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ESCOLA DE ADMINISTRAÇÃO DE EMPRESAS DE SÃO PAULO

OVERCONFIDENCE AND CONFIRMATION BIAS:
Are future managers vulnerable?

FLAVIO DE OLIVEIRA SORIANO

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Thesis presented to Escola de Administração de Empresas de São Paulo of Fundação Getulio Vargas, as a requirement to obtain the title of Master in International Management (MPGI).

Knowledge field: business internationalization

Adviser: Prof. Dr. Isabela Baleeiro Curado

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Approval date:
___/___/___

Committee members:

_____
Prof. Dr. Isabela Baleeiro Curado
EAESP-FGV

_____
Prof. Dr. Sérvio Túlio Prado Júnior
EAESP-FGV

_____
Prof. Dr. Vivian Iara Strehlau
ESPM / Insper

To my family and friends, for their unconditional support
and never-ending inspiration

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ABSTRACT

Decision makers often use 'rules of thumb', or heuristics, to help them handling decision situations (Kahneman and Tversky, 1979b). Those cognitive shortcuts are taken by the brain to cope with complexity and time limitation of decisions, by reducing the burden of information processing (Hodgkinson et al, 1999; Newell and Simon, 1972). Although crucial for decision-making, heuristics come at the cost of occasionally sending us off course, that is, make us fall into judgment traps (Tversky and Kahneman, 1974). Over fifty years of psychological research has shown that heuristics can lead to systematic errors, or biases, in decision-making. This study focuses on two particularly impactful biases to decision-making – the overconfidence and confirmation biases. A specific group – top management school students and recent graduates - were subject to classic experiments to measure their level of susceptibility to those biases. This population is bound to take decision positions at companies, and eventually make decisions that will impact not only their companies but society at large. The results show that this population is strongly biased by overconfidence, but less so to the confirmation bias. No significant relationship between the level of susceptibility to the overconfidence and to the confirmation bias was found.

KEY WORDS: management, decision making, heuristics and decision biases, overconfidence, confirmation bias.

RESUMO

Tomadores de decisão muitas vezes usam "regras gerais", ou heurística, para ajudá-los a lidar com situações de tomada de decisão (Kahneman e Tversky, 1979b). Esses atalhos cognitivos são tomados pelo cérebro para lidar com a complexidade e pressão de tempo da tomada de decisão, reduzindo assim a carga de processamento de informação (Hodgkinson et al , 1999; Newell e Simon , 1972). Embora fundamental para a tomada de decisões, a heurística tem o custo de, ocasionalmente, nos tirar do curso, isto é, fazer-nos cair em armadilhas de julgamento (Tversky e Kahneman, 1974). Mais de 50 anos de pesquisa em psicologia tem mostrado que a heurística pode levar a erros sistemáticos, ou vieses, na tomada de decisão. Este estudo se concentra em dois vieses particularmente impactantes para a tomada de decisão - o excesso de confiança e o viés de confirmação. Um grupo específico – estudantes de administração e recém-formados de escolas de negócio internacionalmente renomadas – foi submetido a experimentos clássicos para medir seu nível de suscetibilidade a esses dois vieses. Esta população tende a assumir posições de decisão nas empresas, e, eventualmente, tomar decisões que terão impacto não só nas suas empresas, mas na sociedade em geral. Os resultados mostram que essa população é fortemente influenciada por excesso de confiança, mas nem tanto pelo viés de confirmação. Nenhuma relação significativa entre o excesso de confiança e a suscetibilidade ao viés de confirmação foi encontrada.

PALAVRAS-CHAVE: administração, processo decisório, heurísticas e vieses de decisão, superconfiança, viés de confirmação.

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INTRODUCTION

The human reasoning has many flaws. However, if just a couple of them are to be pointed out guilty of undermining judgment and decision-making, strong candidates would be the overconfidence and the confirmation biases. Jointly, they not only silently lead us to mistakes, but also keep us trapped into our errors, unable to escape even simple self-created fallacies. These biases affect us all, by contaminating our decision-making. This effect is magnified when this flawed decision-making comes from within companies, because this tends to affect not only the company's employees, clients and supplier, but also society at large. A particular group that is likely to assume decision positions at companies throughout their careers are students and recent graduates from top management schools. The extent to which they are susceptible to the overconfidence and the confirmation biases is a fundamental information not only to raise awareness but also to counteract those biases and promote sounder corporate decision-making.

On one side is the overconfidence bias - the unreasonably high trust in one's own skills and knowledge. Overconfidence causes people to make decisions and take risks they would not if they had assessed their own abilities objectively, that is, based on facts (Rosenzweig, 2014). To their own good, people should be able to acknowledge when, for instance, they are not sure enough about the probability of a certain outcome. Otherwise, they risk ignoring worst-case scenarios, which can translate into disasters. In the business world, for example, if the decision-maker is overconfident in a demand forecast that is later proved wrong, he might have committed too strongly to production decisions and inventory buildup that destroy value for the company. Project duration and budget estimates are another example. When wildly optimistic due to overconfidence, estimates can distort expect return calculations, causing the misallocation of scarce resources.

On the other side is the confirmation bias - the tendency to confirm beliefs or hypotheses with any piece of supporting evidence, while ignoring, forgetting or explaining away disconfirming evidence (Nickerson, 1998). The confirmation bias has been a major antagonist of the scientific development during the last couple of

centuries. Throughout most of our history, we did not have any strong method to investigate nature and objectively learn about our reality. When we invented the scientific method, we finally had a tool to dig ourselves out of the giant hole of self-deception we had been for millennia (McRaney, 2013). For instance, the widely accepted belief that life was spontaneously generated fell apart after the scientific experiments of Francesco Redi and Louis Pasteur. But up until that point in the 19th century, people used to believe - and confirm that belief with evidence they filtered from reality - that life actually sprang out of nonliving materials that contained Aristotle's 'pneuma', or vital heat. While the human natural bias towards confirmation is to start from a conclusion and to work backward to reinforce initial assumptions, one of the scientific method's main tenets is to try to disconfirm the so-called null hypothesis. In other words, the truth is sought after by failing to reject the neutral statement. Once men started applying the scientific method systematically, we went from bleeding the sick as an attempt to cure them to travelling in space. The natural enemy of the scientific method and decision-making, however, remains alive and strong in the human mind – the confirmation bias. In spite of the increasing awareness about it, it remains a silent saboteur for most individuals when gathering information and making decisions. Business decision-makers can be victim of the confirmation bias, for instance, when interpreting reviews and opinions of customers in market research. If they themselves believe in a new product, they might overweight positive comments while explaining away negative consumer feedback. In summary, they do not think in a scientific, fact-based manner, which decreases the quality of their decisions and their effectiveness as managers. With a few instances in which they are actually beneficial, the overconfidence and confirmation biases have deleterious effects on judgment and decision-making. For the sake of sounder decisions is imperative to increase the awareness around them.

Although the overconfidence bias and the confirmation bias have been subject to a series of past studies, a research associating them both was not to be found published on public resources, neither was the population of management students and recent graduates tested for the presence of those two biases, and in that consists the contribution of this work. This research adopted a post-positivist world-view and consisted in a survey applied to participants at distance to measure their score in two

well-known biases. There was significant support to the hypotheses that management students and recent graduates display both the overconfidence and confirmation biases. There was no significant relationship between the level of overconfidence and the susceptibility to the confirmation biases.

1. RESEARCH PROPOSAL

This is an investigation of whether the overconfidence and confirmation biases are displayed by management students and recent graduates, and if those two biases are at all correlated. This study is organized in five main sessions: research proposal, literature review, research methodology, results and discussion. The research questions are *"Are management students susceptible to the overconfidence and confirmation biases? Is the level of susceptibility to those two biases correlated?"*

The three hypotheses that guided this study were the following:

> H1: Management students and recent graduates display overconfidence in their own knowledge
>
> H2: Management students and recent graduates display a tendency to fall into the confirmation bias
>
> H3: Management students and recent graduates displaying high overconfidence are more likely to fall into the confirmation bias trap[1].

Overconfidence in individuals has been measured in experiments by psychologists since several decades, for instance, through the classical experiment of elicitation of confidence intervals (Soll and Klayman, 2004). The confirmation bias has also been

[1] Of course, an individual can become overconfident in a specific conclusion as an effect of the confirmation bias. This relationship is intuitive and clear, and is not under test in this study. Overconfidence will be referred to as innate overconfidence, or the natural tendency of an individual to overestimate his or her knowledge. Of the goals of this investigation is to test whether or not this innate characteristic modulates the susceptibility to fall into the confirmation bias.

measured in individuals in a series of different experiments (Jonas et al., 2001). However, the presence of these biases in the particular population of management students and recent graduates has not yet been subject to a published study. Neither, to the extent of my knowledge, has been the existence of a relationship between the two biases for any population whatsoever.

Although nearly all humans are prone to the overconfidence and the confirmation biases, management students and recent graduates are the future leaders of corporations, and their decision-making is bound to impact value creation in society. The overconfidence and confirmation biases can lead business decision-makers away from optimal decision-making in many ways. Damage is greatest in strategic, course-changing decisions. For example, investment decisions in the corporate world are often unsound because of both an unwarranted high confidence of decision-makers (overconfidence) and a tendency to look only for evidence supporting the investment (confirmation bias). Failed investments have not only financial but also human costs, such as unemployment. Therefore, raising the awareness of those reasoning flaws and training management students against them should be a concern of society in general and of business schools in specific.

Individuals vary radically in their susceptibility to decision-making biases, including the overconfidence and the confirmation biases. To understand if they are present in relationship with one another might help individuals and their organizations become more aware to the susceptibility to the confirmation bi/as in the decision-making process, which is harder to assess but it is enormously detrimental to judgment.

The philosophical worldview - or paradigms, epistemologies and ontologies - adopted in this research is the post-positivist. Also called scientific method, it recognizes that there is no absolute truth of knowledge (Phillips and Burbulles, 2000) and therefore we cannot be “positive” about conclusions when studying human behavior. For post-positivists, causes determine effects, and therefore it is key to identify and understand causes to explain outcomes. It is fundamental to observe and objectively measure reality in order to study behavior. The usual flow of the post-positivist research is the start with a theory, followed by data collection that either supports or refutes this theory, and

then the conclusions and revisions of the theory (Creswell, 2003). The nature of this research is quantitative and involves a survey with close-ended questions that are translated into certain scores. The independent variable is the overconfidence level measured in the elicitation of confidence intervals. The dependent variables of the study are (i) the scores in the case study measuring confirmation bias and (ii) the score in the confirmation inventory (CI) by Rassin (2008), to be further explored in the literature review section.

2. A LITERATURE REVIEW OF BIASES AND DECISION-MAKING

Some theoretical and empirical foundation is useful to understand the purpose, results and meaning of this research. Again, the specific hypotheses being tested are whether management students and recent graduates are susceptible to the overconfidence and confirmation biases and whether those reasoning flaws appear in relationship with one another. Topics that will be covered in this section are (i) heuristics and biases, (ii) decision-making, (iii) overconfidence, and (iv) confirmation bias.

2.1. **Heuristics and biases**

Decision makers often use 'rules of thumb' to help them handling decision situations (Kahneman and Tversky, 1979b). Formally known in psychology as *heuristics*, those cognitive shortcuts are taken by the brain to cope with complexity and time limitation of decisions, by reducing the burden of information processing (Hodgkinson et al, 1999; Newell and Simon, 1972). These simplifying judgmental rules are useful, and sometimes crucial, in the decision making process (Tversky and Kahneman, 1974). Heuristics tend to produce correct or partially correct judgments (Bazerman and Moore, 2009). However, Gilovich, T. and Savitsky, K. (1996) made the point that heuristics are "judgmental shortcuts that generally get us where we need to go – and quickly – but at the cost of occasionally sending us off course". In other words, the quick "rules of thumb" make us fall into judgment traps (Tversky and Kahneman, 1974). Over fifty years of psychological research have shown that heuristics can lead to systematic errors, or biases, in decision-making. A bias is a human inclination to make predictable mistakes under certain circumstances (Tversky and Kahneman, 1974). These biases can have a deleterious effect on decision-making (Simon, 1955). In the last decades, several researchers (Barnes, 1984; Bazerman and Moore, 2009; Schwenk, 1984; Tversky and Kahneman, 1974; Hogarth, 1980; Slovic et al, 1977; Taylor 1975; Walsh 1995) have identified cognitive biases that potentially hinder decision-makers from making optimal decisions in terms of utility maximization (Das and Teng, 1999). But before exploring the major categories of heuristics and biases, it is key to understand human cognition and the decision-making process itself.

2.1.1. System 1 and System 2

Stanovich and West (2000) characterized two systems in human cognitive functioning: System 1 and System 2. This is a useful framework for organizing what academics have learned about judgmental errors and for drawing some strategies to counteract these biases (Kahneman, 2011). System 1 is automatic, effortless, intuitive, emotional, and implicit. People often call it 'gut feeling', and it is the system responsible for dodging an unexpected flying object or getting nervous in a flight turbulence (Caputo, 2013). System 1 learns relationships between simple ideas ("What's the capital of France?") and skills such as reading and turning the head towards a loud sound. We can often not refrain from using System 1 (e.g. thinking Paris when we hear "the capital of France") (Kahneman, 2011). The automatic operations of System 1 creates strikingly complex patterns of ideas, and effortlessly generate impressions and feelings. System 1 mobilizes System 2 when it gets an important or unconventional stimulus, because only System 2 can build thoughts in a systematic manner (Kahneman, 2011). System 1 is responsible for feeding System 2's beliefs and choices. System 1 comes into play to (in rough order of complexity):

- "Detect that on object is more distant than another"
- "Orient to the source of a sudden sound"
- "Complete the phrase 'bread and…' "
- "Make a "disgust face" when shown a horrible picture"
- "Detect hostility in a voice"
- "Answer to 2+2=? "
- "Read words in a large billboard"
- "Drive a car on an empty road"
- "Find a strong move in chess (if you are a chess master)"
- "Understand simple sentences"
- "Recognize that a 'meek and tidy soul with a passion for detail' resembles an occupational stereotype "

(Kahneman, 2011, p.21)

In many situations, System 2 can take over and overrule the freewill associations and impulses of System 1. System 2 is slower, reflective, determined, conscious, and rational (Kahneman, 2011). It is the system we use when deciding which route to take while planning an itinerary, or which courses to attend the next semester at university (Caputo, 2013). Some examples of System 2's activities (in rough sequence of complexity) are:

- "Brace for the starter gun in a race"
- "Focus attention on the clowns in the circus"
- "Focus on the voice of a particular person in a crowded and noisy room"
- "Look for a woman with white hair"
- "Search memory to identify a surprising sound"
- "Maintain a faster walking speed than is natural for you"
- "Monitor the appropriateness of your behavior in a social situation"
- "Count the occurrences of the letter "a" in a page of text"
- "Tell someone your phone number"
- "Park in a narrow space (for most people except garage attendants)"
- "Compare two washing machines for overall value"
- "Fill out a tax form"
- "Check the validity of a complex logical argument"

(Kahneman, 2011, p. 22)

System 1 is obviously much faster in making decisions and is in fact the origin of most biases. Although gut feelings are often quite accurate, people frequently overrely on this automatic system, which leads to judgment mistakes (Kahneman, 2011; Chung, 2004). The busier we are the bigger is our cognitive burden and time constraints, which increases reliance on System 1 thinking. Therefore, a frantic pace increases the likelihood of making costly errors (Milkman et al., 2009).

2.1.2. Heuristics and biases examples

Literature is rife with heuristics and biases examples. Once again, heuristics are 'rules of thumb' that help us handling decision situations, at the cost of making us fall into judgment traps more often than we usually acknowledge (Tversky and Kahneman, 1974). Every heuristic has at least one associated bias. Here is a compilation of the main ones:

Heuristic/ Bias	**Explanation**	**Researchers**
Confirmation	People favor confirmatory data when testing hypotheses. In other words, they prefer consonant than dissonant information in relation to their initial belief.	Baron et al., 1988; Klayman and Ha, 1987
Representati-veness	People have the tendency to imagine that what we see or will see is typical of what can occur, and they neglect true likelihoods of the events. For instance, when making a judgment, people tend to look for traits that correspond with previously formed stereotypes.	Nisbett and Ross, 1980 Tversky and Kahneman, 1974
Availability	People evaluate the probability or frequency of events depending on how readily occurrences are available in memory. When speculating what could happen, we tend to under or overweight past situations, that is, to attribute the incorrect probability to events.	Tversky and Kahneman, 1973 Hogarth, 1980
Anchoring	People have the inclination to make judgments based on an initial estimate as an anchor, and fail to make sufficient adjustments downwards or upwards later on.	Tversky and Kahneman, 1974
Affect	Judgments are mostly evoked by an emotional evaluation that takes place before any reasoning.	Kahneman, 2003
Bounded Awareness	In order to avoid information overload individuals often filter information unconsciously and automatically, which leads to occasional neglect of useful, observable, and relevant data.	Bazerman and Chung, 2005
Risk Aversion	People treat risks relating to perceived gains differently from risks relating to perceived losses.	Kahneman and Tversky, 1979a

Each heuristic can result in several cognitive biases (Tversky and Kahneman, 1974). The availability heuristic, for instance, leads to the retrivability, the imaginability biases, and others. Some biases stem from complex interactions of different heuristics, such as the overconfidence bias (cf. Hall et al., 2007; Slovic et al., 1977). According to Hogarth (1980) there are 29 separate biases that are likely to come up in decision making, whereas Bazerman (1994) mentions 13 biases found in managerial decision-making.

2.1.3. Relevance of heuristics & biases in this research

This section exposed the fundamental mechanisms of heuristics and biases that are behind the biases that are under test in this research: the overconfidence and confirmation biases. Forty years of research have established a strong link between the processes described as System 1 and System 2 thinking and predictable judgmental errors, and shed a light on the observed results of the experiment that has been conducted in this study.

2.2.**Decision-making**

Heuristics and biases are intrinsically related to judgments and decision-making, which have been explored in a vast and varied literature. Next, some useful concepts and discussions will be examined, namely (i) the difference between judgment and decision-making, (ii) the concept of strategic decision-making, (iii) the process management of strategic decision-making, and finally (iv) the main models and theories in the decision-making field.

2.2.1. Difference between judgment and decision-making

Because of different theoretical approaches taken by researchers, it is useful to outline the difference between judgment and decision-making (Davies et al., 2011). Although both concepts definitely share some common ground and definitions, judgment and decision-making have been considered distinct research areas. For Goldstein and

Hogarth (1997) judgment relates to how individuals weight information and the usage levels of available information, whereas decision-making is focused on outcomes in terms of a person's choices and actions, and how those could be improved. Holzworth (2011) sees the difference in terms of research objectives. While judgment analysis focuses on whether people make accurate choices, decision-making analysis concentrates on whether people make rational decisions.

2.2.2. Strategic decisions

Strategic decisions in corporations are a sub-set of decisions in general, and are markedly different from common decisions in the sense that they are made by managers and shape a company's general direction, commit key resources, and set relevant precedents (Mintzberg, Raisinghani, and Théorêt, 1976). These decisions are affected by the decision-maker's past knowledge and experiences, the organizational context in which the decision is taken and the environment itself (Mitchell et al. 2011).

Decisions can be characterized by two dimensions: control and performance (Rosenzweig, 2013). Control defines how much we can influence the terms and outcome of the decision: "Are we choosing among options presented to us, or can we shape those options? Are we making a onetime judgment, unable to change what happens after the fact, or do we have some control over how things play out once we've made the decision?" (Rosenzweig, 2013, p.90). Performance relates to the measurement of success: "Is our aim to do well, no matter what anyone else does, or do we need to do better than others? That is, is performance absolute or relative?" (Rosenzweig, 2013, p.90). Strategic decisions are characterized by a high level of control in shaping the alternatives themselves and the outcomes, and by a performance measurement that is relative to competitors. Business managers are not like shoppers choosing a product on the shelf or investors picking stocks. They face decisions of alternatives that must be shaped and controlled. In addition, managers must inspire and encourage action in the organization in order to outdo competitors. That is what we call strategy, and is exemplified by the decision to enter a new market, launch a new product or acquire another company (Rosenzweig, 2013). Strategic decisions also address the basic long-

term goals of a company, and the selection of courses of action and the allocation of resources required for carrying out these goals (Chandler, 1962).

Given that management strategic decisions are markedly ambiguous, uncertain and often unstructured, there is no reason to expect strategists to be free from cognitive biases (Schwenk, 1984). Academics list many biases that are specifically present in strategic decision processes. For instance, Schwenk (1984) categorizes 11 cognitive biases, including single outcome calculation, illusion of control, and prior hypothesis bias. Barnes (1984) identifies five decision biases that affect strategic planners, such as hindsight, judgments of correlation and causality, misunderstanding the sampling process, availability, and representativeness. If strategic decision makers always behaved optimally, costs and benefits would always be correctly weighted, no relevant information would be overlooked, mergers and acquisitions would always be successful and decisions would be duly revised facing new evidence. However, in reality, billions of dollars are wasted year after year because of suboptimal strategic decision-making and the amount of resources at stake in strategic decisions only grows along time (Milkman et al., 2009). In a knowledge-based economy, a worker's primary deliverable is a good decision. Thus, the interest to reduce strategic decision biases should be also at heart of every strategist. Awareness is necessary to neutralize decision biases, but not sufficient. Deliberate replacement of System 1 with System 2 thinking is imperative to that end (Milkman et al., 2009). Strategies include using weighted linear models to replace intuitive decisions (Dawes, 1971), and taking an outsider's perspective on the situation (Kahneman and Lovallo, 1993).

2.2.3. Strategic decision-making process management

For scholars, decision-making is a process in which a specific choice (or a selection of action) is made after some kind of decision process is carried out (Larsen and Mayrhofer, 2006; Simon, 1976; Smith, 1988). Some researchers talk specifically about the management of the decision-making process (Navickas, 2008). The prototypical managerial decision-making process has three major stages: (i) the preparation of the decision, (ii) the decision-making and (iii) the implementation of the decision (Navickas, 2008). Different factors influence each stage of the process, and therefore it

is useful to separate stages and sub-stages. For instance, on stages of preparation of the decision and decision-making, particular attention should be given not only the competence of the decision-maker, but also the degree of subjectivity involving the decision (Navickas, 2008). The managerial decision-making process is comprehensively analyzed in economics literature by Simon, 1976; Smith, 1988; Buchanan, 1991; Drucker, 1999; Stoner and al., 1999; Pettinger, 2001; Larsen and Mayrhofer, 2006; Marthinsen, 2007.

2.2.4. Normative, descriptive, and prescriptive models of decision-making

People decide in remarkably different ways. Many researchers explored the way individuals make decisions and how they theoretically should make them. Consequently, the range and variety of decision models is vast. Each model can be categorized according to its methodological foundation. Dillon (2006) classifies decision models as normative, descriptive or prescriptive.

- A normative model is a prototypical tool for a perfectly rational decision-maker (Dillon, 2006). A normative model induces the decision-maker to act with the goal of maximizing the chances of achieving the target. In other words, to rationally select the alternative with the highest expected utility (Abbas and Matheson, 2009)
- A descriptive model addresses how people actually decide in the real world, given their cognitive limitation and uncertainty.
- A prescriptive model shows what people should and can do given their cognitive limitations. It is a more modern approach and is tuned to both specific situations, and the characteristics of decision makers.

2.2.5. Rationality and bounded rationality

Classical decision-making theories emphasize decision-making as rational choices based on expectations about the consequences of actions that are aligned with previously set objectives. (March and Olsen, 1986). It would be highly desirable for

organizations that their employees follow such normative models for rational decision-making. However, the gap between normative and descriptive decision-making is wide and has grown in recent times (Luce and von Winterfeldt, 1994). Some authors propose that the gap can be closed by persuading decision makers to adopt more normative techniques (Payne et al., 1993). Although it surely would improve the quality of the decision-making, convincing people to actually use those models is a significant barrier. Therefore, some academics believe the best road to take is to start by forming descriptive models – or how people actually make decisions - and use those as the basis for recommendations - hence prescriptive models (Dillon, 2006). One of the recurring topics of descriptive decision-making literature is the concept of Bounded Rationality (or Limited Rationality), which was suggested by Simon (1955). The basic principle of Bounded Rationality is that all rational behavior takes place within certain constraints, including cognitive limitations (Schoemaker, 1980). According to Simon (1955), rational behavior is typified by a decision maker who has a "well-organised and stable system of preferences and a skill in computation that enables him to calculate, for the alternative courses of action that are available to him, which of these will permit him to reach the highest attainable point on his preference scale" (Simon, 1955, p.99). In his work, Simon mentions human physiological and psychological limitations in decision-making, hence starting the tread of Bounded Rationality.

2.2.6. Expected utility theory

The expected utility theory was created by economists to understand gambling behavior. Daniel Bernoulli developed some work as early as 1738 to address the St Petersburg Paradox (Schoemaker, 1982). Early research involved testing how much money people would be willing to bet depending on how many consecutive coin tosses end up on 'heads'. The expected utility theory proposes that when outcomes are uncertain, utility is multiplied by the expected probability of each outcome (Baron, 2008). Individuals are supposed to always maximize expected utility (Edwards, 1954). However, classical utility theory raises some questions pertaining to the value of utility and probabilities, especially in the realm of the unknown (Davies et al., 2011). Scholars have tried to address these issues. According to the subjective expected utility theory (SEU), in cases

when the probabilities are unknown, a person's own internal estimates of likelihood of different outcomes are used to assess values and probabilities (Savage, 1954). However, even when probabilities are known, people still often 'disrespect' utility theory (Davies et al., 2011). In order to explain such violations of the expected utility theory, especially in decisions involving a degree of risk, Kahneman and Tversky (1979a) have developed the prospect theory.

2.2.7. Prospect theory

The Prospect Theory suggests two main aspects in the decision-making process: the value function and the weighting function. The value function appraises prospect gains by measuring the perceived value of each alternative. The expected value can be positive or negative compared to the person's original viewpoint. In other words, people think in terms of gains and losses compared to the *status quo*. Value also considers the strength of the change compared to the initial base. For instance, an increase in a prize from $15 to $25 looks a lot more valuable than a growth from $2,215 to $2,225 (Kahneman and Tversky, 1979a). The weighting function is similar to the probability multiplication in expected utility theories, but assumes that people do not objectively assess the likelihood of outcomes. Instead, it predicts that people put much more weight to extreme probabilities than they should rationally. For example, moving from having no chance of getting a fatal disease to having a 1% chance has a much larger impact on decision-making than going from a 50% chance to a 51% chance. It has been also proved that people present a more extreme response to losses than gains of the same magnitude (Kahneman and Tversky, 1979a)

2.2.8. Relevance of decision-making in this research

Heuristics and biases themselves would not mean much if there was no relationship with real world decision-making. However, this link could not be clearer. Since people make decisions and take action heavily relying on those "cognitive shortcuts", biases in real world decisions are anything but rare. Naturally, those biases also affect strategic

decisions, the ones that shape the future of individuals and companies. Heuristics and biases are relevant insofar they affect decision-making, and as exposed, they do.

2.3.**Overconfidence**

An extensive body of literature in the fields of psychology, economics and finance indicates that people are generally overconfident (Camerer and Lovallo, 1999; Fang and Moscarini, 2005; Garcia, Sangiorgi and Urosevic, 2007; Menkhoff et al., 2006; Barber and Odean, 2001). According to Rosenzweig (2014), overconfidence in the usual language is a term used when something has turned out badly. For psychologists, however, overconfidence refers to a level of confidence that is excessive or "unwarranted" given the objective reality and historical performance (Rosenzweig, 2014). Over 25 years of research shows that, among other consequences, overconfidence leads to suboptimal decisions of managers and investors (Glaser et al. 2013). Overconfidence in the financial sector, for example, causes late option execution (Malmendier and Tate, 2005), a large number of failed acquisitions deals (Doukas and Petmezas, 2007), and overweighting of private information (Friesen and Weller, 2006). In companies, overconfidence in own skills and neglect of competitors' skills have caused excess market entries (Camerer and Lovallo, 1999). However, even though managerial overconfidence is pervasive, we do not know how much of it is learned and how much is a stable behavioral trait (Billet and Qian, 2008)

2.3.1. Causes of overconfidence

Overconfidence is modulated by many different variables. It is expected to increase when participants do not receive frequent feedback (Gloede and Menkhoff, 2014; Lichtenstein and Fischhoff, 1980). Overconfidence is also expected to grow along with the availability of information (Oskamp, 1965; Tsai et al., 2008), and as questions become more difficult (Lichtenstein and Fischhoff, 1980). It can also be affected by the individual's cognitive style (Tetlock, 2005). Possible causes of overconfidence are anchoring and insufficient adjustment (Soll and Klayman, 2004), the availability and the hindsight biases (Russo and Schoemaker, 1992).

Anchoring and insufficient adjustment

In the original formulation by Kahneman and Tversky (1974), the starting information, or anchor, tends to influence the subsequent adjustment process. Because of insufficient adjustment, individuals leave the final estimates too close to the original anchor. People adjust insufficiently from a starting anchor value (which they generate for themselves) because they stop adjusting once their believe intervals fall within a range of plausible values (Epley and Gilovich, 2006). Hence, overconfidence in numerical estimates can arise from anchoring and insufficient adjustment.

Availability bias

Overconfidence is largely due to people's innate difficulty in imagining all the events that could actually happen (Russo and Schoemaker, 1992). The availability bias exists because "what is out of sight is out of mind" (Tversky and Kahneman, 1973). Since we fail to imagine all the ways events can unfold, we become excessively confident and overweight the likelihood of the few pathways we can actually imagine.

Hindsight bias

Like the availability bias, the hindsight bias relates to our inability to process all possible future scenarios. We end up believing the world is more predictable than it really is. In hindsight, everything seems to be more likely after it has occurred than it did before (Russo and Schoemaker, 1992).

2.3.2. Overconfidence measurement

Overconfidence can be observed in three phenomena: (i) overestimation of performance abilities (also represented by the illusion of control), (ii) overplacement relative to others (or better-than-average effect) and (iii) overestimation of accuracy of own knowledge (also called illusion of knowledge, or miscalibration) (Moore and Healy, 2008). Researchers have designed experiments to measure overconfidence expressed by individuals in these three different ways.

Illusion of control

Langer and Roth (1975) introduced the concept of "illusion of control", and defined it as "an expectancy of personal success probability inappropriately higher than the objective probability would warrant" (p. 311). In situations involving chance, people are inclined to behave as if they were able to control outcomes because of some similarities with skill situations. These similarities include familiarity with the task, selection, competition, involvement, and/or prior knowledge. People have the illusion of control when one or some of these skill-related features are present in a chance situation (Stefan and David, 2013). The perception of controllability is also fuelled by the order of the expected outcomes. If individuals sees a large number of successes at the beginning of a series of events, they tend to grow the illusion of control (e.g. Langer and Roth, 1975; Presson and Benassi, 1996). Therefore, the frequency of reinforcement is another key factor contributing to this illusion and causing overconfidence. In experiments in which pressing a button is often followed by preferred outcomes, people tend to feel the illusion of control, although their actions have no real influence over the results (e.g. Alloy and Abramson, 1979; Tennen and Sharp, 1983; Thompson et al., 2007).

The illusion of control is also observable in the fact that people generally anticipate that they will finish tasks sooner than they actually do. In a series of experiments in which participants should predict completion times for everyday tasks and activities, less than half of participants were able to finish the tasks within the timeframe they had forecasted (Buehler et al., 1994). People build narratives of how thing will unfold, and the availability bias limits the construction of future scenarios with higher hurdles and time-consuming events. In fact, individuals tend to disregard the statistical distribution of past completion times and focus on previous occasions that justify optimism (Kahneman and Lovallo, 1993; Kahneman and Tversky, 1979b; Kahneman and Tversky, 1982). The extensive research in the domain of the illusion of control was aggregated under a unifying theory – the control heuristic (Thompson et al., 1998, 2004, 2007).

Better-than-average effect

The so-called better-than-average effect is a tendency observed by researchers for people to rank themselves above average in positive attributes and below average in negative attributes (Benoît and Dubra, 2009).

The better-than-average effect is observable either for positive and negative traits. People consider themselves to be above average in regards to intelligence, generosity, friendliness, and politeness, and below average in stupidity, stinginess, unfriendliness and rudeness. The better-than-average-effect has been observed for a wide array of skills, such as driving, verbal communication, social abilities, and performance in easy tests (Pahl and Eiser, 2005; Gold and Brown, 2011).

Since many decades, it is known that most car drivers tend to believe that they have superior driving skills than the average driver (cf. Näätänen and Summala, 1975). Around 70-80% of drivers assessed their abilities to be 'above average'. Preston and Harris (1965) carried such experiments with drivers who got involved in accidents and drivers without accident history. When asked about their driving ability compared to the average driver, the two groups presented nearly identical levels of overconfidence.

Illusion of knowledge/Confidence Intervals

Overconfidence is also expressed by the so-called illusion of knowledge. Thus, a popular tool among researchers for measuring overconfidence is the elicitation of confidence intervals involving numerical questions (e.g. Russo and Schoemaker, 1992; Soll and Klayman, 2004). People make implicit or explicit confidence interval judgments all the time, for instance, when calculating how long they are going to take to get to the airport, or how much beverage they should purchase for a party. Participants in confidence intervals experiments are asked to provide quantitative estimates of unfamiliar variables (e.g. when was Beethoven born? What is the population of Thailand?) in terms of ranges that correspond to a certain degree of confidence (e.g. 90%). The participant is completely free to set narrow ranges when he is certain or wide ranges when he is uncertain. However, when people declare they are 90% sure of a fact, they typically get the right answer less than 90% of the time, which can be interpreted

as overconfidence in one's own knowledge (Soll and Klayman, 2004). Klayman et al., (1999) reviewed the body of research and improved the method of confidence interval experiments. Their findings confirmed that there are systematic disparities between subjective confidence judgments and observed accuracy.

Overconfidence is pervasive unless interval questions are very easy (Soll and Klayman, 1999). Participants typically show more overconfidence in areas they have a self-declared expertise (Heath and Tversky, 1991), and less in domains in which they deem to be incompetent (Kruger, 1999). It was also noted that the level of observed overconfidence depends on how the question is framed, what is the domain of the question and certainly, whom you are asking the question (Soll and Klayman, 1999). There is a significant heterogeneity in the individual results – some people are consistently overconfident whereas some people are biased with *underconfidence* (Soll, 1996). It is also know that overconfidence varies depending on the set of questions and how the questions are framed (Juslin et al., 1999; Klayman et al, 1999). Not much is known about on which occasions specifically and why interval estimates are so biased by overconfidence (Soll and Klayman, 2004). However, no one seems to disagree that predictions of uncertain events play a critical role in the decision in applied contexts (Savage, 1954). Winman et al. (2004), stresses the impact of such intervals predictions in real-world decision-making by suggesting:

"Imagine that you intend to purchase a house and ask a financial advisor to predict the interest rate for bank loans over the next year. You could ask him or her to (…) produce an interval, in which it is likely that the interest will fall (…)" (Winman et al., 2004, p. 1167)

2.3.3. Usefulness of overconfidence

Many scholars have defended that overconfidence is damaging for companies, and for instance, it makes managers believe their firm is undervalued, leading them to favor internal rather than external capital sources, even when this is inappropriate (Baker, Ruback, and Wurgler, 2007). However, others have contended that overconfidence in managers is beneficial, because it reduces conservatism and underinvestment, typical

agency costs (Libby and Rennekamp, 2012). For Shapira-Ettinger and Shapira (2008), the usefulness of overconfidence is indeed underrated. Although vast economic literature aims at discouraging overconfidence in decision maker, the researchers argue nevertheless that overconfidence has constructive value in a plethora of situations. In special, those in which individuals tend to show a hyperbolic discounting of future utility, which creates imbalances in their preferences over time. By artificially raising the prospect of future rewards, overconfidence can be vital to offset inhibitory effects of inflated preferences for present payouts. Therefore, overconfidence can yield greater incentive, perseverance, performance, and thus higher achievements (Shapira-Ettinger and Shapira, 2008). This is the case of doctors, soldiers and investors, but particularly true for inventors and entrepreneurs, who are among the biggest risk takers in the modern economy (Åstebro et al., 2007). Overconfidence can lead to self-deception and escapism, but those moods can indeed be rational if they prevent the decision-maker from more destructive moods, such as low motivation and despair. Therefore, the deviation from objective reality created by overconfidence may protect the individual's mental health (Loungeway, 1990).

2.3.4. Relevance of overconfidence in this research

The overconfidence bias is perhaps the single greatest responsible for corporate fiascoes. Overconfidence in psychology means an unwarranted level of confidence in an estimation or likelihood of an event, given expected probabilities based on historical data (Rosenzweig, 2014). Over time, repeated overconfident decisions and actions will most likely have pernicious effects of all sorts on individuals and companies, for instance, overinvestment and losses. Therefore, the awareness of this bias is not only useful but also vital for decision-makers.

2.4.**Confirmation bias**

> "The human understanding, when it has once adopted an opinion, draws all things else to support and agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects and despises,

> or else by some distinction sets aside and rejects, in order that by this great and pernicious predetermination the authority of its former conclusion may remain inviolate." (Bacon, 1939/1620, XLVI)

Confirmation bias is potentially the most widely known and accepted type of inferential error registered in the literature on human reasoning (Evans, 1989). If one single problematic aspect of human cognition should deserve maximum attention, the confirmation bias would be among the top candidates (Nickerson, 1998). When people look for new information, this process is often biased towards the individual's previously held beliefs, expectations and preferred conclusions (Jonas et al., 2001). According to Kassin (2005), "a warehouse of psychology research suggests that once people form an impression, they unwittingly seek, interpret, and create behavioral data that verify it" (Kassin, 2005, p. 219). This routine leads to the preservation of the information seeker's initial position, even in cases in which the available information goes against this position (Johnston, 1996; Pinkley et al., 1995). In short, confirmation bias is the seeking and interpreting of information in ways that are consonant with existing beliefs, expectations, or hypotheses. It accounts for a significant share of disputes, quarrels, and misunderstanding that happen among people (Nickerson, 1998). It is important to make the distinction between building a case consciously, as attorneys and prosecutors do in court, and inadvertently picking only confirming evidence in a case. Only the latter represents the so-called confirmation bias (Nickerson, 1998).

The confirmation bias is dangerous because it leads to the neglect of risks and warning signals, increasing the likelihood of big decision fiascoes (Janis, 1982; Nemeth and Rogers, 1996). Therefore, it is relevant and useful to raise the awareness in individuals and organizations about the biased search of information in order to reduce the likelihood of foreseeable bad outcomes (Jonas et al., 2001; Schultz-Hardt, 1997; von Haeften, 1999). The confirmation bias is not restricted to final decisions. In fact, this bias arises in preliminary judgments when the decision maker is committed to the preferred alternative (Schultz-Hardt, 1997). We expect people around us not to fall into the confirmation bias trap. A medical doctor, for instance is expected to pay attention to alternatives diagnostics even if he feels committed to a specific one. A supervisor is

expected to fairly evaluate the current performance of an employee, and not overly weight prior impressions of the subordinate (Jonas et al., 2001). A teacher is expected not to misread actual performance signals from students as supportive to her initial impressions, and erroneously rank pupils in terms of intelligence (Rabin and Schrag, 1999). Bruner and Potter (1964) conducted a classic experiment in which people were shown blurred pictures that gradually became sharper. Participants started seeing the images at different levels of sharpness, but the speed of the focusing process and the end focus stage were exactly the same for all participants. Amazingly, only one quarter of individuals who began seeing the images at an extreme blurred stage eventually identified them correctly, while more than half of those who started in a light-blur stage correctly identified the images. The scholars then concluded that "interference may be accounted for partly by the difficulty of rejecting incorrect hypotheses based on substandard cues (p.424)."

2.4.1. Rationality and Bayes' Theorem

Bayes's Theorem (or Bayes' Law) concerns the rational update of probabilities facing new evidence. A perfectly rational being will always update its beliefs correctly, and never fall in the confirmation bias trap. The theorem is named after Reverend Thomas Bayes (1701–1761), the first person to show how to use new information to update beliefs (Nelson and McKenzie, 2009). Nelson and McKenzie (2009) describe an example of application of the Bayes' Theorem:

> "Suppose that the base rate of a disease (d) in males is 10%, and that a test for this disease is given to males in routine exams. The test has 90% sensitivity (true positive rate), e.g. 90% of males who have the disease test positive. Expressed in probabilistic notation, P(pos | d) = 90%. The test has 80% specificity, e.g. P(neg | ~d) = 80% (20% false positive rate), meaning that 80% of males who do not have the disease correctly test negative. Suppose a male has a positive test in routine screening. What is the probability that he has the disease? By Bayes' theorem, P(d | pos) = P(pos | d) P(d) /

> P(pos), where P(pos) = P(pos | d) P(d) + P(pos | ~d) P(~d). Therefore, P(d | pos) = (.90 x .10) / (.90 x .10 + .20 x .90) = .09 / .27 = 1/3." (Nelson and McKenzie, 2009, p.2)

2.4.2. Causes of confirmation bias

What causes confirmation bias? Is it a matter of protecting one's ego? Or is it about cognitive limitations? Is it beneficial in any sense? Several mechanisms are at play in the confirmation bias, and interact to cause this ubiquitous phenomenon, such as the desire to believe, the attempt to be consistent and rational, cognitive limitations, positive-testing, overweighting/ underweighting of evidence, the primacy effect, sequential presentation of evidence, selective exposure of information, and the emotional state.

Desire to believe

People find it easier to believe in hypotheses they prefer to be true than in propositions that they would like to be false (Ch'ng, and Mohd, 2010). In an experiment, male participants behaved differently in telephone conversations with female participants that have been described "attractive/unattractive" (Snyder et al., 1977). Their different attitudes evoked more positive responses from women deemed "attractive". By inadvertently providing evidence for the preferred hypothesis, respondents behaved consistently with the assumption, thus creating a self-fulfilling prophecy (Nickerson, 1998). In other words, people tend to have a desire to believe, which greatly influences the search and evaluation of evidences and favors the confirmation bias.

Consistency and rationality

People value rationality, which demands consistency as a pre-requisite (Nickerson, 2008). Darley and Gross (1983) conducted an experiment in which two groups of people watched the same videotape of a student taking a test. The first group was told that the child came from the upper class while the other was led to believe that he was from a low socio-economic background. The first group rated the academic abilities as 'above average', whereas the second group rated the same performance as 'below

average'. Researchers then concluded that the participants formed an initial hypothesis about the student's abilities based on assumptions about the relationship between socioeconomic background and academic skills and then interpreted what they observed in the video to make it consistent with that hypothesis (Darley and Gross, 1983).

Cognitive limitations

People cannot test many hypothesis at the same time, and tend to ignore alternative hypotheses because they simply cannot process differing information simultaneously (Doherty and Mynatt, 1986). According to researchers, this explains why people are adept to select *non-diagnostic* over *diagnostic* information in Bayesian decision settings (Doherty and Mynatt, 1986). The problem is that focus on only one hypothesis at a time can lead to the sustaining of a false hypothesis. If an incorrect hypothesis is close enough from being correct, positive reinforcement will strengthen the incorrect hypothesis, and inhibit further search for an alternative hypothesis (Nickerson, 1998).

Positive-testing

In cases in which there is no compelling opposing evidence, individuals are inclined to assume a statement is true (Nickerson, 1998). Surprisingly, people have the tendency to test hypotheses looking only for reinforcing evidence for their favorite hypothesis even when they have no personal interest in confirming this hypothesis. The tendency to concentrate on the positive side only is known as *pseudodiagnosticity* (Nickerson, 1998; Doherty et al., 1979; Doherty and Mynatt, 1986; Kern and Doherty, 1982; Fischhoff and Beyth-Marom, 1983).

For instance, imagine a game in which there is a simple hidden rule that govern the relationship among a series of three numbers. The participant has to find out the rule and is informed only that the sequence 2-4-6 complies (Wason, 1960). The participant is invited to suggest any sequence of three numbers (or triplets) and receive the information if it complies or not with the hidden rule. Most contestants will come up with triplets that are similar to the one already given at the start (e.g. 6-8-10), because they are working with the hypothesis that the rule is an obvious "add 2". However, testing the rule like this does not add information compared to what is already known. It

would be more productive for contestants to produce triplets that falsify the assumed rule (e.g. 4-4-5). When the individual only produces confirming triplets, he deprives himself of the possibility to discover that the hypothesis is flawed. In reality, the hidden rule of this game is broader than the one implied by the initial 2-4-6 triplet – namely *any sequence in ascending order*. Although producing disconfirming triplets is always more diagnostic than confirming ones, participants rarely do so (Baron, 2008). Wason summarized the results of his experiments: "there would appear to be compelling evidence to indicate that even intelligent individuals adhere to their own hypotheses with remarkable tenacity when they can produce confirming evidence for them" (Wason, 1968/1977, p. 313). In subsequent experiments by other researchers intrigued by this finding, participants were asked to decide which of many hypotheses was the right one to explain a certain outcome. Participants tended to ask questions for which the answer would be "yes" if the hypothesis under scrutiny were true (Mynatt et al., 1977; Shaklee and Fischhoff, 1982), hence testing the hypothesis only positively and favoring the confirmation bias.

Overweighting/underweighting of evidence

People have the tendency to attribute greater weights to evidence that is supportive of prior beliefs or opinions than to information that is contradictory. It does not mean completely overlooking disconfirming evidence, but being less open to them and more likely to look for ways to discredit it or explain it away (Nickerson, 1998). Individuals who wish to believe in astrology will have no trouble in finding some predictions that turned out to be true, and this is sufficient to strengthen their belief. Failed predictions are simply ignored and forgotten (Nickerson, 1998). Preferential treatment to evidence is also known as the *my-side* bias, or the tendency to recall and produce reasons only for the view they support (Baron, 1991; Perkins et al., 1983). In a study, participants were unable to generate arguments against their views spontaneously and only did so when directly requested (Perkins, Farady and Bushey, 1991).

A famous research by Lord, Ross and Lepper (1979) concluded that if people cannot avoid disconfirming evidence, they must be giving it less weight than to confirming information. In the study, students for and against the death penalty were exposed to

short research reports that were fabricated in a manner that both sides were equally strong represented. Participants were asked to rate the quality of the report, and indeed the reports that were aligned with the person's prior belief consistently received higher scores. Strikingly, although people were exposed to arguments from both sides, they ended up with even stronger views about their position than previously. Thus, exposure to disconfirming evidence was not only ineffective, but also counterproductive (Lord, Ross and Lepper, 1979). Lehner et al. (2008) investigated the confirmation bias in complex analysis tasks like those found in law enforcement investigations, and intelligence and financial analyses. They argued that most experiments involved simplistic tasks that did not measure real-world confirmation bias, like the triplets experiment from Wason (1960). The scholars used a case study involving an explosion on the battleship USS Iowa. They offered participants pieces of evidence of different lengths and diagnosticity, which could confirm or disconfirm individual's favorite hypothesis (Lehner et al., 2008). Researchers found that, although participants tend to agree on the interpretation of pieces of evidence, they disagreed on the weighting of the information. Aligned with other studies, participants tended to give more weight to evidence confirming their favorite hypothesis.

Primacy effect

When an individual has to draw a conclusion based on data acquired over time, the information gathered earlier in the process is likely to have more weight than subsequent data (Lingle and Ostrom, 1981; Sherman, Zehner, Johnston and Hirt, 1983). This is known in psychology as the *primacy effect* and it has also been observed by Francis Bacon centuries ago: "the first conclusion colors and brings into conformity with itself all that come after" (Bacon, 1939/1620, p. 36). The *primacy effect* reinforces early hypothesis, and favors the confirmation bias.

Sequential presentation of evidence

Jonas et al. (2001) conducted a series of experiments to measure confirmation bias in situations in which people had access to simultaneous confirming and disconfirming evidence, versus situations in which evidences were presented one after the other (sequentially). They found out that in the sequential case, confirmation bias is stronger,

because when sequentially confronted with additional information, people tend to compare it with one's prior decision reinforcing the availability of this decision in memory (Hogarth and Einhorn, 1992). Thus remembering the prior decision, increases commitment further to it (cf. Tesser et al., 1995). Individuals generally try to interpret additional data in terms of functional connections that they believe already exists (Kahneman et al., 1982). In the real world, sequential information exposure is much more common than simultaneous (Jonas et al., 2001)

Selective exposure of information

According to the cognitive dissonance theory (Festinger, 1957), once committed to an alternative, individuals favor supportive/consonant information rather than opposing/dissonant information. Psychologists accept that people tend to expose themselves more to information sources that are aligned with prior beliefs than those who do not (Festinger, 1957; Klapper, 1960).

Emotional state

Young et al. (2001) decided to investigate the relationship between confirmation bias and emotional states. They showed that "anger results in relatively less confirmation bias than the comparison emotional states". When angry, individuals tended to select less hypothesis confirming data than people in sad or neutral states.

2.4.3. Usefulness of confirmation bias

Belief perseverance is not always bad. Protecting prior beliefs from contrary evidence can be, like in the case of overconfidence, favorable to maintain an individual's ego and mental health (Nickerson, 1998). The confirmation bias is so ubiquitous and enduring because it preserves favorite hypotheses and beliefs (Greenwald, 1980). The confirmation bias is the major force that prevents easy and frequent opinion changes. Very few individuals would be willing to give up long-held opinions and beliefs on the first piece of contrary evidence found, and this has several reasons for being appropriate (Nickerson, 1998). Most beliefs individuals hold are not of the kind that can be

objectively falsified by one piece of data. Those instances have both supporting and contrarian evidence, and the final opinion of the individual depends on the weights one puts on each argument, which in turn depends on personal values. In addition, in many instances the costs of believing a false premise are very different from disbelieving true ones. For example, a medical doctor would be better on the safe side believing a patient has a potentially fatal disease and treating it than not doing anything (Nickerson, 1998).

2.4.4. Relevance of the confirmation bias in this research

Sound businesses depend on sound decisions, which in turn require a balanced search and evaluation of information. Most people, however, fall prey of the confirmation bias and prefer confirmatory evidence to other evidence, putting stakes at unnecessary risk. Awareness of the confirmation bias is paramount to improve the decision-making process' quality, and this is the reason this bias was selected as the topic of this research.

2.5. **Literature Review conclusion**

This literature review should have provided enough background information for the understanding and interpretation of this research. It presented a summary of the published research on heuristics and biases to lay ground for the understanding of the overconfidence and confirmation biases. It also shed a light on the decision-making process, linking the mental processes that harms our reasoning to real world consequences. Finally, it explored the literature on the overconfidence and confirmation biases themselves – how they are born, how they are measured and how they affect decision-making. Many researchers have dedicated significant effort to describe the hidden forces that affect human decision-making, and knowing their conclusions enables us to advance even further this very interesting area of research.

3. RESEARCH METHODOLOGY

This section presents the methodology of the research, focusing on participants and their profile, materials, procedures and the Standards for Educational and Psychological testing.

3.1.Participants

The population or universe in this study were management students and recent graduates of top management schools, between the ages of 23 and 30 of both genders, diverse national backgrounds, up to 5 years of work experience, and advanced English skills (since the test was administered only in English). This sample was selected because this group is considered the next generation of business leaders, who will influence both the business environment and the world in general with their decision-making.

The sample was selected out the author's extended network of people falling in the above-mentioned description. The author met these people during his Bachelor in Business Management at FGV-EAESP (São Paulo, Brazil) from 2007 to 2011 and Masters in International Management (FGV/ESADE/The University of Sydney) from 2012 and 2014. Participants were individually recruited mainly via social media between October 27 and November 3, 2014.

- Of 80 contacted people, 71 answered to the invitation and 59 provided valid responses to the survey.
- 12 results were eliminated from the sample for being incomplete or invalid (mainly participants who took too long to answer to some of the questions, indicating potential check on external sources).
- The average age in the sample was 24.5 years of age.
- 70% of respondents were male and 30% were female.

- 27% of the participants were undergraduate students or just completed their undergrad studies, while 73% were masters students or just completed their masters
- Respondents were from 21 different nationalities.
- Some of the top management schools represented in the sample were: FGV EAESP (Escola de Administração de Empresas da Fundação Getulio Vargas, Brazil), ESADE (Spain), HEC Paris (France), University of St.Gallen (Switzerland), Wirtschaftsuniversität (Austria), Università Commerciale Luigi Bocconi (Italy), Indian Institute of Management Calcutta (India), University of Economics (Czech Republic), Richard Ivey School of Business (Canada), The University of Sydney Business School (Australia) and UCD Michael Smurfit Graduate Business School (Ireland).

3.2.Materials

The data collection method was an online survey created on the platform Qualtrics™ and administered at distance. A survey provides quantitative descriptions of attitudes and behaviors of a population, with the help of a sample (Creswell, 2003). The survey was preferred to interviews to allow a quicker and broader collection of data. The survey was cross-sectional, that is, the data was collected in a short period. The survey comprehended a questionnaire of 10-25 minutes of duration, which the participants were asked to answer without interruptions, without referring to any external sources of information. Time on each question was measured as an attempt to eliminate unusually long response times. The main goals of the survey were to capture individuals' level of confidence in their own knowledge (as a proxy for general level of confidence), and their susceptibility to fall into the confirmation bias trap. The software used for the statistical analysis of data was the Statistical Package for the Social Sciences (SPSS) by IBM.

3.3.Procedure

Participants were not informed about the specific objective of the study (i.e. to measure the relationship of the level of confidence and the susceptibility to the confirmation bias). They were only presented with the following introduction:

> *Thank you for taking this survey and helping science to advance!*
>
> *This is a study about **how people make choices.***
> *If you wish to receive the results of the study, please leave your e-mail address at the end of the survey*
>
> ***I promise you'll be in for some surprises about people and about yourself!***
>
> *It is important that, once you start the survey, you **go until the end without interruptions.***
> *Please **do not use any external sources** to help you answering the questions.*
> *The individual survey responses are **anonymous**.*

The survey was divided into four main sections, starting with (i) a test of overconfidence, followed by (ii) a case study to measure confirmation bias, and (iii) a confirmation inventory questionnaire, and closing with (iv) demographics.

Level of confidence section

In the first part of the questionnaire, people answered to the classical interval confidence questionnaire (Yates, 1990). The questions were modified by the author to avoid easy retrieval of the full answer key online by participants, but were analogous to the original questions and had a comparable level of difficulty. Participants received the following instructions:

> *For each of the questions below, please provide the **NARROWEST RANGE that you are 90% SURE that contains the correct answer.***
>
> *In particular, if you have **"no idea"** then give a **very wide range**; and if you happen to be **quite certain** then give a **narrow range.***
>
> *For instance:*
> *What is the population of Australia?*
> *I am 90% confident that it is between X (lower range) and Y (upper range)*

Then, they were presented the following numerical questions, and asked the lower range and upper range for each one:

1. *Albert Einstein's age at death*
2. *Length of the Amazon River (in km)*
3. *Number of Spanish speaking countries in the world*
4. *Revenue of Walmart in 2013 (in billion USD)*
5. *Average real state price in upscale areas of London/UK (USD/m2)*
6. *Weight of an adult blue whale (tons)*
7. *Year in which Beethoven was born*
8. *Number of daily passengers in the busiest airport in the world (Atlanta International Airport)*
9. *Air distance from New York to Berlin (in km)*
10. *Highest point on Earth (in meters)*

The scoring system used in this study is known as the *bias score*, which is referred to as "calibration-in-the-large" by Yates (1990, p.79). The bias score is calculated by subtracting 90% (confidence level requested) from actual accuracy of estimates. A positive bias score represents overconfidence (Yates, 1990).

For instance, if a respondent gets the right answer encompassed within 6 out of 10 intervals (hence 60% confidence), his level of overconfidence would be 90% - 60% = 30% (thus, it is an overconfident respondent, who probably set unduly narrow intervals). If all intervals encompassed the correct answers (100% confidence), then the individual would have a confidence level of 90% - 100% = - 10% (hence, a slightly *underconfident* individual who probably set way too broad intervals).

Confirmation bias case study section

In the next session, participants were asked to read a case study about an investment decision. The case was inspired in similar confirmation bias experiments (cf. Jonas et al., 2001; Lehner, et al. 2008), to measure participants' inclination to seek confirming evidence after a preliminary hypothesis is formed. In this particular experiment, the preliminary hypothesis consisted of whether the presented investment opportunity was a good idea or not. Participants were presented the following instructions:

CASE STUDY

*You are the managing director of a **venture capital fund.***
Your company typically invests in technology related startups.

*Recently, **you heard the pitch** of two entrepreneurs who presented their venture.*

*This venture is the **first online marketplace where chefs and customers meet to arrange the cooking for private parties and dinners** at home with friends and family.*

*The marketplace makes money by **charging a commission** from the chefs on the business they make.*

*The entrepreneurs **asked for an investment** to finish the platform and invest in marketing to grow it.*

The size of the investment is adequate (follows market prices) for the share being sold to the venture capital fund.

The entrepreneurs declared they have pitched the same idea to three competing venture capital funds.

Then the participants were asked whether they would use the service and whether they would invest in it (as a preliminary decision).

Would you use this service?

- *Yes*
- *No*
- *Unsure*

Do you think this investment sounds like a good idea (preliminary answer)?

- *Yes*
- *No*

In cases in which the participants decided the investment was initially a good idea, they asked to brainstorm a name for the venture and decide on the size of the commission to be charged from clients. Those questions were designed to create emotional attachment to the decision, by making the participant invest energy in the decision.

Can you think of any creative name for this venture?

What do you think would be a fair commission (in %) to charge chefs?

In the next stage of the case study, people were presented with the possibility to read up to six short opinions (two- to four-lines long). They were presented the following instructions:

> *Partners and analysts at your fund have mixed views on this investment.*
> *Now you will be able to read those opinions and make your final decision.*
>
> *The following options summarize the opinion of partners and analysts*
>
> *PLEASE **SELECT UP TO SIX OPINIONS YOU WOULD LIKE TO READ IN DETAIL** BEFORE YOUR FINAL DECISION*

Then a list of six positive and six negative summarized arguments about the investment were listed, and the participant was able to tick up to six of those arguments in order to collect information for the final decision (for the full arguments, please see the Appendix). The case was built in a way that both sides had equally strong arguments.

- *"We have received good feedback from both users and chefs"*
- *"Margins are incredible and the business is extremely scalable"*
- *"There are low entry barriers for competitors"*
- *"The initial feedback is based on a bad initial sampling"*
- *"We can have a 1st mover advantage"*
- *"The team is excellent"*
- *"There's a risk people will contact chefs directly, and chefs will avoid commission"*
- *"We had a big failure in a marketplace investment some years ago"*
- *"It's a huge market with high growth potential"*
- *"We can increase value for user with original content"*
- *"There are not enough qualified chefs to meet demand"*
- *"The team lacks important skills to execute"*

The score in the case study confirmation was measured in a scale similar to that used by Jonas et al. (2001). The score was calculated as follows:

The numerical difference between the number of confirming and disconfirming pieces of information is the measure of the level of confidence. For example, if the participant decided the investment was a good idea (initial hypothesis), and picked four confirming (positive) opinions and two disconfirming opinions (negative), his level of confidence score would be [4 – 2 = 2]. A perfectly susceptible respondent would, after the initial assessment, only select reinforcing information in the opinions section, hence scoring six in the scale. A completely unbiased respondent would, after the initial assessment, select a balanced three negative and three positive opinions, scoring zero. Finally, a perfectly negatively biased respondent would select only arguments that opposed the initial belief, scoring minus six in the scale. Therefore, the scale goes from minus six (maximum negative bias) to six (maximum positive bias).

Finally, participants were asked to make their final decision regarding the investment.

Now that you have heard some opinions, will you make the investment?

- *Yes*
- *No*
- *Unsure*

Confirmation Inventory section

In order to collect addition data points on confirmation bias, participants were asked questions from the Confirmation Inventory (CI) by Rassin (2008). The CI contains statements related to the confirmation bias, phrased in a way that participants do not judge to be problematic. Therefore, instead of directly asking if the individual "tends to solely give attention to information which supports your idea, while ignoring disconfirming information", the author used less obvious phrasings such as "I only need a little information to reach a good decision" (Rassin, 2008)

A 4-point Likert scale was used (Completely disagree; Tend to disagree; Tend to agree; Completely agree). The four points scale was chosen to avoid central answers (neutral).

Only six questions - deemed the most revealing - of the CI were asked, to avoid fatigue in respondents. Namely the following:

- *I only need a little information to reach a good decision*
- *My first impression usually seems to be correct*
- *I usually trust my intuition*
- *Sometimes, I know things before there is actual proof of them*
- *If my reasoning and the physical evidence are in contradiction, I tend to favor my reasoning*
- *Once I have a certain idea, I can hardly be brought to change my mind*

The scoring of confirmation inventory (CI) followed a simple addition, where each point on the Likert scale was added up to reach the final score. Thus, the scale went from 0 ("Completely disagree" with all statements) to 24 ("Completely agree" with all statements).

Demographics section

Finally, the demographics of the respondent were asked, comprising gender, age, nationality, and highest level of education.

3.4.Standards for Educational and Psychological Testing

This research was conducted according to the Standards for Educational and Psychological Testing (thereafter *Standards*) by the American Psychological Association (APA), which provides essential guidelines for the sound and ethical use of testing in psychological research (American Psychological Association et al., 1999). The *Standards* addresses three major sections: (i) test construction, evaluation and documentation, (ii) fairness in testing and (iii) testing applications.

3.4.1. Test construction, evaluation and documentation

In this section, the *Standards* addresses validity, reliability, test development and revision, scaling, test administration and supporting documentation for tests. Validity is referred to as the degree to which theory and evidence support the interpretation of test scores. It is the most important consideration in developing and evaluating tests. Reliability relates to the consistency of the test procedure when repeated on a population. However, since no participant is completely consistent and because of the subjectivity of the test scoring process, there will be always some amount of measurement error. Test development refers to the process of creating a measure of some aspect of a person's knowledge, skill, interest, attitude, or other characteristics. It includes specifying conditions for administering the test, choosing procedures for scoring the performance, and reporting the score to test users. Scaling support the interpretation of the data to enhance comparability. A critical step in the evaluation of test results is to establish cut points to distribute the sample in categories. Test administration defines directions to participants, testing conditions and detail procedures in order to standardize the test. Supporting documents are used to allow test users and reviewers to assess the suitability of the test. A typical documentation specifies the nature of the test and its use, development process, evidence of validity and reliability, scaling and guidelines for administration (American Psychological Association et al., 1999).

3.4.2. Fairness in testing

In the second section, the *Standards* focuses on fairness of designing, conducting, and evaluating tests. It sets standards on fairness and bias, by following four tenets that should guide the test: (i) Fairness as a Lack of Bias; (ii) Fairness as Equitable Treatment in the Testing Process; (iii) Fairness as Equality in Outcomes of Testing; and (iv) Fairness as Opportunity to Learn. In addition, two sources of biases are identified: Content-Related and Response-Related. Test respondents have rights and responsibilities, mainly concerning test security, access to test results and rights when there are irregularities in the testing.

The language background of test-takers must be considered, since any test that employ language might be inappropriate if the test-taker has limited proficiency in that language (American Psychological Association et al., 1999).

3.4.3. Testing applications

In the third section, the *Standards* presents general responsibilities of test users, the group of professionals who participated in the test selection and application. As discussed previously, test users must present evidence of the validity and reliability of the test. The *Standards* then discusses the test's selection and administration, test interpretation, and purposes of testing in psychological, educational, and employment areas (American Psychological Association et al., 1999).

3.5.Data analysis

The data collected in the survey was analyzed using both descriptive and inferential statistics. For the inferential statistics, widely known and respected statistical tools were used, namely t-tests and cross-tabulations.

3.5.1. Descriptive statistics

Descriptive statistics is the analysis to describe, show or summarize data in a significant way in order to find emerging patterns. Descriptive statistics do not allow us neither to conclude anything beyond the dataset at hand nor to test any hypothesis. It is simply a consolidation of the dataset. Descriptive statistics are useful because raw data is usually very hard to visualize. It typically provides frequency distributions such as mean, medians, and spread of observations, such as ranges, variance and standard deviation (Dodge, 2003).

3.5.2. Inferential statistics

Inferential statistics are methods of testing hypotheses or reaching conclusions based on a sample of a given population. Whenever the population is too large to be fully studied, a sample can be used. In order test if facts about the sample can be extrapolated to the entire population, inferential statistics techniques are applied. The main techniques are tests of difference, such as the t-tests and ANOVA, and tests of relationship, such as crosstabs, correlations and regressions. A pre-requisite for inferential statistics is a valid sample, or a sample that correctly represents the population. Biased samples can invalidate any conclusions about the population. It is not possible, however, to perfectly represent the population with any sample. Therefore, even valid inferential statistics are subject to some level of sampling errors (Dodge, 2003).

3.5.3. T-tests

T-tests are techniques that use a Student's t distribution and are used to determine if two datasets are significantly different from each other. The most frequently kinds of t-tests are (i) the one-sample t-sets, in which the average of the sample is tested for significantly differing from a given fixed value, (ii) the paired sample t-test, in which the average of two variables within the same variable is tested for significant differences, and (iii) the independent sample t-test, in which the average is tested for significant differences in two independent datasets (Fadem, 2008)

3.5.4. Crosstabulation and chi-square tests

A crosstabulation is the cross frequency distribution of two categorical variables. Each variable has to have at least two categories to make the crosstabulation possible. The choice of the categories to be applied is arbitrary (eg. low, mid, and high). The display of the crosstabulation is known as contingency table analysis and is one of the more popular statistic tools in the social sciences. The frequency distributions on the

contingency table can be analyzed with the chi-square test, to determine the variables are statistically independent or if they have some sort of relationship. Other conditions for validity are that the sample was randomly selected from the population, categories are mutually exclusive, and a minimum number of observation in each of the quadrants (Fadem, 2008).

4. RESULTS

The data collected in the survey was analyzed through the appropriate statistical tools: t-tests and crosstabulation/chi-square test, by using IBM's SPSS statistical software. The hypotheses were:

H1: Management students and recent graduates display overconfidence in own knowledge
H2: Management students and recent graduates display a tendency to fall into the confirmation bias
H3: Management students and recent graduates displaying high overconfidence are more likely to fall into the confirmation bias trap.

The hypotheses H1 and H2 were tested by using t-tests to check if the scores in overconfidence and confirmation biases were significantly different from zero, indicating the existence of these biases in the population. The hypothesis H3 was tested by using the crosstabulation/chi-square test.

H1: Management students and recent graduates display overconfidence in own knowledge

Of 59 participants of the study, 58 displayed overconfidence in the elicitation of confidence intervals. In other words, only one participant was perfectly calibrated and achieved 90% of appropriate intervals (containing the correct answer), as requested by the exercise. On average, participants showed around 50% of overconfidence – instead of providing correct intervals 90% of the time, they provided only around 40% [bias score = (90% - 40%) = 50% overconfidence]. No valid response showed signs of underconfidence (100% of appropriate intervals, or a -10% score). In a one sample t-test, the overconfidence level was significantly different from 0% (p value = 0.000), meaning that there is virtually no chance that the display of overconfidence in this sample was a simple coincidence.

Overconfidence score	
Descriptive statistics	
Mean	52.4%
Standard deviation	2.5%
Median	50%
Minimum	0%
Maximum	90%
Sample size	59

Table 1: Overconfidence score – Descriptive statistics

Overconfidence score	
One sample t-test (Test value = 0)	
Confidence Level	90.0%
t Stat	21.11
t Critical Two Tail	1.67
p value	0.00%

Table 2: Overconfidence score – One sample t test

H2: Management students and recent graduates display a tendency to fall into the confirmation bias

In the confirmation bias case study (see Table 3), after reading about the investment opportunity, 51% said they would use the website, 30% declared they would not and 19% were unsure (Figure 1). Regarding the investment decision 59% said they would initially invest, while 41% would not (Figure 2; participants were forced to take a position, and could not be choose ‘unsure’).

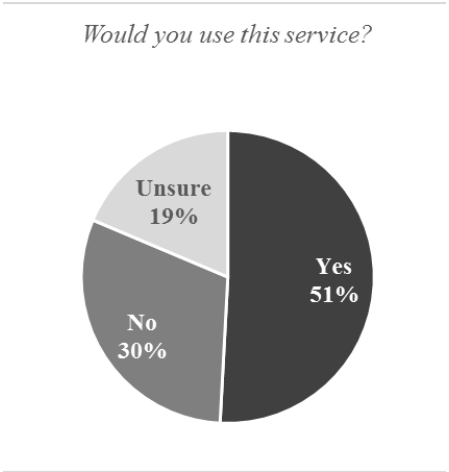

Figure 1: Use of the service

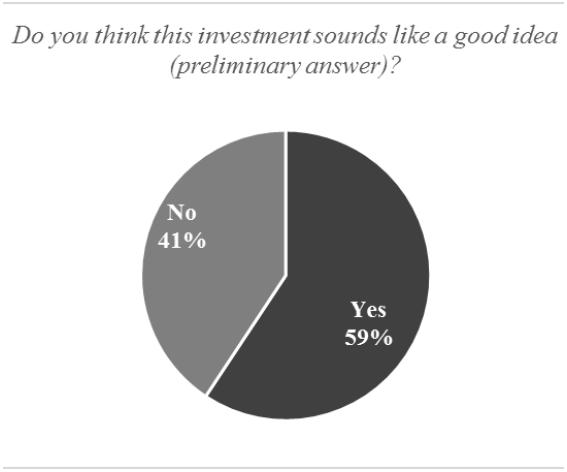

Figure 2: Preliminary investment decision

In the final investment decision, 36% said they would invest in the website, 27% declared they would not and 37% were unsure (Figure 3). In comparison with the initial position, 49% changed their mind, while 51% kept their initial investment decision (Figure 4).

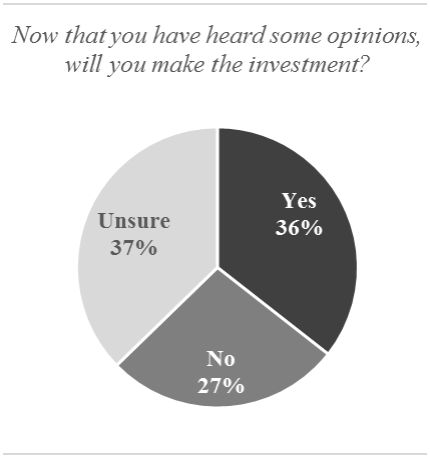

Figure 3: Final investment decision

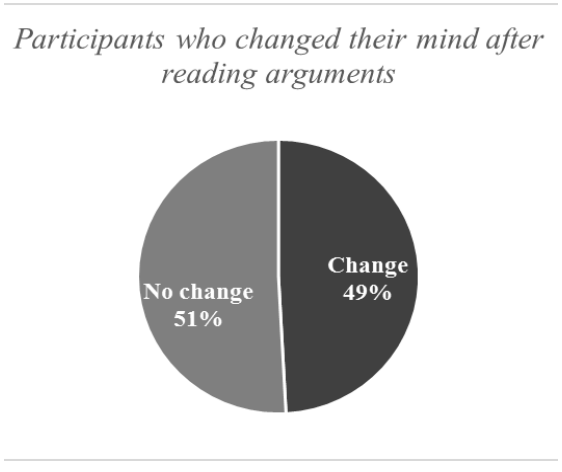

Figure 4: Change of mind (initial vs final decision)

In the selection of opinions about the investment, of the total sample, 39% displayed positive confirmation bias (predominantly sought confirming evidence after assuming an initial position – invest or not invest), 39% displayed neutral behavior (sought balanced evidence irrespective of initial position) and 22% displayed negative confirmation bias (predominantly sought disconfirming evidence after assuming an

initial position) (Figure 5). On average, the overconfidence bias in the case study was 0.54, with a standard deviation of 0.29. In a one sample t-test, the overconfidence level was significantly different from 0 (p value = 0.07), meaning that there is significant evidence ($\alpha = 10\%$) that there was confirmation bias in the sample.

In the confirmation inventory (see Table 5), the average score was 14.83, with a standard deviation of 0.40. Around 65% of the participants scored between 13 and 17 (Exhibit 6). The maximum observed score (24) was also the highest possible in the scale. The minimum score was 9.

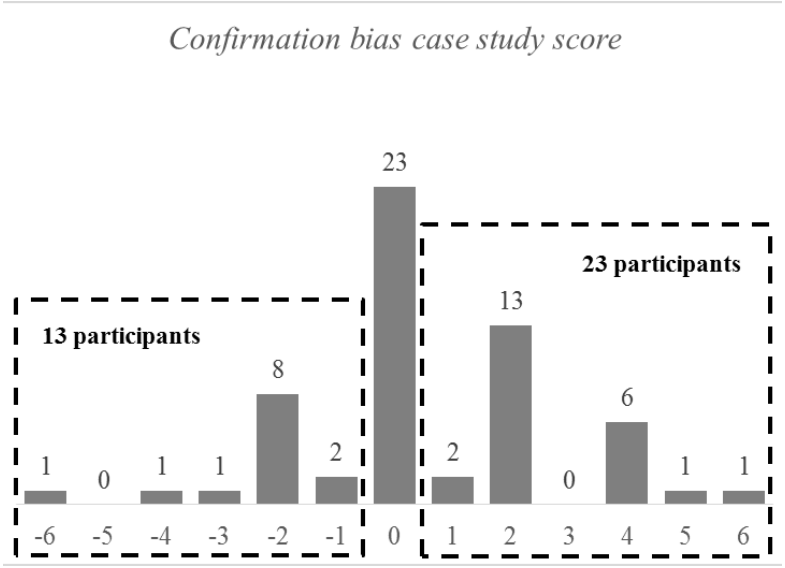

Figure 5: Confirmation bias case study score

Confirmation bias case study score	
Descriptive statistics	
Mean	0.54
Standard deviation	0.29
Median	0
Minimum	-6
Maximum	6
Sample size	59

Table 3: Confirmation bias case study score – Descriptive statistics

Confirmation bias case study score	
One sample t-test (Test value = 0)	
Confidence Level	90.0%
t Stat	1.87
t Critical Two Tail	1.67
p value	0.067

Table 4: Confirmation bias case study score – One sample t test

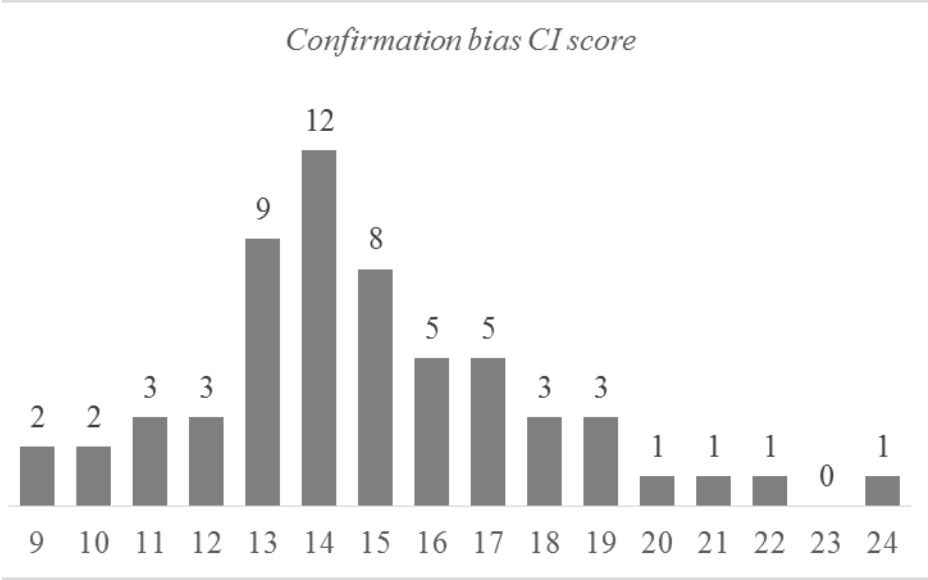

Figure 6: Confirmation bias CI score

Confirmation Inventory (CI) score	
Descriptive statistics	
Mean	14.83
Standard deviation	0.40
Median	14
Minimum	9
Maximum	24
Sample size	59

Table 5: Confirmation bias CI score – Descriptive statistics

H3: Management students and recent graduates displaying high overconfidence are more likely to fall into the confirmation bias trap.

The hypothesized relationship of the overconfidence level and the susceptibility to the confirmation bias was not observed in the experiment. In order to test the relationship, the scores in the overconfidence test were arbitrarily categorized as 'Below 40%' or 'Above 40%'. Likewise, the scores in the confirmation bias case study were categorized as Negative/Neutral (-6 to 0) or Positive (1 to 6). Finally, the scores in the confirmation bias inventory were categorized as 'Below 13' or 'Above 13'. Those categories were established to make the crosstabulation possible.

The crosstabulation score of *overconfidence* and *confirmation bias case study* (Table 6 and 7) rendered a Pearson Chi-Square of 0.422 ($\alpha = 0.10$). Equally not significant, the crosstabulation score of *overconfidence* and *confirmation bias inventory* (Table 8 and 9) rendered a Pearson Chi-Square of 0.262 ($\alpha = 0.10$). Therefore, the null hypothesis for H3 could not be rejected neither using the confirmation bias case study nor the confirmation inventory.

			Confirmation Bias Case Study score		
			Negative/Neutral	Positive	Total
Overconfidence score	Below 40%	Count	13	6	19
		% within Overconfidence score	68.4%	31.6%	100.0%
	Above 40%	Count	23	17	40
		% within Overconfidence score	57.5%	42.5%	100.0%
Total		Count	36	23	59
		% within Overconfidence score	61.0%	39.0%	100.0%

Table 6: Overconfidence score vs Confirmation Bias Case Study Crosstabulation/Contingency Table

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.646[a]	1	.422		
Continuity Correction[b]	.268	1	.604		
Likelihood Ratio	.656	1	.418		
Fisher's Exact Test				.570	.305
Linear-by-Linear Association	.635	1	.426		
N of Valid Cases	59				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.41.
b. Computed only for a 2x2 table

Table 7: Chi-square test Overconfidence score vs Confirmation Bias Case Study

			Confirmation Inventory score		
			Below 13	Above 13	Total
Overconfidence score	Below 40%	Count	8	11	19
		% within Overconfidence score	42.1%	57.9%	100.0%
	Above 40%	Count	11	29	40
		% within Overconfidence score	27.5%	72.5%	100.0%
Total		Count	19	40	59
		% within Overconfidence score	32.2%	67.8%	100.0%

Table 8: Overconfidence score vs Confirmation Bias Inventory Crosstabulation/ Contingency Table

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.259[a]	1	.262		
Continuity Correction[b]	.678	1	.410		
Likelihood Ratio	1.233	1	.267		
Fisher's Exact Test				.372	.204
Linear-by-Linear Association	1.237	1	.266		
N of Valid Cases	59				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.12.
b. Computed only for a 2x2 table

Table 9: Chi-square test Overconfidence score vs Confirmation Bias Inventory

4.1.Discussion

It has been demonstrated by the experiment that in general management students and recent graduates are victims of the both overconfidence and the confirmation biases. The overconfidence bias was strong and consonant with the results obtained by Klayman et al. (1999) and Russo and Schoemaker (1992) in nearly identical experiments, of 40-50% overconfidence bias score. The confirmation bias was present (mean = 0.54), but not as strong as the overconfidence bias. A direct comparison of this result with previous studies on confirmation bias is not possible because of important differences in the method adopted by each author. The results of the experiment in general could be attributed to the principle of Bounded Rationality (Simon, 1955), since rational behavior is limited by certain constraints, including cognitive ones (Schoemaker, 1980). Other specific mechanisms could provoke each of the biases. Regardless of the origin of the biases, though, their impact in business decision-making should be clear and this alone should inspire action to counteract them.

H1: Management students and recent graduates display overconfidence in own knowledge

In a typical business environment, participants of this study and the population they represent will be required to make all sorts of numerical estimates in their day-to-day decision-making. Some of the subjects to estimation will be familiar and easy to assess, like a foreseeable demand spike on Christmas or the setup time of a production line. However, often the subject will be new and alien, like the consequences of an unexpected market announcement to the company's stock price or of a change in the interest rate to a major acquisition financing program. The experiment to assess the overconfidence bias in respondents focused on this second kind of situation, when asked estimates are unfamiliar ('what is the weight of an adult blue whale? What is the distance between New York and Berlin?). In this situation, a balanced decision maker should allow intervals that are broad enough to encompass the correct answer. However, as presented, on average participants only provided the appropriate intervals around half of the time. Since participants were free to set any breath of interval to get answers right 90% of the time, we can deduct they have shown overconfidence in their own knowledge. In other words, the extent to which they were 'sure' of the answer was excessive and unwarranted, given the level of their true knowledge – which translates into 'overconfidence' (Rosenzweig, 2014). This is an alarming finding for both individuals and the companies that they will eventually lead in the future. Being able to generate appropriate confidence intervals is critical for adequate scenario analyses and contingency plans. When the correct answer often falls outside the predicted interval, decision-making is unsound and detrimental to both the company's and the individual's success.

The possibilities of making damaging decisions are endless. In the financial sector, where many of the graduates of top management schools end up building their careers, there can be late option execution (Malmendier and Tate, 2005), failed acquisitions deals (Doukas and Petmezas, 2007), and overweighting of private information (Friesen and Weller, 2006). Some of the mechanisms that could be behind participants' high level of overconfidence are (i) anchoring and insufficient adjustment and (ii) the availability bias. Respondents might anchor themselves in a certain main number, which comes from their life experiences and proxies they hold in their minds for that kind of question, and insufficiently adjust that anchor up and down to provide adequate intervals to encompass the correct answer. Participants stop adjusting when the interval

seems plausible (Kahneman and Tversky, 1974). People often fail to imagine all the ways events can unfold, or how high or low a numerical estimate can be (Russo and Schoemaker, 1992). The availability bias exists because "what is out of sight is out of mind" (Tversky and Kahneman, 1973).

The high level of overconfidence displayed by management students and recent graduates should be a high concern of management schools and companies alike. Training must be given to raise awareness around it and calibrate individuals' confidence level to the appropriate level. One way to do this is to teach people theory, and give them diverse estimation exercises and provide them with feedback about the correct answers. Direct and frequent feedback should open individuals' eyes to their own ignorance, and hopefully make them more cautious when making estimates.

H2: Management students and recent graduates display a tendency to fall into the confirmation bias

Concerning the confirmation bias, only around one third of the participants displayed it in the case study. The other two thirds have shown either a neutral posture or a negative confirmation bias. This means that the majority of participants sought, either consciously or unconsciously, disconfirming evidence after assuming an initial position towards the presented investment (invest or not invest). It is unclear if this 'negative confirmation bias' behavior was acquired in business school or in other experiences, or if it is an innate trait. In the statistical analysis, however, the one third that displayed confirmation bias in the case study was enough to make the mean significantly differ from zero (mean = 0.54). As Jonas (1999) demonstrated, exclusively seeking support evidence and ignoring conflicting information is not a rational process of decision-making for most people. Therefore, one third of participants presented, though in different degrees, an important reasoning flaw. We can only hypothesize about the mechanisms behind the confirmation bias shown by those participants. Perhaps they were positive-testing the investment's attractiveness (see 1.2.2. for a full review). Maybe they were dealing with cognitive limitations arising from the confirmation heuristics (Baron et al., 1988, Klayman and Ha, 1987), which states that individuals in general have a natural tendency to prefer consonant than dissonant information in

relation to their initial belief. Perhaps respondents simply wished to maintain consistency with the initial answer, and ended up displaying the confirmation bias. Each individual showing confirmation bias might have different reasons for that. Further research is encouraged to investigate the mechanisms behind this reasoning flaw.

Contrasting to the overconfidence bias, the confirmation bias displayed by participants was not so pronounced. Perhaps management schools are already providing training, perhaps fundamental investment analyses theory and case studies, to counteract the human tendency to seek confirmation to their preliminary belief. However, as reported, a significant part of the sample showed a bias towards confirmation. This might be enough to prescribe a greater emphasis in the training against this reasoning flaw that affects people's judgment and decision-making.

H3: Management students and recent graduates displaying high overconfidence are more likely to fall into the confirmation bias trap.

No relationship or association was found in this research between the overconfidence level and the susceptibility confirmation bias. In other words, based on the collected data we cannot infer that highly overconfident individual is also more inclined to seek, remember and overweight confirmatory evidence, nor that an underconfident individual is less prone to the confirmation bias.

CONCLUSION

The classical model of rationality has been superseded since long ago. The time when it was believed people were able to decide and act based on logic and reason is well past. Research in heuristics has shown us that the human mind has a special way of operating that saves energy but increases the likelihood of biases and errors. To neglect this reality can be very costly to all. This study has compiled some of the main findings on the heuristic & biases, decision making and overconfidence and confirmation biases, in order to lay ground to a new research on overconfidence and confirmation biases in business students and recent graduates. It was confirmed that this population also falls prey of both biases.

The overconfidence bias displayed by subjects was very strong and in line with previous studies conduct with broader populations. This finding should be a high concern of the subjects themselves, but also of business schools and companies. The confirmation bias showed by participants was not as pronounced, though still present. Perhaps training has partially neutralized its effects on business students and recent graduates. However, the dangers of the confirmation bias are enough grave to prescribe emphasis on counteracting it. It was not possible to establish any significant relationship between overconfidence and the confirmation bias.

The experiment conducted in this study was limited by a number of factors that could be addressed in future research in trying to establish, especially, the relationship between overconfidence and the confirmation bias. Limitations include (i) the setting of the experiment (online survey filled at distance), which was not controlled by the researcher, (ii) natural limitations of written communication to capture the complexity of an investment decision, (iii) unsufficient time to create emotional attachment to a decision, which is important to let the confirmation bias show its effects, (iv) unsufficient attention give by the participant to an artificial decision, (v) information presented in an artificially simultaneous manner, different from the sequential nature of real-world information gathering, and (vi) design of the experiment to give equal weight to arguments, as opposed to letting the participants weight the arguments by themselves. Future research might take advantage of this learnings to make a more robust

conclusion about the existence of the relationship hypothesized. The ultimate purpose of the research in the heuristic & biases and decision-making realms is to improve people's lives. By making critical decision makers in society aware of their own rationality limitation should help to attain this purpose.

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APPENDIX

Full comments of confirmation bias case study

"We have received good feedback from both sides"

“Clients who tested the beta version of the platform simply love it. It’s easy to use and intuitive, and extremely effective to reach chefs. Moreover, users can choose chefs by expertise and that’s a big value for users. On the other side, chefs admit they would never be able to reach those customers otherwise”

"Margins are incredible and the business is extremely scalable"

“We can charge up to 15% commission, and we incur almost no variable costs. Once the platform is running, our costs will basically be marketing and general office expenses. We can export the platform to other countries using the exact same technology, making the platform incredibly scalable worldwide. Furthermore we can expand to other party-related markets”

"We can have a 1st mover advantage"

“If we scale this marketplace quickly, no one will be able to defy us. Look at e-bay, Mercadolivre, and others. Once we get the biggest pool of chefs and users, we will be the unquestionable leader in this market and no one will be able to challenge us.”

"It's a huge market with high growth potential"

“The private party market is estimated at $15 billion and grows at 10% per year. The private dinner market is nearly untapped for chefs, and could reach $5 billion in 5 years’ time.”

"We can increase value for user with original content"

“One guaranteed way to increase traffic to the platform is to generate original content. We can offer cooking and event management advice and once we attract the customer, it will be easier to sell him the main service.”

"The team is excellent"

“One of the founders has commercial expertise in the catering market, and the other one is very knowledgeable in the technical realm. Together their have what it takes to bring the platform forward.”

"There are low entry barriers for competitors"

“Anyone can copy our platform and start a price war. It takes only $20,000 to develop a similar platform and once we share the market with some challengers we’ll have to offer cheaper fees”

"We had a big failure in a marketplace investment some years ago"

“We invested in a handicraft marketplace in the past and it never took off. The transactions were tiny and not recurrent. We lost quite some money at that time.”

"The initial feedback is based on a bad initial sampling"

“The end-user/chefs feedback came from a biased sample of friends and acquaintances from founders, who want the venture to succeed. They have only talked to eight or nine chefs, who are not representative of the national market.”

"There's a risk people will contact chefs directly, and chefs will avoid commission"

“We can’t guarantee the customer will return. Once a user has a bunch of favorite chefs, she will call them directly. Chefs will bypass our fees. After a while only new users will be paying and no one will be a recurring customer”

"There are not enough qualified chefs to meet demand"

“If the full potential of the market is realized, there are not enough qualified chefs to meet the demand. This can result in a bottleneck that will limit our revenues, besides giving chefs some bargaining power on the commission. If we allow bad chefs in, we risk the reputation of the platform”

"The team lacks important skills to execute"

“Although founders have some background in the market and technical skills, they have never managed a marketplace before and lack critical skills to succeed in this market.”