovascular disease (CVD) causes more than half of all deaths across the European Region every year?

Neutrons are the particles in an atom that have positive charge

- ○ True
- ○ False

Did you know that diet soda you're so fond of –given new research showing the habit-potentially increases your chances of getting a stroke?

Helen Clark is the Prime Minister of New Zealand

- ○ True
- ○ False

According to the World Health Organization (WHO) estimates, did you know that pneumonia kills 1.1 million children under the age of 5 every year, and accounts for nearly 1 in 5 of all child deaths?

Marie Antoinette was executed in the 1700's

- ○ True
- ○ False

Did you know that about half of the people with Chronic obstructive pulmonary disease (COPD) do not know they have it, even though they present the symptoms?

In sailing 'leeward' means toward the wind

- ○ True
- ○ False

Did you know that the highest incidence rates of lung cancer are registered among Afro-American men in New Orleans (US) and Maoris in New Zealand, followed by those in UK and the Netherlands?

China won the most gold medals in the 2008 Summer Olympics

- True
- False

Did you know that there is a tendency among patients with diabetes to use insulin as weight control?

One study found that between 7% and 35% of girls and women with type 1 diabetes display symptoms of an eating disorder

All plants need sunlight to live

- True
- False

Did you know that the University of Pennsylvania, discovered that art therapy can be useful in Alzheimer and dementias diseases?
Case studies and several trials suggest that art therapy engages attention, provides pleasure, and improves neuropsychiatric symptoms, social behavior, and self-esteem

In poker, a full house beats a flush

- True
- False

Did you know that diarrhoeal disease is the second leading cause of death in children under five years old?
It is both preventable and treatable. However, each year diarrhoea kills around 760 000 children under five in the world

Atlanta had the busiest airport in the world from 2010 through 2013

- True
- False

Did you know that archaeologists have discovered that tuberculosis affected the ancient Egyptians about 6,000 years ago?
Bone and soft tissues form 85 Egyptian mummies were analyzed. So, why there is still tuberculosis?

The capital of New Mexico is Albuquerque

- True
- False

Did you know that each year nearly 400,000 people under 25 die on the world's roads, on average over 1,000 a day?

Boltzmann formulated the equations to describe electricity, magnetism and optics as part of the electromagnetic field

- True
- False

How many questions do you think you answered correctly?

How many of the 10 previous questions do you think a randomly selected participant in the survey will answer correctly?

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 10 correctly

X

Y

Where are you from?

What is your gender?

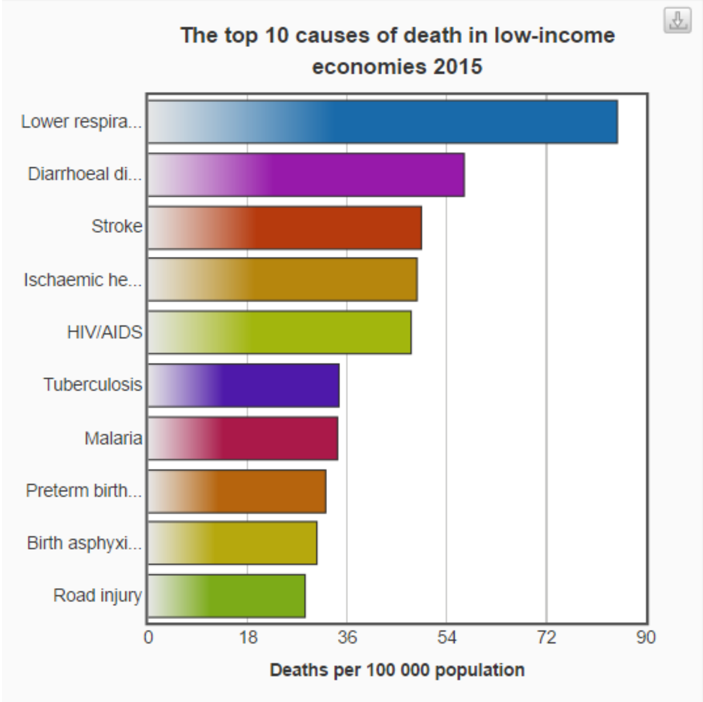
- Male
- Female

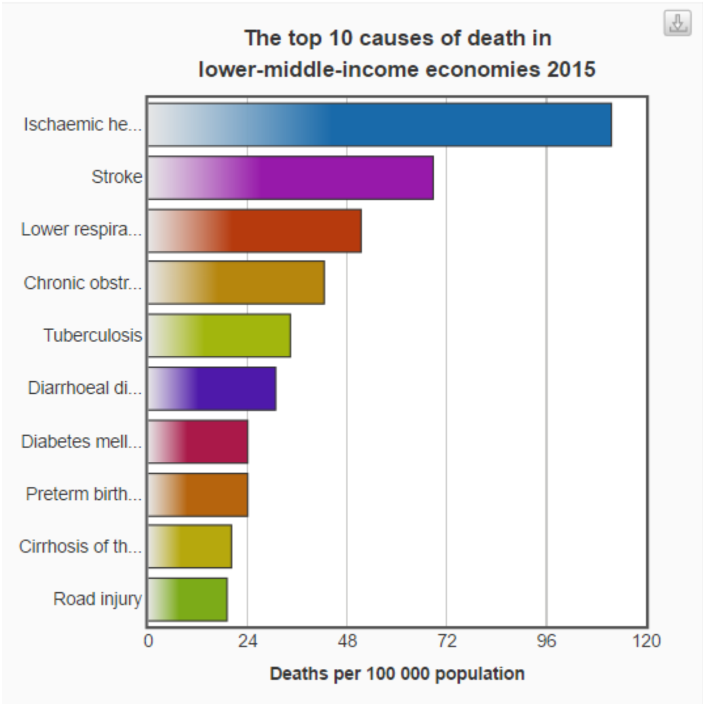
What is your age?

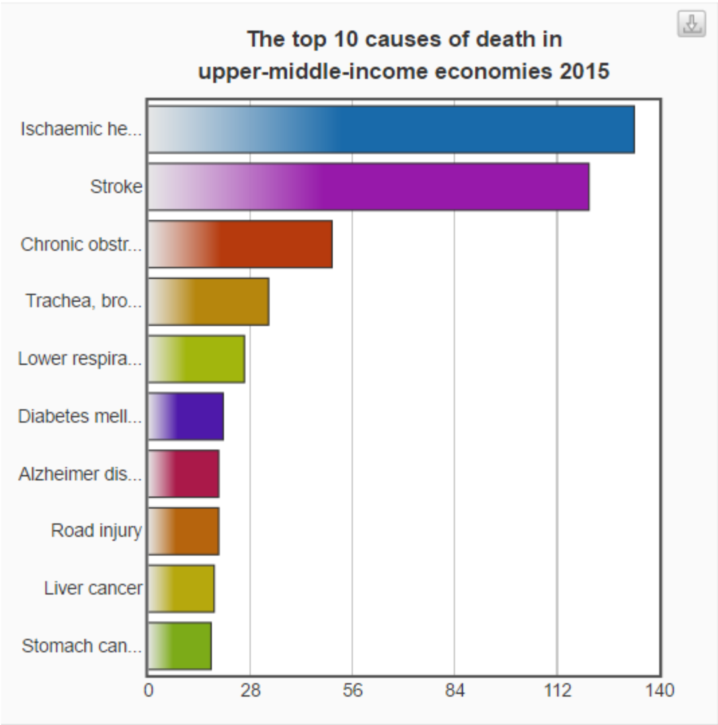
- Under 18
- 18 - 24
- 25 - 34
- 35 - 44
- 45 - 54
- 55 - 64
- 65 - 74
- 75 - 84
- 85 or older

Appendix B: causes of deaths and injuries

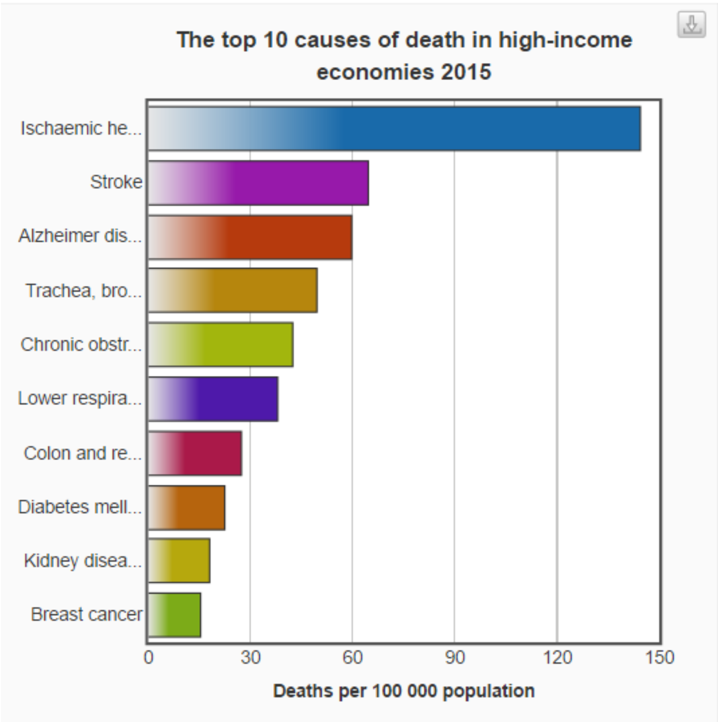
Exhibit 1: The top 10 causes of death in low-income, lower-middle income, upper-middle income and high income economies (source: WHO, 2015).





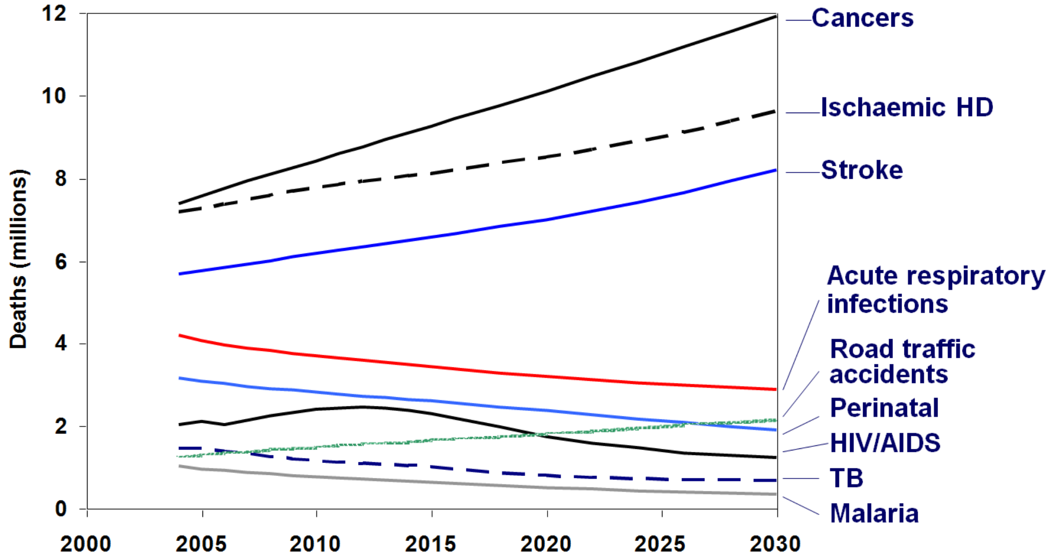


The top 10 causes of death in upper-middle-income economies 2015
Ischaemic he...
Stroke
Chronic obstr...
Trachea, bro...
Lower respira...
Diabetes mell...
Alzheimer dis...
Road injury
Liver cancer
Stomach can...
0
28
56
84
112
140



The top 10 causes of death in high-income economies 2015
Ischaemic he...
Stroke
Alzheimer dis...
Trachea, bro...
Chronic obstr...
Lower respira...
Colon and re...
Diabetes mell...
Kidney disea...
Breast cancer
0
30
60
90
120
150
Deaths per 100 000 population

Exhibit 2: Global projections for selected causes, 2004 to 2030 (source: Mathers and Loncar, PLoS Medicine, 2006).



Appendix C: statistical analysis

Table 20 – Summary statistics

	Mean	**Median**	**Std. deviation**	**Min**	**Max**
Gender	1.423611	1	.495855	1	2
Age	3.284722	3	1.382524	2	6
Nationality	.2291667	0	.4217637	0	1
$E[xi]$	5.868056	6	1.90416	1	10
$E[xj]$	6.138889	6	1.670857	1	10
$E[x_i^-]$	3.222222	3	1.984008	0	10
$E[x_i^+]$	6.729167	7	2.152308	1	10
Over-estimation	-.0069444	0	2.309895	-6	7
Over-placement	-.2708333	-0,125	2.508639	-6.125	6.875
Over-precision	.6041667	1	.4907359	0	1