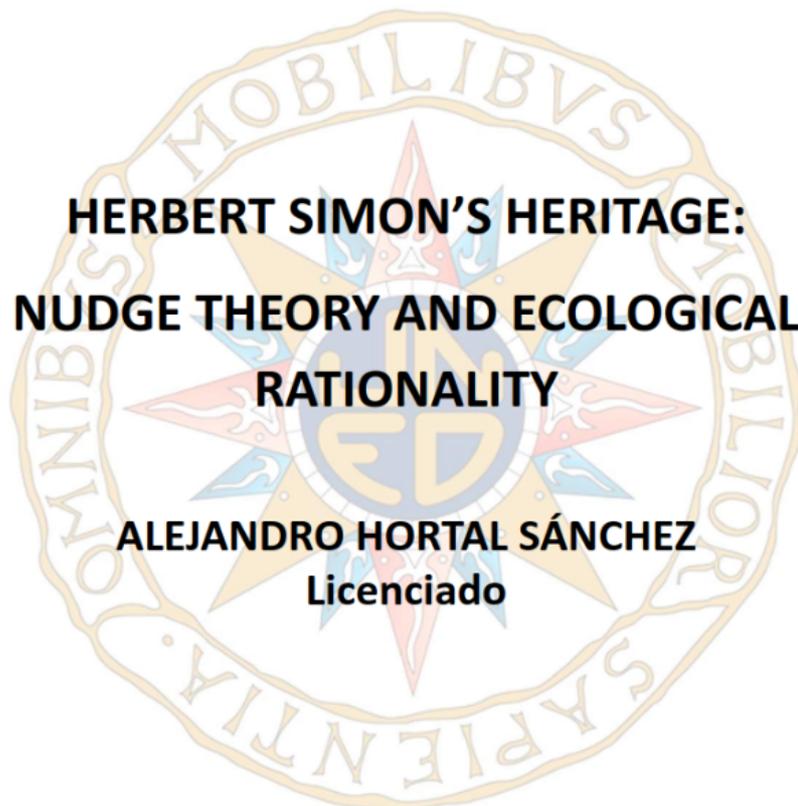




TESIS DOCTORAL

2018



Departamento de Lógica, Historia y Filosofía de la Ciencia

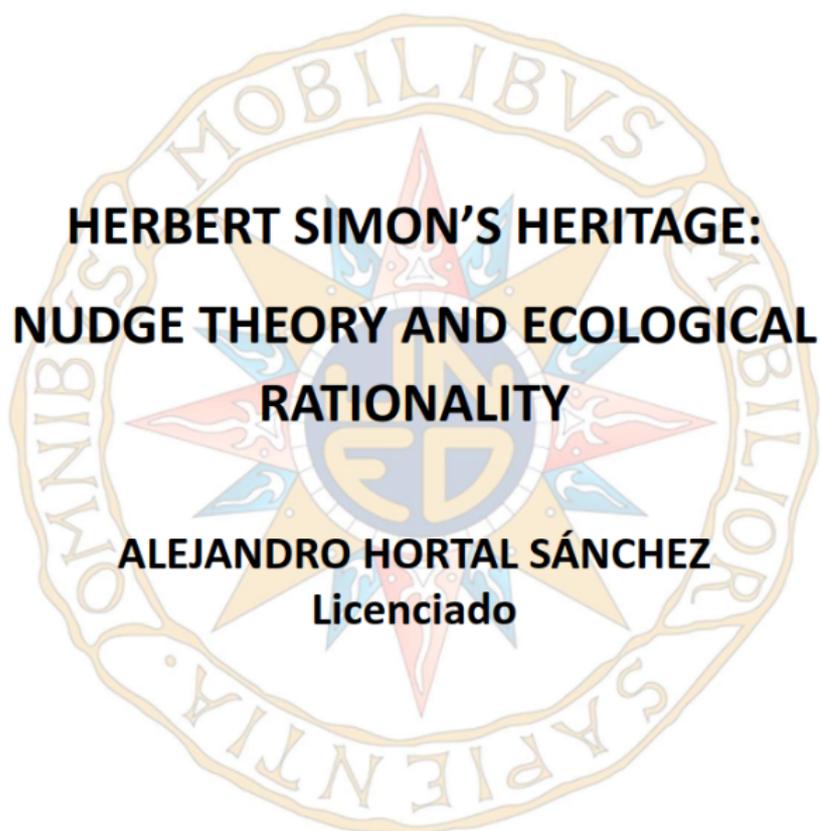
A thesis submitted for the degree of
Doctor of Philosophy

Under the supervision of
Dr. J. FRANCISCO ÁLVAREZ ÁLVAREZ (UNED)



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ACKNOWLEDGMENTS

Above all, I would like to thank my wife Laura and my two sons, Lex and Pablo, for their patience, love, and support during these years. There are no words to express my appreciation and indebtedness to them. It is for them that I want to become something better.

Needless to say, I would also like to express my gratitude for the essential advice, support, words of encouragement, and dedication that my thesis director, Francisco Álvarez, has given me during these years. Without him and his willingness to direct this thesis a decade ago, all this would have been impossible. His visit to the United States, where I live, during the late part of the summer of 2017 provided me with the last push I needed to complete this task.

Thanks to my family in Spain. They have been an essential part of this project. My sister Raquel and my brother Pablo have been a big help. But I would like to thank especially my sister Marta, who dealt with much of the paperwork, bank visits, and trips to UNED in that 46 bus route; and my mother, always very proud and asking me about my progress, always with that special support a mother can only give.

My friends and neighbors, Dr. Tim Blackburn and Dr. Jessica Richard have always been an inspiration. Tim, directly, helped with some specific issues related to the English language. He corrected a couple of articles providing insightful comments. Their friendship and support is something that I do not take for granted.

My friends at the University of North Carolina at Greensboro, where I work, have been fundamental. Felipe Troncoso and Dr. Ignacio López have been a constant source for support and motivation. Thanks to Dr. López (Nacho), always pushing me to finish. His friendship, encouragement, wisdom, and those beers we have had together with Felipe have been crucial. Nacho represents the virtuous model of scholar I eventually would like to become.

Thanks to Dr. Amy Williamsen, head of my department in UNCG. It is difficult to feel appreciated in a working environment, but she has always made me feel that I was. She has provided me with the support needed in my tasks as a scholar and instructor. She has given me the opportunities to fulfill my potential in teaching and in researching for this thesis.

Dr. Elena Ayllon, a long time friend, who always gives me the opportunity to present my research in the Complutense University where she works. She has opened social and ethical possibilities to my future research. We have a research article pending.

Thanks to my Friends in Spain, Sergio Utrilla and Raúl Rubio: to Sergio, also a philosopher, for those long nights of debates and insightful comments.

Thanks to Dr. David Teira for his initial support, practical advice, and his celerity to answer emails, and to every organizer or participant of the seminars I gave in the faculty of philosophy of the UNED.

I am also thankful to my mother-in-law, Lin. She has always been a great help since I moved to United States. During these years writing the thesis, she has always provided her support.

Thanks to Dr. Ana Hontanilla, who reviewed an abstract for one of the talks I gave at the UNED, to Dr. Mariche García Bayonas, always funny and encouraging.

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1. RESUMEN

Herbert Alexander Simon, economista y científico social nacido en Milwaukee en 1916, propuso un modelo que cambiaría la forma de pensar la racionalidad en el campo de la economía y las ciencias sociales. Su búsqueda de un estudio empírico del comportamiento racional lo empujó a criticar el modelo estándar de la economía clásica por su falta de realismo, ya que había presupuesto a un individuo con infinita memoria y capacidades cognitivas, con racionalidad perfecta y la capacidad de optimizar. La mayor parte de la vida académica de Simon tuvo como objetivo la construcción de un modelo más realista de racionalidad que tuviera en cuenta las limitaciones o cotas a las que los individuos se enfrentan en sus decisiones. A pesar de que Thorstein Veblen ya había afirmado que los individuos no poseían capacidades computacionales completas, iba a ser Herbert Simon el que desarrollaría por completo esta propuesta.

La racionalidad acotada apareció como un concepto fundamental, derivado de la utilización de la psicología en la teoría de la racionalidad, que podría proporcionar una base realista a una disciplina que carecía de ella. Al observar los procedimientos de racionalidad en lugar de los resultados, o la racionalidad sustantiva, como Simon la llamaba, se desarrolló un programa de investigación que supondría un paso fundamental en la revolución del comportamiento en las ciencias sociales. La racionalidad acotada, basada en la noción empírica de que los individuos no pueden optimizar, sino

"satisfacer", se convirtió en el modelo que desafió a los supuestos ideales del enfoque estándar.

La perspectiva innovadora de Simon sirvió como influencia de la presente revolución en las ciencias sociales. Amos Tversky y Daniel Kahneman primero, Richard Thaler, Cass Sunstein, y Gerd Gigerenzer después, basaron sus teorías en el modelo propuesto originalmente por Herbert Simon.

En buena parte de las ciencias sociales coexisten en la actualidad dos puntos de vista diferentes acerca de nuestra racionalidad: el pesimista, que ve nuestras limitaciones como errores sistemáticos situados en la raíz de nuestro posible comportamiento irracional; y el optimista, que concibe esos límites como ventajas ecológicas. El primer punto de vista, el pesimista, lo mantienen Tversky y Kahneman en su programa de investigación sobre heurísticas y sesgos, y también se sostiene en la teoría de "pequeños empujones" o *nudges*, que Thaler y Sunstein proponen a raíz de aquel enfoque de Tversky y Kahneman. El segundo, el optimista, ha sido desarrollado por Gerd Gigerenzer y el Centro de Comportamiento Adaptativo y Cognición (ABC por sus siglas en inglés) en el Instituto Max Planck para el Desarrollo Humano, y por otros psicólogos evolutivos como Leda Cosmides y John Tooby.

Mi propuesta en esta tesis no es solo desarrollar en qué medida la herencia de Simon se puede ver en el actual debate sobre la racionalidad, sino también el de desarrollar una perspectiva axiológica dentro de este debate. Mantengo, siguiendo la línea de Javier Echeverría y J. Francisco

Álvarez, que la racionalidad no solo es acotada, sino también axiológica. Los individuos se comportan con racionalidad acotada con el fin de llegar a fines específicos, pero también actúan de acuerdo a razones particulares. Este enfoque integral arrojará algo de luz en el debate acerca de la visión pesimista y optimista de la racionalidad. El modelo de la racionalidad axiológica acotada que propongo estará de acuerdo con las principales proposiciones de la visión optimista, pero sin rechazar, como un enfoque secundario, los intentos en política pública de la perspectiva pesimista. En esta tesis afirmo que la propuesta de Gigerenzer para educar a las personas sobre el riesgo y la incertidumbre es paralela a un modelo axiológico acotado de la racionalidad. De acuerdo con este punto de vista, cualquier política que intente influir en las decisiones deberá tener la educación de los individuos como su objetivo principal. Este modelo también defiende que las personas no son tan racionales, en la forma instrumental, como nos gustaría. Los pequeños empujones o *nudges*, por lo tanto, deben formar parte de cualquier política que trate de aumentar la eficacia de nuestra conducta, pero como un mecanismo secundario que solo debe ser puesto en práctica después de que las propuestas educativas hayan abordado e intentado influir las razones por las que las personas se comportan.

Esta tesis se centra fundamentalmente en el análisis de la obra de Herbert Simon en la racionalidad: sus antecedentes, su crítica al enfoque estándar para la racionalidad, y su herencia en el debate sobre la racionalidad. La introducción a los aspectos axiológicos de racionalidad debe ser vista como complementaria a mi análisis acerca de Simon. Con este fin,

mi objetivo es mostrar que la herencia de Simon se puede ver dentro de los debates actuales sobre la racionalidad, reconociendo al mismo tiempo que el debate en sí carece de un componente axiológico. Una vez que este componente se inserte y aparezca una visión más completa de la racionalidad, se hará evidente que el enfoque optimista sobre las políticas públicas basado en la educación se debe priorizar, pero sin el rechazo a los pequeños empujones.

Esta tesis, por lo tanto, se estructura en tres partes principales: el capítulo 3, dedicado a la obra de Simon y su punto de vista sobre la racionalidad; el capítulo 4, dedicado a la herencia de Simon dentro del debate entre la racionalidad ecológica de Gigerenzer y la teoría de los pequeños empujones; y el capítulo 5, donde se explica el modelo de racionalidad axiológica acotada y se usa para clarificar aspectos de este debate.

2. INTRODUCTION

Herbert Alexander Simon, an economist and social scientist from Milwaukee (1916), proposed a model that would change how social sciences in general and economics, in particular, think about rationality. His search for an empirically based study of rational behavior pushed him to criticize the standard model held by mainstream economics for its lack of realism since it assumed an individual with infinite cognitive capacities and memory. This individual had a perfect rationality and the capability to maximize. Most of Simon's academic life was aimed at building a more realistic model of rationality that took into consideration the limitations or boundaries that individuals face when deciding. Although Thorstein Veblen had already claimed that individuals did not possess complete computational capabilities, it was going to be Herbert Simon the one who would develop this approach to a complete model.

Bounded rationality appeared as a critical concept, born from the use of psychology in theory of rationality, to provide a realistic foundation for a discipline that lacked it. By looking at the procedures of rationality instead of the outcomes, or substantive rationality, as he called it, he developed a research program that was at the center of the behavioral revolution in social sciences. Bounded rationality, based on the empirical notion that individuals cannot optimize, they "satisfice", became the model that challenged the ideal assumptions of the standard approach. Our decisions are judged according to satisfactory or not satisfactory basis

Simon's groundbreaking perspective eventually sprung a revolution in social sciences. Amos Tversky and Daniel Kahneman first¹, Richard Thaler, Cass Sunstein, and Gerd Gigerenzer later, based their theories on the model originally advanced by Simon. Bounded rationality led to the behavioral revolution in social sciences that many of these authors participate in.

Currently, there are two different views about our bounded rationality: a pessimistic one that sees our limitations as the systematic errors at the root of our possible irrational behavior; and an optimistic one, that conceives those boundaries as ecological advantages. The first perspective is held by Tversky and Kahneman's heuristic and biases research program and by "nudge theory", Thaler and Sunstein's policy-making approach. The second one has been developed by Gerd Gigerenzer and the Center for Adaptive Behavior and Cognition (ABC) at the Max Planck Institute for Human Development, and other evolutionary psychologists like Leda Cosmides and John Tooby.

My proposal in this dissertation is not only that Simon's heritage can be seen in the current debate about rationality, but also that in order to have a comprehensive understanding about it, an axiological perspective has to be introduced. I maintain, along with the lines of Javier Echeverría and J. Francisco Álvarez, that rationality is not only bounded but also axiological. Individuals behave with a bounded rationality in order to arrive at specific ends, but also according to specific reasons. This comprehensive approach will shed some light on the debate about the pessimistic and optimistic view of rationality. A bounded axiological rationality model will agree with the main

¹ Kahneman's nobel prize lecture, for example, was titled *Maps of Bounded Rationality*.

propositions of the optimistic view, but without rejecting, as a secondary approach, the policy-making attempts of the pessimistic perspective. In this thesis, I claim that Gigerenzer's proposal to educate individuals about risk and uncertainty are parallel to a bounded axiological model of rationality. Considering the reasons why individuals behave as rational would push for a more optimistic view of our rationality. According to this view, any policy-making approach should have the education of individuals as its primary goal. The model also understands that individuals are not as rational, from a goal oriented perspective, as we would like. Nudges, therefore, should become part of any effective policy that might try to increase the efficiency of behavior, but as a secondary mechanism that only functions after educative proposals have tackled the reasons why individuals behave.

This dissertation is centered on the analysis of Herbert Simon's work on rationality: its precedents, its criticism of the standard approach to rationality, and its heritage in the rationality debate. The introduction to the axiological aspects of rationality should be seen as complementary to my analysis about Simon. To this end, I aim at showing how Simon's work can be seen in current debates about rationality, while claiming that the debate itself lacks an axiological component. Once this component is inserted and a more comprehensive view of rationality appears, it becomes clear that the optimistic approach in policy-making should be prioritized, but without the rejection of nudges.

This essay, therefore, is structured in three major parts: Chapter 3, devoted to Simon's work and his view on rationality; chapter 4, dedicated to

Simon's heritage in the rationality debate between Gigerenzer's ecological rationality and nudge theory; and chapter 5, the explanation of the bounded axiological rationality model and its use to shed light in the above-mentioned debate.

Chapter 3 occupies most of this thesis. In there I start by drawing a taxonomy of the main different views of rationality using Weber's distinction as a guideline. The pages of section 3.1 will be devoted to these different perspectives. The goal is to introduce the means-end schema of rationality and the axiological one. These perspectives will be eventually used for clarifying certain aspects of Simon's work as well as the axiological model that will eventually be introduced.

Section 3.2 explains the concept of rationality held by mainstream economics and the assumptions it had in regard to the type of human being that is at the center of its theories. The notions of *homo economicus*, Bayesian rationality, expected utility, instrumental rationality, maximization, and "as if" clauses of maximization will be introduced, since they will be the target of Simon's criticism.

In section 3.3 I will analyze Simon's work, centering it around his criticism of the mainstream economics' model of rationality, his development of bounded rationality, "satisficing", and procedural rationality. I claim that this criticism is the direct consequence of his empirical epistemology, a constant foundation of his academic research throughout his life. I argue that it will be this empiricism what pushed Simon to develop the model of bounded rationality and to look at rationality through the lenses of psychology. Part of

section 3.3 will be devoted to the role that Simon's first book had in the evolution of bounded rationality. That part is a version of an article I published (Hortal 2017) on the subject.

In that same section, I will look at a specific consequence of bounded rationality: dynamic inconsistency in our decisions. That example will help understand in what way this model describes with accuracy our behavior while is also able to provide robust explanations about the decisions of individuals, in this case, voting preferences.

In section 3.3 I also explain what is not bounded rationality while describing Thomas Sargent approach, I will introduce the work of Gigerenzer that will later be developed, and the views of bounded rationality of Ariel Rubinstein.

Section 3.4 will be centered on Simon's legacy in regard to his ecological perspective. Simon understood rationality using the metaphor of the two blades of some scissors. One is our mind and the other one is the environment. This idea is present in both views of the rationality debate. In this section, considering ecological rationality, the work of Tversky and Kahneman on heuristic and biases will be explained, as well as the proposals of Gigerenzer.

In chapter 4 I will draw a map of the relationship between the Simon, Tversky and Kahneman, Gigerenzer, and nudge theory (Thaler and Sunstein). This chapter will unveil Simon's legacy in those two different perspectives on rationality. It will fully describe the two different views, the debate, and their possible issues. I will explain the notions of "systematic errors" in rationality,

nudging, libertarian paternalism, the role of education if our rationality is bounded, and the problem of autonomy.

Axiological rationality will be the epicenter of Chapter 5. There I will provide a more comprehensive view of rationality and shed some light into the debate between the optimistic and the pessimistic view.

Currently, while the rationality debate is not the center of the majority of the research conducted in social sciences, it does occupy a relevant position. This year, the author who developed nudge theory, Richard Thaler (Kahneman's friend), won the Nobel prize in economics for his work on decision theory and behavioral economics. Nudge theory, the policy-making sister of Tversky and Kahneman's heuristic and biases research program, is becoming very popular. Policy makers, governments, and other agencies around the world have been implementing the nudge theory approach to ensure that people's decisions are more efficient as judged by themselves. Richard Thaler, together with Cass Sunstein published a well-known book about them (2009). Sunstein himself, as part of the Obama administration, was able to put into practice nudge theory as administrator of the White House Office of Information and Regulatory Affairs (OIRA). The United Kingdom created the Behavioral Insight Team or *Nudge Unit* with the same purpose: since we are not optimizers, and we systematically fail to arrive at rational decisions, the intervention of choice architectures may be desired in order to increase efficiency. Japan, New Zealand, Australia, Germany are examples of countries that have a nudge unit.

Currently, most research conducted favors the pessimistic interpretation of rationality. But there are a few exceptions: Gerd Gigerenzer, The AMC group he directs, and evolutionary psychologists like Tooby and Cosmides. They all challenge the view and the policy-making approach that comes from it on the basis that individuals are not as irrational as described by the pessimistic approach. What they consider irrationality, the optimistic view sees them as ecological advantages: those biases have to be matched to specific environments for their efficiency. Gigerenzer, and other authors, also challenge nudges or the whole notion of libertarian paternalism since they compromise the autonomy of the individuals.

Today social sciences are involved in what has been called a behavioral revolution. This thesis aims at participating in that discussion by analyzing the role of Herbert Simon as a father figure in this movement.

This thesis also leaves some unanswered questions, especially in regard to current mechanisms that appear to solve some issues created by our bounded rationality: the use of algorithms to help individuals (like judges) make decisions (like the length of sentences).

3. RATIONALITY IN HERBERT SIMON

3.1. The Concept of Rationality

3.1.1. Introduction

The concept of rationality is the epicenter of this work. I will be presenting in this chapter a variety of theories and models that deal with different ways to understand rationality as a philosophical, economic, social and psychological concept. The objective of this chapter, therefore, will be to provide an overview of the main approaches to rationality according to the different perspectives that we will be considering in the future pages of this thesis. Since different disciplines, even within the fields of philosophy or social sciences, provide different interpretations of rationality or, better said, different ways to face the issues related to rationality that are researching, I consider necessary to shed some light to this critical concept.

Consequently, the aim of this chapter is to clarify, from a general position, what we are referring to when we talk about rationality in decision theory with the objective of sharing a common understanding about the central concept on which this dissertation is based upon. To this end, in these next pages, I will be analyzing a few coordinates that represent the main tendencies in the academic papers and books that are at the epicenter of the discussion.

The foundation of the classification that I will provide here, although based on the taxonomy used by Max Weber in his "Economy and Society" (1978), will also expand towards other concepts. This classification, based on

the different types of social actions, can be a good starting point since, implicitly or explicitly, the majority of authors that are doing research on the concept of rationality are either using Weber's division, or a modified version of it.

Weber, in the book above-mentioned, claimed that our social actions can be understood under the following schema:

- means-end (or Instrumental approach)
- Value (or axiological)
- Traditional
- Affectual

He used the concept of "social action" distinguishing it from "rationality". Rationality, he asserted, can be *practical*, *theoretical*, *substantive* or *formal*. Stephen Kalberg posited (1980) that, in Weber's work, we find that traditional and affectual social actions cannot be considered rational; means-end action can be formal, practical and theoretical; and our axiological action falls under the substantive rationality.

Most current discussions about rationality within social sciences use, implicitly or explicitly, as mentioned above, some distinctions considered by Weber, but more often they refer to the concept of "rationality" rather than the idea of "social action".

We may encounter different methodologies and classifications of the concept of rationality among scientific journals, but since Weber's approach is the genesis in which the majority of them rest, I find that using it in this introduction can be very practical since it can provide a basic idea from where

the debate is coming from, and the direction that it is taking. The use of Weber's distinction is not an accidental tool, it also serves to illustrate some current debates about models of rationality, since they take different positions about means-end schema and the axiological rationality distinction.

The objective here, therefore, is not to provide a deep analysis, but a mere clarification of the two main uses of the term "rationality" (or types of social action), among others, as they were explained by Weber. It is important, nevertheless, to point out that although Weber divides (1978a, 24–5) the term in 4 uses: instrumental, value, affectual and traditional, (Kalberg 1980) here I will be mostly referring to the differences between the means-end schema and the value rationality approach, as they are the most representative in the field and the most pertinent for the objective of this thesis. Although they are part of his classification, "affectual" and "traditional" were disregarded by Weber himself as non-rational.

Together with the above-mentioned uses, which they basically belong to the traditional version of practical rationality, I will also consider "cognitive rationality" as one of those aspects that will need an explanation. Although it may belong to the realm of theoretical rationality, cognitive rationality has practical implications. Some authors (Boudon 2010) even considered that axiological rationality can be defined as a version of the cognitive one.

There are different frames that we can use in order to face the concept of rationality. The different types that I will be discussing here are not all the types that exist across all disciplines, but they are definitely those that are needed for the undercurrent analysis of this thesis.

This chapter will continue as follows. First I will be providing a clarification about the definitions of rationality. I will continue with an explanation of the means-end schema and the value (or axiological) approach to rationality. After these two main pillars are explained, I will proceed with the two other parts of Weber's division: the traditional and the affectual. That will lead to the cognitive rationality, and I will finalize the chapter with the adverbial division of rationality drawn by Herbert Simon in his first book "Administrative Behavior". All these clarifications will provide a great frame of reference for the discussions of rationality that this thesis will contain.

3.1.2. Definitions of rationality

There is not a single definition of rationality. There are many definitions and approaches. I could start these paragraphs with a semantic definition of rationality, or with a philosophical explanation of the concept, but by doing that I would have to choose one of the different views of the concept and I would have to reject some others. Each definition of rationality that I could use here comes attached to a theory or a particular vision of how rationality is or should be. Is it rationality to act according to reasons? Is it to choose the best means to obtain the desired objectives? Are we behaving rationally when we just express our values, or we behave according to tradition or feelings? All these questions have valid answers, and they open different views of rationality. My purpose here will be to explain some basic differences between the main approaches to rationality as a concept used by social sciences. Those

definitions will be the basis of the analysis of the current debate between two different approaches: the pessimistic and the optimistic.

A view of rationality will also provide a view of what irrationality is. For example, an approach that conceives rationality when acting according to intentions (Demeulenaere 2014) will see irrationality when individuals act unintentionally: “non-intentional and unconscious causes affect intentional decisions” (Demeulenaere 2014, 517). This perspective, for example, looks at the reasons or intentions to act in a specific manner.

In a different view, rationality can be seen as consistency or coherence. It would be, therefore, a type of rule. This type of coherence is one of the central attributes of rationality according to psychologists Amos Tversky and Daniel Kahneman “the definition of rationality has been much debated, but there is general agreement that rational choices should satisfy some elementary requirements of consistency and coherence” (1981, 453). The idea that if we prefer A to B and B to C, we cannot prefer C to A. Tversky and Kahneman posited that this type of coherence is at the center of human rationality: “In the absence of an objective criterion of validity, the normative theory of judgment under uncertainty has treated the coherence of belief as the touchstone of human rationality” (Tversky and Kahneman 1983, 313). Under this premise, irrationality would be the lack of coherence: an individual would act irrationally, or she is not consistent with her preferences:

Consistency is only one aspect of the lay notion of rational behavior. As noted by March (26), the common conception of rationality also requires that preferences or utilities for particular outcomes should be predictive of the experiences of satisfaction or displeasure associated with their occurrence. Thus, a man could be judged irrational either because his preferences are contradictory or because his desires and aversions do not reflect his pleasures and pains. The predictive criterion of rationality can be applied to

resolve inconsistent preferences and to improve the quality of decisions. (Tversky and Kahneman 1981, 458)

When addressing rationality, the standard approach is to consider it under the means-end schema. The majority of the research conducted views rationality under that assumption. Accordingly, rationality is to choose specific means to arrive at desired ends. The standard view, an approach that we also see in Herbert Simon's research, sees rationality as an efficient action that relates means to ends (Barros 2010). Most authors (Nozick 1993; Hands 2014) consider this means-end schema the default theory of rationality.

Considering this means-end frame, rationality can be "instrumental" or "value". The difference would rest on the stress it is given to either the means or the ends. If we attend to Weber's definition, rationality is instrumental when we consider specific means in the achievement of the desired goals. Its success depends on how effective or efficient is in achieving these goals or desires (Nozick 1994, 64). In Weber's words, an action is instrumentally rational if it is "determined by expectations as to the behavior of objects in the environment and of other human beings; these expectations are used as 'conditions' or 'means' for the attainment of the actor's own rationally pursued and calculated ends" (Weber 1978a, 24).

An action is value-rational when is guided by the conscious belief that the action itself has inherent value despite the consequences. Consequences for value rationality are not a priority, that is, what matters is not the outcome of an action, but the action itself. According to Weber, an action is value-rational if it is "determined by a conscious belief in the value for its own

sake of some ethical, aesthetic, religious or other form of behavior, independently of its prospects of success" (Weber 1978a, 24–5).

As I mentioned above, the instrumental is the default theory of rationality (Nozick 1994, 133). Although there are different frames that can be used to talk about rationality, the means-end schema is the most widely used in the academic literature. It is one thing to consider that our actions are instrumental, and another one to think that our actions are *purely* instrumental. As Weber posited, when we decide, the purely instrumental means-end approach is very rare "The orientation of action wholly to the rational achievement of ends without relation to fundamental values is, to be sure, only a limiting case" (Weber 1978, 26).

During the following pages, I will explain different types of rationality, being the instrumental approach the first one on my list, due to this status as "default" version of rationality. Besides instrumental and value rationality, I will follow Weber's path considering also actions that can be affectual (determined by the actor's feelings) and traditional (Weber 1978, 25). These last two "types of social action" will be discussed, together with a few more types of rationality, in the following pages.

As an example, Weber's social actions fall under different types of rationality (formal, practical, substantive, and theoretical). The practical and the formal type of rationality are part of the means-end calculations, but they do it in different ways. For example, as Kalberg claims, while practical rationality acts according to interests, our formal rationality follows rules, laws, and regulations (1980, 1161).

For the sake of using the same type of nomenclature used currently within social sciences, I am referring to *rationality* or *approaches to rationality* to what Weber called types of social action. It is important to point out that Weber himself differentiated between rationality types and social actions. If we attend to the distinction he proposed about the different types of rationality (formal, practical, substantive, and theoretical) as they relate to the different types of rational social actions (Kalberg 1980, 1161), the means-end schema that we find in the instrumental approach is a type of social action that falls under the formal or the practical rationality category. According to Weber, all types of social actions can either be classified according to a means-end schema or according to a value-rational one (Kalberg 1980, 1148). The means-end type of social action would fall under the categories, as mentioned above, of formal and practical Rationality: "As conscious regularities of action that aim to master reality, practical and formal types of rationality are based typically on man's capacity for means-end rational action; substantive rationality derives typically from value-rational action" (Kalberg 1980, 1160).

Not only formal rationality, which refers to "rules, laws and regulations" (Kalberg 1980, 1161), captures this means-end schema, also the concept of practical rationality has been broadly used in philosophy and social sciences, but within our discipline and the topics we are dealing with in these pages, practical rationality will be considered as the efficient way to act for the achievement of goals. According to Rescher, for example, practical rationality deals with the successful quest of pursuing appropriate objectives (1995, 26)

The objective of the next sections, therefore, is to provide a descriptive map of the different types of rationality that social scientists are using. Not all the types will be explained, but I hope to cover the most representative ones: Instrumental, traditional, affectual, practical, communicative, creative, value, cognitive and objectively-corrected rationality. The idea is to provide little introductions to each type to have the basis for our analysis. These definitions will clear the space and clarify what type of rationality frame we are using in the different parts of this thesis, without losing sight of the general scope of this work. This will serve also as the premise to understand how some social scientists within the field of economics have been using the idea of rationality.

3.1.3. Means-Ends schema of Rationality

Weber claims that an action can be considered instrumentally rational if it is “determined by expectations as to the behavior of objects in the environment and of other human beings; these expectations are used as ‘conditions’ or ‘means’ for the attainment of the actor's own rationally pursued and calculated ends” (1978, 24). Instrumental rationality, therefore, can be defined as the causal connection between means and ends. It is the efficient achievement of goals by selecting successful means. This conception of rationality is at the intersection of all theories of rationality (Nozick 1993, 133). As mentioned above, the instrumental model is the one that understands rationality focused on the achievement of ends through specific means.

According to Herbert Simon, an action is, therefore, rational from an instrumental frame if it is designed to maximize (as much as possible) the achievement of a determined goal in a specific world (Simon 1982, 2:405). Simon even asserted that reason is ultimately instrumental: "Reason, taken by itself, is instrumental. It can't select our final goals, nor can it mediate for us in pure conflicts over what final goal to pursue..." (Simon 1983, 106). This position understands reason as a tool used for the attainment of goals and it can be measured according to its efficiency. Reason, Simon argued, cannot tell us where to go, it can only tell us how to get there (1983, 7).

When mainstream economics considers decisions and rationality, the instrumental frame will be the standard approach. Something is instrumentally rational with respect to the goals or ends to achieve. These ends appear from a matrix that comprehends beliefs, desires, and preferences (Nozick 1993, 140). The ends appear to us under this conception of rationality, as given: "In a broad sense, rationality denotes a style of behavior (A) that is appropriate to the achievement of given goals (B) within the limits imposed by given conditions and constraints" (Simon 1982, 2:405). Under that assumption, as Dahl and Lindblom posited, "an action is rational to the extent that it is correctly designed to maximize goal achievement, given the goal in question and the real world as it exists" (1953).

For the majority of social scientists, rationality is always linked to the connections between ends and means, being the ends some type of object of our desires. We are instrumentally rational whenever we are able to achieve our preferences. According to Weber,

An action is instrumentally rational [...] when the end, the means, and the secondary results are all rationally taken into account and weighed. This involves rational consideration of alternative means to the end, of the relations of the end to the secondary consequences, and finally of the relative importance of different possible ends (1978, 25).

Expected utility would be the theory that comes from these assumptions: "An instrumental conception of rationality is thus linked to the identification of value with utility. Were value a standard, then reason might have a role in determining this standard which would go beyond mere maximization" (Gauthier 1986, 26).

Under this frame of interpretation of rationality, the question is not if rationality is instrumental, but if all rationality is (Nozick 1993, 133). Hargreaves-Heap y Varoufakis explain that a subject will show an instrumental rationality if she has preferences that may satisfy the following conditions:

A person is deemed instrumentally rational if he or she has preferences which satisfy the following conditions:

- (1) Reflexivity: No alternative x_i is less desired than itself.
- (2) Completeness: For any two alternatives x_i, x_j , either x_i is preferred to x_j , or x_j is preferred to x_i , or the agent is indifferent between the two.
- (3) Transitivity: For any x_i, x_j, x_k , if x_i is no less desired than x_j , and x_j is no less desired than x_k , then x_i cannot be less desired than x_k .
- (4) Continuity: For any x_i, x_j, x_k , if x_i is preferred to x_j and x_j is preferred to x_k , then there must exist some 'composite' of x_i and x_k , say y , which gives the same amount of utility as x_j (Hargreaves Heap and Varoufakis 1995, 8).

Many authors that conceive rationality as instrumental may also use different approaches besides this instrumental one. We find an example of this in Giere or Laudan, that extrapolate this conception of rationality to other fields of study, like the epistemological one. According to Siegel's view about these authors, they posit an instrumental approach to rationality at the same

time that they argue in defense of a naturalized version of the philosophy of science

...both defend the 'naturalizing' of the philosophy of science. They argue that important philosophical questions concerning science –including questions concerning the normative evaluations of competing scientific theories, and the rationality of decisions to accept/reject such theories- are properly settled on empirical grounds. Giere and Laudan both accept the legitimacy of normative rationality, but insist that rationality be understood instrumentally, in means end fashion (Siegel 1996, 116).

According to Hargraves Heap, to be rational is to behave trying to achieve some determined objectives in the most satisfactory way. In that way, we can assume the connection between the instrumental rationality approach and the view that presupposes that our behavior maximizes the utility function of the subject in question (a type of mathematical representation of the preferences of the individual).

The rationality model that defends an instrumental view also posits the existence of preferences attached to the decisions of an individual:

Individuals who are instrumentally rational have preferences over various 'things', e.g. bread over toast, toast and honey over bread and butter, rock over classical music, and so on and they are deemed rational because they select actions which will best satisfy those preferences. One of the virtues of this model is that very little needs to be assumed about a person's preferences. Rationality is cast in a means–ends framework with the task of selecting the most appropriate means for achieving certain ends (i.e. preference satisfaction); and for this purpose, preferences (or 'ends') must be coherent in only a weak sense that we must be able to talk about satisfying them more or less. Technically we must have a preference ordering because it is only when preferences are ordered that we will be able to begin to make judgments about how different actions satisfy our preferences in different degrees (Hargreaves Heap and Varoufakis 1995, 7).

The individual rationality embodied by the instrumental approach refers to the idea of *Homo Economicus* and it is usually expressed formally by the maximization of a utility function under constraints. This can be under

conditions of certainty, that would be the case of Jevons, or by means of probability, which we find the works of Bernoulli (Walliser 1989, 7).

To conclude, the objective of this section was to generally explain what do we mean when we refer to instrumental rationality and how other authors have defined it. Most of them agree that the instrumental approach is the standard view of rationality as it comprehends a means-end schema with the potential to explain how our decisions are made and how they should be made according to its efficiency. According to this view, decisions are made in order to achieve certain ends that are proposed according to what it is desired. Individuals, therefore, choose what they think are the most effective means in order to arrive at these ends. Expected utility theory is a way to develop this idea.

Whenever agents look at the results of their actions, they are acting instrumentally, Pierre Demeulenaere explains:

Instrumental action as the choice made by an actor of a definite action because of its consequences. In Weber's definition of Zweckrationalität, both aspects are present, and even a third one: the right choice of the means (supported by empirical evidence), the anticipation of consequences, and the comparison of the ends given those predictable consequences (2014, 523).

The goal of this section was to include the means-end schema at the beginning due to the fact that, as we mentioned above, it is the one authors consider the standard version. In the following pages, I will explain other approaches to rationality. Some of them will be compatible with the instrumental view, some will be not.

3.1.4. Value (axiological-expressive) rationality

Weber, in his masterpiece *Economy and Society* (1978) that I have been citing throughout these pages, used the term "value-rationality" (*wertrational*) to describe a type of action that captures whenever agents act correctly according to specific rules independently of its success. That term was translated by Raymond Boudon as "axiological rationality" after introducing it as one of the most difficult concepts from Weber (Boudon 1997, 4). The concept of "axiological Rationality" is central to this thesis and it is something that will be seen in detailed in chapter 5. It will be used to clarify certain aspects of the rationality debate between the pessimistic and the optimistic approach. To this end, It is not my intent here in this section in which I am providing an introduction to rationality, to go into many details. This section is simply a mere presentation of what "value-rationality" is and how it will be used.

Weber explained that an action is value-rational if it is "determined by a conscious belief in the value for its own sake of some ethical, aesthetic, religious, or other form of behavior, independently of its prospects of success" (1978, 24–25). In that type of decision or action, the value is placed not in the end or the consequence of the action, but in the act itself. The agent finds value in the action she is performing regardless of the outcome:

The meaning of the action does not lie in the achievement of a result ulterior to it, but in carrying out the specific type of action for its own sake [...] Examples of pure value-rational orientation would be the actions of persons who, regardless of possible cost to themselves, act to put into practice their convictions of what seems to them to be required by duty, honor, the pursuit of beauty, a religious call, personal loyalty, or the importance of some "cause" no

matter in what it consists. In our terminology, value-rational action always involves "commands" or "demands" which, in the actor's opinion, are binding on him. It is only in cases where human action is motivated by the fulfillment of such unconditional demands that it will be called value-rational (Weber 1978, 24–25).

What these types of actions are expressing is a belief in the validity of the action itself due to some type of religious, aesthetic, etc. importance. Subjects adhere themselves to certain values that may be reflected in specific actions. When a certain action is materializing that value, we find that subjects may perform it regardless of the consequences. These actions are what Weber called value-rational. Weber claimed that an action that is value-rational does not have to be rational *per se* (in the instrumental way). He argued that the more we consider a value as unconditionally absolute, the more chances this action will be within the spectrum of irrationality (understood under the instrumental frame). The other side of this idea is that, for the same reasons, it is very difficult to find actions that only consider the end, without considering the values of the actions that lead to these ends.

Value-rational action may thus have various different relations to the instrumentally rational action. From the latter point of view, however, value-rationality is always irrational. Indeed, the more the value to which action is oriented is elevated to the status of an absolute value, the more "irrational" in this sense the corresponding action is. For, the more unconditionally the actor devotes himself to this value for its own sake, to pure sentiment or beauty, to absolute goodness or devotion to duty, the less is he influenced by considerations of the consequences of his action. The orientation of action wholly to the rational achievement of ends without relation to fundamental values is, to be sure, essentially only a limiting case (Weber 1978, 26).

In a way, the value-rationality approach claimed by Weber defends that there are some non-observable motives that can explain the reasons why we

act in certain manners. It is what Rescher called the "evaluative rationality", which deals with the task of making correct evaluations (Rescher 1995, 26).

...even everyday actions of "primitive" man could be subjectively means-end rational, as, for example, when specific religious rituals were performed with the aim of receiving favors from a god. In Weber's eyes, this pure exchange relationship as it existed in sacrifice and prayer [...] was identical in form to the modern businessman's calculation of the most efficient means to acquire profit. Likewise, the fact that the values in premodern societies diverged widely from modern values did not, for Weber, call into question the basic capacity of man to orient his actions rationally on the basis of values (Kalberg 1980, 1148).

Boudon captures the problematic of this concept claiming that, although sometimes axiological (value) rationality is understood in cases where an agent acts according to the values she has internalized, some other times it is conceived as meaningless, "as a contradiction between the two terms 'value' and 'rationality'" (Boudon 1997). This is what Boudon denominates the "pedestrian" interpretation of axiological rationality, which claims that acting according to values is not rational, "only being congruent with values could be qualified as rational" (Boudon 1997, 5). Part of the objective of this thesis will be to shed light on the discussion between rationality and its axiological approach within the context of a more general debate about rationality in the social sciences. At this moment I can only advance that my position here will be close to the one defended by Raymond Boudon in which there is nothing irrational (or that it is incomplete to see irrationality that way) about acting according to values. Only a very reductionist view of rationality would conceive axiological rationality as irrational. Boudon "has insisted that rationality should not be understood only as instrumental or utilitarian, but should also involve what he has named

'cognitive' and 'axiological' dimensions" (Demeulenaere 2014, 515). Weber, with the introduction of axiological rationality, asserted that rationality cannot be just instrumental. As Boudon claims, agents have good reasons to act the way they do, that is, not just reasons, but good reasons if we consider their situation, their values and the information they possess. Under this approach, people would be acting rationally whenever they have good reasons to act that way. Weber, as mentioned above, Rescher (1995, 26), Boudon (2003), J. Francisco Álvarez, Javier Echeverría (2008) and many others sustain the same type of view by claiming that rationality can have many more approaches than the mere instrumental one. With the objective of clarifying these conceptions, I will revisit Boudon's axiological rationality in chapter 5.

3.1.5. Traditional Rationality

When Max Weber wrote about what he called "traditional" social action, he started by noticing that this type of action can be barely considered oriented. This types of actions, according to Weber, are almost automatic, and they respond, most of the time, to customary stimuli that steer our decisions. In Weber's words:

Strictly traditional behavior, like the reactive- type of imitation discussed above, lies very close to the borderline of what can justifiably be called meaningfully oriented action, and indeed often on the other side. For it is very often a matter of almost automatic reaction to habitual stimuli which guide behavior in a course which has been repeatedly followed. The great bulk of all everyday action to which people have become habitually accustomed approaches this type (1978, 25).

The basis to behave according to tradition is found in the idea that the action is valid if it has always been. Custom, therefore, will mark the validity of the action. As a wife, adopting the last name of your husband after getting married, can be the perfect example of this type of action. The rationality behind can only be found in the tradition. Some people may provide some expressive (value) argument about it, some may attach some instrumental approach. My wife, for example, after 5 years of being married without changing her last name, decided to adopt mine arguing that life, at a bureaucratic level, would be much easier.

Weber gives us an example of traditional motivations when he talked about labor in certain fields:

Traditional motivations to work are particularly common in agriculture and in home industries — both cases where also the general attitude toward life is traditional. It is characteristic of this that the level of performance is oriented either to products which are stereotyped in quantity and quality or to a traditional level of earnings, or both (1978, 51).

When individuals behave following the dictates of a traditional authority can also be an example of this type of rationality. Resting on an established belief that comes from specific traditions may be the basis of some of our actions (Weber 1978, 215).

According to Kalberg's interpretation of Weber's views of rationality, "traditional action" as a mental process, is non-rational (1980, 1161). But, it all depends on the conception of rationality in which you frame your decisions. A reductionist view would only consider a specific approach. A more

comprehensive view would have to include different aspects of what rationality is, narrowing, therefore, the scope of what irrational behavior is.

3.1.6. Affectual Rationality

Max Weber, explaining the different types of social actions in his book "Economy and Society", posited that we act using our *affective* rationality when we consider emotional and impulsive reasons to behave the way we do. Weber himself doubts if we are right to consider this type of action as rational since it comes from impulses related to feelings.

These types of actions are defined not by the actor's goals or value system, but by her emotional state of mind or reaction to specific circumstances. The actor is not considering, therefore, specific means to arrive at her desired goals, neither a system of values in order to arrive at a decision. In these occasions, the actor carries herself away from a "rational goal-oriented" approach walking through the boundaries of what it may be called rational.

In the words of Weber: "purely affectual behavior also stands on the borderline of what can be considered 'meaningfully' stimulus. It is a case of sublimation when affectually determined action occurs in the form of conscious release of emotional tension. When this happens it is usually well on the road to rationalization in one or the other or both of the above senses" (Weber [1922] 1978, 25). An affectual action, therefore, is one undertaken as a means of satisfying the immediate demands of an emotional state, such as

romantic passion or anger, for example. Our emotions, or our affective rationality, have effects on our decisions, the information we use, and how we process it. "Normative-affective factors shape to a significant extent decision-making, to the extent it takes place, the information gathered, the ways it is processed, the inferences that are drawn, the options that are being considered, and those that are finally chosen" (Etzioni 1988, 127).

According to social psychologist Robert Zajonc, one of the first and strongest proponents of the importance that affect has in our decision-making, the types of emotions we are defining here are connected somehow to our cognitive processes: "An affective reaction, such as liking, disliking, preference, evaluation, or the experience of pleasure or displeasure, is based on a prior cognitive process in which a variety of content discriminations are made and features are identified, examined for their value, and weighted for their contributions" (Zajonc 1980, 151). Zajonc even considered this type of feelings as *postcognitive*.

The idea that our affective rationality is useless was criticized by the Israeli-American sociologist Amitai Etzioni, who explained that our affective processes or emotion fulfill a series of specific functions:

1. Interpretation and Organization of information about one's own functioning, and about the environment (...)
2. Mobilization and Allocation of resources is influenced by the affective state of the organism (...)
3. Sensation Seeking and Avoiding may occur in order to reach an optimal level of arousal (...)
4. Affect is a way to communicate with others (Etzioni 1988, 139).

In a way, affective motivations are necessary for our decisions. They provide relevant information that may help (or not) our cognitive capabilities

when deciding. They can be a force to complement our rational behavior and a way to shape our identity (Pugno 2004). In this report, Maurizio Pugno, an economics professor at the University of Cassino, claims that in the animal kingdom, when we have to analyze rationality there, we are not accusing animals of failing badly (rationally speaking) when they follow their emotions. Most of the time, animal's behavior is not self-destructive, and they do not act irrationally when they follow their affective reasons (Pugno 2004, 5). According to this author, affective motivations are, therefore, a non-direct reaction (learned or innate) to a stimulus or a set of stimuli that may be coming from our unconscious identity (Pugno 2004, 10).

Damasio argues (1994) that rationality, in an instrumental ends-means frame, is not enough when deciding. Our rational decisions need the collaboration (complementary relationship, Pugno would call them) of these types of emotion.

The role of emotions in our decision has been broadly researched by psychologist and criticized by mainstream economists. As we will see in future pages, the claims from rational choice theory would reject any type of emotional interference in our decisions if we want to arrive at the best path for our success, that is, in order to choose the best means to arrive at our end, emotions must be put aside. But this is a matter that we will be dealing with later on.

The notion that we, somehow, are capable of segregating all out affectual frame whenever we decide or whenever we see the world, is rather an excessive idealization. Starting from our perceptions, it is clear that

whenever we see a house, as Zajonc explains, we do not just see a house, we see a "handsome house" or an "ugly house". He argues that "we buy the cars we 'like,' choose the jobs and houses that we find 'attractive,' and then justify those choices by various reasons that might appear convincing to others who never fail to ask us, 'Why this car?' Or 'Why this house?'" (Zajonc 1980, 154). Affective reactions are something that we cannot escape from.

Depending on the type of theory we are using or the discipline we may belong to, decision-making can be seen from a normative approach or a descriptive approach. A mainstream normative approach would see affectual rationality as something negative that we have to deal with when we decide when trying to achieve specific ends. Some of these versions, as we will see, are coming from the mainstream classical and neoclassical decision-making theories, which conceive the role of affect as a type barrier that would separate us from a perfect decision.

Antonio Damasio, the neuroscientist I mentioned before, in his work "Descartes' Error" (1994), describes a series of cases in which several patients had their rational capabilities impaired after complications in certain parts of the brain involved in emotional processes. This led him to the conclusion that this types of effects are a necessary aspect of our decision-making. According to this, positive and negative affective emotions or feelings are a necessary condition for our decisions (Slovic et al. 2007, 1335).

In this thesis, part of the major challenge will be to explain the exact role emotions and other factors may play in our decisions and how they are

captured in the rationality debate. In decision-making processes one thing is clear, our emotions and our affectual rationality play a fundamental role.

3.1.7. Cognitive rationality

In a nutshell, cognitive rationality can be defined as the consistency between current beliefs and the information we possess (Walliser 1989, 7). Attending to the division used by Nicholas Rescher (1988) to differentiate the different forms of rationality (cognitive, practical and evaluative), the cognitive type deals with our beliefs, that is, in what way we may be justified to believe what we do. Under this definition, cognitive rationality is considered active in the sense that the information it gathers has to be actively sought.

Several authors have linked cognitive and instrumental rationality (Radnitzky 1987; Walliser 1989) while some see them as independent (Boudon 1998). Radnitzky argues that scientific research has a specific aim, which is the intellectual progress. That is the reason why research (or science) is conducted. According to this, the cognitive rationality falls under the category of instrumental rationality: "What matters in the first place is whether or not a statement –be it a 'basic' statement or a theory is true. In the case of 'basic' statements the key problem is a practical problem: efficiently to allocate scarce resources of time and effort" (Radnitzky 1987, 176). When considering cognitive rationality in particular and science in general from an economic theory perspective, their task becomes instrumental: what means do I need in order to achieve a desired end. Scientists stop believing in a

theory as soon as objections against it arise, making it costly to defend (Boudon 2003, 8). In his view, Radnitzky considers cognitive rationality preliminary a type of instrumental rationality since it is the first step towards a decision, that is, the information we gather to sustain our beliefs. These beliefs will be used to determine the best means possible for the desired end, the best decision to arrive at the desired goals.

Raymond Boudon, as mentioned above, considers cognitive rationality independently from the instrumental one. In the case of science, for example, he argues that there is nothing to gain when substituting 'costly' for 'difficult', referring to the difficulty to use a specific argument to defend a theory or a belief.

Since this is a mere introduction to different (not all) types of rationality as they are used by social scientists, I am not going to expand too much in the ramifications of cognitive rationality and in its connections with other types of rationality. There is a lot to say about this matter, especially in regard to what Walliser denominated the *weak* cognitive rationality as it is a way to designate what Herbert Simon called *Bounded Rationality* (Walliser 1989, 13). Cognitive rationality is also at the epicenter of Boudon's theory of rationality in a complementary approach with the axiological rationality. Both authors, Simon and Boudon, will be discussed in chapters 4 and 5.

3.1.8. Herbert Simon's adverbial classification of rationality

Facing the confusion that the concept of rationality brings to the study, Herbert Simon attempted to characterize it from a division based on adverbs. He posited that the best way to clarify this concept is to use it in conjunction with adverbs (Simon 1997, 85).

- The decision of an agent (or agents) is "objectively" rational if she does what she has to do to achieve her goals. Simon uses the word "fact" referencing the objectivity of the relationship between cause (the specific action) and the effect (the attainment of the desired end). Despite the problems of affirming the objectivity of rationality, we must consider Simon's proposal as an instrument for understanding the concept we are talking about here. We will say, then, that it is objectively true that if our purpose is to travel by plane, we will have to go to the airport. The use of the word "objectivity" can be worrisome when it is used on its own, but not if we understand it within the context of a cause and effect relationship, that is, within the means-end schema argued by Simon (Simon 1997, 73). The objective of Simon was to account for the causal relationship between determinate behaviors and specific ends, very similar to formal logic, where there is a necessary implication between both. This causation does not have to be necessary. This approach is very close to the standard definition of rationality given by Edward Stein in his book *Without Good Reason*. According to Stein, the standard definition

considers that we express rationality whenever we reason in accordance with principles based on rules of logic, probability, etc (1996, 4).

- According to Simon, a decision of an individual is "subjectively" rational if it is able to maximize her behavior according to the knowledge she possesses. To this end, this type of rationality can be understood also under the means-end schema (cause and effect). What is subjective, according to Simon's perspective, is the knowledge the individual has about the cause and effect relationship of the decision.
- A decision may be "consciously" rational if "the adjustment of means to ends is a conscious process" (Simon 1997, 85).
- The decision of an agent will be "deliberately" rational, according to Simon, if there is an intention to cause a desired outcome.
- The decision of an agent or agents will be organizationally rational if it is oriented towards the organized group or collectivity.
- Someone can be personally rational if her behavior or decision is focused on the individual herself, that is, if in the relationship between cause and effect, the individual is represented in both terms.

Behavior, according to Simon, is not only determined by rational factors. There are other components that play a part when we decide: "Rationality, then, does not determine behavior [...] behavior is determined by the irrational and non-rational elements that bound the area of rationality. The area of rationality is the area of adaptability to these non-rational elements" (Simon 1991, 88).

3.1.9. Conclusion: The means-end approach.

The main goal of this first part of the thesis was to introduce the different approaches we may give to the concept of rationality within the social sciences. We have seen that there are different frames that we can use in order to discuss "rationality" and different ways to understand how it works: from a normative perspective to a descriptive; rationality as instrumental or as axiological, etc. Onward, the objective will be to analyze, within the default approach to rationality as a mean to obtain desired goals, different theories that have discussed it, especially those that were oriented towards its efficiency. Can we use a rationality model in which subjects always maximize? Are they successful? Do they simply try to maximize but fail to do so? If they fail, is this an imperfection or is it an ecological advantage? The mainstream approach to rationality was used by social scientists, classical and neoclassical economists, in particular, claiming that economic agents are perfectly rational beings with an *Olympian*² capacity to maximize their utility. That type of economics was founded on the assumption that subjects behave rational, and 'rational' meaning goal oriented.

The following chapters will be devoted to the model of rationality posited by the mainstream economics, rational choice theory and how Herbert Simon criticized those views. This criticism of the rationality model of

² Herbert Simon used the adjective Olympian to criticize the attributes mainstream economics gave to individuals when discussing rationality, since it assumed they had perfect rationality and infinite cognitive capabilities.

mainstream economics would constitute the beginning, in my opinion, of the behavioral revolution.

The objective of the following sections will be to draw a historical line that would lead to the understanding of Simon's work on rationality and how it may have triggered this behavioral revolution. Although both, mainstream economics and Herbert Simon, adhered to an instrumental view of rationality, in Simon we will see some attempts to attend to procedural causes. The goal of the next sections of this chapter three will be to explain the basis of the rationality approach. Section 3.3 will be devoted to Simon's work and his criticism of that rational approach with the introduction of his bounded rationality theory and his procedural approach that rested on a more empirical methodology.

3.2. Rationality in Mainstream Economics

3.2.1 Introduction

The aim of this section is not only to clarify the idea of rationality that emerges from mainstream economic theory³, but also to explain the way in which the subject who possesses such rationality acts as prescribed by the classical and neoclassical postulates (mainstream approach). Some authors (Von Newman 1959, Sen 1977, Gintis 2000, Crowther-Heyck 2005, Arnsperger and Varoufakis 2006, Rankin 2011) denominated this neoclassical subject "economic man" or *homo economicus*: "Omniscient master calculator of the world of neoclassical economist" (Keita 1992, 43)

In these next pages, I will clarify some matters concerning the concept of classical and neoclassical economics in regard to the notion of rationality they assume and its postulates. First I will delineate the differences between classical, neoclassical, heterodox and modern economics following the work of Colander (2000). The objective is to understand the concept of rationality that has been forming over the last two centuries within the field of economics. As we will see, although there are many differences between the different schools and periods, we can also find many similarities. Some ideas about rationality that are given in mainstream economics remain in the epistemic corpus of some economic schools today. This chapter then aims at exploring these differences and similarities to precise in detail how these

³ Mainstream economic theory will refer here mostly to classical and neoclassical economics, without entering into their historical differences.

schools use the concept of rationality to later explain how Herbert Simon criticizes it.

3.2.2. Classical and Neoclassical Economics

The intent of the following lines is not to deeply analyze the differences between classical and neoclassical economics, but to introduce the concepts, so we can understand how Simons used them to criticize their view of rationality.

According to Colander, the first one to coin the term "classical" to denominate a type of economy was Karl Marx in "The Misery of Philosophy" (Colander 2000, 130) and he did it when speaking of David Ricardo. Within the group of classical economists, from the history of economics, the authors that best represent it are J. S. Mill, David Ricardo, Malthus and Adam Smith. The former will be the economist who will be followed quite faithfully by those economists who are part of the classical school, correcting and revising some of his Ideas, but always respecting its most important principles (Veblen 2004, 30)

Most scholars claim that the classical era comprehends the 18th and 19th century while the neoclassical era begins with economist Carl Menger and the marginalist revolution. Veblen introduced the term "neoclassical" in his 1900 article "Preconceptions of Economic Science" (Veblen 1900). During that period, the most representative economists were the above-mentioned Menger, but also Jevons and Walras, among others. The social sciences at

that time were undergoing structural changes as they introduced mathematics into their fields. In economics, the incorporation of mathematical formalism was culminated by Marshall, Irving Fisher, and John B. Clark between the years 1890 and 1900, as Crowther-Heyck (Crowther-Heyck 2005, 63) points out. The marginalist revolution shifted the focus of economics, which aimed primarily toward progress and poverty, devoting its study primarily to efficient management of means and profit maximization. As an example of what we are saying, we can consider the type treatment given to the concept of "value", previously linked to work, and now more related to the exchange of goods.

By the 1920s the mathematization of economics had already been extended to other schools and authors, being incorporated and used by John Commons, Thorstein Veblen, etc. As I mentioned before, the latter author was responsible for coining the term "neoclassical" (Veblen 2004, 58) to synthesize the marginalism of Menger and Jevons with the more classic ideas of Smith, Ricardo, etc: "it was a negative description of Alfred Marshall's economics, which itself was a type of synthesis of the marginalism found in Menger and W.S. Jevons with broader Classical themes in Smith, Ricardo, and J.S. Mill. Thus, from the beginning, the term was used by an outsider to characterize the thinking of another group "(Colander 2000, 131). This was quite satisfactory since what Marshall sought was the continuation with the classical theory: "This is a satisfying 'result, to the extent that Marshall, more than any of the other marginalist founders, sought to present his theory as having a Substantial continuity with classical economics "(Aspromourgos

1986, 266). This neoclassical school represented, in this way, some aspects of the past along with some change: "neoclassicism 'implies both continuity and change: a positive, basic relation to the earlier classical theory and some development beyond it" (Aspromourgos 1986, 265). In fact, according to the latter author, Veblen considered Marshall's economy "neoclassical" as having in common with the "classical" approach to utilitarianism and the use of hedonistic psychology (1986, 266).

It should be noted that the term "neoclassical" has been used, and it is currently used, more frequently from the most external writings to the field of economics than from the internal writings. The same can be said about its use from the heterodox schools of economy (feminist economics, etc). Some scholars advocate for the disappearance of the term "neoclassical":

My suggestion, then, is that rather than distinguish/identify a group on the grounds of a fundamental inconsistency in (ontological) theory and (methodological) practice, the term 'neoclassical economics' should be dropped from the literature, as a few others have already suggested (Lawson 2013, 980).

It is also from philosophy, sociology or political science that this concept is used pejoratively to criticize some of its points, among them, the idea of a perfect rationality capable of maximizing.

Not only the term "neoclassical" is sometimes used by heterodox economists to criticize certain aspects or ideas of current economists, it is also used from a historical point of view to refer to the economics practiced in a more standard way Between 1870 and 1930. This does not mean that neoclassical elements of that period have not survived the passage of time

and the change of tendencies. In Colander's words "Modern economics involves a broader world view and is far more eclectic than the neoclassical terminology allows. To capture that eclecticism, modern economics must be given to much broader, and more sympathetic classification, including the penumbra surrounding the core ideas "(2000, 133)

In general, neoclassical economics focused on marginal trade offs and, in terms of rationality, one could say that it assumed an agent with a very powerful rationality when maximizing behavior. Since this approach implied a maximizer agent, a necessary consequence was the acceptance of a methodological individualism. As Colander asserts, in neoclassical economics, as a foundational basis, there can be no one but the individual. The market will then be responsible for transforming this individuality into social rationality.

According to E. Roy Weintraub (2007), neoclassical economics postulates that:

1. People have rational preferences that relate outcomes to values.
2. Individuals maximize utility and firms maximize profits.
3. People act independently based on complete and relevant information.

Weintraub, in this same article, describes neoclassical economics as a metatheory. We should apply this adjective, he believes, to specific parts of the economic science. For example, we may write about the neoclassical theory of profits, or employment, etc. "Neoclassical economics

conceptualized the agents, households and firms, as rational actors. Agents were modeled as optimizers who were led to "better" outcomes. The resulting equilibrium was 'best' in the sense that any other allocation of goods and services would leave someone worse off. Thus, the social system in the neoclassical vision was free of unresolvable conflict" (Weintraub 2007).

With the arrival of modern economics, many of the ideas discussed above evolved. The type of economics that is currently practiced, although a direct consequence of neoclassical economics, epistemically speaking differs from it. Despite the fact that some central ideas remain as an essential part of the current economy, its epistemic core has changed dramatically. Today's economy, for example, does not focus so much on the management of scarce resources at any given time, but on growth. We must conceive these scarce resources as "those decisions that the individual can take, which are necessarily limited. It means that whenever you want a good, you have to give up something else to get it: nothing is free" (Martínez García 2004, 145). But this issue has been more or less resolved. What economics focuses more (among other things) on these times is growth. Utilitarianism, accepted in the neoclassical era, is widely rejected by current economists and, instead of focusing on marginal offsets, game theory has taken on a more relevant role. Economists and social scientists started to reject the perfect rationality postulated and used models where agents are closer to the human version described by psychology and not as perfect or Olympian as prescribed before. This evolution is due, above all, to the introduction of models such as

Herbert Simon's bounded rationality (of which I will speak in depth and detail in section 3.3) and the theory of rationality based on norms.

Although there is much criticism regarding the treatment that neoclassical economics gives to the idea of rationality, there are models within this school that distance themselves from this perfect version of rationality. Arnsperger and Varoufakis, in an article on neoclassical economics, affirm the following: "criticism that neoclassical economics necessarily posits hyper-rational bargain-hunters, never able to resist an act that brings them the tiniest increase in expected net returns, is apt but not telling. There are plenty of neoclassical models with boundedly rational agents" (Arnsperger and Varoufakis 2006, 1).

Neoclassical theory has inherited much of what here concerns us from classical theory. That is why I will sometimes speak of classical or neoclassical concepts, since the use of such concepts is similar in any of the two eras. One of the objectives of this thesis is to try to understand the concept of rationality from the parameters in which it has been used: either from classical or neoclassical theory, heterodox or modern. Thus, what I am trying to construct here is the basis for understanding the criticism that this concept received in the second half of the twentieth century. At the epicenter of this critical approach we find, from a historical perspective, Herbert Simon's concept of "bounded rationality".

Simon, in this criticism, often referred to the "classical theory" or the "classical approach". This following paragraph shows an example of the use

of the adjective "classic" by Simon, sometimes using it in the context of classical theory, or classical economics:

...if we assume the global kinds of rationality of the classical theory the problems of internal structure of the firm or other organization largely disappear. The paradox vanishes, and the outlines of the theory emerge when we substitute for 'economic man' or 'administrative man' a choosing organism of limited knowledge and ability (Simon 1982, 2: 254).

Simon also referred to the "classical concept of rationality" (Simon 1987, 245). Although in "Sciences of the Artificial" (Simon 1996) he used the concept of "neoclassical economics" to refer to the abstract treatment that the contemporary economic theories (related to this school) made of the concept of rationality (abstract, says Simon, since they direct their attention to the external environment of human thought, concentrating on decisions that are optimal for the maximization of its utility function, that is, to achieve that purpose). In the words of our author:

...the idealization of human rationality which is enshrined in modern economic theories, particularly those called neoclassical. These theories are an idealization because they direct their attention primarily to the external environment of human thought, to decisions that are optimal for realizing the adaptive system's goals (maximization of utility or profit) They seek to define the decisions that would be substantively rational in the circumstances defined by the outer environment (Simon 1996, 23).

Earlier, in a chapter entitled *The revival of neoclassical economics*, he also spoke of the resuscitation of neoclassical economics (Simon 1979a). It is also common to find current authors who use the adjective "classic" to refer to this concept of rationality (Mumble and Putnam 1992, Gigerenzer 2002b, 170, Lehrer 2009, 77), although it is still more common to use the neoclassical adjective (Ng and Tseng 2008). In some instances we find

authors that write about this subject calling this approach "the standard model" (Sanfey et al 2003) or, in some cases, the "new classical economics" (Klamer 1984). More or less these type of schools can be referred (as I have been doing with frequency in this thesis) as "mainstream economics". That is mostly how I will refer to it.

3.2.3. The heritage of neoclassical aspects in economics today

Contrary to Colander, other authors classify part of the modern economy as neoclassical. This is the case of Arnsperger and Varoufakis, who claim that many of the essential ideas of this economic school continue to prevail today. According to these authors, neoclassical economics can be summarized in the following three axioms (Arnsperger and Varoufakis 2006, 2):

1. Methodological Individualism: I explained some of it in the previous pages. Colander states that although this individualism is a central part that has not disappeared, it has evolved, especially concerning to the rationality of the individual. Currently, the individual (the economic man of this school), tends to be described as being closer to the human being insofar as the criticisms raised in the second half of the 20th century are introduced into neoclassical theory by heterodox economists. As we will see when we explain Herbert Simon, this

criticism would introduce a more psychological character to the study of the individual.

2. Methodological Instrumentalism. According to these authors, all behavior is based on preferences, which are what motivate our actions. Behavior in itself is the medium that agents use to maximize their preferences. In this way, neoclassical economics separates preferences from beliefs (which help predict possible future states) and the means to satisfy them. In this way, everything we do and say is reduced to an instrumental artifact aimed at the satisfaction of preferences. This theory, therefore, will be closely linked to instrumentalism "neoclassical theory is a narrow version of consequentialism in which the only consequence that matters is the extent which a homogeneous index of preference-satisfaction is maximized "(Arnsperger and Varoufakis 2006, 3)
3. Methodological equilibrium. Although methodological individualism has given way to methodological instrumentalism, the desire for prediction in the macroeconomic (social) framework was still not possible. Something else was needed, according to Arnsperger and Varoufakis, to be able to achieve it: one had to postulate that the instrumental behavior of the subjects was coordinated in such a way that when adding the different attitudes or behaviors could reach a sufficiently regular

state, regular enough to allow its prediction (Arnsperger and Varoufakis 2006, 6).

3.2.4. Methodological Individualism in Economics

Methodological individualism asserts that individual decisions can be used to formulate explanatory models that may be used in economics. My intention here is not to critically analyze it, but to just give an account of it. It is one of the main ideas that survived, within the evolution of neoclassical economics in these times. It is still postulated and developed from many areas of modern economics, being especially challenged by the new institutionalists (Colander 2000, 135-136). Methodological individualism is based on the idea that individual decisions can form an explanatory model of variables to understand economics. In Arrow's words:

In the usual versions of economic theory, each individual makes decisions to consume different commodities, to work at one job or another, to choose production methods, to save, and to invest. In one way or another, these decisions interact to produce an outcome which determines the workings of the economy, the allocation of resources in short. It seems commonly to be assumed that the individual decisions then form a complete set of explanatory variables. A name is given to this point of view, that of methodological individualism (Arrow 1994, 1).

The concept of "methodological individualism" was originally used by Joseph Schumpeter in 1908 in an article entitled *Der methodologische Individualismus*, although later appeared used by John Hicks in 1934, Fritz Machlup in 1937 and by the Austrian School of the hand of Ludwig von Mises in 1949, who used these words to define their methodological position

(Geoffrey M. Hodgson 2007, 1). Elster defines it as the doctrine of every social phenomenon (of its structure and change) that are in principle only explicable from an individual point of view, including its properties, objectives and beliefs (Elster 2003, 22). This individualistic egotism assumed by economics makes it possible to discriminate, from the more orthodox classical schools, the social factors that can influence action: "Most current economic models assumes that people pursue only their own self-interest material and do not care about "Social" goals "(Rabin 1993, 1281).

Arrow, in the aforementioned article, affirms that the individualistic paradigm is based on the idea that all type of social interaction is reduced to interactions between individuals. This individual, in both economic and social circumstances, is very much like an atom in chemistry. Whatever happens in these fields can be fully described if we understand the actions of the individuals involved (Arrow 1994, 3). Over the years, since Adam Smith, individualism has survived the different schools and has been inserted in its methodological apparatus, reaching theories as that of Herbert Simon's bounded rationality or being resurrected by game theory: "They all depend on the closest realization of individualism in economic theory, which is to be found in game theory [...] which offers the appropriate mathematical framework that facilitates an abstract understanding of economics" (Arrow 1994, 4).

Game theory, in its most standardized version, is based on the main notion that agents always try to maximize their utility function: "Both players or organizations are assumed to be maximizing agents and the paucity of

discussion of either group leads to a common elision between these agents and 'individuals'" (Cramer 2002, 1847).

From game theory, it is not only assumed that the subjects who are playing have a perfect rationality, but it is also assumed that such rationality is a common knowledge of all players (C. Lee 2011).

Although Schumpeter only attempted to use the term "methodological individualism" applied to economics, after his death it extended to much of the social sciences:

Schumpeter regarded 'methodological individualism' as a limited analytical option, characteristic of 'pure economics'. By contrast, since his death, most advocates and opponents of 'methodological individualism' have treated it as a purportedly universal principle for use in the social sciences (Geoffrey M. Hodgson 2007, 3).

3.2.5. Aspects of Rationality in mainstream economics

3.2.5.1. Introduction

An action is rational, according to the parameters of mainstream economics, if it tries to maximize its objective. This idea can be explained as follows: "an action is rational to the extent that it is 'correctly' designed to maximize goal achievement, given the goal in question and the real world as it exists. Given more than one goal (the usual human situation), an action is rational to the extent that it is correctly designed to maximize net goal achievement" (Dahl and Lindblom 1953, 38). In other words, rationality is presented in this way from an instrumental framework, based on the distinction between means and ends. Citing a more current example of a

definition of rationality (Gilboa et al., 2010), we may say that, in a rational decision, certain preferences have to be satisfied according to certain levels of information. An agent will act objectively rational if between a pair of alternatives 'f' and 'g', for example, if according to the information given the case is $f \geq g$, consider the option 'f' at least as desirable, according to its usefulness, as the 'g' option, and the agent can defend and convince this choice in a satisfactory manner and with reasonable arguments to other subjects. Similarly, an agent will act subjectively rational if, in the same situation, the agent cannot be convinced that it is wrong to choose 'f' in the presence of 'g'.

In the context of decision under uncertainty, we propose axioms that the two notions of rationality might satisfy. These axioms allow a joint representation by a single set of prior probabilities and a single utility index. It is "objectively rational" to choose f in the presence of g if and only if the expected utility of f is at least as high as that given each and every prior in the set. It is "subjectively rational" to choose f rather than g if and only if the minimal expected utility of f (with respect to all priors in the set) is at least as high as that of g (Gilboa et al., 2010, 755)

The mainstream economic theory (classical or neoclassical economics) does not only remain in a specific proposal on rationality, but it entails a certain vision or way of understanding the economic subject. By postulating a certain view of rationality, this type of economics does not only give a version of rationality, it also gives us an approach to understand individuals and their decisions. According to Simon (Simon 1987, 241), traditional economic theory postulates an economic man (*homo economicus*) who, in the way of being "economic", she is also "rational." That is to say, it is her economics that makes the subject to be rational, and from this theory it is assumed that this subject has a series of determined faculties to practice that rationality. Among

these faculties are a thorough knowledge of the medium in which her decisions are to be developed and the extremely well organized way of organizing her system of preferences, as well as a set of cognitive abilities: sensational computational capacity that allows them to perform good calculations to maximize her decisions and thus reach the highest level of all their preferences. As Ricardo Pascale (2007) states: "The 'protective' waist *à la Lakatos* of neoclassical economics was composed in the 50s of the twentieth century among other aspects: a perfect individual and collective rationality, where calculus was the dominant element and, was supposed, therefore, the optimization of the elections".

Simon is going to call this type of rationality exhibited by these agents "substantive rationality" (Simon 1976b), "global rationality" (Simon 1955, 1972, 1983, 1987, 1991), "Olympian rationality" (Simon 1982, 1983, Simon et al., 2008), or "perfect rationality" (Simon 1997a). Some others (Dosi 2004) will also call it hyper-rationality, complete rationality (Selten 2001; Gigerenzer 2008a), or comprehensive rationality (Jones 1999). Throughout this writing I will most of all call this model of "perfect" or "ideal" rationality. The use of this adjective is not neutral, nor are the rest of adjectives previously used. Each one of them is going to suppose a way of conceiving rationality and a determined criticism of contrary positions.

3.2.5.2. *Homo Economicus*

The subject that acts according to this standard model of rationality is called, following the most recent tradition, economic man or homo economicus, (L. Lee, Amir, and Ariely 2009; Rankin 2011; Cramer 2002), denoting that it is this concept of human model which is used from some standard neoclassical versions of the economic sciences.

This economic man is supposed to have such a profound knowledge of the environment, such an organized system of preferences and a calculating capacity so high, that he is able to make the best possible decision (the one that gives him maximum usefulness) to arrive at his ends. This model of rationality also postulates a full scale of rewards function by actions (Simon 1987, Chapter 12, 2.2).

In addition to her supposed rational abilities, she is also given an omniscient knowledge of the medium, and of her preferences:

Economic man has a complete and consistent system of preferences that allows him to always choose among the alternatives open to him. He is always completely aware of what these alternatives are; There are no limits on the complexity of the computations I can perform in order to determine which alternatives are best (Simon 1997a, 87).

The type of environment postulated by this model is one of which the actor has an objective knowledge of. Rationality grants those principles that reflect this objective knowledge of reality (Mumby and Putnam 1992). Under this model, the environment is presented to the actor in a full and complete way, so that he can choose the best path that maximizes her decisions. In addition, in order to be able to act from this perfect rationality, the subject

must have a complete description of each of the consequences of each alternative, and she must be able to compare them in order to choose the best way (Simon 1997a, 78).

3.2.5.3. A note on Bayesian Rationality

Some authors (Albert 2009) explore the idea that perfect rationality is related to Bayesian rationality. The main traits of Bayesian rationality can be summarized as follows:

"Bayesian rationality argues that rationality is defined instead by the ability to reason about Uncertainty. Although people are typically poor at numerical reasoning about probability, human thought is sensitive to subtle patterns of qualitative Bayesian, probabilistic reasoning (Oaksford and Chater 2009, 69).

I suggest, following the line of Harsanyi (1978), that this type of rationality is based on four postulates:

1. Complete ordering of preferences (complete pre-ordering) of all possible situations.
2. Continuity: If we have a sequence of situations A_1, A_2, \dots , that addresses a particular situation A_0 , and another sequence B_1, B_2, \dots , towards B_0 , assuming $A_k \geq_i B_k$ for all k , then $A_0 \geq_i B_0$.
3. Probabilistic Equivalence: Assume a risk situation that can be expressed as a lottery. If there are two lotteries with the same probability of risk and success and similar prizes, a rational agent will be indifferent in the choice of one or the other.
4. The "sure-thing principle": A rational agent will not choose a lottery that awards something less desirable than another.

These postulates are closely connected with the concept of maximization of utility that emerges from the model of perfect rationality. Bayesian rationality therefore focuses on the idea of learning and making decisions based on knowledge and choice of probability distribution of a given event. For this, selections of previous probabilities are selected on different possible "worlds" in order to extrapolate them to future events for their possible prediction. After observing some event, a probabilistic distribution is adopted for every future event similar to that of previous observed events and this will be repeated over and over again, updating these probabilities with each observation made (Bayesian learning). These probabilities thus represent personal or subjective degrees of beliefs that attempt to predict the future based on past observations, and there may be differences in the way or in the data chosen to make these distributions:

Bayesian rationality rests in the recipe alone, and the choice of the prior probability distribution is arbitrary as far as the issue of rationality is concerned. Thus, two rational persons with the same goals may adopt prior distributions that are wildly different (Albert 2009, 53).

If the individual can obtain all the possible information about a specific event (ideal rationality) he will be able to make a perfect decision, if he applies the aforementioned Bayesian principles. This type of perfect (ideal) rationality is associated with this type of Bayesian methodology because of the mathematical (probabilistic) ability to make predictions. In Max Albert's words: "Perfect rationality, which is identified with Bayesian rationality, is the

practically unachievable but theoretically important and normatively important ideal of rationality" (2009, 57).

In order to be perfect, rationality needs intellectual powers that go beyond the human (Olympic, as described by Simon) with infallible and unlimited memory, and a quick and perfect calculating ability in complicated operations. The human being described in these coordinates is an agent that acts for the achievement of specific ends, arriving at them in the most "economic" way possible.

The reason economics is concerned with human behavior and decision-making is this: to the extent that the market is going to be determined by the different actions that an individual or a group of individuals can take, economics cannot obviate an analysis, within the discipline itself, of how these decisions are taken and how the agents come to them. The stock market, or any other type of economic negotiation thus becomes an incomparable framework for the study of human behavior insofar as:

1. The objectives are usually clear (maximize the utility function)
2. Are developed in concrete means, although complex
3. And the means are quantifiable.

This creates an optimal environment for this type of studies since this medium and the behavior of these actors can be simulated and studied in cases like the election of stock or investment funds, the purchase of automobiles, etc. As Simon says (Simon et al., 2008, 4-5), "at the micro level, we already have most of the components we need to substitute a realistic theory of the firm for the fictitious theory that now occupies the textbooks"

adding a little later that "neoclassical economic theory assumes that the problem agenda, the way in which problems are represented, the values to be achieved (the utility function), and the alternatives available for choice have all been given in advance" (Simon et al., 2008, 5)

These type of assumptions generates a determined basis on which only a model of ideal rationality can be built. Needless to say that, as I will explore in future pages, this stability is generated by obviating different important issues for decision-making, such as the way in which different problems become part of this agenda, the values that subjects have when they act or how alternatives to action are created (Simon et al., 2008, 5).

Herbert Simon referred to this optimism at the beginning of his work "Reason in Human Affairs" (Simon 1983). According to him, this view is represented in the neoclassical thesis that, if we can think enough, that is, if we use our reason at its maximum expression we can solve any type of problem. In economic terms, the use of reason gives us the possibility to maximize the result of our decisions.

When the criticisms against the rationality model of mainstream economics started to appear, part of their efforts were focused on discrediting the approach that individuals can have a perfect Bayesian rationality. Specifically, psychologists Tversky and Kahneman will present part of these criticisms in their heuristics and biases research program.

3.2.5.4. The expected subjective utility of Savage

When we combine the idea of Bayesian rationality framed within the context of a utility function that assumes all the subjective values that an

actor has in making a decision, we obtain the decision theory of subjectively expected utility proposed by Savage (1972) following the work of Ramsey and Von Neumann. Savage's attempt was to create a theory based on a personal or subjective view of probability (Savage 1972, 5). The purpose of this work was to account for the rational processes that intervene in decision-making in situations of risk. This theory would trim the universality aspirations of the ideal rationality mentioned above. That is, if rationality is universal, it has to be universal insofar as two different subjects in identical situations and with similar objectives are rational if they act, or they decide in the same way. Savage is going to deny this assumption by including, within the decision-making, the subjective values of every subject. The model of rationality advocated by Savage is personal (or subjective) in the way that opposes that universal version. To do justice, I have to say that some authors have shown by experiments that many agents do not make decisions according to this model of expected subjective utility.

In this regard, Simon asserted, following the footsteps of Allais, that the problem of this theory lies in the way in which it posits the stability and consistency of the utility function of the subject and the assumption that she can assign a cardinal number as a measure of her taste or predisposition over a particular future situation. In addition, this subject has to face a well-defined set of alternatives and must be assumed to make the decision that actually maximizes her utility function (Simon 1983, 12-13).

A few paragraphs later, Simon explained in a concise way the main components of this theory of expected subjective utility:

1. A cardinal function of utility.
2. A comprehensive set of alternative strategies.
3. A probability distribution of future scenarios associated with each strategy.
4. A policy to maximize expected utility

Savage main goal was to introduce these probabilities to express the decision maker's beliefs, connecting Bayesian statistics with a behavioral foundation. His postulates were normative principles to follow in order to be rational, rather than a descriptive explanation of human decision under uncertainty.

3.2.6. Instrumental Rationality and Maximization

3.2.6.1. Introduction

This section is devoted to an analysis of rationality based on instrumental parameters that it is assumed to be able to maximize. It is the rationality of the *homo economicus*. During the following pages I will address the topic of maximization as a central postulate of mainstream economics. Neoclassical economics is an approach to economics that relates supply and demand to an individual's rationality and her ability to maximize utility or profit. This idea of maximization would also be the epicenter of criticisms in future economic schools. Herbert Simon, critical with this perspective, affirmed that the coordinates from which the economic man of the classical theory is described can be summarized by alluding to the idea of a subject who always maximizes her decisions (Simon 1996, 25). This objective of maximizing,

reducing costs and increasing profits, is the internal means of our decisions, as well as the cost and benefits functions are the core of the external environment. In a footnote, Simon (1996, 25) explained that the difference or the border between the inner and outer environment must be traced in the skin of the agent or the entrepreneur, as he called it, being thus the firm part of this external technological environment. The brain, he posited, is part of the internal environment, aided by computers.⁴

From the moment mainstream economics theory defended the idea of maximization without considering the processes by which the actor can make certain decisions, the kind of rationality that is exhibited is substantive (in Simon's terms). The way in which this substantive rationality is treated can be, according to Simon, either descriptive or normative. It assumed that this individual is able to fully contemplate all that is presented to her, understanding all available alternatives present and future, as well as the consequences of each strategy in such a way that she can assign probabilities to different future states. This subject is even capable of reconciling different (social) values by synthesizing them into a single utility function (Simon 1983, 13-14). In this section we will be discussing certain aspects related to the idea of maximization as connected to rationality (from an instrumental perspective). Within the general scope of this thesis, this section will precede Simon's work, since his model of bounded rationality,

⁴ This will be relevant eventually for the extended cognition theory, which includes as elements of our internal computational capacity, parts of the external environment (F. Adams and Aizawa 2001; FR Adams and Aizawa 2006; Clark and Chalmers 1998; Wilson 2002).

together with his procedural approach and his notion of "satisficing"⁵ will represent a major criticism of the idea of individuals as utility maximizers.

3.2.6.2. Instrumental Rationality

In short, the instrumental model of rationality can be defined as that which comprises such rationality from parameters focused merely on the achievement of goals or objectives through determined means. From the instrumental framework an action is considered rational if it is designed to maximize the achievement of a given goal in an existing concrete world (Simon 1982, 2: 405). Accordingly, reason in its own is purely instrumental. It cannot select our final objectives and it cannot mediate in our conflicts when choosing those objectives. According to Simon, for example, the only thing rationality can do, viewed from the instrumental framework, is to help us achieve these goals efficiently (Simon 1983, 106). Combining this model of rationality with the postulate about methodological individualism mentioned above, will result in a view of rationality, as defined by the classical theory, that closely resembles the one presented by Robinson Crusoe: "The rationality of the classical maximizing procedures is Essentially the rationality of Robinson Crusoe "(Simon 1982, 2: 205). According to Nozick, something is instrumentally rational when is oriented to the achievement of goals, and these are born of an array of beliefs, desires and preferences (1993, 140). Thus, the question is not whether rationality is instrumental or not: Nozick

⁵ A combination of two words: "satisfy" and "suffice". It was coined by Herbert Simon to highlight the idea that individuals do not maximize, they rather "satisfice".

states in his book, this need not be justified. The important thing is to know whether the instrumental part constitutes all rationality or is only part of it (Nozick 1993, 133). That is the main approach to rationality. It is instrumental. But as we will see, that cannot be the whole picture. Rationality, as we saw in Weber, can also be axiological.

Hargreaves-Heap and Varoufakis claim that a person reflects an instrumental rationality if she has preferences that satisfy the following conditions: Reflective, complete, transitive, continuous. In the words of these authors:

A person is considered instrumentally rational if he or she has preferences which satisfy the following conditions:

- (1) Reflexivity: No alternative x_i is less desired than itself.
- (2) Completeness: For any two alternatives x_i , x_j , either x_i is preferred to x_j , or x_j is preferred to x_i , or the agent is indifferent between the two.
- (3) Transitivity: For any x_i , x_j , x_k , if x_i is no less desired than x_j , and x_j is no less than x_k , then x_i can not be less than x_k .
- (4) Continuity: For any x_i , x_j , x_k , if x_i is preferred to x_j and x_j is preferred to x_k , then there must be some 'composite' of x_i and x_k , say y , which gives the same amount of utility as X_j (Hargreaves Heap and Varoufakis 1995, 8)

Conceiving rationality as an instrumental is given in contemporary authors, such as Giere or Laudan (Siegel 1996, 116), who come to extrapolate the application of an instrumental conception of rationality to other fields as the epistemological one. In the case of these authors and according to Siegel's interpretation, they do so while they defend a naturalized version of the philosophy of science.

Laudan and Giere accept, together with an instrumental vision defined under a scheme of means and ends, a normative. According to this conception of rationality we can explore the instrumental value that values and beliefs, cognitive processes and different scientific methodologies have for the attainment of our objectives or ends. It is for the same reason that they have

an instrumental value that we can say these beliefs and methodologies are that they are rational (Siegel 1996, 116)⁶.

According to Hargreaves Heap and following the discourse here, acting in an instrumental way and trying to achieve certain goals in the most satisfactory way is to be rational. Accordingly, we can assume the connection between instrumental rationality and behavior designed to maximize the utility function of the *homo economicus* (mathematical representation of the preferences of this individual). Thus, preferences, according to this model, are represented as functions and the agents are assumed to be rational because they select an action capable of maximizing utility (Hargreaves Heap and Varoufakis 1995, 5). This author criticizes a monistic view of rationality, affirming the existence of actions that are outside the framework defined by means and ends, that is, far from the instrumental scheme (Khalil 1998, 285; Álvarez 2002).

The model of instrumental rationality assumed by mainstream economic theory affirms the existence of preferences on the part of the individual (for example, we prefer Mac to PC or vice versa), but without having to explain those preferences:

Individuals who are instrumentally rational have preferences over various 'things', e.g. Bread over toast, toast and honey over bread and butter, rock over classical music and they are considered rational because they select actions that will best satisfy those preferences. One of the virtues of this model is that very little needs to be assumed about a person's preferences. Rationality is cast in the means-ends framework with the task of selecting the most appropriate means for achieving certain ends (i.e. preference satisfaction); And for this purpose, preferences (or 'ends') must be coherent in only a weak sense that we must be able to talk about satisfying them more or less. Technically we should have a preference ordering because it is only

⁶ The conclusions reached by Siegel are very different from those of Laudan and Giere, since Siegel rejects the possibility of any need to restrict naturalistic philosophy to an instrumental rationality because naturalism is an incomplete philosophy of science

when preferences are ordered that we will be able to begin to make judgments about how different actions satisfy our preferences in different degrees (Hargreaves Heap and Varoufakis 1995, 7).

3.2.6.3. Maximization

Neoclassical economists, therefore, assume a rational actor who in the process of looking for the achievement of determined ends, will be able to maximize her utility function in a way that may satisfy her preferences in the most optimal way. Accepting this does not imply the denial of the possibility of including in this function other values that agents would have to consider, such as the welfare of other individuals:

In economics, the subjective desirability of a particular choice is quantified by its utility function. Although the classical notion of utility only concerns the state of the decision maker's individual wealth, the utility function can be expanded, when people take into consideration the well-being of other individuals, to incorporate social preference (Lee 2008, 405).

But from the more orthodox neoclassical coordinates, those that focus on the individualistic postulate of actions, the maximizing zeal of the rational subject will be the only engine of the behavior of this economic man. Rationality maximizes when selecting the best alternative of all those that are at its disposal, while dealing with a real medium in all its complexity (Simon 1997a, 119).

According to Herbert Simon (1997a, 45), this desire to maximize, either on the part of the individual or a company, can be dominated by the "efficiency principle", although as this author points out, more than a principle is a definition of what can be considered a "good" or "correct" administrative

behavior. It will not explain or predict how we have to act to maximize our actions, but it does postulate that this maximization has to be its goal. Simon argues that one could distinguish two possible types of maximizing an action and, as a consequence, two ways of understanding its rationality: one objective and another one subjective. It all depends on whether it is possible to maximize in an "objectively" correct or is simply done relatively, that is, the behavior is correct to maximize if we contextualize it within the current knowledge of the subject: "A decision may be called 'objectively' rational if in fact is the correct behavior for maximizing given values in a given situation. It is 'subjectively' rational if it maximizes attainment relative to the actual knowledge of the subject" (Simon 1997a, 85)

Simon claimed that von Neumann and Morgenstern included maximization as explanatory models within game theory. In games where there is uncertainty and the only known is the probability distribution of the results, the agent subject will have a cardinal utility function and will choose based on maximizing the expected value (Simon 1997a, 127).

From an instrumental view, rationality is a mode of behavior directed to the achievement of objectives within given conditions and limits. These objectives are reduced to maximizing the expected value of a utility function (Simon 1982, 2: 405). In this way a rational decision will maximize the value of the decision of the action (Nozick 1993, 138). So, if we follow the classical economic model, rationality will have to be equated with the maximization of this utility, and we would have to assume, as Rescher asserts, that there is a meaningful "utility" that agents want to maximize (Rescher 1988, chap 7).

Although this sounds obvious, what mainstream economics defends is the possibility that human beings are capable of finding the best possibility path to optimize this utility function. And from here it should be noted that "the best" is considered from the objective standards of mathematization of said function: the best alternative that represents the greatest benefit (at the lowest cost). Rationality especially relies, from these classical or neoclassical parameters, on intelligence in order to perform this maximization (Rescher 1988, chap. 1). This intelligence uses its own memory, collective memory, medium and any other form of information to base the decisions that are made on it. The more information we can have, the better we should be able to maximize benefits. Within this model, information walks parallel to rationality and, as a consequence, lack of information will lead to the emergence of irrationality in decision-making (Cook and Levi 1990, 5).

The maximization hypothesis of utility, according to Conlisk (1996) has been a very powerful generator of theories. In trying to understand rationality from the framework of unlimited rationality (the type postulated by the neoclassical approach), economics is able to understand and give meaning to many phenomena, but always from an ideal normative angle discriminating, as some authors argue, a more real model of the cognitive processes that take place within the agents who make these decisions or who try to maximize this utility. The postulate of perfect ideal rationality seen from an instrumental framework along with the idea of maximization turns this model into normative: "Rationality necessarily entails prescriptivism since its

components of means and ends are required assumptions for coherent thought" (Keita 1992, 94)

According to Rescher, from the framework of neoclassical economics, all behavior is maximizing, that is, there is always a possibility that maximizes action, the only thing we must do as agents, as rational economic humans, is to find such possibility. The more information we have about the environment and the different outcomes that our decisions can bring about, the closer we will be to finding that maximization.

In order to maximize the value of our profit in a given decision, we must allocate some usefulness to each of the possible results of our actions, in addition to being able to assign conditional probabilities to those results, given our actions. To all this we must add the difficulty in calculating the evaluations and comparisons of the expected profits of all our alternatives, for each action we take (Byron 2005, 313). From the classical model of economics, what is intended is to be able to explain economic phenomena from the point of view of agent and rational decision under the assumption that the intention of these subjects can be explained assuming that they will always try to maximize this utility. Thanks to these assumptions, some variables that make the study of behavior somewhat complex to explain can be anchored. If we grant that the subject always acts in order to maximize, we have already fixed the final objective of each of our actions. Classical theory thus succeeds in reducing any kind of behavior to this attempt to maximize our usefulness or considers that these agents act as if that desire to maximize was their only goal. As we shall see, although far from reality,

this postulate greatly facilitates the study of economic agents. Only from this assumption can we understand the idea of a perfect rationality. Hargreaves Heap and Varoufakis assert the following advantages in accepting these assumptions for the study of economics:

The ability to represent the idea that people are instrumentally rational in the sense that they act so as best to satisfy their preferences through the metaphor of utility functions and the assumption that people maximise expected utility is an analytical convenience. It greatly simplifies the way that choice problems are represented and solved (Hargreaves Heap and Varoufakis 1995, 15).

Some authors (Manzini and Mariotti 2009) pick up on Samuelson's original idea (Samuelson 1938) about revealed preference, its fundamental objective is to show the relationship between "complete rationality" and the maximization of such utility. In order to be able to maximize, a complete rationality has to be accepted. Individuals should be able to distinguish both, the costs and the benefits of different decision alternatives, choosing the one that may provide the best balance, thus optimizing the such decision as Boudon explains (2003, 3-4). Accordingly, Álvarez posits that parallel the behaviorism of the times, Samuelson's approach understood that the preferences of individuals could be seen through their behavior in markets (2009, 178).

The maximization of our decisions must be understood from the framework of methodological individualism and the ideal of a perfect rationality.

The new orientation of neoclassical economics [...] shift from aggregates and policy prescription to a discipline concerned mainly with atomistic units and objective statements to particular moments in the behavior of these units. The

particular moments referred to here are, of course, the moments of the maximization of utility (Keita 1992, 44).

According to this author, the way of understanding rationality on the part of economists as the vehicle for maximizing utility can only lead to an instrumental version of that rationality (1992, 94). But this instrumentalism of rationality only applies to the choice of means, not the goals one wants to achieve. What rationality tries, according to this model, is to be efficient in the way to reach its ends. As Caplan (2008, 99) explains while quoting Anthony Downs (1957, 5), the term rational never applies to the agent's purpose, but only to the means: "The term rational is never applied to an agent's ends, but only to his means. This follows from the definition of rational as efficient, i.e., maximizing output for a given input"

The notion of utility maximization implies that the agent is able to estimate the marginal costs and benefits of the search in a situation where he has to decide between different possibilities (Simon 1979a, 356). The instrumentalism of this perception of rationality is mixed with a few drops of hedonism by guaranteeing the attainment of individual pleasure as a determined end of our search as agents. In this way, the economic man conceived by the classical theory can judge in a comparative way the effectiveness of these means in order to reach the desired objectives, as well as to be able to maximize the pleasure or the benefits, although with the passage from classicism to neoclassicism, what is maximized is the utility function (Ng and Tseng 2008). In this regard Hargreaves Heap and Varoufakis make a clarification on the relationship between classical economists and the idea of maximizing pleasure:

This maximising, calculative view of instrumental reason is common in economics, but it needs careful handling because it is liable to suggest an unwarranted connection with the social philosophy of Utilitarianism as presented by Jeremy Bentham and, later, John Stuart Mill (especially since J.S. Mill is a key figure associated with both the beginnings of neoclassical economics and the social philosophy of Utilitarianism). The key difference is that Bentham's social philosophy envisioned a universal currency of happiness for all people. Everything in people's lives either adds to the sum total of utility in society (i.e. it is pleasurable) or subtracts from it (i.e. is painful) and the good society is the one that maximises the sum of those utilities, or average utility (Hargreaves Heap and Varoufakis 1995, 10)

3.2.6.4. Maximization and Nash equilibrium in game theory

The introduction of game theory within the field of economics made us understand that the idea of being able to maximize is rather difficult insofar as one has to take into account the variable behavior of the other individuals with whom one competes for power to optimize benefits: "The economic man journeyed into neoclassical economics, maximizing wealth and pleasure took on the most generic term of maximizing utility, often described the benefits for the individual" (Ng and Tseng 2008, 278).

From this assumption, the maximization will be achieved if we arrive at the so-called Nash equilibrium, when considering other behaviors that can affect the utility function of the original individual. This equilibrium was named after the mathematician John Forbes Nash and it was formulated for the first time in 1951. According to this, Nash's demonstration, in non-cooperative games there is always the possibility of reaching at least one of these points of equilibrium (Nash 1951, 286). A formal definition of this balance can be found in the article by Binmore et al.

The Nash bargaining solution is formulated in terms of a set of utility pairs that represent possible deals on which two bargainers may agree, and a disagreement pair (d_1, d_2) that represents the utilities the bargainers will receive if there is no agreement. The Nash bargaining solution (S_1, S_2) is then the point in X at which the Nash product $(s_1 - d_1)(s_2 - d_2)$ is maximized subject to the constraints $s_1 - d_1$ and $s_2 - d_2$. (Binmore, Shaked, and Sutton 1989, 753)

Thus, Nash equilibrium is the maximization of the utility function within the framework of game theory: "Nash told the world that the bargaining problem has a solution and that it happens to be the one which maximizes the product of bargainers 'Utility functions' (Hargreaves Heap and Varoufakis 1995, 143). Considering a determined game between two agents that accounts for the possible actions of the other agent to make a decision that maximizes her benefit, we will speak of equilibrium if, the utility function of both agents is maximized in a coordinated way, even if there is a possibility to take greater advantage of the situation individually. In this way, if we turn to some of the examples of games provided by literature, such as the classic prisoner's dilemma, we can see that the equilibrium obtained by collaboration with the police provides the greatest degree of maximization for the set of the players.

	Confess	Not confess
Confess	3,3	0,5
Not confess	5,0	1,1

In this kind of games, in order to maximize joint profit, the agents' cooperation should be preferred to the possible reward and subsequent risk of not participating in this cooperation (Cook and Levi 1990). Nash equilibrium is achieved through a collectively stable strategy ("stable" means here that no other strategy can "invade" it (Axelrod 2006, 56)). Agents arrive at this strategy through "evolutionary processes" (Axelrod 2006, 170) and they are capable of optimizing the joint utility function of the group of agents that follows a specific norm of cooperation. mainstream economists claim that by following this already established (stable) cooperative norm, it is possible to achieve the desired ends in an instrumental way, thus maximizing the benefits.

Nash equilibrium refers, therefore, to a set of strategies: "Nash equilibrium refers to a set of such strategies from which individual players cannot increase their payoffs by changing their strategies unilaterally" (D. Lee 2008, 404). Game theory manages to surpass the conception of the agents as independent or atoms, as already had done previously by the classic theory: "discipline concerned mainly with atomistic units and objective statements regarding particular moments in the behavior of these units. The particular moments referred to here are, of course, the moments of the maximization of utility" (Keita 1992, 44). This model of seeing the individual has been dominated by the idea of "economic man" which, according to Paul Krugman (2007), has reigned among economists for the last two centuries. This hypothetical economic man or *homo economicus* to whom Krugman refers, knows what he wants, and his preferences can be expressed

mathematically with a utility function. His decisions are the logical consequence of his rational calculations on how to maximize such function. According to this, the most orthodox version of classical and neoclassical economists defends a model of an agent very close to this economic man, who assumes the possession of a perfect rationality (Vanberg 2004, 18) and whose behavior is based on preferences or "means" capable to maximize certain objectives or ends (Arnsperger and Varoufakis 2006, 3).

3.2.6.5. Game theory, maximization, "feeling of justice" and biology.

The language used by classical economists in this area can be extended to other disciplines, such as biology. Some biologists argue that individuals try to maximize their interests from an evolutionary point of view, although recognizing the possibility that this is not the only interest that motivates their behavior. This self-interest shown can also be combined with social reasons such as the welfare of others:

Behaviors of humans and animals can change frequently, as they seek to maximize their self-interests according to the information available from their environment. This makes it difficult to predict the outcome of a decision-maker's actions and to choose optimal actions accordingly [...] Humans and animals indeed act not only to maximize their own self-interest, but sometimes also to increase or decrease the well-beings of Others around them (D. Lee 2008, 404).

We also find models that explain the possibility of acting based on a sense of justice: if I know with certainty, within a game between individuals, that the other subject will collaborate, I will also collaborate. If he is not going

to do it, I will not do it either, although this will negatively influence the maximization of my utility function (Rabin 1993). This sense of justice can be seen in game theory in the example of the ultimatum game (Gale, Binmore, and Samuelson 1994), and can be reduced to neurobiological processes (Sanfey et al., 2003). The ultimatum game is based on the idea of two players, I and II, that have to be divide a certain amount of money. The player I receives the money and she is in charge of allocating the money for the division. If Player II accepts the proposal (the money offered), the two are left with their amounts. If player II rejects the amount, none is left with the money. From a classical economic point of view, player II would never reject any offer suggested by player I. That is, if 10 euros have to be dealt, and player I offers II the amount of one euro, classical and neoclassical economy predicts that player II will always have to maximize his utility function by accepting the amount offered by player I. If we pull player II from context and offer him to choose between having one euro or having nothing, the answer is obvious. But if this choice occurs within the framework of the ultimatum game, experiments show that many of the participants are satisfied with the idea of punishing player I if they believe that the offer is not fair. According to Binmore, Gale and Samuelson (1994, 57) referring to Güth's research (1982), the average offer was about half of the total amount, and that player I had almost the probability of the 50% of staying with her amount of the money if she was offered a third of the total sum to the player II. The results of these experiments are also repeated in studies by Binmore and others (Binmore, Shaked, and Sutton 1989; Sanfey et al., 2003; D. Lee 2008).

The consequences of the experimental results of this game call into question the idea of a rationality free of all emotion that tries to maximize its utility function, unless it includes the idea of "justice" that seems to be more emotional than rational. Some neurobiological studies (Sanfey et al., 2003) suggest that, within the framework of the aforementioned game, offers that the subject II considers unfair cause activity, according to images produced by magnetic resonance imaging, in brain areas related to emotion (such as the anterior insula) and related to cognition (pre-frontal dorso-lateral cortex). In fact, this study points out the importance (shown by magnetic resonance), of the anterior insula when rejecting unfair offers, thus indicating the relevant role of emotions in decision making and corroborating Rabin's findings (1993) on the role of the idea of "justice" in them, and on the role of hormones in the rejection of unequal offers, as D. Lee explains: "Hormones are also known to influence social behavior. For example, high testosterone increases the likelihood that the recipient will reject relatively low offers during the ultimatum game" (2008, 405) .

3.2.6.6. Optimization

Mainstream economics describes decision processes as attempts to maximizing the utility function while postulating an instrumental rationality based on the attainment of ends. The way to maximize this function is by choosing the "best" of possible alternatives among all the options. In mainstream economics it is not enough to satisfy a series of requirements,

but rather to ensure that the rational actor is able to optimize these decisions: "Economics is by definition the study of optimizing behavior" (Conlisk 1996, 686). This concept of optimization is crucial, since it is supposed to be parallel to the perfect ideal rationality model defended by the more orthodox lines of economy, thanks to which the actor really has the best of all possible decisions, the one that maximizes profits minimizing costs to achieve the desired ends: "In standard optimization theory, agents act as if they perform exhaustive searches on all possible decisions and then pick the best" (Conlisk 1996, 675).

According to Philippe Mongin (2000, 76), there are at least two ways that the concept of "optimization" can be used: as a principle that can be applied to the agent, and as a model used by the theorist to understand the behavior of economic subjects.

From the assumption that the subject agent is able to find the best decision, classical economics constructs its model of rationality: "A rational process in which the choice of a 'best' is central we will call optimization" (Simon 1982 , 2: 219). According to this model, the optimization process is conscious, intentional and accurate. In addition, it occurs as a consequence of the necessary accumulation of all possible information about the environment that directly or indirectly related to the decision making process we are managing. Once the information is accumulated, the agent has the computational capacity to calculate and predict the different consequences that would result from each of the possible decisions, if taken, to achieve these objectives, as indicated by the Instrumental framework

Instrumentally rational actions implement the best means to one's given ends. Optimizing conceptions of rationality endorse this demand [...] If you accept a theory of instrumental rationality like decision theory, which purports to capture the relevant notion of ends in a preference ordering, then you adopt an optimizing conception of rationality, and you will think that rationality demands maximal preference satisfaction (Byron 1998, 67–68).

Once everything is calculated and predicted, the agent can deduce the "best" way to achieve its goals, optimally, maximizing therefore her utility function: "The neoclassical model is developed in terms of the fact that economic agents know all the alternatives and that they evaluate them correctly and, therefore, decide in optimal terms, maximizing" (Pascale 2007, 332).

3.2.6.7. Pareto-optimality

The model described by neoclassical economics, especially from the branch dedicated to the welfare of society, is based, as I have explained, on the individualist postulate of action, and from this derives many of the axioms related to rationality. Within the framework of optimization, within the framework of a society, this optimal situation is described by the Pareto-optimality, named after the sociologist, economist and philosopher Vilfredo Pareto, who used it in their studies on economic efficiency and income distribution. Debreu describes it this way: "Pareto optimum is a state where consumers cannot get better off without making a consumer worse off" (1954, 588), that is, the welfare of some can be kept constant without our conclusions being affected. But if, on the contrary, the small movement (from

one form of social state to another) increases the welfare of some individuals and diminishes that of others, it can not be said that change is advantageous for the collective as a whole.

To add a little more information to this subject, I will refer to the idea of equilibrium developed by Vilks (1992) and collected by other authors (J. W. Smith, Lyons, and Sauer-Thompson 1997). According to this, any neoclassical economic theory has to be based on the possibility of a balance between the agents. This equilibrium is a simultaneous optimization (J.W. Smith, Lyons, and Sauer-Thompson 1997, 118)

According to some authors (Etzioni, Piore, and Streeck 2010) the optimal choice to which the classical or neoclassical (mainstream) economists refer is the consequence of perfect rationality and occurs when all the necessary relevant information is obtained, retained and processed to draw from it the possible logical conclusions that allow these subjects to reach that optimal choice. According to this model, a rational being is capable of deducing the logical consequences of a given set of premises, which can be defended in a reasonable way. Also, by using evident facts, she can evaluate them in a dispassionate way (without emotions) optimizing her decisions (Gintis 2000, 320).

As we are seeing, the use and defense of the concept of optimization by classical and neoclassical economics fits perfectly with the philosophy derived from its rational model. This model is based on the possibility of a perfect rationality capable of maximizing the utility function of the individual / economic man. Some authors (Walliser 1989) argue that *optimization* is the

strong version of instrumental rationality, leaving as a weak version the *limited rationality* of Simon that we will analyze later: "The two notions of rationality are functionally distinct, but are expressed structurally in similar forms. Each one has a strong form (optimizing rationality) and some weaker ones (bounded rationality)" (Walliser 1989, 8).

When the objective to be optimized is only one, Mikulás Luptácik calls it a *simple objective optimization* and if it consists of several objectives, a *multi-objective optimization model* (Luptácik 2009, xi). An example of the several objectives is found when a company proposes not only to obtain economic benefits by sales, but to respect the environment and to provide fair remuneration to its employees.

The neoclassical economic model of optimization in our decisions has also been used in the field of biology, especially within behavioral ecology. According to Gigerenzer (2008a), optimization arguments have been used as a possible way to verify if a particular type of adaptive argument can explain a specific phenomenon. This model is constructed to include the components of the explanation (conditions such as difficulties, exchanges). After this, the next step would be to calculate the optimal behavior, given these conditions and if these predictions fit with the empirical data obtained. It can be argued, therefore, that a model has been obtained with a coherent explanation about the reason for such behavior (Gigerenzer 2008a, chap . 3).

3.2.6.8. A note on the relationship between economics as a science and the optimization postulate

The view of rationality as instrumental, aimed at achieving ends, it is central to mainstream economics. Individuals maximize by selecting the optimal path that leads to find a particular goal. This approach will capture all explanation of rational behavior: "instrumental rationality, attentive exclusively to a selection of ways of action that optimize the relationship between our objectives and our means" (Álvarez 2002). This is the view of rationality classical organization theory (Mumby and Putnam 1992, 469), and classical economics in general as described by Pascale and mentioned earlier (2007, 328).

There is a possibility that the postulate of optimization in decision making makes the study of rationality by economics something much easier to work with, and with it, the possibility of this discipline as a science. Some arguments, as Conlisk (1996, 685) concludes that without the possibility of optimization models, economic theory would degenerate into a series of *ad hoc* hypotheses capable of covering or describing all facts but unable to become a closed science and without the possibility of being refuted or falsified, Popper style (2002, 10). According to Arjo Klamer (1984), Lucas and Sargent (1978) would defend a position according to which theories of economics, in order to be scientific, must be based on the neoclassical postulate of individual optimization (Klamer 1984, 283), which in addition to providing theoretical elegance, is capable of producing a well-developed calculation (Gigerenzer and Selten 2001, 11).

What concerns us here is not the idea or perhaps the desire for optimization of the individual, but the way in which neoclassical economics relates optimization to the idea of rationality. Accordingly, the rational agent will be that economic subject, with preferences and objectives, able to optimize from her own individuality thanks to the complete knowledge of the environment in which her actions are developed. Economics, in order to create coherent models and to have a plausible scientific structure, must include these models of optimization within its field. This way to understand decisions, although separated from how real individuals behave, as I will argue later, provides logical meaning.

Neoclassical economics has not been able to defend the idea of a subject that constantly optimizes and that is able to show in her real behavior the economic postulates explained in previous pages. Since this individual with these actions could not be found, economic sciences have had to resort to a normative rather than descriptive model. Such individual (or company) used in their research, does not have to optimize or maximize, but has to behave rationally as *if* she optimizes or maximizes. Under this approach, it is possible to save many appearances while giving logical coherence without having to explain the empirical problems that appear with an economic model centered on an olympic decision maker capable of optimizing.

According to Elster, in his article *When rationality fails* (Cook and Levi 1990, 21; Elster 1989, 4), this classical model of rational action theory includes three different operations capable of optimizing: Finding the best action according to certain beliefs and desires; forming the best belief that

can be demonstrated based on existing evidence; and the possibility of optimizing the collection of the exact amount of evidence, given previous wishes and beliefs.

The above-mentioned idea that an individual can sacrifice a safe economic gain to satisfy the desire for justice, or due to anger, will pushed us to rethink the way in which classical or neoclassical theory conceives rationality as the maximization of the utility function. To do this, the agent must list all the options offered by the environment, evaluate each one of them and choose the best one. The individual has to do all this by isolating each of the three previous components from the other two emotional ones (Slote and Pettit 1984, 167). Optimization is only possible, therefore, thanks to the ability to perform any necessary calculation, no matter how complicated, to discover the optimal path of action. Her ability to calculate, according to this model, is unlimited and does not commit errors (Rubinstein 1998, 8-9) while, at the same time, is able to reach an optimal level of communication (Echeverría and Álvarez 2008, 176).

3.2.6.9. "As if" clauses of maximization

Under that model, economy faced the impossibility of empirically substantiating the olympic capacities of the economic decision maker. This provoked the appearance, with the help of psychology, of an approach within economics that incorporated a more realistic approach to the study of human decision making. Instead of a rational model based on a subject that always

acts maximizing, a model that interprets or assumes an agent that acts as if she maximizes.

The idea that economics could focus on a model that assumes a rational actor acting as if maximize was introduced by Alchian (Alchian 1950) and developed by Friedman (1953) in the face of the constant criticism that the standard model aroused and the confusion between a descriptive and a normative conception of economics.

According to Alchian, in note twelve of his famous article, economics has to operate under the assumption that the actors who are the subject of their study act as if they optimize:

It is not even necessary to suppose that each firm acts as if it possessed the conventional diagrams and knew the analytical principles employed by economists in deriving optimum and equilibrium conditions. The atoms and electrons do not know the laws of nature; The physicist does not impart to each atom a willful scheme of action based on laws of conservation of energy, etc. The fact that an economist deals with human beings who have sense and ambitions does not automatically warrant imparting to these humans the great degree of foresight and motivations which the economist may require for his customary analysis as an outside observer or "oracle." The similarity between this argument and Gibbsian statistical mechanics, as well as biological evolution, is not mere coincidence (Alchian 1950, note 12, page 216).

According to Milton Friedman, economics, as a positive science, cannot make value judgments nor defend any ethical position. Following Keynes's steps in this regard, economics must deal with "what is" rather than "what should be", providing a system of generalizations with predictive capabilities objectively. The task of this science, according to this author, is to develop a theory or hypothesis (a language designed to promote organized and systematized reasoning) that achieves valid and meaningful predictions

(Friedman 1953, 7). If predictions are contradicted, according to Friedman, the theory should be discarded.

However, he knows that economics raises many criticisms because of the assumptions it makes, above all, as we have said, within the models defended by its more orthodox lines:

It assumes man to be selfish and Money-grubbing, a lightning calculator of pleasures and pains, who Oscillates like a homogeneous globule of desire of happiness under the impulse of stimuli that shift him about the area, but leave him intact [...] assumes markets to be perfect, competition to be pure, and commodities, labor, and capital to be homogeneous (Friedman 1953, 30-31).

Because both economic agents and markets do not really behave in this way, the realism of all these descriptions is greatly questioned, so Friedman jumped in his defense by arguing that a scientific theory, or its assumptions, cannot be totally realistic in the immediate descriptive sense because of the number of factors that should be considered when developing theories. If we want to conduct a study of wheat price changes, Friedman argued, we should take into account supply and demand, the type of currency used, the type of credit, the personality of the people involved in the transactions ... and this is not very practical (Friedman 1953, 32). It is then that Friedman took the giant step when he stated that the phenomena to be predicted behave in the framework of observation as if they occurred in a hypothetical and highly simplified framework with only the most important forces:

A meaningful scientific hypothesis or theory typically asserts that certain forces are, and other forces are not, important in understanding a particular class of phenomena. It is frequently convenient to present such a hypothesis by stating that the phenomena it is desired to predict behave in the world of observation as if they occurred in a hypothetical and highly simplified world containing only the forces that the hypothesis asserts to be important [...]Such a theory cannot be tested by

comparing its "assumptions" directly with "reality,." Indeed, there is no meaningful way in which this can be done. Complete "realism" is clearly unattainable, and the question whether a theory is realistic "enough" can be settled only by seeing whether it yields predictions that are good enough for the purpose in hand or that are better than predictions from alternative theories (Friedman 1953, 40–41).

Friedman did not want the descriptive power of the actual events of his economic theories to be the measure of their scientific robustness, but their capacity to get close to predict economic events. Thus, according to an article written together with Savage (Friedman and Savage 1952), the function of a scientific hypothesis is to predict phenomena that we have not yet observed. They argued that individuals choose from alternatives with given risks as *if* they tried to maximize the expected value of a certain amount called "utility". This is a hypothesis that allows us to make predictions about individual behaviors and must be tentatively accepted as any other scientific hypothesis that can achieve correct predictions about certain events, if it does so more frequently than any of the alternative theories (Friedman and Savage 1952, 473), adding shortly afterwards that the evidence did not contradict this previously formulated theory.

Gigerenzer, in his work entitled *Rationality for mortals* (2008a), posits that the lack of psychological realism was an objection that Herbert Simon made several times against the mainstream economic model. The argument that was launched from the classic theory to criticize these attacks was based on the idea that the economic agents do not optimize, but they act as *if* they do. In this way, whenever the optimization model can predict the behavior of these agents, economists should not worry about other psychological or social factors (Gigerenzer 2008a, chap. 5). As Teira and Zamora (2009) affirm referring to Friedman's pretensions: "It seems that positive economics should

be independent of any particular ethical position or normative judgments, for it deals with 'what is', not with 'what ought to be'"

Thus, following the line of discourse traced by these authors regarding the analysis of Friedman's work, when economists predict, they have to do so in a way that eliminates any normative judgment on the matter. The theories that are elaborated from the economic sciences must be developed from the (normative) neutrality of the scientists who elaborate them. In this way, the predictions (based on the idea that people are capable of acting as if they were these neoclassical economic men) formulated by the field of economics reach a level of objectivity similar to that of the physical sciences. As David Teira states in his doctoral thesis that according to Friedman "there is no difference between the explanation of action as proposed by the economist and the explanation of any other physical phenomenon" (Teira 2004, 353). This is Friedman's attempt, so well expressed by Herbert Gintis in describing the goals of the social sciences in general:

In physics and chemistry the experimental method has the additional goal of eliminating all influences on the behavior of the object of study except those controlled by the experimenter. This goal can be achieved because elementary particles, and even chemical compounds, are completely interchangeable, given a few easily measurable characteristics (atomic number, energy, spin, chemical composition, and the like). Experiments in human social interaction, however, can not achieve this goal, even in principle, because experimental subjects bring their personal history with them into the laboratory. Their behavior is therefore ineluctably an interaction between the subject's personal history and the experimenter's (2000, 319).

Economic sciences have always dreamed of attaining the epistemological status possessed by the physical sciences. In this respect Boudon (2003, 2) points out that in an attempt to imitate the Vienna circle and

physics, classical theorists of practical action claim that the explanation of a phenomenon is to interpret it as the consequence of a series of predicaments. In the same way, a good sociological theory must interpret any social phenomenon as the result of an individual rational action. But trying to imitate the methodology of physics or biology poses many problems because, as Keita says, it is impossible to have a "third person point of view" (1992, 79) in the analysis of rational behavior. The methodology used by biology and physics is not appropriate for the social sciences given the nature of human behavior: "the problem with neoclassical economics is that its founding theorists adapted from mechanics to methodology of research that was wholly inappropriate" (Keita 1992 , 82).

According to this model, agents would act as if they possessed and analyzed all knowledge necessary for action. Following Friedman's example on the billiard player applied to a tennis player, we would say that the neoclassical model that uses clauses "as if" assumes that player would be using Newton's classical physics to guess where the ball is going to end up within the track, considering different variables such as initial velocity, wind force, etc. Perhaps, following this model, the actor does not really know all these variables and is not good at applying the physical equations, but she acts as *if* she knew them and as if she were trying to maximize his movements (decisions).

3.2.6.10. "As if" clauses and maximization under constraints

Many economists (Sargent 1993), realizing the lack of empirical realism of the *homo economicus* prescribed by neoclassical (mainstream) economics, introduced the idea that optimization occurs under constrictions. Therefore, the perfect rationality of the *homo economicus* appears when dealing with these constraints and taking them into account. This approach assumes constrictions but always respecting the rational model that optimizes. By retaining this optimization, the theoretical demands of this model are greatly increased by having to consider variables that in the most orthodox model of optimization do not appear. These variables will refer to the agents' abilities to overcome the constraints and will have to be reflected both mathematical and psychologically. According to Berg and Gigerenzer (2010, 133), many behavioral economists point out that the optimization posited by neoclassical economics focuses on assumptions that are not real. By adding restrictions to the perfect rationality by keeping the maximization postulate, Berg and Gigerenzer argue that these agents must assumed a more heroic rationality in decision making, since now they have to optimize a more complex function due to the inclusion of these restrictions.

As mentioned before, one of the proponents of this model of rationality based on optimization under constraints, Thomas Sargent (1993), conceives that this way of understanding the behavior of individuals is very disconnected from the economic man postulated by classical economics. The alternative theory, says Sargent, is an economic man based on the idea that it does not matter if these subjects maximize or not, only those who act as *if* they

maximize survive. Economics will assume that agents are able to decide and behave as having full rationality (Crowther-Heyck 2005, 6) and as if they could conduct exhaustive searches of all possible decisions and choose the best one (Conlisk 1996, 675) .

In the article entitled *Behavioral Economics: a Methodological Note*, Amitai Etzioni states that some authors (Gary Becker, for example) argue that this ideal of optimization (although criticized by Etzioni) can be achieved if the aggregate behaviors of a number of individuals is taken as a reference. Thus, even if 90% of the agents are wrong in their maximizations, the remaining 10% will find the optimal decision (Etzioni 2010, 51). In this approach, it is not possible that economics can predict the optimization of individual agents, but if we take a group of individuals, the aggregate of their actions can be considered as an object of prediction. With this, economy saves the phenomena without having to discard the core concept of optimization.

Not only in economics optimization is used as a model of understanding human behavior. It has extended to other fields such as psychology:

With or without constraints, has spread beyond economics. Psychologists often propose models of cognition that assume almost unlimited memory, storage capacities, and computational power. That is, many psychologists also build as-if models of behavior, as illustrated by various Bayesian approaches that model behavior but not cognitive processes (Gigerenzer 2008a, chap. 5).

3.2.7. Conclusion: *Homo Economicus* Revisited

Little by little we are seeing how the model of rationality and behavior is being configured from the framework of neoclassical economics. From these coordinates we understand that the postulated economic agents (*homo economicus*) are attributed a series of very peculiar characteristics such as individuality, the perfect utilization of rationality from an instrumental point of view or, at least, the idea that they act *as if* they enjoy a pretty clear order of preferences and infinite cognitive possibilities.

The difficulties given by the environment and by the individual's own cognitive capabilities and how they impose constraints on the subject become, therefore, irrelevant, as we have also seen, since under this theories individuals are always able to optimize.

John Stuart Mill was among the first to define economic man as the subject of study of political economy. Mill defined it as alienated from social influences. But this author was not trying to define the ontological nature of the human being, but the characteristics of the same that must be taken care of by economics:

Political economy [...] does not treat the whole of man's nature as modified by the social state, nor of the whole conduct of man in society. It's confessed with him alone as to who desires to possess wealth, and who is capable of judging of the comparative efficacy of means for obtaining that end. It predicts only such of the phenomena of the social state as take place in consequence of the pursuit of wealth. It makes between abstraction of every other human passion or motive... (Mill 1844, 138).

From the economic sciences it is much easier to study a subject free of all the reasons for acting other than those of his own interest in generating

wealth for himself. As stated by Ng and Tseng "Without complications such as personality, value, belief, and emotions, economic man's behavior can be explained by his own self-interested orientation" (2008, 266). Although it is assumed that the economic man possesses a perfect rationality capable of predicting all the possible results of each action, in this previous article Ng and Tseng clarify shortly that it is quite unreal to speak of this type of individual and that the most we can say of her is that she is a very powerful analytical tool for economic analysis. Irene C. L. Ng and Lu-Ming Tseng assert that the differences between the homo economicus and the homo sociologicus are not based on the ontological assumptions that they can make of the human being. The evolved version of economic man, the one that introduces the strategy within the decisive parameters of behavior, does not pretend to be an essential human model, but a tool of the economic sciences: "Homo Economicus is a cornerstone on which economic theories are Built" (Ng and Tseng 2008, 267).

From a historical context, the emergence model of decision maker may respond to specific demands within the field of economics. It is from this parameter that Mill's words make sense. The appearance of the selfish economic man model as an artifact of analysis may be the answer, therefore, to some difficulties found in political economy. Ng and Tseng reflect the need not to attempt to postulate an independent ontological status for this homo, but must be understood as an attachment to a specific type economic analysis.

Since its introduction, this concept of economic man has been changing and evolving. Initially as the central axis of economic, even surpassing the borders of this science and moving fluidly to others like sociology and psychology. Later, when used by neoclassical economics, many of the characteristics of *homo sociologicus* were understood from their egoism, so if humans cooperate, they always do so in an interested way. Even sacrifice may be seen from a pure selfish interest perspective (Ng and Tseng 2008, 269).

But these models were short in predicting and explaining human behavior, so the *homo economicus* became a strategist individual who considered the behavior of others as one of the variables to observe in order to decide and maximize a utility function. Game theory provides the coordinates of application of this evolved *homo economicus*, and to the extent that this theory has become more sophisticated and robust, predictability increased, including cooperation as a maximizing strategy. In this way, economics leaves the individualistic Robinson Crusoe as a model to understand decisions, adopting a more interactive cooperative model where individuals also consider the actions and decisions of other agents while integrating parameters such as social framework, roles, values, beliefs, etc. (Ng and Tseng 2008, 271). According to the most current version of *economic man*, the agent's utility function will consist not only monetary values, but also her social or welfare values, without contradicting her supposed egoism in the maximization of that function, without abandoning her selfishness.

The existence of deviations from the neoclassical model of economy does not imply the abandonment of its most basic assumptions regarding the rationality of economic actors. The famous Nobel Prize-winning economist Paul Krugman (2009, 262) states after a brief introduction on "behavioral economics", that although these economic actors show imperfections in using their rational capacities in economic problems (such as savings or distribution issues of capital in retirement plans), it is difficult to find economists (even "behavioral") who defend that the utility maximization thesis must be replaced. Rational consumer theory, according to Krugman, is the main way in which economists analyze consumer behavior. But one thing is to affirm the need to follow a kind of rational human model for the study of economics, and another thing is to deny that this type of model is real, ontologically speaking. Paul Krugman (as well as so many other neoclassical economists) does not deny the lack of perfect rationality of economic actors (PR Krugman 1995b, 206), but merely discusses a methodological need that occurs in the study of economy. Krugman in fact argues that individuals show imperfect rationality in many economic scenarios (savings, recessions, etc.).

The methodological model used by Krugman is clear in the following paragraph:

So the papers in this volume are linked by a methodological approach that uses abstract models but is willing to cut corners on rigor to gain insight. This methodology brings with it a natural attitude toward modeling style: a strong preference for maximum simplicity. For economists who believe that maximization and equilibrium are unchallengeable axioms rather than frequently convenient metaphors, simplicity and elegance are less important than Truth. For economists who are actually building empirical models, complexity may be necessary in order to save the phenomena. If one is trying to build insight, however, it is essential to clear away as much clutter as possible. That means looking for the simplest, cleanest model that makes the point (P. R. Krugman 1995a, xi).

Of course, the simplest model that can be used to save the phenomena is the one that includes the idea of rationality attached to the parameters of utility maximization. As Sugden explains: "In mainstream economics, explanations are regarded as 'economic' to the extent that they explain the relevant phenomena in terms of the rational choice of individual economic agents" (1991, 751).

James Marcum, professor of economics at the University of Texas at Baylor, argues (2003) that there are parallelisms between the philosophy of science (especially in physics) and neoclassical economics. Although I do not share the main thesis of his article, in it we can find that a very simple explanation of the reductionism of neoclassical economics:

An important philosophical presupposition for neoclassical economists patterning economics after physics is reductionism. As physicists reduce complex natural phenomena to particles and forces, so neoclassical economists reduce complex social phenomena to individual agents and their rational choices (Marcum 2003, 7-8).

The economic man who assumes economic neoclassicism has to be considered as an atomic individual (Janet Landa and Xiao Wang 2001, 217) disconnected from all his social and environmental influences. But if this is a methodological resource, as some have argued and explained earlier, for the segregation of conceptual parts that do not correspond to economic models, but to psychological, social, biological, etc. Should we deny the very reality of the human subject in order to save, in this way, an economic science built on a base (a certain idea of individual) totally wrong? One of the possible

answers can be found in the studies of Landa and Wang. They affirm that the subject of the theory of rational action proposed by neoclassical economics is a normative approach that provides a generalized approximation of representative behaviors of individuals. They deny the possibility that this model of decision maker may represent a descriptive theory (2001, 218).

This individualism, even if it is methodological, does not imply the disappearance of sociological factors, but it is the basis of these. If what neoclassical economics prescribes is that agents maximize their utility function, a particular individual must be the maximizer. As David Colander says: Someone must be the maximizing agent. In classical economics, according to this author, it is the individual. Subsequently the "market" will be responsible for translating this individual rationality into social (2000, 134). During the last two centuries, economic thought has been dominated by this idea of economic man, this idealized subject who knows what he wants and who can be expressed mathematically with a utility function and whose decisions are the result of reasonings calculated to achieve his objectives. Herbert Simon empirical approach to rationality models in economic theory would challenge the epistemological validity of the perfect rationality model at the center of the *homo economicus* of mainstream economics.

3.3. Herbert Simon and The Model Of Bounded Rationality

3.3.1. Introduction

The main objective of this section is to provide a descriptive and critical analysis (from a historical and conceptual framework) of Herbert Simon's work focused on the model of "bounded rationality" and how this model represented an epistemological challenge to the perfect rationality approach postulated by mainstream economics. This section is the central axis of this dissertation since it would be connecting, in a critical movement, the interpretations of rationality and human behavior of mainstream economics with Simon's criticism that will put in motion a behavioral revolution in social sciences. The criticism of the ideal models of mainstream economics will be culminated by the research of Tversky and Kahneman.

The focus of this section, therefore, is Herbert Simon, as he represented the beginning of the change of how economics (and, sometimes, other social sciences) understood our rationality. To do this, I will proceed by explaining the appearance and use of this model, followed by a historical review of its use, and its development within Simon's research through the years. I will be discussing the empirical epistemology of Simon as a philosophical foundation of his theory and how bounded may relate to procedural rationality in an attempt to provide a more realistic interpretations of our decision processes, attending not only to the cognitive limits of

rationality and their relationship to the environment, but also to the role of emotions. During the course of the following pages I will discuss dynamic inconsistency in our decisions as an example of our bounded rational behavior as well as the mathematical and psychological foundations of Simon's theory. I claim that the main reason the would push Simon to adopt a different and more realistic interpretation of our rationality rests on his empiricism. To this end, I will be using an article I published about this matter (Hortal 2017). Here the notions of procedural and bounded rationality are analyzed as an effect of Simon's epistemological philosophy, while I explain the evolution of his theories and models to explain the way individuals decide.

In the last parts of the section devoted to Simon I will be discussing some of the repercussion of Simon's work. I will talk about the concept of bounded rationality in itself and how it was used by Thomas Sargent, Ariel Rubinstein, and others, while introducing some of the Gerd Gigerenzer's views about the matter in his ecological rationality.

3.3.2. The Concept of Bounded Rationality

In the previous section, I outlined the main features of the model of rationality that emerges from mainstream economics. In following pages, I will be highlighting, as a preliminary step in Simon's criticism, the different ways of understanding this notion of rationality the emanates from the classical and neoclassical theories and the assumptions that must be assumed in order to

maintain it. I will be clear throughout the following pages that the version of rationality postulated by the classical and neoclassical economics differs quite radically from the reality of how real individuals decide, according to what we can observe. Ariel Rubinstein in his work "Modeling Bounded rationality" (1998, 8-9), posits that in the model of perfect rationality, every time an agent faces a decision, she has a complete knowledge of the problem in question, and she is aware of the possible alternatives of action that are presented to her and from which she must choose. In addition, this individual has the preferences sufficiently clear as to be able to define a determined order of all the possible alternatives. To all this, such idealistic economic model had to assert that individuals possess the necessary cognitive ability to carry out any kind of calculation necessary to discover the optimal action, the one which maximizes her utility function. Accordingly, her capabilities to calculate are unlimited while not making any mistakes in applying them, showing also indifference between alternatives that are logically the same. This type of characteristics are not proper to real human beings, but to *homo economicus*. Thaler denominated this ideal type of agent *Econs* (2015).

As we shall see in depth, any empirical analysis of the rational demands of mainstream economics will result in an epistemological failure. The arguments provided by this framework, as we have described above, are based on the idea that economics does not focus on the processes that determine subjects when making decisions, but on behavior itself (Rubinstein 1998, 10), since thanks to this rationality, the subject is able to achieve the goals proposed in an instrumental way. All that is enough for mainstream

economics to save the phenomena. In fact, economics does not have to admit, as we have seen, that subjects act with a complete rationality (perfect, ideal). They just have to behave as *if* they do.

Herbert Simon initiated the most robust critique of the model of perfect rationality used by mainstream economics. He himself, at the age of 25, had already had enough experience in life to account for the limits of the framework presented by economists to understand how subjects maximize their expected subjective utility (Simon 1991, 87). As Simon explained in some of his letters (Crowther-Heyck 2005, 6), the idea that agents behave in a way as if they had complete and perfect rationality is something more of fantasy than of reality. What we need, our author claimed in another letter, are people who behave less like gods and more like laboratory mice. He argues that the world is too complex for individuals to follow that supposed ideal rationality (Simon 1991 , 86).

Crowther-Heyck asserts that Simon, In his doctoral thesis in 1942 (2005, 379 n ° 77), began to use this criticism of find an idea about the limits of rationality. The main topic of his dissertation fell under the field of political sciences and dealt with the decision-making processes of administrative organizations (Dasgupta 2003 , 684). This thesis will later became his first published book "Administrative Behavior," whose first edition dates back to 1947. Simon, in the commentary on the fifth chapter of the fourth edition of this book, stated that in the real world, human behavior is intentionally rational, but boundedly so. Álvarez explains, an I think that Simon had the same intention, that the use of a bounded rationality model is not a defense

mechanism but an attempt to capture the information structure of the particular situations we try to model (Álvarez 1999, 349).

In the second chapter of *Administrative Behavior*, when discussing the efficiency that can be achieved in an administrative organization, Simon admitted the existence of a series of "limits" that may be expressed in organizational settings and in behavior in general when trying to choose the correct decision (Simón, 1997a, 45). Later on he also conceded that these boundaries do not completely limit rationality. If the notion of bounded rationality is already drawn or not in his first work is a matter of debate, in fact Barros (2010) affirms that Simon's first work shows a continuation of the classical models of economics and that it is not until later on, in the mid fifties, when this concept fully appears, with all its critical power: "*Simon, in Administrative Behavior (1947), though emphasizing the distinction between effective and theoretical behavior, assumes the model of global rationality*" (Barros 2010, 457). The objective of Simon's work, according to Barros, was to differentiate practical and theoretical behavior, making sure that the topic of rationality was addressed, together with the issue of its limits. But the theory will not be outlined until years later. According Barros, it would be an anachronism to think that "*Administrative Behavior*" contained the origin of the idea of bounded rationality, which in reality will not appear until 1955 (2010, 459).

The limits of rationality to which Simon referred to are not based on the influence of passions, emotions, or the unconscious. These boundaries are inherent to the human organism as an agent capable of processing

information. As Crowther-Heyk says (2005, 9) this is what forces the agent to simplify the actual situation in which he decides to be able to operate on it. As Klaes and Sent (2005) propose, Simon began to use this concept to draw the attention of economists to issues that were being ignored. The concept of *bounded rationality* was written for the first time in his work "Models of Man" in 1957, trying to capture a more realistic version of the human being that should be at the center of economic the research about rationality and decision theory.

What Simon was about to begin with his general theory and with his introduction of a different concept and model to understand the rationality of economic agents and organizations, is an epistemological revolution that brought economics closer to a more empirical approach to rationality, using psychology as a tool.

3.3.3. The use of the term of Bounded Rationality in research literature

Until Simon coined the concept of "bounded rationality" in 1957, several similar concepts were used since the year 1840. These included "limited intelligence", "finite intelligence", as well as the use of adjectives related to the concept of rationality as "incomplete", "limited", "administrative" or "approximate" (Klaes and Sent 2005, 27).

Simon, for example, started to talk about the limits of rationality in his doctoral thesis which was published in the form of a book under the title of "Administrative Behavior". There he referred specifically to the "limits of rationality with which the principles of rationality must deal with" (Simon 1997a, 46). Before using the adjective "bounded" he also spoke of "approximate rationality" to allude to an organism that may have information but a limited computational capacity (1956, 129):

The broader aim, however, in constructing these definitions of "approximate" rationality is to provide some materials for the construction of a theory of the behavior of a human individual or groups of individuals who are making decisions in an organizational context (Simon 1955, 114)

The above-mentioned study led by Klaes and Sent on the historical origins of the use of the concept of "bounded rationality" points out that the term has been used continuously since 1957 by Simon and others to criticize a specific position supported by the classical or neoclassical (mainstream) branch of economics when addressing issues related to rationality and decision theory. According to Arnsperger and Varoufakis, this concept has also been used by economists contrary to the postures of Simon (2006, 1). That is the case of Thomas Sargent's (1993), whose version of bounded rationality denotes a type rational behavior under restrictions that is closer to the neoclassical standard model (Klaes and Sent 2005, 28) than to Simon's approach.

The model of bounded rationality can be found in economic theories (eg, Simon and many others), it can be applied to game theory (Hargreaves Heap and Varoufakis 1995), to geography (Krider and Weinberg 1997),

biology (Griffiths P. E and Stotz K 2000), and even to nursing (Whitehead and Russell 2004).

During the nineteenth century, the notion of a limited rationality or intelligence was associated with our intellectual capacity in a general way and rarely associated with decision making. Nowadays, in most cases, the concept is linked to studies or theories belonging to the branch of economics, business, business administration, psychology or philosophy. In economics, those who use it most frequently, they do it from a framework centered on the behavior and decisions of subjects as a way to criticize the most orthodox versions of neoclassical economics.

According to Klaes and Sent, the concept of "bounded rationality" has been used since 1945, specifically in economics, history, political science, philosophy, sociology (2005, 46), arguing that this concept was institutionally established during the 1990s (2005, 48).

I argue that the determinant factor that gave rise to the model of bounded rationality was the lack of empiricism (or realism) that appeared from the neoclassical economy in relation to the actual processes of rationality expressed by individuals. This meant that from the field of economics and political science, research tried to turn to the field of psychology to fill this gap, especially in reference to the real decision making processes. When research turned to psychology, what was discovered was something that psychologists already knew: the limits we face when deciding rationally. These limits are both internal (low memory, limited calculating ability, etc.) and

external (the complexity of the environment in which we make decisions, the possession of too little information, etc.). Needless to say, these limits are conceived as such because there is a standard economic theory that prescribed a limitless computational capacity.

The recognition of these limits made the epistemological foundation of the economy to shake, since it did not take into account all these real and existing processes in human behavior. Economics found itself between the Scylla of ignoring these limits while practicing an economy based on unrealistic assumptions about the human rationality, and the Caribs of having to face these limits with the result of an increase in its complexity due to the amount of variables to consider, losing part of its epistemological robustness. Different authors will circumvent these monsters, or embrace them, as we shall see, in many ways. An example was the above-mentioned "as if" theory by Milton Friedman, where economic subjects only had to act *as if* they were rational.

3.3.4. Herbert Simon

3.3.4.1. Introduction

Having explained the assumptions that neoclassical economics held about the rationality of individuals, this section will be devoted to Simon's research work and criticism of the approach.

Simon began to build his administrative theory as a preliminary model in order to criticize the lack of reality of the classical models in regard to organizations in particular and economics in general when discussing rational theory. Simon, already in his doctoral thesis, published in 1947 "Administrative Behavior" (1997a), started to introduce the methodologies practiced by psychology to understand the rational processes that are at the root of different economic decisions. Economics, until that moment, had mainly focused on the final objectives of rationality (instrumental approach) of these agents without trying to explain what really "goes through the head" when acting in one way or another, and endowing these individuals with rational abilities more proper to gods of the Olympus than to actual humans.

The question that Simon tried to answer was the following: How do subjects really decide when the conditions established by economists, based on a perfect rationality, are not fully met? The answer that emanated from Simon's theory revolved around the model of bounded rationality: when subjects can not optimize, they satisfy on their way to find decisions. Decisions, accordingly, not only went from being optimal to being satisfactory, they could also be found heuristically through a maze of possibilities (Simon 1991, 369).

I argue that Simon's different concepts linked together and they all revolve around the model of bounded rationality. Among these concepts we find the above-mentioned notion of *satisficing*, but we will also see others such as *procedural rationality*, *substantive rationality* or *administrative rationality*. All of them will complete, in Herbert Simon's research, a

conceptual framework to explain human behavior based on the criticism of the model of perfect rationality of mainstream economics. A criticism that sparked a revolution.

3.3.4.2. The origins of the model of bounded rationality

"...theories, however plausible and "obviously" valid, can be destroyed totally by the obstinate facts of the real world..." (Simon 1991, 35)

The purpose of entering into the biography of Herbert Simon is to account for some of the author's experiences that may make us better understand the origins of his approach to rational theory. Thus, in the following pages, I will relate passages from the life of Simon that have some relevance with the ideas that appear in his research. Attending to the biographical origins and the "genetic" moment of Simon's theories will help us understand in what way his exposure to empiricism and some other specific events in his life may have contributed to his criticism of mainstream economics and the development of the bounded rationality model.

I here claim that the central axis of Simon's theoretical model lies in this idea of "bounded rationality", which gives a specific character to the rest of the ideas that appear in his works. In fact, in his autobiography he accounts for the existence of two related ideas that are at the epicenter of his intellectual career: 1) human beings are only capable of achieving a very limited rationality; and 2) as a consequence of their cognitive limitations, they

are usually identified with sub-objectives. He later added that he would not mind describing his entire scientific heritage as something related to his "Administrative Behavior" where these two ideas were forged (Simon 1991, 88). About the theoretical origin of these ideas in Simon, we will return later. About their origin within his personal life, we can pinpoint a specific moment, when Simon was at the age of 16 or 17, and began to work with cattle following a specific (and in theory fruitful) model. This experience would show Simon some of the epistemic limitations of economics as it had been practiced. The major limitation was related to the lack of experimentation conducted in before arriving to theories and its separation from empirical reality, above all in regard to the limits of rationality, both internal and external. Limits that make our decisions somewhat more complex to deal with than what economists postulate.

Herbert Alexander Simon was born in Milwaukee, Wisconsin, on June 15, 1916, the son of a German immigrant engineer and a pianist. At the age of 16 (1932) he met Maurice Davis, who decided to seek investors (including Herbert Simon's father), to buy grazing land and cattle to sell in Chicago, not far from these pastures. Maurice had the theory that the cattle would eat "reed canary grass", so he made the business plan based on this type of grass, which was planted in "Rockmash". Simon became the right hand of Maurice, alternating high school (at the beginning), and the University of Chicago (later), with farm chores. In fact, to complement his tasks at the cattle ranch, Simon was constantly studying the relationship between the

price and the quality of the commercialized cattle, even hanging charts related to that on the wall of his university dormitory (Simon 1991, 51) .

Shortly after commencing cattle ranching, Maurice committed suicide by shooting himself in the head at a Minneapolis hotel, a fire destroyed much of the grass seeds for the crop and an epidemic of conjunctivitis infected most cattle, leaving more weak and thin, every day that passed and saw them when they were administered drops in the eyes. But, according to Simon, what ended the business of the cattle was the decision of the cattle itself to eat nothing of the type of grass planted for its consumption. They could eat everything except that kind of grass, knocking down fences (even with barbed wire and electrified ones), to get out of the grasslands. That was a clear example of something that did not work within the models used by the economy of the moment. And here is why he described this event in his life:

In essence our failure was a vivid demonstration, which I have never forgotten, that theories, however plausible and "obviously" valid, can be destroyed totally by the obstinate facts of the real world. Davis had brought us an unbeatable scheme for raising cattle profitably. The cattle had a different scheme. No doubt my later deep skepticism of the *a priori* of the mainstream economics had some of its origin in this experience (Simon 1991, 35).

This *a priori* that Simon alluded to was nothing but the attempt of classical economics to postulate a series of models to describe (or prescribe) a reality that did not exist, among them the idea of a perfect rationality capable of optimizing. In response, Simon began to draw the notion of a limited rationality.

Although academically based on his doctoral thesis and its publication in "Administrative Behavior", Simon applied the model of bounded rationality to political science, economics, psychology, theory of organizations and computer science.

His animadversion with neoclassical economics also had its roots in the ideas of a young Simon, who came to the University of Chicago with a set of political beliefs that were close to socialism. These political views had their origin in his life in Milwaukee and its important working middle class.

During his university years, he frequently attended Carnap's classes on logic and philosophy of science, where he learned to value the mathematical foundations of scientific theories:

I found several faculty members from whom I could learn how to apply mathematics to empirical matters. Three persons outside the political science department played especially important roles in this stage of my education: Nicolas Rashevsky, Henry Schultz, and Rudolph Carnap (Simon 1991, 51).

Carnap was very important to Simon, since his thesis project, which he started to work on as early as 1937, was based on the logic of the social sciences and on the logical foundation of the management sciences. Mathematics, therefore, was of fundamental importance for the kind of social sciences practiced and developed by Simon, and crucial to understand his theories. According to Simon himself, "Mathematics is a language; it's a language that sometimes makes things clearer to me than do other languages..." (Simon 1982, 2: 209). According to this, Simon would translate the phenomena of social sciences into the language of mathematics for his

better scientific understanding, even claiming that in "mathematical models incorporating rational and non-rational aspects of behavior: the non-rational are limiting conditions that 'bound' the area of rational adjustment" (Simon 1982, 2: 215).

Together with many other aspects of his life, Simon's experience with cattle forced the idea that science must be based on mathematical formulation and empirical experimentation (Crowther-Heyck 2005, 74). Simon, therefore, was not critical of the standard economics' use of mathematics, which he found essential to any science. He was against any economics practiced *a priori*, without the experimental methodological aspect (Keita 1992, 9). The use of mathematics in economics and social studies was not Simon's invention. What I argue here is the importance that mathematics had for Simon, due to his positivist epistemology. If there is any reason why a theoretical debate can be established between Simon's economic theories and neoclassical economy is due to the fact that both had a mathematical foundation:

The new classical economists value, above all, rigor and precision in analysis, and show a strong predilection for a mathematical style of argument in both theoretical and empirical discourse (Klamer 1984, 282)

It is from this mathematical basis that Herbert Simon attempted to criticize the neoclassical postulates related rationality. Simon's central argument rested on the idea that neoclassical economics lacked a robust empirical foundation. Empiricism was a constant line throughout Simon's research. In a footnote in his autobiography, Simon explained that although

the content of this work is based on studies of behavior, the facts are derived from observation and experience (Simon 1991, 59n).

At the age of 22 and while preparing a part of a book on techniques of municipal administration (1947a), Simon outlined the current knowledge about administration science that existed at that time. During his research for the development of this work, he encountered the "classical theory of organization". This theory is based on the main points of the classic works of Leonard White (1955) and Gulick and Urwick (1937). Attempting to separate himself from the paradigm established by this classical theory, Simon read the new work written by Chester Barnard on the functions of the executive (1968), which he considered "exceedingly superior" (Simon 1991, 73) to any other work on administration. This book brought the idea to our author that life in administration is not much different than life in general. Organizations, accordingly, can be understood by applying what we already know about human behavior in general, including aspects like "loyalty" and "identification," essential concepts within the study of organizations.

Simon argued that this discipline had an epistemological need: the need to incorporate systematic observations and experimentation to make it somewhat scientific. All this pushed Simon to abandon the idea of writing a thesis about the logic foundation of administrative theory and instead, to dedicate his research to behavior and organizations (Simon 1991, 74). The objective was the study of human behavior in organizations, within the context of decision-making, similar to the study of a laboratory rat in a labyrinth.

Simon's objective therefore was to observe decisions as if they were a series of successive ramifications.

Simon asserted that in the work "Administrative Behavior" we could find the origin of the idea of bounded rationality and, although the root of this work is found in Barnard's theories (mainly in the aspect referring to the personal identification with the company), the idea of bounded rationality only appeared rather dimly in that work. That is, while Barnard's work is a precedent of Simon's theory of the firm, it is impossible to find any reference to any notion of a limited rationality. In fact, according to Simon (1991, 87), the closest notion of this concept that can be found in Barnard's work is the idea of opportunism and strategic factors, which in turn he borrowed from John R. Commons. But even so, the bounded rationality model (expressed at that time as the limits of rationality) eventually evolved from its initial versions to take a different shape (as we will see in future pages) in the later works written by Simon. Bounded rationality will become not only a model applicable to the theory of organizations, but also something that can be used to understand decision making processes at an individual level, acknowledging, as he does in a personal letter (Crowther-Heyck 2005, 95), the importance of psychological barriers in logical behavior.

According to Crowther-Heyck, for Simon, understanding decision-making processes is the basis for bringing the reform of administrative science. A discipline that should be closer to a research

methodology capable to provide a closer relation with "reality". In order to do so, Simon set up what he called "administrative experiments":

Simon's commitment to empiricism in the social sciences extended to the possibility of performing social experiments. In *Administrative Behavior*, he toyed with the idea of "administrative experiments" in which the researcher would study one specific organizational phenomenon under conditions that isolated the issue of interest from all other factors impinging on organizations. Such stringent methodological conditions, he pointed out, scarcely ever prevailed in the "administrative experiments" reported in the literature (Dasgupta 2003, 687).

The main epistemological argument that Simon used to reform the science of administration was based on the idea that the descriptions of the events that it accounted for suffered too much from simplification, superficiality and lack of realism (1947a / 1997, 44).

3.3.4.3. The critique of the rationality model of classical economics

These accusations, and especially the last one, were the beginning of Simon's criticism of the classic (mainstream) economic model. A criticism that extended throughout the intellectual life of Simon, who received the Nobel Prize in economics, partly thanks to the research he did to develop this model of bounded rationality, cornerstone of such critique. The following is part of his speech when receiving this award on December 8, 1978:

The classical theory of omniscient rationality is strikingly simple and beautiful. Moreover, it allows us to predict (correctly or not) human behavior without stirring out of our armchairs to observe what such behavior is like. All the predictive power comes from characterizing the shape of the environment in which the behavior takes place. The environment, combined with the assumptions of perfect rationality, fully determines the behavior. Behavioral theories of rational choice - theories of bounded rationality - do not have this kind of simplicity. But, by way of compensation, their assumptions about human capabilities are far weaker than those of the classical theory. Thus,

they make modest and realistic demands on the knowledge and computational abilities of the human agents, but they also fail to predict that those agents will equate costs and returns at the margin (Simon 1979a, 347)

Dasgupta, referring to the versatility and application of multiple disciplines by Simon, claimed that we can find, within the theoretical model represented in "Administrative behavior", remains of theories that come from the field of psychology. The influence of Tolman, as an example of this "collaboration" with psychology, was clear in regard to the conduct with purpose, the ideas of "fact" and "value" of Ayer, the theories about the habit and the attention of Dewey and William James, or the mathematics of von Neumann (Dasgupta 2003, 696). All these influences created a strong foundation on which to build the critique of the model of rationality posited by the classical theories of administration in particular, and by mainstream economics in general. This is the historical course in which Simon laid the foundations for drawing a more "realistic" model of rationality. Something that started with the epistemological problems that appeared when describing the behavior of individuals according in the classical theories of administration and organization, and ended with a more general critique that covered the rationality approach sustained by the entire field of mainstream economics.

As I have already mentioned, this new approach started to appear in Simon's work when criticizing the lack of realism of the descriptions provided by the standard administrative theory (Simon 1997a, 44). Since administration science was a field that tried to explain the way in which organizations must be built and how they should work to be as efficient as possible, its scientific objective lied on the idea of maximization of goals. This was also the central

idea in the general field of economics. In this way, the *administrative man*, the subject studied by the administrative sciences, was parallel to that "economic man" that was assumed by classical economic theories. Both, therefore, had as their sole objective the maximization of their utility function to obtain the optimum benefit, cutting costs as much as possible. This is what Simon calls "the principle of efficiency", even though it is best interpreted as a definition, rather than a principle (Simon 1997a, 45). According to Simon, this definition describes what is considered a "good" or "correct" administrative behavior, but there is nothing explained about the specific way to maximize. Simon simply posits that maximization should be achieved.

I argue that it is in these words that Simon deciphered what the problem of classical economics was: not only its lack of realism, but also that the explanations were normative and did not come to describe the actual processes individuals or organizations use to arrive at such maximizations. Simon, referring to the principle of efficiency as something merely normative used to explain what he called a good or a correct behavior, introduced the limitations of this model. That is, the standard model could not give an account of the actual processes of economic agents, either individually or within the framework of an organization. In "Administrative Behavior" we began to see that the main postulate of classical theory (maximization) was nothing but a prescription indicating that maximization should be the ultimate goal of administration. A prescription that was not able to explain anything about how to do it:

Actually, the 'principle' of efficiency should be considered as a definition rather than a principle: it is a definition of what is meant by 'good' or 'correct'

administrative behavior. It does not tell how accomplishments are to be maximized, but merely states that this maximization is the aim of administrative activity, and that administrative theory must disclose under what conditions the maximization takes place (Simon 1997a, 45)

3.3.4.4. Towards bounded rationality

Simon not only criticized the classical approach on maximization, but he also wondered about the factors that can determine the level of efficiency that can be achieved in an administrative organization, and about the different aspects that may jeopardize this ideal of maximization. He established that there were many number of boundaries that may affect the members of an organization. So many, Simon posited, that making a list would be impossible. These limits quantitatively and qualitatively harm the behavior that individuals employ to maximize their decisions. Accordingly, Simon divided these limits into two: limits that affect the ability to act and limits that bound our ability to make correct decisions. (Simon 1997a, 45). To the extent that those limits were determined and surpassed, the organization would be able to *approximate* to a desired level of efficiency.

Simon did not use the above-mentioned concept of *approximation* freely. In Simon's research, the idea of maximizing objectives most times would have been something impossible. From the moment that Simon recognized the impossibility of achieving the desired maximization due to the limits imposed by the environment and by our way of dealing with it, the only thing possible to do was to satisfactorily approximate to the objectives set. Assuming these limits from a realistic framework of behavior, Simon denied

the possibility of maximization prescribed by the standard theory of economics. By subjecting rationality to a realistic sieve describing how agents' decision-making really took place, we could not expect a rationality capable of circumventing this set of limits. Simon stressed the idea that achieving an optimal decision is illusory and impossible. The only thing that subjects could aspire to, he proceeded, was to make a satisfactory decision, not an optimal one. The realistic approach would understand that the *only* thing we could hope for our decisions was to have a certain level of preference, without achieving the ideal objective (the one able to maximize our utility function). This maximization, Simon claimed, was just an ideal figure far from the reality of our actual decision processes:

In particular, no "utility function" needs to be postulated for the organism, nor does it require any elaborate procedure for calculating marginal rates of substitution among different wants" (Simon 1956, 138).

Simon therefore proposed the idea that in order to achieve this optimization we must have the opportunity to circumvent a series of limits, either at an individual level or within a group of individuals or companies:

To the extent that these limits are removed, the administrative organization approaches its goal of high efficiency. Two persons, given the same skills, the same objectives and values, the same knowledge and information, can rationally decide only upon the same course of action. Hence, administrative theory must be interested in the factors that will determine with what skills, values, and knowledge the organization member undertakes his work. These are the "limits" to rationality with which the principles of administration must deal (Simon 1946, 64).

In this article from 1946, he affirmed that the limits of rationality could be defined as those related to the abilities, habits and reflexes of individuals,

which no longer belong, as our author explained, to the realm of the conscious. Here, Simon also included the skills (or lack thereof), and the reaction time. To this end, decisions, may be limited by the loss of speed of your mental processes, memory, cognitive limits, etc. (Simon 1997a, 46).

Simon also proposed a series of parallel limitations that started with the values maintained by the individual himself. These values could change the way individuals decide, especially within an organization. In this last aspect, factors such as loyalty could contribute to improving the performance of these individuals (Simon 1946, 65). In considering these boundaries within the individual's membership of an organization, Simon also included a third way in which rationality may be bounded: the depth of knowledge relevant to the development of the functions of the individual.

These three forms of limitations are not the only ones:

Perhaps this triangle of limits does not completely bound the area of rationality, and other sides need to be added to the figure. In any case, this enumeration will serve to indicate the kinds of considerations that must go into the construction of valid and non-contradictory principles of administration" (Simon 1946, 65; 1997a, 47)

In addition, Simon maintained, these limitations were variable and could be altered simply by being aware of them. Both the article on the proverbs of the administration (to which we are here referring) and his work on administrative behavior, are the result of his doctoral thesis. The ideas expressed in both works are quite similar in terms of the limitations of the rationality and the lack of realism of the description that classical economics makes of it. In the edition of "Administrative Behavior" that is in use here

(1997), Simon included commentaries to each one of the chapters. Part of Chapter V of this book is devoted to these limits of rationality. In the accompanying commentary, Simon pointed out, 50 years after the first edition, the obviousness of the lack of full rationality of human behavior. Although we attempt to have a complete rationality, we can only show a bounded one (1997a, 88). In that same commentary, Simon made the necessary distinction between emotion and reason, while assuring that they were not opposed. Emotions, he argued, help us motivate ourselves and focus on our goals.

It is within this Chapter V that Simon introduced a section specifically devoted to the limits of rationality. The main idea of Simon's discourse was based on the criticism of the classical model, which presupposes an ideal rationality capable of seeing all the alternatives before making a decision, with the capability to predict the consequences of each alternative of every possible decision. Simon criticized that the mainstream classical economics model assumes that we are able choose the best alternative, thanks to a system of values that uses as criterion, the best possible decisions that would lead behavior to the desired end (Simon 1997a, 93). This description fits perfectly with the classical theories of rationality and requires a thorough knowledge and anticipation of the consequences that follow each of the possible decisions. The main objective of Simon's critique within the theory of organizations was to eliminate the description that classical theory makes of subjects as instruments and the replacement of this ideal abstraction with a model that had all the influences that realistically interfere with the perfect

rationality postulated by this standard economic theory. These subjects have desires, motives, and goals and are cognitively limited in their learning and problem-solving skills (March and Simon 1993, 157). Within this classical model, from the moment the consequences are anticipated, subjects actually would use their imagination to predict the future attaching a set of values to each of their predictions. But, according to Simon, these values could only be imperfectly anticipated (1997a, 93). Simon argued that individuals were limited in their rationality since they could not consider all values, knowledge and relevant behavior to arrive at a single decision out of the many possibilities: "Human rationality operates, then, within the limits of a psychological environment. This environment imposes on the individual as "givens" a selection of factors upon which he must base his decisions" (Simon 1997a, 117). These decisions, Simon continued, are more than propositions of fact, describing a future situation that can either be true or false. They have an imperative property, as they are able to select one future situation instead of another, while guiding our behavior to choose a specific alternative among several. These decisions, Simon summarized, can be either factual or normative (1997a, 56), and can be described from the instrumental rationality frame of "means and ends" (1997a, 73), since a chain of ends and means can be considered as a series of anticipations that connect a value with an end and with any behavior that may satisfy that end. Any element of this chain can be considered as "mean" or "end", depending on its connection with the specific value that is considered as "end" of the chain or the behavior that carries out. Although Simon objected to

instrumental rationality, he did not consider it necessary to eliminate the framework (language) of "ends and means", since this frame could be useful for the understanding of these issues (1997a, 76). I here share with Crowther-Heyck (2005, 112) the idea that Simon considered that the "means and ends" framework was insufficient to understand the full scope and the reasons for human decisions.

For Simon, the function of knowledge in decision-making processes was to determine the consequences of each of the possible decisions we made (Simon 1997a, 78), but this knowledge is incomplete and unreachable, since we can only aspire to have a "fragmented" knowledge about the conditions that surround each action. Although subjects want to achieve the necessary rationality to arrive at a perfect decision, they always are bounded by the limits of this knowledge, and to surpass them, Simon stated, subjects must develop a number of procedures, such as the possibility of imagining that they are able to reduce the number of possibilities of choice, etc. (1997a, 94). To the limits of knowledge, Simon also added the difficulties to predict the consequences of our possible actions and the risk associated with them (1997a, 95-96).

Simon summarized in the commentary on Chapter V of the fourth edition of "Administrative Behavior", that the central problem of management theory was that of the boundary between the rational and non-rational elements of human social behavior, pointing out that at the time the first edition was published in 1947, the topic of the limits of rationality was not very relevant. In "Administrative Behavior" the criticism of the rational model of

classical economic theory and *homo economicus* had not been fully developed from the figure of the *administrative man* capable of satisficing rather than optimizing (1997a, 118). It is clear that although Simon started to see some limitations within the perfect model of rationality, most of his work during his first years was founded on the assumptions of mainstream economics. He acknowledged this in 1997, in the commentaries he added to his first book. It would be an anachronism to see in "Administrative Behavior" a theoretical opposition, within the framework of the appearance of the concept of "bounded rationality", of these classical foundations. What we can see in "Administrative Behavior" is the beginning of a criticism that would not be fully developed until years later. In his first book, Simon did set in motion the idea of how individuals or organizations could reduce the set of alternatives to consider within our decisions (Crowther-Heyck 2005, 114) in order to deal with the limits of our rationality, while at the same time trying to carry out its research from a more realistic framework than that of classical theory. In fact, he later mentioned in his autobiography, his own doctoral thesis contained the "basis and much of the superstructure of the theory of bounded rationality" (Simon 1991, 86). This idea, Simon continued, had its origins in a study of the recreational department in Milwaukee, and was consolidated in some studies on municipal activities that were conducted in California during the late 1930s and early 1940s (Crowther-Heyck 2005, 85-88). According to this, and as it was recognized in his autobiography, "Administrative Behavior" was founded on two related ideas: human beings only possess a bounded rationality and, as a consequence of this limitation,

they are only capable of identifying themselves with close objectives or sub-objectives (1991, 88).

3.3.4.5. A real model of rationality within a complex environment

During the 1950's Simon published two articles in which he would exposed, with more detail, the rationality model that he would later developed during his academic life. *A Behavioral Model of Rational Choice* (1955) and *Rational choice and The Structure of the Environment* (1956). The central argument of these two articles was centered on the idea that the global (perfect, olympian, etc) rationality of economic man prescribed by classical economics had to be replaced by another model of rationality compatible with the way in which we obtain and manage information in a complex environment (Simon 1955, 99). The classic rationality model assumed economic subjects who possessed complete knowledge about the values of the environment in which their decisions were made, while they also had a well-organized system of preferences, and a cognitive ability that allowed to make complex calculations to reach the maximum of its preferential scale. This *economic man* possessed all necessary capabilities to maximize his decisions within a complex environment.

To dissuade any type of idealism from all his rational models, Herbert Simon used the same scientific methodology used in psychology. This system, needless to say, unveiled drastic divergences with the classical model.

In the article of 1955 mentioned above Simon focused on the theory of rational choice from a behavioral and psychological point of view. To this end, he posited a series of limits or restrictions found in our decisions: the set of alternatives to choose, the relationships that determine the achievement or satisfaction of the proposed objectives, and the order of preferences within these objectives (Simon 1955, 100).

All these had to be contextualized within the restrictions imposed by the external environment, which Simon called "givens", and from the internal environment or organism. But if we accepted this distinction, Simon affirmed that we had to consider the organism itself as external conditioning too:

The environment we shall discuss initially is perhaps a more appropriate one for a rat than for a human. For the term environment is ambiguous. We are not interested in describing some physically objective world in its totality, but only those aspects of the totality that have relevance as the 'life space' of the organism considered. Hence, what we call the 'environment' will depend upon the 'needs,' 'drives,' or 'goals' of the organism, and upon its perceptual apparatus (1956, 130)

The role of the environment is fundamental to understand the decisions individuals make. Simon argued that this is something that cannot forget, since our decisions are made within an environment that determines them:

The outer environment determines the conditions for goal attainment. If the inner system is properly designed, it will be adapted to the outer environment, so that its behavior will be determined in large part by the behavior of the latter, exactly as in the case of 'economic man'. To predict how it will behave, we need only ask, 'How would a rationally designed system behave under these circumstances?' the behavior takes on the shape of the task environment (Simon 1996, 12).

Simon defined this environment as the behavior of other individuals, markets, companies, etc. that surround and shape any decision, while the internal environment is formed by the objectives and the abilities to make rational decisions on the part of the individual, the company, etc. The continuous adjustments we make depending on the environment in which our decisions are made, Simon proceeded, allows us to adapt to this environment (Simon called "substantive rationality") because of our computational and cognitive limitations to be able to discover our behavior is better suited to the circumstances (Simon 1996, 25).

This idea of the role of the environment in our decisions is widely accepted and shared by different authors. Some define the idea of bounded rationality differently than Simon. This is the case of the 2011 Nobel prize recipient in economics Thomas Sargent, who argued that human behavior simply reflects the environment in which it chooses (1993, 81). Better explained, Sargent posited, in regard to the relation between environment and behavior: "Human behavior simple: the apparent complexity of our behavior is the reflection of the complexity of the environment in which we find ourselves..." (Sargent 1993, 110), an approach that is extremely close to the theories maintained by Simon.

In his first book, Simon stated that decisions are made within a given environment ("givens") and they are accepted by the decision-maker as the basis of his choice, and the behavior has to adapt within parameters given by the environment itself (Simon 1997a, 92). As human beings that we are with

our social characteristics, most of our decisions are made in an external environment shaped by institutions (Simon 1983, 78).

Another author, Bryan Jones, not only emphasized the role of the environment in our decisions, he also classified this connection in three different types of influence: the immediate environment, in which our strategy is based on the previous environment; the vital environment, in which we turn to the experience of our life together to decide; and the biological environment, to which we adapt thanks to evolutionary processes (2001, 7). Jones clarified this a few pages later: "Decision maker adjusts to the environment by being intendedly rational, but sometimes bounds on rational adaptation show through to the current decision-making situation" (2001, 52).

Gerd Gigerenzer, who proposes a model of ecological rationality based on heuristic principles, also points out this relationship between the environment and the organism in decision-making: "In order to understand behavior, one needs to look not only the brain or mind but also into the structure of the physical and social environment" (2007, 76).

Considering this connection between the environment and our organism, if we want to criticize the classical model of rationality completely from a model based on the limits of rationality or bounded rationality, as Simon did, we must also assume that these limits are not simply found in our cognitive capabilities, but also they appeared immersed in the complexity of the environment:

Simon argued that reality is complex in relation to people's mental or computational capabilities he was making an ontological statement. Thus, it is

not quite right to say that the theory of bounded rationality relates 'uncertainty' to the decision maker and not to the nature of the environment (Dequech 2001)

Some authors defend this connection while also trying to demonstrate that subjects may exploit the external environment to deal with these limitations imposed by the subject herself and by the environment. that would be the case of the extended cognition approach (Clark and Chalmers 1998). Others have proposed an ecological rationality model centered in this relationship, either the version defended by Gigerenzer (1989, 2002a, 2002b, 2007, 2008a, 2001) or the one promulgated by Vernon Smith (2003, 2008))

Only from the model of classical rationality can we postulate an independence between the environment and our rationality, that is, only from the assumption of a perfect and complete rationality we can understand a disconnection between these two. As Max Albert (2009, 58) recognizes, only under the assumption of a perfect rationality, these principles can be presented as independent from the environment and applicable to all possible worlds. "Useful principles of rationality cannot be useful in all possible worlds; they must be adapted to the world we actually live in" (Albert 2009, 59).

According to Simon, we can understand the relationship between the external environment and our internal capabilities with the following metaphor: "Human rational behavior [...] is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor" (Simon 1990, 7) . In the words of José Manuel Robles explains it:

...rational behavior can be understood as a pair of scissors. One of the blades of these scissors corresponds to the structure of the environment in which the

decision is to be made, while the other corresponds to the subject's computational capacities. Thus, to understand the behavior, we must understand the action as if the two sheets of this scissors were closed in such a way that the two structures, mental and contextual, would have been matched. To this end, while the structure of the environment is more or less immutable, the cognitive capacities of the subjects should adapt to exploit the particular structures of such environment (2005, 41).

Once the relations between the organism and the structure of the environment had been identified, Herbert Simon, in the article *A Behavioral Model of Rational Choice*, highlighted some classic elements of decision making. The objective was to proceed with the criticism of the mainstream (classical) approach to rationality which implied a series of demands for the organism in charge of choosing incapable to be empirically sustained. From granting the individual the ability to assign values related to the benefits to each possible scenario of his choice, to the criteria according to the possibility of obtaining benefits, the classical explanation of rationality was far from realistic.

Simon denounced the impossibility for the conditions described by classical economics to be given. There was a lack of empirical evidence about this type of rational capabilities and we just cannot rely on pure introspective evidence to defend a model based on perfect rationality. But, Simon continued, we cannot dismiss the idea that the unconscious can make better decisions than our conscience (1955, 104).

It is important to note that some authors, such as Gigerenzer, consider the unconscious role (emotions, intuitions, etc.) as an important tool in decision making. These mechanisms can give rise, as we shall see more

closely in sections 3.4 and 4.3, to heuristic processes that may give us clues as to how we should act to try maximize our behavior within a given framework. This maximization does not refer, therefore, to the classical economics that we have previously mentioned.

The satisfaction at the time of deciding replaces in Simon the yearning and possibility of optimizing. Within Simon's article, the idea of *satisficing* appeared attached to the context of decisions after a process according to which, when individuals cannot optimize, because the rationality completely postulated from classical economics did not exist as such, they satisfy. In this way, Simon defined an optimal program as the one that maximizes a given utility function. If, Simon argued (1955, 108), instead of maximizing, what is required is for this function to reach a certain point that may satisfy certain needs, decision processes become something more realistic and attainable.

In addition to the problem of reaching an optimal solution, Simon found impossible to arrive at a unique solution when deciding. From the classical point of view, all alternatives are evaluated before making the decision. But this rarely happens in the real world. When subjects decide, the alternatives are considered sequentially and, sometimes, without knowing the order of the procedure. Once you have reached an alternative that meets the minimum needs, the individual stops searching for others. Simon called this the "level of aspiration" (1955, 111).

This article attempted to provide a definition of "rational choice" based on what Simon called "approximate rationality" (1955, 114). His ultimate goal

there was to construct a theory of human behavior, either an individual or a group level, using decision making theory based on the idea that although rationality itself may be intendedly rational, realistically is limited or approximate. To this end, Simon argued in the conclusion of his article, that it was necessary to criticize the notion *economic man* postulated by the classical theory. Simon saw this notion as an unreal idealization of how individuals behave, positing instead a figure that Simon had already introduced in his first work: the *administrative man* (a subject who decides from a capacity and limited knowledge). As a consequence of these deficiencies, the organism simplifies the means that she must handle cognitively, causing differences between the "objective" reality and the simplified model (Simon 1955, 114).

Later on, in a commentary 1997's edition of "Administrative Behavior," Simon acknowledged that although *economic man* maximizes, his "cousin", the administrator, satisfies by looking for an action that may be good enough, to stop looking for more alternatives. This *administrative man* recognizes that the world is but a simplification of the complete reality. In this way, when we make decisions we do not try to evaluate each of the possible alternatives that lead us to maximize the utility function, but we observe a few that are relevant, finding a good enough alternative that satisfies our expectations: because managers satisfy rather than maximize, they can choose without having to examine all possible alternatives and without having to know that they are, in fact, all the alternatives (Simon 1997a, 119)

According to Simon, individuals arrive at a satisfactory decision by simplifying the environment. This allows them to cognitively deal with it:

Now if an organism is confronted with the problem of behaving approximately rationally, or adaptively, in a particular environment, the kinds of simplifications that are suitable may depend not only on the characteristics—sensory, neural, and other—of the organism, but equally upon the structure of the environment. Hence, we might hope to discover, by a careful examination of some of the fundamental structural characteristics of the environment, some further clues as to the nature of the approximating mechanisms used in decision making (Simon 1956, 130).

The environment, therefore, would depend on the subject's objectives, needs, and her perceptual apparatus, limiting the "planification horizon" (Simon 1956, 131) of her decisions. In this way, when a subject has a decision, she must consider the possible alternatives (not all, as we have seen), the possible future "movements" that the organism can see, and the different "clues" that can be found in the environment that may indicate what will best lead us to satisfy her needs.

Simon claimed that these clues can increase the likelihood of finding satisfactory decisions. These clues can be framed within the environment itself, as well as in the organism, that is, in a complementary way. The clues that the subject extracts from the environment are the result of simplifying it to a "living scale" providing "certainty" in the decisions. According to Simon:

...there exist clues in the environment (either the actual visibility of need-satisficing points or anticipatory clues) which permit the organism, sufficiently frequently for survival, to select specific paths that lead with certainty, or with very high probability, to a need satisficing point (Simon 1956, 136)

3.3.4.6. Procedural and substantive rationality

Simon's main criticism is clear: the model of rationality of classical economics is not a model that can be used to describe, in a realistic manner, the processes by which subjects decide. This classical model postulates a global rationality that is ideal and complete, not reflecting the reality of the rational processes of actual individuals. Simon argued that the classical approach does not conform to reality because it forgets a series of limits or boundaries that come from the complexity of the environment as well as the cognitive limitations of those subjects, making the objectives marked by this rationality something impossible to fulfill as described by the classical theory. To this end, Simon redefined the objective of optimizing our decisions substituting it with the idea of *satisficing*. Individuals stop searching for alternatives once they reach a certain satisfactory point, within the search for solutions. As mentioned, in Simon's work, the *economic man* becomes an *administrative man* capable of dealing with these limits by simplifying the environment within his cognitive capacities. Within this new model, subjects are able to handle any complex environment by reducing it to their scale, allowing them to reach satisfactory decisions.

In this way, Simon had already introduced the concepts and ideas that would be the basis of his criticism: rational approximation, satisficing, administrative man, and the simplification of the environment. Historically, there were still some concepts that had to be developed, such as procedural and substantive rationality.

According to Shyam Sunder in an article published in the book edited by March and Augier on regard to Simon's theories (March and Augier 2004, 502), the concept of procedural rationality was described by Simon in 1935. Procedural rationality will not appear as a theoretic concept until the mid-1970s (Simon 1976b). Some authors (Barros 2010) affirm that this last concept of procedural rationality better reflects the essence of Simon's ideas and criticisms than the one of bounded rationality.

According to Bryan Jones, both substantive rationality and procedural rationality have their limitations within the framework of choice. From the substantive point of view, our rationality was directly limited in our decisions, that is, in what we chose. Within the field of procedural rationality, the limits are in the way in which these decisions are made (Jones 2001, 54).

I argue that although the concept of bounded rationality is very generic, that does not imply that the concept itself is theoretically empty. Simon's theory stem from the criticism of the classical model, but problems arose when trying to explain how rationality works. That is, it is from the point of view of procedural rationality that he can draw the criticism of global rationality due to its lack of realism. It was when Simon focused more on the processes than on the outcomes of rational actions that the idea of bounded rationality appeared. Theoretically, it is Simon's procedural rationality the one that unveils the epistemological problems of standard economics in regard to optimization. The concept of satisficing is the logical consequence of

observing the real processes of rational choice, abandoning the substantive rationality model.

Simon, in an article from the 1980s, explained how mainstream classical economics described rationality (Simon 1986). He argued that that this approach to economics had nothing to say about the content of goals and values, postulating a global consistency of behavior. The consequence of this was the assumption of "a world" in which the behavior of economic agents is objectively rational in relation to the total environment (both present and future) within which the actor acts. In other social sciences and within Simon's theory, the nature and origins of the values that we employ in our rational decisions must be found empirically. Science must give an account about the way decisions change over time and how they are connected with the environment. It should explain how rational agents use strategies to deal with complex environments, as well as including those other aspects that are not rational, but affect behavior. (Simon 1986, S210). According to Simon:

Behavior is substantively rational when it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints [...] Behavior is procedurally rational when it is the outcome of appropriate deliberation (1976b, 130).

Economics, therefore, conceived rationality as related to the decisions we make (substantive rationality), while the other social sciences focused on the processes used (procedural rationality) (Simon 1986, S210).

3.3.4.7. The limits of rationality

Simon partially changed the focus of study of economics while discovering the limits that rationality must face in the decision processes (bounded rationality). He put this change in motion in his first work in 1947, when in the first Section Of Chapter V talked about the limits of rationality by asserting that actual behavior falls short from the objective rationality in at least three aspects (Simon 1997a, 93-7):

1. Rationality requires complete knowledge and anticipation of the consequences that follow each action. Although realistically speaking, its knowledge is not complete and it is always fragmented.
2. Since the consequences of every action are part of the future, our imagination acts on behalf of our experience, because we do not have experience of the future, while at the same time assigning a value to each one of those consequences. These values can only be anticipated imperfectly.
3. Ideal or global rationality requires a choice among all possible alternatives, but in reality, only a few of them can be considered.

In a slightly more simplified way, and after 25 years, Simon outlined the limits rationality as follows: risk, uncertainty, incomplete information about the alternatives, complexity and constraints of the environment that impede us to calculate the best possible decision (Simon 1972, 163-4).

Along the same lines, Forester (1984) argued that neoclassical rationality postulated a well-defined problem with a complete set of alternatives, information about the base, the consequences of each alternative, values and preferences while also providing knowledge about time, skills and resources needed to act rationally. The limits, Forester posited, appeared in each of the previous sections:

Simon and March proposed that actual decision making situations were characterized by a different set of attributes than the rational-comprehensive position abstractly assumed. They suggested instead that actual decision makers faced:

- ambiguous and poorly defined problems;
- incomplete information about alternatives;
- incomplete information about the baseline, the background of 'the problem';
- incomplete information about the consequences of supposed alternatives;
- incomplete information about the range and content of values, preferences, and interests, and
- limited time, limited skills, and limited resources (Forester 1984, 24)

Simon, while introducing the limits of rational processes, he was also criticizing the model of global or complete rationality: "It precisely because of these limitations on its knowledge and capabilities that the less global models of rationality described here are significant and useful" (Simon 1987, 254). Rationality, when limited, adapts itself approximately to the exigencies caused by the complexity of the environment and its own limitations so it can simplify the mechanisms of choice (Simon, 1956, 129). This allows economic agents to arrive at satisfactory decisions (not optimal). Rationality is bounded, therefore, since it is unable to decide considering all aspects of knowledge, values and behavior relevant to it:

The limits of rationality have been seen to derive from the inability of the human mind to bring to bear upon a single decision all the aspects of value,

knowledge, and behavior that would be relevant. The pattern of human choice is often more nearly a stimulus-response pattern than a choice among alternatives. Human rationality operates within the limits of a psychological environment. This environment imposes on the individual as 'givens' a selection of factors upon which he must base his decisions (Simon 1997a, 117)

Simon was seeking to clarify that due to the rational limits, we fabricate a simplified image of the reality, so we can act. This simplified view becomes the framework of the decisions we make.

Simon is not alone in this view about simplification. According to Crowther-Heyck, the cognitive abilities of individuals are very small if we compare them to the problems they face. "As a result the human actor must 'construct a simplified model of the real situation in order to deal with it' (2005, 9).

This simplification may have its risks. Pagano, for example, argues in an article entitled *Limited Rationality and Institutional*, in a book edited by Hodgson (2007), that the uncertainty about the future due to our lack of information, may have its risks. If we try to create a contract, Pagano proceeds, between two different parts, when we simplify it (since both parts lack predictive faculties), what we have is something incomplete.

Contract incompleteness is by no means due to the fact that agents are unable to forecast the implications of their future actions and that they are somehow limited by their rational ability to gather all the relevant information and to compute the optimal solution (Pagano 2007, 21).

The limits or boundaries of rationality, according to Pagano, can be experienced in many aspects. Accordingly, we suffer from communicative

impediments. The communication of information always carries a cost. When transmitting information, some of it gets lost due to the differences between the parts that are communicating (Hart 1990), and even if there was no cost for the information, the agents are still limited by their capacity to store and process the information received.

There is no doubt that, as stated by Pagano (2007, 23), if the ultimate goal is optimization, we must always consider that individuals are also conditioned by their limits by their calculating capacity. In this regard, Bryan Jones points out that people cannot perform the necessary calculations, within the matrix of decisions, to arrive at the optimal outcome. But if we take into consideration our rational boundaries, Jones continues, this would be the least of our problems, because of our ability to write and record numbers and perform calculations is something that we can do externally (Jones 2001, 45). This would fit in parallel with Clark and Chalmers' (1998) theory of extended rationality, whose main argument rests on the idea that our cognitive abilities do not simply stay in our "mind", but rather they extend to the external environment.

To all this we have to add the little capacity that individuals have to produce and develop preferences when deciding, and the lack of consistency in the decisions that may be considered "irrational". On this point, Cook, Levi, O'Brien and Faye, in the introduction of the book published by the first two (Cook and Levi, 1990), affirmed that our preferences can be altered by "frames". These frames were the focused of Tversky and Kahneman in their prospect theory (1981). Our preferences, therefore, can be altered depending

on how the information is presented and the context in which decisions are made (Cook and Levi 1990, 7-8).

Considering the context of the environment as an active agent within the creation of preferences that can change our decisions at a given moment, is something we can also find in Simon's first ideas, explained in the article about rationality and the structure of the environment (Simon 1956). There, Simon emphasized the importance of the environment to understand the reason for certain rational decisions.

3.3.4.8. Emotions and Bounded Rationality

In the article written in 1987 entitled *Making Management Decisions: the Role of Intuition and Emotion*, Simon decided to write about two different aspects of our decision making process: intuition and emotion. So far, he claimed, those two aspects had been neglected by the science of administration.

He first pointed out that sometimes the term 'rational' is used by social scientists in decision making theory as consciously analytic, while non-rational refers to "decision making that is intuitive and judgemental", and irrational when is related to emotions (Herbert A. Simon 1987, 57). Chester Barnard, in his *Functions of the Executive*, Simon explained, shared this distinction, arguing also that sometimes when managers need to make decisions in a judgemental way, they need a rapid response. This speed does not allow

them to have a sequential analysis of the situation, but they still feel confident about what they have done. The reason rests on psychological factors, the environment or some social environment.

According to Simon, his own book *Administrative Behavior* was seen as based on logical reasoning, so there it is impossible to see an account about the role of intuitive judgement similar to the one mentioned above. Although we have two different physiological parts of the brain, Simon proceeded, they both are able to make "competent judgement or reach reasonable decisions rapidly -without evidence indicating that they have engaged in systematic reasoning, and without their being able to report the thought processes that took them to their conclusion" (Herbert A. Simon 1987, 58), Reason does not need to be systematic. Rationality can be intuitive. We can deduce from Simon's words that having a rationality approach only related to systematic logical reasoning can be very restrictive.

Individuals, according to Simon, are able to make judgements according to specific cues in the environment that help them recall, if they are experts or familiar enough with the situation, satisfactory outcomes to specific decisions. Intuition can evoke knowledge individuals have in a rapid way. He claimed, criticizing the perspective that individuals may behave as bayesian decision makers, that in uncertain scenarios, situations are treated as a dilemma rather than a situation where probability can be applied.

According to Simon, while intuition is an adaptive mechanism that results from practice, learning, and expertise; emotions are the outcome of

"more primitive urges, and it is more often than not inappropriate. We must not confuse the 'nonrational' decisions of experts -the decisions that derive from expert intuition and judgement- with the irrational decisions that stressful emotions may produce" (Herbert A. Simon 1987, 62).

Emotions, therefore, that are the result of stressful situations that may produce irrational behavior. Stress, for example, may interact with cognition impeding productive behavior.

Rational decision making can be analytical as it can be intuitive. It would be false to reduce reasoning, Simon concluded, as a mere analytical or logical decision. They both are rational strategies that are efficient in decision making. Individuals do not have the luxury (bounded rationality) to use just one of the approaches. The source of irrational behavior, for example, can be found in behavioral responses to emotional mechanisms like stress, which can be a deterrent for reasoning. Others may be related to feelings like anxiety, fear, guilt, etc. They may provide "temporary personal comfort at the expense of bad long-run consequences for the organization" (Herbert A. Simon 1987, 62)

Simon clearly follows in his distinction about rational, non-rational and irrational behavior an instrumental approach where rationality is linked to the achievement of desired goals (with either by analytic or by intuitive decision making). Emotions are considered in this approach as a possible source for irrational behavior, that is, for a behavior that may be counterproductive.

Other authors will follow among the same line. Pagano, for example, includes our emotional capacities as part of our boundaries. There is a vast amount of literature about how our emotions limit our rational choices. We can highlight due to its simplicity and clarity the work of Jonah Lehrer "How we decide" (Lehrer 2009) and the work of neuroscientist Antonio Damasio, "Descartes' Error" (1994), also on the role of emotions in our decisions. Emotions, sometimes, can be a barrier to rational decisions, or, sometimes, they can be an ecological advantage.

From a post-structuralist critique, such as the one from Dennis K. Mumby and Linda L. Putnam (1992), the role of emotions within the bounded rationality model could be reinterpreted because of the importance that this model gives to the ideal rationality. Our rationality is bounded because there is a perfect ideal that falls short from. The objective is to have perfect rationality, but due to certain limitations we cannot achieve it. In my opinion, what they are criticizing is more the view of bounded rationality maintained by Sargent, rather than the one Simon proposed.

According to their critique, the model of bounded rationality is based on a manichean and binary conception (emotion and reason), in which the second is valued as positive and worthy of attainment, but the former is discriminated. Bounded rationality model sees emotion as something from which we have to separate, a limitation of our rationality or, as we have seen (Herbert A. Simon 1987), a source for irrational behavior. It is considered as opposed to the final objective: that desired objective rationality that fits with a series of masculine values discriminating the feminine ones like the emotions.

Thus, the main goal of Mumby and Putnam was to bring the field of decision-making theory of the emotional as positive, and throwing the idea that subjects suffer from "bounded emotionality":

Although this concept is a powerful heuristic device, it stems from a system of binary opposites that privileges the masculine over the feminine. By deferring the meaning of bounded rationality, a theorist can reread this construct and create alternative ways of reconceptualizing organizations. By contrasting an alternative organizational concept, bounded emotionality, with bounded rationality, a "play of differences" is evoked to demonstrate the precariousness of fixed meaning and to reclaim the lost dimensions of the feminine experience. However, the concept of bounded emotionality is not intended to function as the exact opposite of bounded rationality (Mumby and Putnam 1992, 468).

The reading they did of the concept of bounded rationality rested on the idea that it is a fictitious model, not because it does not exist, but because it delimits a specific textual reality. Simon took the definition of rationality used by classical theory, that is, intentional, reasoned, aimed at obtaining ends and he added the adjective "bounded", suggesting that the optimal decision is limited because the subjects act with incomplete information, a limited number of alternatives, attribute determined values to certain consequences of their actions, etc. Ideal to make optimal decisions. According to Mumby and Putnam, both concepts ("rationality" and "bounded") reflect a limited and masculine view of our decisions:

Both the concepts of bounded and rationality reflect a limited view of organizing, one defined by patriarchy as a dominant value system. Rationality sets up a mind-body dualism, devalues physical labor, and co-opts emotional experience. Employing the concept bounded as a limitation to rationality separates decisions from actions (Mumby and Putnam 1992, 469).

But this is not the whole picture. Some proponents of the bounded rationality model, as John Conlisk explained, understand emotions as a way to help us reach the optimal decision (from a rational point of view) as described by classical economics. Accordingly, inherited emotions and social norms such as anger, shame, loyalty and altruism can improve economic performance in a way that moves away from traditional economic theory. For example, loyal individuals tend to cooperate better, and we trust more a person who blushes when lying. (Conlisk 1996, 677).

What is done from this perspective and what Mumby and Putnam are criticizing is the subjection of the emotions at the service of the rational ideals described by mainstream economics, when they could be comparable and complementary (Mumby and Putnam 1992, 482). Why should not be also talking about emotional limits (bounded emotionality) within our decisions?

In the exposition of our rational limits, we can highlight the studies made by the above-mentioned Bryan Jones in his work *Politics and the Architecture of the Choice* (2001) where, after pointing out the choice capabilities of the subjects described by classical economics (explained in the previous section), he emphasized the limitations that these subjects actually suffer in their decisions with respect to the ideal marked by the classical theory, highlighting the notion that individuals do not consider all the outcomes of the decisions they are facing. They suffer from cognitive "hallucinations" and preference changes, depending on the context in which the decision is presented. They cannot either control their behavior (Ulysses and Sirens), nor calculate probabilities. They are identified (emotionally, for example) with the

means Instead of the ends to be achieved (Jones 2001, 45-6). Although we try to be rational, there may be emotional mechanisms that alter our decisions:

Whenever someone makes a decision, the brain is awash in feeling, driven by its inexplicable passions. Even when a person tries to be reasonable and restrained, these emotional impulses secretly influence judgment (Lehrer 2009, xv)

According to this, while classical and neoclassical economics postulated an ideal of rationality that did not exist in order to save the phenomena, some authors turned to psychology to really understand how rational processes occur and discovered that such description falls short of how we really decide. Psychology provided the epistemological framework for a real description in which our decisions are made while pointing out the lack of empirical rigor of those theories that did not consider rational limits. On this aspect, Weyland emphasizes that the empirical findings that cognitive psychology has left are enough to reject any kind of explanation based on the supposed ideals of a complete rationality:

Cognitive psychology has established the robust empirical finding that human rationality is inherently bounded by innate, insuperable limitations on information processing. Since attention is finite and scanning the environment for the relevant information is costly, people cannot comply with the ideal typical standards for rational choice (Weyland 2007, 45)

While some authors argue that the limits of our rationality are found in our capacity to calculate, others like Jon Elster, assert that the greatest problem within our decisions is found when we suffer constraints in the value we assign to the information we manage (Elster 1990), or the limitations we

endure when not knowing when to stop collecting information to be able to decide in the most rational way (Elster 1994, 318-19). As J. Francisco Álvarez (2002) says, referring to Sen (Sen, Last and Quirk 1986), values act as filters that select the information to be used in decisions. In this way, following Raymond Boudon (1998, 2001, 2003), the importance of axiological rationality should be highlighted as a fundamental part of the determination of information it should be used. Sen's theory of positional objectivity (1993) is relevant to this matter, since it allows us to understand how the context in which rational processes are developed can alter the vision of reality and the information to be managed⁷.

Thus, the boundaries and costs of information are introduced into decisions, not only as an inherent characteristic of the subject that decides, but above all, as a part of the environment and the technology used (Simon 1979a, 504) as an extension of our cognitive processes. Some authors, Douglas explained (Douglass C. North 1993), relate the emergence of power institutions with incomplete information and our limited mental capacities to process information. According to this, Douglas continued, institutions were created to reduce the uncertainty caused by these information deficiencies. But institutions are not the only remedy for these limits: unconscious and automatic processes (the intuitions Simon referred to) can also be used to save the work and time of more deliberative processes:

⁷ In a later chapter we will see how bounded rationality complements itself in an intrinsic way with the axiological rationality model to form, following the studies of Álvarez and Echeverría (2008), a bounded axiological rationality model: a more comprehensive approach to understand our decisions.

Since our theories and thought processes about social systems involve the conscious and deliberate use of reason, it is necessary to constantly remind ourselves that human activity is diffused and dominated by unconscious, autonomic, neuropsychological systems that enable people to function effectively without always calling upon the brain's scarcest resource attentional and reasoning circuitry. This is an important economizing property of how the brain works. If it were otherwise, no one could get through the day under the burden of the self-conscious monitoring and planning of every trivial action in detail (V. L. Smith 2003, 468).

Along these lines, cognitive psychology stressed the need to consider the relevant role of intuitions or even emotions (in a direct opposition to Simon's perspective) within the decisions as a method economically (and ecologically) effective. Lehrer, in his work *How We Decide*, quotes Joseph Ledoux, another neuroscientist, who summarized the position explained here:

The advantage [of the emotional brain] is that by allowing evolution to do the thinking for you at first, you basically buy the time that you need to think about the situation and do the most reasonable thing (Lehrer 2009, 99).

Not only emotions help us how to decide, they also help to make better decisions within complex environments and with little information. According to similar approaches, many "tools" can be useful, among them, fast and frugal heuristic processes (Gigerenzer 2002b; 2007; 2008a; 2001), which we will discuss later on.

3.3.4.9. The mathematical foundation and the help of psychology

If we delve deeper into Simon's work, what we are going to see is an ongoing attempt to ground his theories with mathematical models. The aim

was to translate into mathematics the psychological and social theories which were then also used to understand economic phenomena (Simon 1982, 2: 211). This is clear from the beginning of his academic career, which was greatly influenced by the philosophy of logical empiricism (Crowther-Heyck 2005, 60). Simon studied mathematical economics and mathematical biology and he conceived mathematics as the language of scientific discovery. The influence came, not only from the classes he took, but also from other important academic figures related to that discipline. As he acknowledged in his autobiography:

I found several faculty members from whom I could learn how to apply mathematics to empirical matters. Three persons outside the political science department played especially important roles in this stage of my education: Nicolas Rashevsky, Henry Schultz, and Rudolph Carnap (Simon 1991, 51)

In reference to Rudolph Carnap, Simon stated that he was of great importance to him due to his interest in the logic of the social sciences. His doctoral thesis project began as an attempt to study the logic of administrative sciences (Simon 1991, 53). Among his influences we cannot neglect the importance of the University of Chicago (Herbert A. Simon 1991, 62–63) and the academic trends of the time, especially in the faculty of political science and subsequently the linguistics of Chomsky.

Simon recognized that the use of mathematics should be a fundamental requirement for economics (Simon 1982, 2: 212), but not for social sciences. As the two fields got closer in Simon's work, one had to feed from the other, maintaining the most fruitful methodologies to best describe (in

the most realistic way) the rational processes of economic actors. As Simon claimed: "Psychological postulates –generally contrived in the comfort of the armchair- have long been a part of social science theory" (Simon 1982, 2:210). To get rid of this lack of rigor, to get up from the "armchair" (Simon and Bartel 1986), and to provide the theories with more realism, the explanatory models of the sociological and psychological sciences had to be translated into mathematical language. Using economic models, Simon continued, would allow the discipline to predict how behavior can be affected by changes in the environment that may condition, bound or limit our rationality. It is important to note that this article was collected in Volume II of "Models of Limited Rationality" dating originally from 1954, when Simon began to focus on the idea of the limits of rationality more frequently than before.

Within the mathematical models applied to the bounded rationality model, the non-rational elements are incorporated into the model as conditions that limit the area of such rationality (Simon 1982, 2: 215). Simon claimed that we can even include in this model of mathematics (with probability distributions) how subjects face their lack of information and their ability to predict future consequences (Simon 1982, 2: 221).

According to Keita (1992), neoclassical economists had already used mathematical models to talk about the rationality of subjects. Since Edgeworth (1881), the use of mathematics has been common throughout the history of the economic sciences, who even tried to apply them to moral theories. What Simon tried to do was to introduce psychology into the part of

economics that study rationality. The objective was to assure that the former can be subject to mathematical models as rigorous as other disciplines subject to other sciences. What economics lacks is not mathematical rigor, but empirical experimentation, since the rational processes of the subjects that it describes do not represent those found in real processes.

The introduction of psychology as a way of understanding a procedural rationality provided the research of rational processes with a much needed empirical foundation for that branch of economics. For Simon, using the actual science that studies behavior and rationality was a methodological imperative to rescue this classical theory of economics from falling into idealism. Simon even recognized that the common language that unites the different social disciplines is the language of sociology and social psychology:

The social sciences [...] are undergoing at present a very rapid process of reintegration [...] the common diplomatic language for the scientists participating in the process is the language of sociology and social psychology.... (Simon 1982, 2:209)

If mainstream economics was able to assume an economic agent with the capability to maximize her utility and profit, it was because it discriminated psychology to account for these rational processes. This reductionism did not allow to account for other mechanisms that affect rational processes in human behavior (Simon 1982, 2: 341). This was the battle that Simon fought and one of the reasons for the inclusion of psychology in the economic sciences.

The union of economic and psychological models appeared in Simon at the beginning of his article on rational choice and structure of the environment (1956, 129). Standard economics, not being able to provide explanations for rational processes, left aside the way in which subjects altered the environment in their minds in a limited subjective way (not even in an approximate way, Simon argued). Only psychology provided an explanation on how subjects make the world they observe something radically different (due to these limitations):

The decision maker's information about his environment is much less than appropriate than approximation. The term 'approximation' implies that the subjective world of the decision maker resembles quite closely the external environment but lacks, perhaps, some fineness of detail. The Psychological evidence contradicts this view -the perceived world is fantastically different from the 'real' world. The differences involve both omissions and distortions and arise in both perception and inference (Simon 1982, 2:342)

3.3.4.10. Satisficing as a process to stop the search for more alternatives

The idea of bounded rationality forced the reconsideration of the perfect rationality model postulated by standard economics, since it did not consider the limits we face. From the moment these limits appear in a realistic framework of the description of rational processes, the vision of global rationality previously intended had to be revised and rejected:

We need to replace the global rationality of the economical man with a kind of rational behavior that is compatible with the access to information and the computational capacities that are actually possessed by organisms, including man, in the kind of environments in which such organisms exist (Simon 1955, 99).

According to Simon, since individuals cannot maximize when they decide, our behavior has to adapt to the circumstances of the environment. This adapted behavior, Simon argued, has always fallen short of the ideal maximization postulated by economists. Since there is no possibility to optimize, we can adapt well enough to "satisfice" our pretensions within the decisions made. The consequences of the application of the model of bounded rationality to the decision processes are being extended. From the moment we face these limits, the possibility of optimizing our utility function disappears and it is replaced by an ideal that, instead of maximizing, satisfices those pretensions. Simon asserted that this is in fact how agents deal with cognitive difficulties within a complex environment. (1956, 129).

When Simon replaced the concept of maximization with the concept of *satisficing*, he did so from the field of psychology introducing real aspiration levels, rather than the optimizing ones of the classical *homo economicus*. Real subjects do not optimize, they satisfice. In a psychological analysis of the rationality of economic subjects, Simon proposed, we can discover that we do not have enough capacity, nor the environment is so simple, as to optimize our decisions. satisficing is the only realistic choice: to look for an option, maybe not the best, but good enough to stop looking for other alternatives. This idea can only come from psychology:

But if all alternatives are not to be examined, some criterion must be used to determine than an adequate, or satisfactory, one has been found. In the psychological literature, criteria that perform this function in decision processes are called aspiration levels. The Scottish word 'satisficing' (=satisficing) has been revived to denote problem solving and decision making that sets an aspiration level, searches until an alternative is

found that is satisfactory by the aspiration level criterion, and selects that alternative (Simon 1972, 168).

Simon referred to "procedures of satisfaction", an indication that the model related to procedural rationality and not to the substantial one. Some authors argue the the main foundation of Simon's theory is that concept of procedural rationality. That is Barros's perspective (2010), who thinks that the epicenter of Simon's theory is not the concept of bounded rationality (a more general and less profound concept), but the concept of procedural rationality. From procedural rationality (based on the comparison of economic and psychological models), we can arrive at the other ideas that surround Simon's theory of rationality. This procedural rationality originated directly from the methodology of the psychological sciences, reason why it is different from the substantive rationality (more typical from the realm of mainstream economics):

I shall use the phrase 'substantive rationality' to refer to the concept of rationality that grew up within economics, and 'procedural rationality' to refer to the concept that developed within Psychology (Simon 1976b, 130).

Here the importance of the title of chapter V of his first work "The psychology of the administrative decisions". The terminology used, therefore, separated what Simon was doing from the economic standards of the moment. When speaking of "habit", "memory", "positive stimuli", and psychological environment (Simon 1997a, 97-103), Simon was introducing psychological terms in the economic discipline.

To deduce the procedurally or boundedly rational choice in a situation, we must know the choosing organism's goals, the information and conceptualization it has of the situation, and its abilities to draw

inferences from the information it possesses. We need know nothing about the objective situation in which the organism finds itself, except insofar as that situation influences the subjective representation (Simon 1985, 294)

From the parameters of classical economics, the rational person always objectively reaches the best decision given her utility function. But from psychology, Simon claimed, this subject only makes her decisions in a reasonable "procedurally" manner according to the knowledge she has and her ability to calculate (Simon 1986, s211). Due to this limitations, agents proceed by trying to find satisfactory solutions to her choice problems (Simon 1963) rather than optimal.

The reasons why classical economics was inclined to apply the model of substantive rather than procedural rationality was clear. Economic theory, obviating cognitive processes and their limitations was able to draw more fruitful conclusions than if it had to explore all these variables mentioned. With a perfect and global rationality it is necessary to postulate a utility function that the subject must maximize. But the disadvantage of this model was also clear: it lacked empirical rigor.

Simon's purpose was to increase this rigor by founding the structures of economic decisions on the models of psychology, transforming global (complete) rationality and optimization in a procedural rationality that can only reach a certain degree of satisfaction. Rationality is thus procedural if it is the "result of proper deliberation" (Simon 1976b, 131), in the way psychologists use that term. This rationality is studied within situations that represent problems in which the subject must inform and process this information to

decide how to act. As Simon affirmed, from the procedural model, the interest was not in the result of action, but in the method used to discover the path to take (Simon 1976b, 132). This may seem an attempt to distance himself from an instrumental view of rationality. I claim that Simon, across his writings, did not ultimately reject instrumentalism. Some writings may appear to open a door to a different frame to understand rationality far from the purely instrumental approach, but other writings are centered on that idea. When Simon discussed procedural rationality, instrumentalism shared the spotlight with other frame that looks like Weber's axiological rationality. But when referring to emotions as irrational, for example, (Herbert A. Simon 1987), his view of irrationality was linked to productivity in an instrumental interpretation.

Simon claimed that when looking for the best decision, there are problems that cannot be addressed from a model of substantive rationality. An example can be found in the problem of sales rep traveling across the country to different cities on different dates. The problem of the *traveler salesman* seems to have a relatively easy solution, but in reality it presents a big issue. The answer to the problem is known. We know how to solve it, but only in theory. In practice, the solution is not applicable during the time that is computationally needed to obtain its result. The objective is to find the shortest route that returns it to his origin while visiting all cities, traveling the shortest distance possible (Gutin and Punnen 2002, xi). As Simon asserted, this problem focuses on procedures for finding good solutions, not the best (Simon 1976b, 133).

Simon understood that if we consider that uncertainty lies in the subject and not in the environment of the decision framework, we must explore the rational problems that arise from the subject preventing her from reaching a full rationality. Classical economics (Muth 1961), not wanting to deal with this variable, placed uncertainty as part of the environment, taking it away from the individual (Simon 1976b, 142). To provide economics and rationality theory with realism, Simon suggested that we must apply the theory of procedural rationality based on empirical exploration and complicated algorithms (Simon 1976b, 147), rather than worrying only about the results of rational choices (Simon 1978, 2). This unveiled the space between the reality that the subject perceives and the one that "really exists" (Simon 1978, 8). We have to deal with the environment with heuristic searches that results in satisfactory outcomes, rather than optimal. One of Simon's clearest example is found in chess: subjects that play chess, since they cannot consider each of the possible movements in a game, they have to settle and consider only a few of them. They learn to recognize those movements who achieve a *satisficing* result (Simon 1983, chapter I).

The theory of the search for heuristic techniques has been cultivated by computer science, artificial intelligence and the branch of psychology responsible for the processing of information. Thus, when the environment is structured in a certain way and not in a random way, and the solutions to decision problems are related to the way in which the structure of this environment is arranged, any intelligent system (a subject, for example) able

to detect the regularities of the structure can exploit it to find solutions to these problems (Simon 1978, 12).

The topic of solution searches for heuristic processes will be addressed later on, when I focus on Gerd Gigerenzer's theories of ecological rationality. Simon's theories will be the foundation for several approaches that recognized the boundaries of rationality. We can differentiate two "schools". The first one is based on Tversky and Kahneman's prospect theory, where these boundaries are really a problem that we have to deal with. That theory rests on Simon's bounded rationality model understanding those boundaries as systematic deviations from a normative ideal. That was not Simon's perspective. While Simon claimed that there was not an ideal rationality and that maximization was a fiction, prospect theory argued that if there are boundaries, it was because the optimal decision does in fact exist. Anything different than such optimal approach was a systematic deviation of the perfect rationality that was impossible or extremely difficult to be resolved. Thaler and Sunstein (2008), following the research of Tversky and Kahneman, proposed a theory for public policies based on *nudges*. They propose positive reinforcement by changing the choice architecture in order to influence behavior without limiting liberty. Nudges would exploit our so-called deficiencies to push individuals or groups to make better decisions for themselves. The view is considered pessimistic since it is founded on the idea that individuals are basically irrational and hard to educate. The other perspective on rationality, Gerd Gigerenzer's ecological approach, is more optimistic. Simon's bounded rationality is also the basis for such theory.

Gigerenzer, like Simon, considers the impossibility of maximization and rejects any type of nudging in public policy. For Gigerenzer, those rational boundaries are not a problem we have to deal with, but an ecological advantage.

For Simon, therefore, any theory of rationality that does not explain the way in which it is possible to search for possible solutions to specific problems and how they can be selectively achieved, it is an incomplete theory (Simon 1982, 2: 454-55). To this end, performing a search with heuristic procedures and lowering the requirements to stop searching for better alternatives can simplify the scenario of rational decisions, allowing us to understand how we can deal with a complex environment from a bounded procedural rationality (Stirling 2003, 9).

Simon introduced explanations about the mechanisms that allow us to stop looking for alternatives to satisfy our objectives, the most important, as I mentioned before, was the idea of "satisficing". A subject does not continue to search when a "good enough" alternative is found. Subjects can also stop searching due to their level of aspiration, impatience or discouragement (Simon 1979b, 1:32). By placing the aspiration level to satisfactory rather than an optimal point, subjects can deal with their bounded rationality. If we are selling a house, we may consider a certain acceptable price, for example 100,000 euros even if the optimal (and better) price was 150,000. As Simon stated, while in psychology the limit is placed within the level of aspiration, economics sets it when a price is reached that results in indifference between

buying and not buying (Simon 1955, 104). This is how the satisficing rule is explained by Simon:

- (i) Search for a set of possible outcomes (a subset S' in S) such that the payoff is satisfactory [$V(s) = 1$] for all these possible outcomes (for all s in S').
- (ii) Search for a behavioral alternative [...] whose possible outcomes all are whose possible outcome all are in S' [...]

If a behavior alternative can be found by this procedure, then a satisfactory outcome is assured. The procedure does not, of course, guarantee the existence or uniqueness of an [alternative] with the desired properties (Simon 1955, 106).

In chess this is exemplified by Simon in the way a player conforms to a good enough move instead of continuing to look for an optimal one. From the classical theory of economics, subjects must look only for the alternatives that maximize their utility function. Simon argued that this is unrealistic description of how individuals operate due to their limitations:

"Since the organism, like those of the real world, has neither the senses nor the wits to discover an "optimal" path—even assuming the concept of optimal to be clearly defined—we are concerned only with finding a choice mechanism that will lead it to pursue, a "satisficing" path, a path that will permit satisfaction at some specified level of all of its needs" (Simon 1956, 136).

This was also a rejection to the idea of perfect rationality maintained by mainstream economics since such theory claimed the possibility that when having all relevant information and exploring all possible alternatives, we can arrive at the best possible decision. A procedural approach to rationality revealed to us, according to Simon, that since not all of these alternatives can

be considered, we must rely in a criterion that allows us to know that we can find one satisficing alternative:

But if all alternatives are not to be examined, some criterion must be used to determine than an adequate, or satisfactory, one has been found. In the psychological literature, criteria that perform this function in decision processes are called aspiration levels. The Scottish word 'satisficing' (=satisficing) has been revived to denote problem solving and decision making that sets an aspiration level, searches until an alternative is found that is satisfactory by the aspiration level criterion, and selects that alternative (Simon 1972, 162).

Both the optimization and the satisfaction model of rationality are models that attempt to explain how to arrive at decisions in complex environments and with certain cognitive limitations. According to Simon, while the optimization model tries to approach as closely as possible to the best solution, trying to simplify these environmental complications so that they are situated at the level of the subject, satisfaction-based models focus on seeking this simplification in a different way. They assimilate more of the details of the situation of the real world, but conforming with a satisfactory decision, rather than trying to reach best (Simon 1982, 2: 417). This causes subjects to fade from the bounded rationality model to seek satisfactory rather than optimal solutions, while replacing objectives with tangible sub-goals that can be reached more easily (Simon 1979a, 501). In fact, when individuals come across problems in which they have to decide between possible alternatives, according to Simon, those alternatives are evaluated sequentially and not all at the same time, as predicted by classical or neoclassical economics. It is this way of considering alternatives that make individuals stop in the one that is good enough. As our author claimed: "we may regard the

first satisfactory alternative that is evaluated as such as the one actually selected" (Simon 1955, 110).

The reason why we have to settle for a satisfactory solution rather than the best of all possible ones is that we cannot do it better. We are limited: "The real economic actor is in fact a satisficer, a person who accepts 'good enough' alternatives, not because less is preferred to more but because there is no choice" (Simon 1996, 29).

Simon posited that some economists have tried to eliminate the importance of the difference between optimizing and satisficing, among them Milton Friedman. More recent works claim that although "satisficing" demands less than maximization in an epistemological sense, it is incomplete and difficult to use. It is possible, as Oliver Williamson thinks, that subjects maximize relying on an ecological argument based on natural selection. Needless to say, Williamson proceeds, that with maximization the theory is easier to approach: "But while it is easy to agree that satisficing is a less demanding postulate than maximizing, the analytical toolbox out of which satisficing works is, as compared with maximizing apparatus, incomplete and very cumbersome. Thus if one reaches the same outcome through the satisfying postulate as through maximizing, and if the latter is much easier to implement, then economists can be thought of as analytical satisficers: they use a short-cut form of analysis that is simple to implement.² Albeit at the expense of realism in assumptions, and at the risk of overapplication, maximization often gets the job done" (Williamson 1995, 23). He asserts this not without acknowledging the dangers of postulating that type of unrealistic

approach: "Yet rationality excesses — of which four kinds can be distinguished: oversimplification, maximization, natural selection and hyperrationality — are a chronic hazard" (Williamson 1995, 22) .

Other authors also recognize the difficulty of establishing which of the alternatives may be good enough, and how to determine this issue can raise criticisms. That would be the case of Wynn Stirling (2003, 9). Stirling proposes a satisfactory model different than the one used by Simon. Instead of an attempt to maximize, since we are bounded by practical limitations, satisficing must be the ideal to achieve (Stirling, 2003, 10).

Some other versions that also apply the satisficing model can be found within the "info-gap" theory developed by Yakov Ben-Haim since the 80s, in which the optimization is the robustness of the failures within the decisions, so they help us deal with our "lack of severe information". The goal of seeking a "robust satisfaction" of our decisions, may be more practical and may help us survive better than a model based on optimization (Ben-Haim 2006, 6).

The alternative theory to safeguard the health of the *homo economicus* was explained previously: it does not matter if the subjects satisfy or optimize, what matters is that if they act as *if* they maximize (Sargent 1993), along the lines of the arguments proposed by Friedman.

For Simon, satisficing is also given scientific research. Simon emphasized that even science itself is practiced by agents who possess bounded rationality and that there is no other choice than to satisfy:

I have sketched a theory of scientific discovery to which my study of these problems has led me. It is not a theory of global rationality but one of human limited computation in the face of complexity. It views discovery as a problem solving; problem solving as a heuristic search through a maze; and heuristic search as the only fit activity for a creature of bounded rationality (Simon 1991, 386).

According to Bendor, in his introduction of the work published by himself (2010), Simon's original purpose in introducing the concept of "satisficing" was to consider it only related to a theory of searching for alternatives in decision theory. It is virtually defined as a search of a sub-optimal aspiration level. The administrative man (opposite to the economic man of the classical theory) is the one who satisfices and adapts to the circumstances of the environment, exploiting them in order to achieve a satisfactory result in their decisions.

With the introduction of an epistemological methodology that took into account the processes by which subjects made decisions, and leaving aside the focus only on the outcomes, the figure of the administrative man appeared supplanting, in a more realistic manner, that of the economic man. When discovering that in reality individuals were not able to optimize according to what was postulated by the classical model, Simon pointed out that the level of aspiration had to be *reduced*, stopping the search when a good enough alternative was found. The implementation of a methodology focused on procedural rationality by Simon, made the ideal of optimization of the *homo economicus* a methodological resource rather than a real description of the facts, or a normative idealization that facilitated the study of economics by eliminating from its field variables (which fall within the rational

limitations of individuals) that complicated the epistemological objectives of such science.

Substantive rationality can only appear in simple enough situations, similar to those which have been manipulated from our imperfect rationality (Simon 1976b, 144). But the inclusion of procedural rationality within the theory opened a distance between the real (objective) environment of the decision and the one perceived by the individual from her subjectivity. This distance complicates more our capacity to decide in a satisfactory way since the environment in which these decisions are framed can be a very distinct representation of that objective environment: "In complex situations there is likely to be a gap between the real environment of a decision (the world as God or some other omniscient observer sees it) and the environment as actors perceive it" (Simon 1978, 8).

When considering the environment as part of the individual's decisions, within the framework of procedural rationality, organisms are assumed to use the clues that allows them to reach the most satisficing outcomes, through a learning methodology. The external environment determines, according to this view, the conditions for achieving objectives. The organisms must adapt to this external environment in order to be able to operate satisfactorily within it:

The outer environment determines the conditions for goal attainment. If the inner system is properly designed, it will be adapted to the outer environment, so that its behavior will be determined in large part by the behavior of the latter, exactly as in the case of 'economic man'. To predict how it will behave, we need only ask, 'How would a rationally designed system behave under these circumstances?' the behavior takes on the shape of the task environment (Simon 1996, 12)

By not being able to manipulate as much information as possible from the external environment, subjects push away the idea of maximizing their utility function and accept the good enough alternatives, not because they prefer less, but because they have no other choice (Simon 1996, 29). Simon, to study rationality and human behavior, used artificial systems, arguing that if we are able to understand these physical systems of information processing symbols, we can extrapolate these results to studies on individuals, since they belong to the same family of Information processors (Simon 1996, 21) using symbols to represent the environment and the information about it in order to decide. The symbols designate objects, relationships and actions within this environment and simplify to our scale the material to be processed in order to arrive at satisfactory decisions.

In game theory, for example, we see that those outcomes that favor cooperation in opposition to selfish behavior, are better explained when introducing the idea of satisficing. Only from a satisfactory model of rationality can one understand the decisions of cooperation within games such as the prisoner's dilemma, in which actors can abandon behaviors that can maximize individual results.

Subjects process information from the environment and act according to it, but not in a neutral way. It requires its transformation. Thus, as Bryan Jones (2001, 8-9) states, objective information is transformed and the "inputs" do not necessarily reflect certain "outputs". There is an imperfect relationship between our brain and the environment that lies at the very root of our rationality. Jones argues that due to our all our biological and cognitive limits,

we process information poorly, and we tend to react to new information negligently or giving too much importance (2001, 23).

When we face the alternatives considered, we do not do it together, but sequentially: one at a time. This is due to our lack of memory and the impossibility of comparing the different attribute of all alternatives, especially when these attributes can be related with central values of the individual. "An alternative satisfices [...] if it meets the aspiration levels along all dimensions. If it is not found, the search is undertaken for new alternatives"(Jones 2001, 61).

According to this view, the idea of "satisficing" does not have to be something negative. It is unreasonable to attempt to deal with all available information. Individuals use heuristic processes to arrive at satisfactory decisions in a practical way, taking into account the cost of manipulating and storing information. Many times, these heuristic processes can lead us to the same solutions as if we were deciding in a completely rational way and we were trying to compute as much information as possible

Deciding agents know (consciously or unconsciously) that they are rationally limited. That is why "techniques" are developed in order to deal with these limitations when we act. Many strategies are based on the biological capabilities of the body itself, such as emotions, allowing us to direct our attention to a specific issue relevant to our decision. Other experiences learned socially or individually through trial and error. "Psychologists hypothesize that subjects make systematic errors by using decision

'heuristics' or rules of thumb, which fail to accommodate the full logic of a decision, as when a person makes systematic forecast errors by using adaptive rather than rational expectations" (Conlisk 1996, 670).

Daniel Kahneman explains in his last book (2011) the difficulties that subjects face when performing probabilistic calculations. It can be seen that we are able to master grammatical structures at the age of four, but as far as mathematics is concerned, our cognitive abilities are very limited. The main goal of the program on heuristic processes and biases that Tversky and Kahneman (1974, 1981) proposed highlighted these difficulties within the processes of human choice. When humans use intuitive methods to act (shortening the response time when behaving, for example), they make mistakes when predicting events, judging hypothesis, estimating frequencies, etc. (Kahneman 2011, ebook 158 location of 9841).

In our decisions, since we are in a complex environment, we have to act under the uncertainty that causes the complexity of this environment and the bounded rationality that we possess. To deal with these factors in an efficient way, according to this approach we operate through a series of "shortcuts" that make it possible for us to act satisfactorily, even though we may not have all the necessary information to optimize the results of our decision.

Although for Simon there is no reason to think that if we have all the necessary information we will achieve satisfactory results. Information, on the one hand, is expensive, and on the other hand, having it does not guarantee

the maximization of the utility function described by classical economics. The way we manipulate or communicate this information may cause our decision not to be optimal.

From the perspective of ecological rationality, heuristic processes are necessary for our decisions but, within prospect theory, Tversky and Kahneman argue that they may also be a source of prejudice and error.

With the model of bounded rationality, Simon emphasized the ability subjects have to act in a way that they can practically overcome these rational limits and the essential role of the idea of "satisficing", that allows to stop searching when a good enough result is found. Esther Mirjam-Sent claims that "loosely articulated heuristics, or rules of thumb, Simon argued, governed the process of gathering information and choosing alternatives. According to Simon, these heuristics were employed generally because they had been proved successful in the past. Furthermore, they implied that the decision-maker was searching merely for an adequate solution" (1997, 332).

When we decide, what we try to do is to discover and select alternatives that are good enough, and only in rare exceptions can we reach optimal solutions to specific problems. This is one of Simon's departure from the classical and neoclassical theories of economics, which claim that having all information about the alternatives and preferences would allow us to arrive at the optimal decision, thus avoiding the possible problems we face when deciding. The more information, the better. Preferences, therefore, are represented mathematically through a utility function "and the individual

chooses the action that maximises their utility" (Hargreaves Heap 2004, 43), and their decisions are based on rational calculations to maximize this function (P. Krugman 2007). The idea of an economic subject capable of maximizing a utility function can only make sense from an aprioristic view of the human condition based on the individualistic egoism postulated by the classical or neoclassical model. This model, as I have described above, focuses on the idea that individuals always seek this maximization and it assumes a subject that is perfectly capable of predicting each of the consequences of her actions and capable of choosing the best that may serve the desired purposes. As Irene C L Ng and Lu-Ming Tseng put it:

Without complications such as personality, value, belief, and emotions, economic man's behavior can be explained by his own self-interested orientation. Other elements such as social norms are akin to rules of the game - economic man maximizes his utility within these rules. In economics therefore, the definition of the game rules can define the boundary of economic man's behavior, but does not change the fact that economic man will always be self-interested. In other words, for the economic man, even sacrifice is driven by self-interest (2008, 268–9)

Simon denied the existence (methodological or ontological) of such utility function, since it cannot capture all the possible variables that participate in the decision making (Simon 1983, 18). By abandoning substantive rationality and embracing the procedural model, Simon discovered that this utility function was no more than another idealization of classical and neoclassical economics.

When psychological methodology was introduced in the economics field, there was also an attempt to incorporate social and psychological values within this function. An example can be found in the work of Lindbeck (1997),

in which the author complemented the economic values of the utility function with social norms. The *homo economicus*, from this perspective, is subject to these social rules since this had an intrinsic value that increased the utility (Ng and Tseng 2008, 272). This perspective was criticized since the new utility function, that one that included psychological and social factors, was more complex to calculate and operate with. Since social and psychological components were included, there were many more variables to account for in order to find the optimal path.

Caplan (2008), when talking about the possibility of voters considering more than their economic prosperity when deciding for a candidate (they may also act according to their political ideals), claims that psychological and social factors may also be included in the utility function (page 17). The ideological principles of voters are variables that from the field of economics can be considered as part of this utility function. This also poses a theoretical problem, since now it has to be explained what rules and values must be included in the function:

While incorporating social values, norms, and customs into an individual's utility function or game rules is convenient, explaining why these social values, norms and customs matter in the first place is more problematic (Ng and Tseng 2008, 277)

The problem is perfectly explained by Simon when he argued that if we maintain the notion of a global rationality that maximizes utility, according to the requirements of classical economics, we must have all the information about the variables of this function to reach the optimal solution.

"But utility maximization, as I showed, was not essential to the search scheme -fortunately, for it would have required the decision maker to be able to estimate the marginal costs and returns of search in a decision situation that was already too complex for the exercise of global rationality." (1979a, 503)

Since we have to include all different types of variables within the same function, the complexity to calculate its possible optimization is also multiplied.

The mainstream economic model proposed an economic subject whose rationality fell under an instrumental perspective. This subject was rational insofar as she optimized her utility function. From this perspective, social, psychological or ecological values were added to this function, but always respecting the idea that she had to deal with this utility function postulated by this vision of the economy. These values are undeniable in human condition, and if economists wanted to center their theoretical model around the idea of maximization of the utility function, they must include them in it. The consequence was a very complex utility function due to the vast amount of variables to consider. The other solution, more according to the standards of classical economics, was to obviate the values and to interpret the subject as only motivated by the rational maximization of the function, without attending to other variables. This simplifies economics and makes subjects easier to study in terms of their decisions.

Since this way of studying the rational choice did not consider such important factors of our behavior, it faced an immensity of epistemological problems, especially when trying to corroborate the theoretical models with

the real behavior of the Individuals: as Simon denounced, these do not behave as the model described.

One of the answers to the epistemological problem was to claim that this interpretation of economics and its studies on rationality is, rather than descriptive, prescriptive. Also, as Friedman posited, we can consider that individuals behave *as if* they act rationally, obviating also all other mechanisms that affect decisions.

In the field of economics, ontology speaking, nobody denies the social character of *homo economicus*. Some also include cooperation as part of the utility function, that is, we do not only behave to maximize our utility function, we also consider others (Rankin 2011). In Herbert Gintis' words:

Economic actors are not self-regarding, but rather in many circumstances are strong reciprocators who come to strategic interactions with a propensity to cooperate, respond to cooperative behavior by maintaining or increasing cooperation, and respond to free-riders by retaliating against the 'offenders', even at a personal cost, and even when there is no reasonable expectation that future personal gains will flow from such retaliation (Gintis 2000, 311).

Some economists even deny the premise that economy as a science has to be centered on individual agents, but in social agents that interact among themselves in a determined social and ecological environment: "The economic process is a social, not individualistic, phenomenon taking place within a finite biophysical universe" (Gowdy and Erickson 2005, 18).

The standard field of economics had been using a methodology based on the individuality of the agents complemented with an instrumental vision of their rationality. But if the rationality that the economy postulated implied a

behavior that had to be selfish, result-oriented and consistent over time, we would have to deny the existence of such rationality since individuals do not possess any of the aforementioned qualities (Gintis 2000, 320).

The other possibility was the one introduced by Simon: by including these limitations in our rational process, we are recuperating the empirical reality of the individuals economics studies. By assuming a model of rationality that accounted for the boundaries we face, Simon, following his positivist epistemology, brought economics closer to the real decision processes we see in individual agents.

Not only psychological and social factors were neglected, the beliefs of the individuals were also discriminated by the neoclassical economics. According to this, our behavior is guided by our references, which are a mean to maximize our utility function:

Preference is given, current, fully determining, and strictly separate from both belief (which simply helps the agent predict uncertain future outcomes) and from the means employed. Everything we do and say is instrumental to preference-satisfaction so much so that there is no longer any philosophical room for questioning whether the agent will act on her preferences. In effect, neoclassical theory is a narrow version of consequentialism in which the only consequence that matters is the extent to which an homogeneous index of preference-satisfaction is maximized (Arnsperger and Varoufakis 2006, 4).

Following Simon's rational model, from the coordinates of bounded rationality, organisms cannot maximize any utility function. A real description of the rational processes allowed Simon to see that organisms are not capable of considering all possible consequences of their actions and, therefore, cannot find the optimal solution to a problem. When behaving, we take time into consideration, we cannot consider all the alternatives in a

parallel manner, but in a linear one: we are contemplating and abandoning alternatives until we find one that is satisficing enough. As Simon stated:

In particular, no 'utility function' needs to be postulated for the organism, nor does it require any elaborate procedure for calculating marginal rates of substitution among different wants (Simon 1956, 138).

In order to describe how rationality operates as described by the model based on satisficing, the comparison of alternatives does not occur in a total single approach, but in a sequential or linear movement (Baumol 1979, 76). This way to proceed challenge the classical assumptions and altered their model. An effect of this type of procedure is found in the individuals are affected by dynamic inconsistency. In economics, dynamic inconsistency⁸ is an event in which the preferences of an individual change over time in such a way that a particular preference can contradict a previous one or differ from it.

⁸ Also called or time inconsistency

3.3.5. A Note about the Role of Empiricism in Herbert Simon: "Administrative Behavior" within the evolution of the Models of Bounded and Procedural Rationality⁹

3.3.5.1. Introduction

In light of the importance that Herbert Simon and his concept of Bounded Rationality (BR) have been acquiring among behavioral economists in general (Geiger, 2015, p. 2) and, as an example, in regard to *nudge theory* (Muramatsu & Fonseca, 2012) and other branches of behavioral economics in particular, this section aims at contextualizing the role of Herbert Simon's book *Administrative Behavior* (AB), within the framework of the evolution of his ideas. Some authors see in this first work a strong criticism of classical and neoclassical elements. A different position is argued here. Simon's first book, far from being extremely critical and opposed to mainstream economics, did share some of its fundamental ideas. The common element that unites AB with the rest of Simon's work is not the criticism of the classical approach, but an epistemological frame, based on empirical methodology, which contributed in the introduction to psychological factors in the explanation of economic agents. Some authors, like Gustavo Barros, mentioned this disparity (2010, p. 457). Here I try to highlight to that extent that what was constant during his research career and what pushed Simon to a complete rejection of the classical paradigm years later was this

⁹ An essential part of the following chapter was used for an article I wrote that was published in the Brazilian Journal of Political Economy, October 2017 (Hortal 2017).

philosophical empiricism. This empirical approach, among other factors, was the main foundation of his models of bounded and procedural rationality. Simon's constant use of a positivist approach, not only made him the epicenter of this epistemological viewpoint in public policy (Cruise, 1997), but also helped him to develop other concepts (satisficing, etc.) that eventually introduced a new paradigm in rational theory within the larger context of a behavioral revolution (Mingus, 2007; Geiger, 2015). This new paradigm was yet to be seen in Simon's first book.

In the history of social sciences, economics and management some authors (Dequech, 2001; González, 2004; Brown, 2004; Sent, 2005; Callebaut, 2007, p. 77) have written about the importance of Herbert Simon in criticizing the standard (classical and neoclassical) economic model, even considering him a point of inflexion in how the theory has changed when describing and explaining economic decisions. Many of them pay little or no attention to the evolution of this criticism. Other authors (Barros, 2010) have argued that the first writings of Simon are in line with the neoclassical tradition in economy, as opposed to those written later, which are centered on the idea that neoclassical postulates are unrealistic. The objective of this article is to contextualize *AB* within the epistemological evolution of his research, analyzing some of the elements of his criticism of mainstream economics that were present then, while shedding light on other elements that were absent. This will clarify the role of his first book within the general scope of his empirical philosophy, the true and constant foundation of his theoretical

building that gave birth to the models of bounded and procedural rationality, fundamental premise of behavioral economics.

This concept, which appeared for the first time in his book *Models of Man* (Simon, 1957) and its parallel concept of "procedural rationality" (Simon, 1976) were coined by Simon to criticize the theory of rationality of neoclassical economics, accusing it of being an ideal generalization of how agents really behave. During Simon's extensive research career, these concepts appear and reappear with the same intention and powerful criticism. Considering that Simon's doctoral thesis was published as a book (Simon, 1997 [1947]), the question this article answers is if, in that first book, we can implicitly see the above-mentioned model, as Simon himself posits (Simon, 1991, p. 87), or if it would be an anachronism to see such work as the birth of it (Barros, 2010, p. 459).

3.3.5.2. Empiricism in Herbert Simon

Although there are elements in *AB* that depart from the neoclassical tradition, there are also ideas in line with it. The important element that was constant during his career was the empirical frame of his research, that is, his "world view," borrowing Reva Brown's terminology (2004, p. 1246). What we do not find in his first writings is a deep opposition to classical economics. Simon's logical evolution goes from the introduction of empirical methodologies that helped giving birth to his theory of rationality and its limits,

to a new alternative model of rationality. In his first book, he challenged parts of mainstream economics, but kept and used some of its central terminology, e.g. "maximization" or the "criterion of efficiency" and premises. It would be in subsequent articles (Simon, 1955, 1956) that he later introduced new concepts and models (satisficing, and administrative man) replacing those belonging to the neoclassical paradigm.

Simon himself (1991, p. 53) and others (Crowther-Heyck, 2005, p. 70; González, 2004, p. 12) noted that one of the most important influences he had as a student at the University of Chicago was the logical positivism of his professor Rudolf Carnap. Such influence can be seen in his doctoral thesis, which started as an attempt to study the logical foundations of administrative science. The original title of Simon's thesis was *The Logical Structure of an Administrative Science*.

Carnap's positivism had a long lasting effect in Simon: "I had already embraced a logical positivism that I have never relinquished (I would prefer to call it *empiricism* now)" (Simon, 1991, p. 44). As Crowther-Heyck explains:

This philosophy was based on the radical empiricism of Ernst Mach and the formal-logical understanding of mathematics developed by Gottlob Frege, Bertrand Russell, and Alfred North Whitehead. The logical empiricists held that the only things we could know for certain about the world were our sensory experiences of it. (2005, p. 71)

His philosophical empiricism was already present at the end of the 30's, when he and other friends interested in epistemology met regularly to

discuss different interests and projects always under the umbrella of logical positivism (Simon, 1991, p. 75).

Simon explains in *AB* that "scientific propositions [...] are statements about the observable world and the way in which it operates" (1997 [1947], p. 356); these statements can be classified as "true" or "false," as opposed to ethical statements based on preferences. Observation, therefore, had to be the epistemological epicenter of any research, not only about the physical world, but also about our behavior. Simon's empiricism was never as radical as the one practiced by the above-mentioned philosophers, but he understood the need to integrate the mathematical formalization and empirical testing.

Experimentation was also central for his research, and together with mathematical models, social sciences were not in a position to ignore the actual behavioral processes anymore, for if they wanted to have any scientific status, Simon's epistemology demanded a realistic explanation of human behavior and its processes. This empiricism is one of the reasons why Simon started to analyze behavior as a psychologist: not only looking at the outcomes of decisions, but also the process itself. As Bryan Jones explains "Simon also developed what he termed a procedural model of rationality, based on the psychological process of reasoning" (Jones, 1999, p. 301). In order to accurately describe economic events, Simon needed the help of psychology. There may be other reasons why Simon introduced psychology within the field of economics (historical, social, biographical, philosophical, etc.), but as Sent pointed out (2004), as part of the old behavioral economics movement, Simon was motivated to find empirical laws in order to describe

behavior as accurately as possible. His effort to explain the behavior of agents from a positive perspective was a significant departure from the neo-classical approach: "whereas mainstream economics started from given alternatives and known consequences, old behavioral approaches began with empirical evidence about the shape and content of the utility function" (Sent, 2004, p. 742). Positivism, as expressed and practiced by Herbert Simon, affected the field of public policy for almost 20 years, as Peter Cruise pointed out (1997).

3.3.5.3. The need for psychology

Although the collaboration between psychology and economics in Simon was not necessarily forced only by his own empiricism, it is clear that this epistemological approach pushed him, among other contributing factors, to establish this connection (Sent, 2004, p. 739). One of the reasons why Simon looked for the help of psychology was to attach the economic and organization theory about agents to some empirical data.

Relying on the work of Chester Barnard, the objective of *AB* was to build a vocabulary and a framework to describe, from a psychological and logical point of view, the decision processes of administrative organizations (Simon, 1997 [1947], p. 131). In his autobiography he explained that although *AB* lies within the classical tradition, it is almost wholly empirical (Simon,

1991, p. 59). This empirical methodology is partially linked to the use of these two disciplines, mainly psychology, to describe the phenomena in organizations. William James (for the traditional topics in psychology) and Edward C. Tolman's behaviorism influenced Simon's first work (Simon, 1997 [1947], p. 93 n.). Tolman, whose book *Purposive Behavior of Animal and Men* (1932) included a theory based on means and goals (purposive behaviorism) based on experiments with rats and mazes, especially helped Simon with his instrumental approach to rationality as goal-oriented (Simon, 1991, p. 190). According to Crowther-Heyck "this notion of purposeful behavior as being characterized by the selection of alternatives was fundamental, for it provided an avenue for observing the 'choice which prefaces all action'. Choice, understood as decision-making, would be the keystone for the reconstruction of administrative science" (2005, p. 102). When Simon introduced the topic of rationality in chapter IV of *AB*, he described choice as a cognitive rational decision under an instrumental framework. Therefore, once psychology became part of the investigation, he also had to admit that humans did not always follow the rational predicament. This statement, as he recognized (Simon, 1997 [1947], p. 72), contradicted a large part of the classical and neoclassical economic theory.

It is important to point out that Simon worked in the department of psychology at Carnegie Mellon University, and some consider him the founder of the information processing approach to cognitive psychology (Kotovsky, 1989, p. xvi.) Empiricism was one of the most significant factors that led Simon to embrace psychology and the analysis of behavioral processes.

Once the psychological methodology was adopted, Simon's most important concepts started to appear in the structure of its models and theories -bounded rationality, satisfice, and procedural rationality: "cognitive psychology has established the robust empirical finding that human rationality is inherently bounded by innate, insuperable limitations on information processing" (Weyland, 2007, p. 45).

The field of administrative science was in need of a better methodology that increased its scientific status. This methodology, according to Simon (1991, p. 73), had to include systematic observations and experimentation. In 1946 he wrote a preface to the first edition in which he argued for an experimental approach to administrative science (Simon, 1997 [1947], p. xi). In order to successfully pursue research on this subject, according to Simon, an experimental control was needed in order to isolate the effects studied (1997 [1947], p. 48).

3.3.5.4. The problematic value elements

An administrative science had to be based on factual elements and had to produce factual statements. Since decisions, as part of the research within administrative science, had a value and a fact component, the value component had to be left out of the scope of scientific research because its propositions could not be "objectively described as correct or incorrect" (Simon, 1997 [1947], p. 56). Value elements for Simon were important, but

due to epistemological requirements and in direct contradiction to the work of Barnard (Cruise, 1997, p. 352), they had to be outside of the theory, leaving us with an instrumental understanding of rationality (Álvarez Álvarez, 2002) under a means–end schema. Simon himself recognized the limitations of such approach (1997 [1947], p. 75) stressing, not only the importance of the value questions in the means employed but also how insufficient this was as a full description of decisions (Crowther-Heyck, 2005, p. 112).

The empiricism of Simon's first book is not a matter of dispute. What requires consideration is the presence of a strong criticism of classical economics there. What we find instead is a weak criticism of the classical economics postulate that humans are always or generally rational. "That misconception [...] has been decisively refuted by modern developments in psychology and sociology" (Simon, 1997 [1947], p. 72).

As noted by Crowther-Heyck (2005, p. 101), the application of empiricism to social sciences had an important problem: the human mind. With the use of psychology, the influence of Tolman's purposive behavior and the use of concepts like *cognition* or *purpose*, which Simon defined as docility (Crowther-Heyck, 2005, p. 102), he was able to navigate through administrative science using an empirical epistemology. According to Crowther-Heyck, he created a "true science" by considering human behavior as operational (selection of behavior alternatives). Simon found his observable element in human choices, which are considered as decisions, without having a clear difference (Simon, 1997 [1947], p. 3).

3.3.5.5. Bounded and procedural rationality

In *Models of Man* (1957, p. 198) Simon introduced the concept "bounded rationality" for the first time. Nineteen years later he would use the term "procedural rationality" (Simon, 1976). That last term, epicenter of his empirical methodology, although not explicitly present in his first book, was implicitly used. *AB* is essential to understand his theory, not because we see in this book his most important concepts, but because with it, Simon puts in motion some of the elements that took him to the deepest criticism of mainstream economics, which did not fully happen until the late 1950's, with the introduction of concepts such as "administrative man", "satisfice", "bounded rationality" and, in the 1970's, with the introduction of the term "procedural rationality", coined in order to describe aspects of his theory that were present before.

His empiricism, partially connected to the use of psychology, also influenced him to look at the process of election, more than the outcome itself: procedural rationality "as it is empirically-grounded, it captures the real cognitive capacities of people, i.e. the bounded aspect underlined by the 'costly rationality' conception. But it goes further than this conception. The procedural aspect characterizes the presence of deliberation in the process of choice. The choice conditions are not given to the decision-maker, but are the subjects of a search process. As people are not assumed to know all future situations, alternatives and their consequences, the search, the evaluation

and the ranking of the various possible actions stem from a deliberation process" (Chaserant, 2003, p. 166).

Simon's empiricism, among other factors, helped him to accept certain limits of rationality, but his goal then was just to call attention to some limitations of the economic theory, without proposing a new model. The alternative model arrived later, as mentioned above. *AB*, therefore, is the initial criticism, a negative exposure of the epistemological limitations of a theory, but not a constructive criticism. There is a fundamental connection between Simon's empiricism the new model of rationality, an empiricism that was already present from the beginning and a foundation for his entire career. Although Subrata Dasgupta, for example, already mentioned Simon's commitment to empiricism (2003, p. 687), The author did not emphasize enough its importance in the development of the different concepts and theories coined by Simon.

The first steps in the evolution of Simon's theory, from his partial defense of some neoclassical elements, to his rupture with the mainstream model in economics, started with the criticism of the "linguistic and conceptual tools" (Simon, 1997 [1947], p. xi) of the standard administration theory. On his journey he revised the description of human decisions proposing a different model of rationality and an alternative model to understand economic behavior and decisions.

On the one hand, we had a "classical" Herbert Simon who used an instrumental idea of rationality, suffered from a rationalistic bias, and

supported the idea that the objective of any organization was to maximize according to the criterion of efficiency, recognized by neoclassical theory as profit maximization or cost minimization; on the other hand, he accepted that humans were not always rational, and that such rationality had limits (Simon, 1997 [1947], p. 45). As Joseph Mahoney explains:

Simon is consistent with the logic of economics and uses the familiar language of information, efficiency, implementation, and design. Unlike neoclassical economics, however, Simon also insists on coming to terms with cognitive limitations, which are discussed in terms of constraints, authority, routines... (2004, p. 6).

What is relevant for Simon's future theory of rationality is the empirical approach to the distinction between factual and value decisions. Only factual decisions can be falsified; value decisions can be good, but they cannot be described as correct or incorrect. Simon's empiricism demanded an instrumental version of rationality similar to the concept of efficiency. This concept is the fabric of his (means-end) instrumental view of rationality in *AB*, since to be efficient is to "take the shortest path, the cheapest means, toward the attainment of the desired goals" (Simon, 1997 [1947], p. 12). As Davis claims (1996) Simon's concept of rational is equivalent to efficient, so organizational rationality is economic efficiency. An efficient individual is someone "that attempts rationally to maximize the attainment of certain ends with the use of scarce means" (Simon, 1997 [1947], p. 45).

Simon's empiricism required an approach to rationality based on the falsifiable and measurable concept of efficiency under the means-end

schema. The outcome is the instrumental view of rationality, rejecting any other value proposition due to their lack of scientific status.

As Robert Bartlett (1989, p. 306) indicated, Simon's first work starts with a classical economics definition of rationality as an attribute of behavior. To this classical rationality some limitations were added (produced by Simon's empirical requirements). Simon is using both a substantive rationality (when is appropriate to the achievement of goals within limits) and a procedural approach (outcome of a deliberation, process of choice) without clarifying their differences, which did not happen (Bartlett, 1989, p. 307) until 1964 in *A Dictionary of Social Sciences*. Until that moment Simon kept using a version of substantive rationality, parallel to the implicit use of a procedural approach to rationality, since its scientific status was extremely high: substantive rationality neglected all types of internal psychological factors and focused only on the external environment (Bonome, 2010, p. 31) when explaining rationality. This provided an approach close to the one we practiced in Physics.

In the subsequent writings Simon clarified his position and, in 1976, he clearly classified both conceptions in his article *From Substantive to Procedural Rationality*. Substantive rationality was originated in the economics field and procedural came from psychology.

In an attempt to describe and explain all factors that intervene in rationality Simon had to attend to those from our "mind" as they were connected to the environment (Simon, 1956). Procedural rationality provided

that type of insight. When Simon classified substantive rationality as a form of global (perfect) rationality that neglected the psychological processes involved in rational decisions, he associated the term with the classical and neoclassical traditions in economics. Once the limitations of rationality were considered and the model of bounded rationality well established, as it was in 1976, Simon coined the term of procedural rationality to refer to the concept developed within psychology related to the rational activity "when it is the outcome of appropriate deliberation."

Although efficiency is considered part of the instrumental terminology in Simon's *AB*, it is also a concept that manifests the implicit use of procedural rationality in his theory. The search for efficiency can be seen as the search for procedural rationality (Simon, 1976, p. 133), since this concept relates to our ability to find "appropriate adaptive behavior" (Bartlett, 1989, p. 308) through our cognitive capabilities.

Simon's 1976 article already incorporates other parts of his theory into the concept of procedural rationality: bounded rationality, satisficing, and the criticism against classical and neoclassical economics and perfect rationality are all interrelated in the construction of the above-mentioned concept. In *AB*, Simon did not use the term "procedural rationality," but he did in fact apply its methodology by looking at the process of thought and psychological factors that affected rationality within the organizational frame. The concept of efficiency is an example: "most of Simon's discussions of efficiency relate to

his critique of neoclassical substantive rationality, which offers a standard against which behavior can be judged" (Bartlett, 1989, p. 309).

3.3.5.6. Instrumental rationality

As I mentioned in page 25, the instrumental approach is the default (Nozick, 1993, p. 133) theory of rationality and it is the only one that does not need justification (but it is not the only theory). For Simon, reason is entirely instrumental (Callebaut, 2007, p. 80). His definition of rationality as it is given in his first book was conceived under a means-end frame: "rationality is correct if it selects appropriate means to reach designated ends" (Simon, 1997 [1947], p. 72). A few years later, in 1964, in an article he wrote for a dictionary of the Social Sciences, the concept had not changed much: "In a broad sense, rationality denotes a style of behavior (A) that is appropriate to the achievement of given goals (B) within the limits imposed by given conditions and constraints" (Simon, 1982, p. 405).

We can trace the psychological origins of Simon's instrumental conception of rationality in Tolman's behaviorism, but its philosophical roots are placed, according to Nieuwenburg (2006, p. 89), in David Hume (never mentioned by Simon) through Alfred Ayer, whose influence was recognized by Simon himself (1997 [1947], p. 55n).

From a general perspective, Simon's objective was to explain rationality from a realistic point of view. This empirical methodology caused him, in *AB*, to accept specific limits within rational processes (1997 [1947], p. 45) accusing, therefore, the classical theory of the firm of not giving any explanation for them. The introduction of these limits was in part due to the fact that Simon looked at the rational process, more than the outcome itself, in explaining how agents and firms operate. This analysis of procedures was the first step of what later would be his "procedural rationality."

His desire for a realistic (empirical) explanation of the theory of the firm pushed him to look at the procedures of how agents decide, admitting certain limits that affected the level of efficiency desired by a single member of an organization. The way Simon linked "limits" with "efficiency" denoted a connection with an instrumental understanding of rationality: reason cannot select final goals; it only tells how to reach them (Simon, 1983, p. 106). But an instrumental rationality theory does not necessarily imply the rejection of a methodology based on the study of rational processes. In Simon's first book we find a first version of what he eventually denominates "procedural rationality" that is not only instrumental, but also considers the cost of acquiring information to arrive at an optimal course of action (or a satisfactory one). Hargreaves Heap referred to it as the "procedural version of instrumental rationality" (Heap, Hollis, Lyons, Sugden, & Weale, 1992, p. 4). The idea of having an instrumental rationality that incorporated "satisfaction" as explained by Michael Byron (1998), is the "satisficing conception of

instrumental rationality": we do not need to choose the best means to arrive at our goals.

3.3.5.7. The classical elements of AB: maximization and efficiency

Herbert Simon's concept of rationality in his first book was drawn between two ideas: the need to be efficient (criterion of efficiency) and the limits to achieve it. Maximization was still the objective: "this maximization is the aim of administrative activity, and that administrative theory must disclose under what conditions the maximization takes place" (Simon, 1997 [1947], p. 45). Simon's criterion of efficiency selects which alternative produces the largest result according to our resources, and it can be seen, as he himself explains, analogous to the concept of maximization of utility (1997 [1947], p. 258). Simon clarified that such criterion did not always dominate the behavior of administrators; it would only if they were rational, it would. This type of rationality was not a common characteristic of human behavior; in fact, he criticized mainstream economics in that same paragraph for using this model to describe and explain behavior in the market. Efficiency was seen by Simon as a way to clarify that if two results can be achieved with the same cost, the greater result is to be preferred.

Simon's chapter IX of *AB* was an account of the criterion of efficiency and a refutation of its criticisms. While supporting it, he also introduced the

aspect of valuation into the process denying a ruthless, mechanical, and Machiavellian (the ends justifying the means) interpretation of such criterion (1997 [1947], pp. 259–60), but he placed this valuation outside of science, arguing that "the adaptation of means to ends is the only element of the decisional problem that has a factual solution" (1997 [1947], p. 260). Simon noted that this was not an excuse to eliminate the importance of valuation, admitting that to consider administrative activity free from valuation was just an "abstraction from reality which is permissible", but cannot be carried to extremes.

Accepting valuation was not a form of expressing an alternative view of rationality (expressive or axiological), but simply a statement acknowledging that, in decision theory, we have value and factual elements (Simon, 1997 [1947], p. 55). He was not accepting some type of axiological rationality as Boudon (1998) does. As a social scientist, Simon wanted to have empirical (factual) information about the decision processes involved in behavior and that was epistemologically easier with the criterion of efficiency. Every decision contains an ethical element that is the expression of a preference involving a motivational state; therefore, "reasons for actions are always dependent on the presence of certain desires in the psychology of those who are to perform those actions" (Nieuwenburg, 2006, p. 90).

In *AB*, rationality was fully instrumental, and maximization (through the criterion of efficiency), although difficult to achieve due to certain limits, was the goal of any firm. Maximization, therefore, was admitted as a possibility, and not as an ideal and unrealistic goal. Efficiency had to have a level that

corresponded with the limitations described by the theory. Around half a century later Thomas Sargent (1993) will propose a theory of rational limits similar to that of Herbert Simon's first book, based on maximization under constraints. As a sign of his evolution against the rational approach of mainstream economics, Simon himself would later criticize this theory (Callebaut, 2007). Sargent, an advocate of the rational expectations theory, introduced limits of rationality but kept the ideal of optimization (Gigerenzer, 2004, p. 391). Simon's first work and the work of Sargent are similar in the sense that although constraints are admitted, the ideal of maximization had not been fully rejected and a new alternative approach had not yet been proposed. Simon calls this type of rationality in his first book "subjective rationality", which "maximizes attainment relative to the actual knowledge of the subject" (Simon, 1997 [1947], p. 85). Sargent's bounded rationality was similar to that of the early Simon but radically different from the later Simon, when the alternative model of rationality was fully developed. Sargent's approach to the limits of rationality was neoclassical because through learning, he attempted to reestablish the symmetry among subjects: "Sargent tried to link his interpretations of bounded rationality and artificial intelligence with those of Simon. This link turned out to be rather weak. Since Sargent wanted to restore symmetry by incorporating learning, he embraced neoclassical theory" (Sent, 1997, p. 335).

Dwight Waldo (1948, p. 202) also criticized efficiency as a normative approach. In reference to an article written by Simon and Ridley (1938), he expressed his discomfort and denounced that the value of efficiency was just

a "mirage", an ideal. It would be unfair to describe Simon's concept of efficiency in *AB* as an idealization similar to those he later censured. Nor was it a concept that could have emerged from an empirical approach but from a normative wish where "over-all efficiency must be the guiding criterion" (Simon, 1997 [1947], p. 43). Good behavior, for a firm, could be defined as that criterion of efficiency: it did not express how to obtain maximization but just that maximization was the aim of any organization, and administrative theory the one explaining "under what conditions the maximization takes place" (Simon, 1997 [1947], p. 45). Maximization existed in the early Simon, but it was affected by specific limits that could be exposed under a procedural analysis of rationality.

In *AB* Simon started to look at the process (procedural) of decision making, arriving at the conclusion that rationality was not as perfect as what is described in classical economics. Simon's rationality model took these imperfections into consideration, but it was not until later that Simon introduced an alternative model of rationality opposite to that postulated by mainstream economics. His alternative model had to wait until the appearance of his two seminal articles about these issues (Simon, 1955, 1956): the inclusion of cognitive processes and limits in rationality, and the addition of the term "bounded rationality" (1957). Only at that moment did he fully reject the classical and neoclassical ideals of maximization and global rationality by proposing a new paradigm. His theory then became a true alternative and not a mere modification to the one postulated by the previous economic frame. We can see in Simon an evolution in his criticism of

mainstream economics that goes from accepting parts of it (i.e. maximization) to the proposal of a new model.

3.3.5.8. The evolution towards the models of bounded and procedural rationality

The most important element that started to appear from his first writings and remained throughout Simon's career was the empirical methodology that led him to the concept of "procedural rationality" (Simon, 1976). Some authors (Barros, 2010) even argue that this concept is much more powerful than bounded rationality, which they define as a negative concept that emanates as a criticism of the global rationality model of mainstream economics. Although not explicitly mentioned in *AB*, Simon used a classical version of procedural rationality under an instrumental frame. While we may consider procedural a form of rationality different from the one used by mainstream economics, Hargreaves Heap (1992, p. 4) explains that this type can also be a version of instrumental rationality since it allows actions to be guided by procedures in order to satisfice (instead of maximizing) a decision towards a specific goal. This procedural instrumental rationality is the one present in Simon's first book, though not fully elaborated. It will be entirely defined and integrated in Simon's model almost 30 years after the publication of his doctoral dissertation with the paper *From Substantive to Procedural Rationality* (1976). In this article, he juxtaposed substantive and procedural rationality, classifying the first as originated in the

core of economics: "I shall use the phrase 'substantive rationality' to refer to the concept of rationality that grew up within economics, and 'procedural rationality' to refer to the concept that developed within psychology [...]. Behavior is substantively rational when it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints" (Simon, 1976, p. 130). Simon linked his definition of substantive rationality with the achievement of goals considering limitations. This substantive rationality is equivalent to the rationality model of Thomas Sargent in *Bounded Rationality in Macroeconomics* (1993) and, therefore, to some versions of rationality posited by Simon in his doctoral dissertation. According to Simon, the reason why neoclassical economics embraced a substantive theory of rationality was its lack of empirical methodology (1997, p. 369), neglecting the observation and explanation of any process of deliberation in decisions. The evolution of Simon's theory of rationality can be traced as follows:

1. 1947: Limits of rationality, maximization under constraints (similar to Sargent's model which he later criticized), and criterion of efficiency.
2. 1955-56: Satisficing instead of maximizing.
3. 1957: Introduction of "bounded rationality" as a term referred to the model introduced the previous years.
4. 1976: appearance of the concept "procedural rationality" to provide terminological depth to the alternative model of rationality.

The constant application of his empirical methodology is what took Simon from point 1 to 4 in proposing a new rationality paradigm in social sciences. His philosophical empiricism was the cement that glued the different bricks of his theoretical building and is at the foundation of his rational model based on the concept of "procedural rationality", which logically (not historically) precedes "bounded rationality."

Since in his first book he had not fully developed the new model of rationality and was embracing some classical concepts, there were no clear differences between procedural and substantive rationality in it: behavior in this first book is rational when it is appropriate to the achievement of given goals within certain limits. Using his own terminology from 1976, Simon's rationality was a matrix of substantive and procedural elements. To this end, the criterion of efficiency can be classified under the substantive row, while the different limits listed by Simon in chapter II of his first book (1997 [1947], p. 45) could be placed under the procedural column. With the inclusion of other elements within Simon's theory in the following years, the substantive row eventually disappeared, but not his instrumental approach.

Herbert Simon's instrumental view of rationality was permanent during his research years and the need to introduce different forms of rationality has been broadly stressed by many (Hargreaves Heap, 1989; Boudon, 1998, 2003; Echeverría & Álvarez Álvarez, 2008). Here I do not pretend to point out this need but to draw a line of evolution for his most critical writings: those in which he separates himself from the mainstream economics paradigm. Simon's use of "maximization" to explain efficiency shows that the procedural

approach serves the purpose to show that the process of rationality is imperfect when it tries to reach its goals. But rationality as it was defined and used in his first book also resembled the substantive rationality that he later criticized (Simon, 1976). Although Barros points it out this anachronism (2010), it is important to contextualize it within the whole scope of Simon's works and his empiricism.

3.3.5.9. Conclusion

There may not be a necessary connection between Simon's empiricism and his theories, but that this epistemological approach was present as part of his research methodology is undeniable. In Simon's philosophical fabric, his empiricism is the weft that unites all different concepts (or warps, to keep the metaphor) linked to the criticism of classical and neoclassical economics. This criticism is not the foundation of his work, but consequence of his positivist philosophy. His book *AB* is the first step of this path. There, although he had not fully drawn yet his complete theory, he shared the idea that a realistic approach had to be imposed when explaining behavior from an economic perspective. There were several classical elements in his first work, but they eventually disappeared with the constant application of the above-mentioned philosophical standards, which produce the complete rejection of the mainstream model of rationality and the implementation of a new paradigm within social sciences in relation to the rational behavior of subjects: the models of bounded and procedural

rationality. Neither "bounded" nor "procedural" are terms that appeared in that book. The genesis of these concepts is found later (Simon, 1955, 1956), where Simon introduces the concept of "satisficing" opposed to "optimizing." Bounded rationality appeared for the first time in *Models of Man* (Simon, 1957), and his theory will be completed with the other concepts, implicitly used already, but not coined until the mid-seventies (Simon, 1976).

Although his epistemological view is constant during his career, it is left to clarify if Simon's empiricism is the only motivation that pushed him to develop his theories or, if this is not the case, in what way other factors contributed to his research. Herbert Simon not only introduced a new paradigm in rational theory, but also took the first steps towards an empirically based economics.

3.3.6. An Effect of Bounded Rationality: Dynamic Inconsistency

Bounded rationality claims that search processes are sequential, and that we pause searching when we find a good enough alternative. Since we cannot compare all the alternatives simultaneously, time becomes an important influence in our decision. Through time, we behave inconsistently, challenging therefore, the axioms of classical and neoclassical economics. It is because we show these inconsistencies that the standard rational model is not adequate to explain our rationality. By manifesting rational inconsistencies within time, sometimes produced by the sequential consideration of

alternatives, rationality appears to us as bounded. This entails a direct confrontation with the fundamental principles of classical economics: transitivity and consequence. The objective of the following paragraphs, therefore, is to show, by using what has been called *dynamic inconsistency*, how the model of bounded rationality may be able to explain certain behavioral attitudes.

As Sen explained (1977), the mainstream approach, according to Edgeworth's view, a person's decisions are considered rational if they can be explained on the basis of a certain preference relationship consistent with the definition of revealed preference, that is, if all decisions can be explained as those in which the subject has chosen the most preferred alternatives with respect to her own preferences. The person is, therefore, consistent with herself. According to Keita (1992, 96), mainstream economics assumed that rational economic agents were coherent in their decisions, had a complete knowledge of the market, and possessed preferences that were not cyclical, always trying to maximize their utility function.

When we observe the real behavior of individuals, as for example in the surveys about their intention to vote, we see that these axioms are not fulfilled. In the following paragraphs I will show the importance of when the information appears in our environment in decision making: Individuals value recent information differently than information they previously had.

The idea that voters do not act rationally can be approached from two different points of view: one that defends the irrationality of the act of voting.

This line of study is based on the idea that never an individual's decision is going to affect the outcome of a specific election, so voting is unnecessary. The other one studies the rationality of the decisions of voters in reference to their own values and preferences. It is the latter that investigates the consistency and transitivity of individuals. Some authors maintained that voters sometimes do not vote not because it is instrumentally unnecessary, but because they may feel unhappy, without the capacity to influence in their representatives or because how corrupt they are (Álvarez 1992, 75). The examples provided here come from polls in the primaries of the Republican party for the general elections of fall 2012 during the period of August 2011 to December of that same year.

From the fields of economics, political science and psychology, many authors (Caplan 2008; Bendor 2010; 2011) have argued that voters don't follow the behavioral prescriptions of classical economics as expressed by rational choice theory. Following this idea, Simon's model of bounded rationality (1957) can be used, to provide a more robust explanation than the one provided by mainstream economics. I claim the using the bounded rationality model we can explain the different swings in voters' preferences shown in polls during the primary elections of the conservative party in the U.S. from August to December of 2011. Some of the reasons for such change can be found in how information is processed from the way it is presented within a frame (A. Tversky & Kahneman 1981) and how the choices of voters, at a given moment, are affected by the difficulty to consider all alternatives of a decision at the same time. Voters, therefore, fall short from the ideal

rationality postulated by mainstream economists, challenging the notion of *homo economicus* prescribed by some authors (L. Lee et al. 2009; Rankin 2011; Cramer 2002).

The idea that voters don't act rationally can be approached from different perspectives: one that argues about the irrationality of voting per se¹⁰, other that refers to the different paradoxes, like Condorcet (Binmore 2008, 154) which shows "situations where transitive preferences of individuals combine to make an intransitive collective preference" (Kurrild-Klitgaard 2001, 135), and another which tries to understand the rational status of the actual choice of such voters. I here explain the reasons why voters may change their preferences (in some examples, more than once) before deciding and how this may be a good example of bounded rationality. The data was taken from opinion polls done during the months of August to December of 2011 for the primary elections of the Republican Party in the USA. The information will show the changes of preferences to determine the frontrunner at a given moment and the position of the other candidates according to percentage points.

During that interval, several candidates had changed their relative positions as desired front runners for the Republican Party nomination. The restrictions or boundaries (time inconsistency is one of the consequences of them) within an already complex task environment, made potential voters consider not all information relevant in a given moment to arrive at the best

¹⁰ Based on the idea that the act of individual voting is not likely to change the outcome of an election (Boudon 2003).

decision (that one which would satisfy their utility function), but only a few of the possibilities and always in a sequential manner. This sequence may forced us to be inconsistent.

The specific moment when the information is received affects our preferences. Data shows that voters tend to forget the information about the negative or positive actions of candidates in favor of new information. If I know that a candidate was accused of sexual misconduct in a specific moment, I would not consider voting for him/her. If in a few weeks later, I was informed that another candidate had accepted money from a lobby whose values I disagreed with, although I may consider (value) the sexual misconduct a worse act than the second one, I may shift my preference to vote for the first candidate. The reason may be found, as Bryan Jones explains (2001, p.25), in how we normally consider new information more relevant than the old information. This produces inconsistency in our preferences, choices, and their relationship with each other, making the optimization postulated by mainstream economists impossible: individuals are dynamic or time inconsistent. As expressed by Rosanas (2004, 13), individuals may not be able, or be willing, to make decisions in accordance with their values (contradiction). It is a disagreement between your earlier self and your later self about your preferences. Our bounded rationality makes the time of arrival of new information, and not the importance of such, be one of the factors that produce these inconsistencies. I here consider time inconsistency in its general approach (how time or the order of information interferes with a decision) as a case of prospect theory (Kahneman & Amos

Tversky 1979) following the approach of Loewenstein (1988) who linked it to intertemporal choices. Although both prospect theory and Herbert Simon's approach have in common the idea that our rationality is bounded, they both differ about positive and negative consequences of this and about what to do as individuals or as policy makers, once we are aware of this boundaries.

As I have been explaining, individuals, due to their bounded rationality, cannot optimize: they satisfice. The model of bounded rationality argues that our rationality is "restricted", and this is something that can be observed in many experiments (Conlisk 1996, p.670). These boundaries were summarized by Simon (1972, p.163): the risk, uncertainty, incomplete information about alternatives, and complexity in the cost function or other environmental constraints are so great that they prevent the actor from calculating the best course of action, "only" being able to achieve a satisfactory decision. Bryan Jones claims that organisms trying to satisfice instead of optimize will show the following characteristics:

1. *Limitation on the organism's ability to plan long behavior sequences, a limitation imposed by the bounded cognitive ability of the organism as well as the complexity of the environment in which it operates.*
2. *The tendency to set aspiration levels for each of the multiple goals that the organism faces.*
3. *The tendency to operate on goals sequentially rather than simultaneously because of the 'bottleneck of short-term memory'.*
4. *Satisficing rather than optimizing search behavior" (Jones 1999, p.301)*

The introduction of rational choice theories in political science was developed during the second half of the 20th century and included different

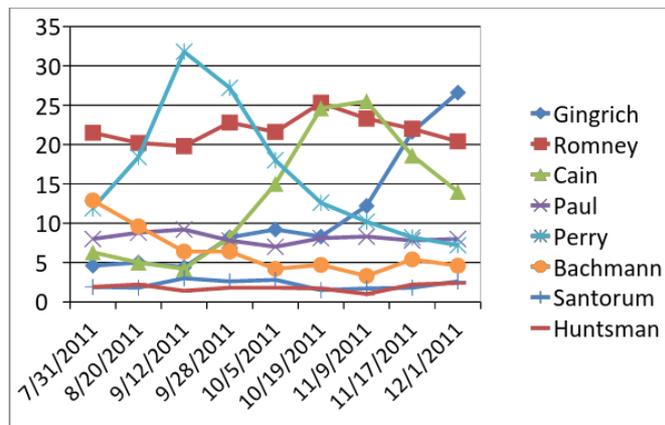
subfields: party competition, voter turnout, and the one we are considering here: voter's choices (Bendor 2011, p.1). Rational Choice theory modeled social and economic behavior according to preferences describing this social behavior as the aggregate of individual choices. It assumed that our preferences are complete and transitive.

While rational choice theory was able to predict some events within the political frame, it was not able to stand empirical tests very well, specifically in regard to voter turnout (Bendor 2011, p.18) and the choices of voters in an election. Although rational choice theory assumed a voter that was fully rational, tests constantly showed that this is far from true:

Some of our cognitive constraints are obvious. For example, our attention is sharply limited: we can consciously think about only one topic at a time. Some are more subtle: e.g., we are sometimes sensitive to small differences in how problems are described (framing effects) (Bendor 2011, p.19).

Until the first week of December of 2011, there had been already six changes for the front runner position in the RPN polls. The candidates observed were: Gingrich, Romney, Cain, Paul, Perry, Bachmann, Santorum, and Huntsman. On December first, the situation was the following: 26.6%Gingrich, 20.4%Romney, 14.0%Cain, 8.0%Paul, 7.2%Perry, 4.6%Bachmann, 2.6%Santorum, and 2.4%Huntsman. Percentages show people's intention of vote for the frontrunner candidate of the republican party. Considering the weeks from July 31st to December 1st, the changes had been the following:

	7/31	8/20	9/12	9/28	10/5	10/19	11/9	11/17	12/1
Gingrich	4.6	5	4.4	8.2	9.2	8.3	12.2	21.6	26.6
Romney	21.5	20.2	19.8	22.8	21.6	25.3	23.3	22	20.4
Cain	6.3	5	4.2	8.2	15	24.6	25.5	18.6	14
Paul	8	8.8	9.2	7.8	7	8.1	8.3	7.8	8
Perry	11.9	18.4	31.8	27.2	18	12.6	10.2	8.2	7.2
Bachmann	12.9	9.6	6.4	6.4	4.2	4.7	3.3	5.4	4.6
Santorum	1.9	1.8	3	2.6	2.8	1.5	1.7	1.8	2.6
Huntsman	1.9	2.2	1.4	1.8	1.8	1.7	1	2.2	2.4



If we explain voting processes from the model of rationality of mainstream economics, we will find that voters would always arrive at the best decisions in a way that would never be incoherent with their values and preferences, being able to choose among all possible alternatives, always aware of what these alternatives are (Simon 1976a, xxvii). Accordingly, voters must have the list of all alternatives, the determination of all consequences that will follow (in the future) if the alternative is "elected" and, as Gustavo Barros explains: "the comparison of the alternatives, that should be evaluated by the sets of consequences following each one of them, according to the pre-established ends (utility, profit or any other specified pay-off function)" (Barros 2010, 457)

Mainstream economics assumed that if I were to decide between candidates, I should first obtain all information possible, apply my calculative capabilities, and decide according to values, beliefs and a specific utility function. But what we find if we "get up from the sofa"¹¹ is a very different scenario than the one described before. A model of bounded rational agents would explain the behavior of subjects in a more satisfactory manner.

The data above-mentioned shows the changes of preferences during a specific period of time. This is a normal scenario and very common in decision processes. Most of the time, the change of preferences is due to new information arriving about candidates (or alternatives) and its repercussion to the choices the voters make according to the values they have, rather than related to a change of values by the subjects themselves.

The opinions of the voters were shaped by the information they gathered from media, which is able to influence voters' choices dramatically. This type of influence was not seriously researched until the 80's (Lenz 2009, p.821). The influence may come from debates, campaign advertising (Johnston et al. 1992, p.213) or news (Iyengar & A. F. Simon 2000), although as Marvin Kalb explained, the final goal of most media is not to report news, but to increase profit: he called it "the new news" (Kalb 1998, p.3).

So, in order to keep the voters interested: "What better enticement than sex, sleaze, and scandal" (Iyengar & A. F. Simon 2000, p.154). In order to make up their minds, voters not only focus on these issues about the

¹¹ Words used by Simon to criticize the lack of empirical realism of classical economists (H. A. Simon & Bartel 1986)

candidates, they will also look at other political or personal information about them. In general, agents cannot observe and analyze all information about their future decision, rather "they attend selectively to a few issues that appear important at the moment" (Iyengar & A. F. Simon 2000, 156–7). Such importance can also be controlled by media or through the influence that other candidates have in media outlets. Voters can be "primed" by the rhetoric of the information they receive, and that includes how that information is presented, and when it is released. The rhetoric is used to persuade voters telling them how to vote (Johnston et al. 1992, p.240). Here the issue of priming will not be considered as described before or as criticized by Lenz (2009). The focus, rather, is in how the timing in the release of information affects our choices, challenging the view of voters as subjects who would consider information about candidates disconnected from when that information was acquired.

What was difficult to understand and problematic to conceive, according to the mainstream model of rationality, was the idea that if we eliminate time, and voters were to consider all the possibilities and all information available at a given moment, the changes of preferences would have been very different. Looking at the information that arrived to voters prior the changing in the polls, we see that the mere fact that this information is recent, automatically gave it more relevance than if it were older. We can find an example in the decline of Cain's run for republican nominee, connected to the release of information about an extramarital affair he had during a few years of his life, the accusations of sexual harassment by two women, and

the way he handled himself when this information was released. On December 3rd, Cain suspended his campaign. During that same period of time, the candidate in front of all polls was Newt Gingrich, ahead by a margin of 6.2% above his closest follower, Mitt Romney.

Gingrich's marital life, according to the same values, was very similar, if not worse, than that of Cain. Now this is not to say that there might not be other hidden (unconscious) factors involved in the decision of voters to switch their preferences, but it's necessary to highlight that voters changed their mind right after the release of such news. If you present two candidates (A and B) with similar biographies as those from Cain and Gingrich, challenging in the same way the values some voters may have, on paper, the majority of them would argue that the candidates are not that much different in respect to the values held. But one model is the one where we decide on paper and we are able to rationally choose and satisfy our expected utility, and another where we have to decide based on information that has been framed (Kahneman & Amos Tversky 1979; A. Tversky & Kahneman 1981) and given in a specific way and at a specific moment of our decision: "As framing experiments [...] have repeatedly shown, if two decision makers use sufficiently different representations, their behavior will differ in some choice contexts even if they are using similar operations" (Bendor 2011, p.24). The goal of Tversky and Kahneman with "prospect theory" was to criticize the expected utility theory as a descriptive model of decisions under risk arguing that choices may shift depending on how the information is presented,

violating, therefore, the axioms of expected utility theory (Kahneman & Amos Tversky 1979, p.263).

In an experiment described by Kahneman (2011, pp.101–2), a group of students was asked to assess their happiness. Half of the students had to answer the following questions: How happy are you these days? How many dates did you have last month? The experimenters were trying to find a correlation between the answers, and they found none. The other part of students was asked the same questions but in reverse order. The results were different. The correlation between number of dates and happiness was as high as correlations are within the psychological field. What happened? What came to mind in the second scenario was the number of dates and that affected the feelings about the second question. Dating was not in the mind of the students in the first scenario, but it was in the second establishing a relation with the answer to the second question. From this experiment it's clear that depending on the order of the questions we may describe ourselves more or less happy. Something similar occurs with the order of how the information arrives to our knowledge, affecting our judgment about how relevant or important this information is. The rational model of classical economics cannot give an account of this type of contradiction and is not able incorporate them to its scientific structure.

Understanding the above-mentioned polls under the satisficing behavior frame of the bounded rationality theory provides a more accurate model than the complete rationality one, which falls short in explaining the "apparent" irrational behavior of voters. Applying Jones' third point to the data

helps us to understand the impossibility of considering all informative aspects of a decision in a specific moment from an objective point of view. Recent information will always be more relevant than old information, even when the old one could be more important if time is eliminated from the decision environment. When we consider alternatives sequentially, time affects our decisions as time affected how voters dealt with the information provided about Cain's affair in relation to the information (which at that moment was not being considered) about the different affairs Gingrich has had. Choices depend not only on the set of alternatives presented to those deciding but, as Manzini and Mariotti support (2009), also on the frame in which these alternatives are presented. Such choice has to be formalized introducing the frame: $c(S,f)$, where "c" is the choice, "S" the set of alternatives and "f" the frame. An example of frame could be the moment in time in which the alternatives in S are presented (Manzini & Mariotti 2009, p.391).

Tversky (1972) proposed a theory of "elimination by aspects" in which an individual chooses among alternatives without comparing all aspects at once but by considering one aspect at a time, eliminating alternatives along the way (Conlisk 1996, p.676). As Simon anticipated:

It appears, then, that in actual behavior, as distinguished from objectively rational behavior, decision is initiated by stimuli which channel attention in definite directions, and that the response to the stimuli is partly reasoned, but in part large habitual (1997a, p.102).

Going back to the polls, Perry's ups and downs could easily be explained by this model. The appearance of new information¹² about his gaffes at the September 12th debate in Tampa (FL), together with a couple more unlucky appearances during that week in September, forced his decline in the polls and change voters' choice:

First, humans are cognitively constrained in many ways, e.g., there are limits on short-term memory and on attention. Second, these mental properties significantly affect decision making. Third, the impact of these information-processing constraints increases with the difficulty of the choice problem that a person faces (Bendor 2011, p.28).

Individuals, when deciding among different alternatives, have to evaluate different pieces of information, some of it must be rescued from memory. The problem of evaluating alternatives in such way is that time is not neutral to our decision processes and affects them producing inconsistencies. This is a specific case of a more general description of dynamic inconsistent behavior.

3.3.6.1. Dynamic Inconsistency¹³

The concept of dynamic inconsistency was introduced by Strotz (1955) and it can be defined as the discrepancy of preferences during a period of

¹² The one about Merck's contributions: "Rep. Michele Bachmann pointed out that Perry's former chief of staff, Mike Toomey, was a lobbyist for Merck, the drugmaker set to make the HPV vaccine and profit from the mandate. Perry's response must rank among the all-time most ill-advised debate lines. 'The company was Merck, and it was a \$5,000 contribution that I had received from them,' Perry said. 'I raise about \$30 million. And if you're saying that I can be bought for \$5,000, I'm offended.'" (Ward 2011) This may allow us to believe that he does not sell himself cheap.

¹³ Also "time inconsistency"

time, where "the individual's future behavior will be inconsistent with his optimal plan" (Strotz 1955, p.165). That inconsistency is the result of not being able to optimize backwards (Fischer 1980, p.94). Because many real-life decisions involve multiple stages of choices and uncertain events, subjects sometimes try to decide from a present moment any possible choices in the future; these may include different procedures to mitigate health problems or preferences for candidates in the future considering the arrival of new information. A dynamically inconsistent behavior may occur when a participant's planned choice differed from his/her final choice. According to Barkan and Bussemeyer, "when we are given full information, actual experience should not change our planned preferences, and the utilities we use to evaluate the decision problem should stay constant [...] this change inevitably affects the perceived values associated with the next stage of the decision problem, making the original plan less desirable" (1999, p.553).

Time and the order of how information is received affect our decisions, and to be time consistent we will have to act in the future in a way that would maximize present values of utility, and these actions must remain optimal in the periods when actions are to be taken. But this is not the normal scenario of human decision; neither is it the one we see in the polls above-mentioned: "Time consistency requires that the future be discounted at a fixed rate, independent of when the costs and benefits of the actions actually occur. People tend not be time consistent. Rather, they appear to have higher discount rates over payoffs in the near future than in the distant future [...]"

people often favor short-term gains that entail long-term losses" (Gintis 2000, p.313).

When alternatives are not presented in a preference ordering and appear simultaneously, our constraints play an important role in our decisions. When individuals must also factor previous knowledge about the alternatives, the amount of information to take into consideration makes the choice extremely difficult. If we have to face two alternatives and we have only one piece of information about them, the choice is fairly simple (Car1 Vs Car2, taking into consideration their prices). If we start adding more pieces of information, the complexity increases. Car1 Vs Car2, considering price, fuel economy, appearance, safety, etc. Now, imagine that the information is not presented in a simultaneous manner, that is, we have to access our memory to obtain that information. That makes decisions extremely difficult.

Loewenstein (1988) linked inter-temporal decision making to prospect theory: "when people choose between immediate and delayed consumption, the reference point used to evaluate alternatives can significantly influence choice" (1988, p.200). He saw the inconsistency of decisions within time as a special case of Tversky and Kahneman's theory. Taking this linkage one step further, I posit that time frames the information we receive: whenever we deal with information collected in different moments in time, and how time influences our decision (even the order in which the information is collected in the past or the possibility of future gains), shows an example of how our rationality is bounded. The order in which information is received can change

the value we give to that information in the same way that a specific form of presenting a problem can alter the way we may decide.

With the arrival of new relevant information, preferences shift, sometimes regardless of the importance of it. New information is taken into consideration by the subjects in a deeper and more dramatic way than the information previously known. As Bryan Jones asserts: "they tend to react to new information with neglect or overestimation" (2001, p.25). The fact that the information is new will affect the way it is considered and it will alter its relevance, opposing the view of the standard model, which understands a rational actor who is time consistent "We say that a strategy is time-consistent if at no information set reached as the decision problem unfolds does reassessing the strategy for the remainder of the decision problem lead to a change in the plan of action" (Rubinstein 1998, 72). What we see from subjects is a behavior that does not follow such consistency, that is, when new information arrives, our preferences may change: "time inconsistency is obtained as a consequence of changes in preferences (tastes) during the execution of the optimal plan" (1998, 75).

A complete rational agent would eliminate the time factor, comparing two different candidates by focusing, as many voters do to select their choices, by trying to avoid those who may differ from their values. But polls showed that our preferences are inconsistent with our own values and may shift with respect to how recently we obtain the negative information about the candidates. We are bounded rational agents.

3.3.7. What is not Bounded Rationality

I have explained so far the mainstream economics model of rationality and how it was challenge by a more realistic one in which rationality is bounded. I provided an analysis of Simon's theories while attending to his empirical foundation and motivations. I also highlighted one of the consequences of bounded rationality: individuals are dynamically inconsistent. All these points are connected through the notion of bounded rationality, so it would be important to delineate the borders of this idea by explaining what bounded rationality is not, according to Simon's original view.

Simon's model of bounded rationality was characterized by a greater degree of empirical realism than that of rational choice theory, and many authors, such as Gary Becker, have used it seeking to "save the phenomena", combining the classical and neoclassical model with the one Simon proposed. The result was an attempt to maintain the optimization postulate while recognizing the limits of rationality: "Several economists argue that even if many individuals act in ways which seem to conflict with the rational, utility-maximizing assumptions – in aggregate, they act as if they were optimizers. For instance, Gary Becker..." (Etzioni 2010, 51)

Along these lines we have the thesis presented by Selten in his work with Gigerenzer (Gigerenzer and Selten 2001), claiming that bounded rationality is neither irrationality (prospect theory and nudge theory) nor a form of optimization taking into account the rational limits (Thomas Sargent). Other

theories that borrow the name of bounded rationality to give an empirical account of the errors that occur within the rational processes of human beings, Gigerenzer and Selten claim, cannot be called models of bounded rationality, since they have nothing to do with the concept that was originally presented by Simon.

A framework that defends optimization taking into account the costs produced while we search for it, considers bounded rationality, not as what it really is (a search mode using fast and frugal heuristic methods), but as an optimization process (similar to the classical model), just adding certain restrictions (Gigerenzer and Selten 2001, 5). Accordingly, agents would attempt to continually revise their expectations in order to smooth out the imperfections in their rational predictions (Sargent 1993, 21).

According to Sargent's theories, the aggregate of bounded rationalities can optimize if these limitations are taken into account and mutually neutralized within a social framework. From this perspective, our limited rationality would cease to be and it would be replaced by an optimizing model thanks to social cooperation as an aggregate of agents.

3.3.7.1. Rational Expectations theory

The theory of rational expectations, originated by Muth and popularized by Lucas and Sargent, among others, appeared at the Carnegie Mellon University, precisely where Simon worked to develop his model of bounded

rationality. It was in 1971, according to Simon (1991, 250) when Lucas and Sargent launched this theory nationally and internationally. Simon worked with Holt, Muth and others on the use of mathematics in business models in the early 1960s (Holt 1960).

In the mid-1960s, the neoclassical tradition from Chicago seized the department of economics and Simon, gradually shifted to that of psychology. Although he was an outspoken advocate of the use of mathematics in the social sciences (Simon 1982, 2: 211), authors such as Sargent or Lucas took such use to radical extremes (Sent 1997, 324). In 1970 Simon was already in the psychology department at Carnegie Mellon University accusing Muth of being the culprit of his departure.

John Muth, in the article *Rational Expectations and the Theory of Price Movements* (1961), described a model of rationality that dealt with uncertainties by saving the neoclassical tradition and initiating the theory of rational expectations. Muth claimed that agents were able to optimize being able to overcome rational limitations. When rational agents have expectations, and these expectations come from predictions about future events based on information, they can be considered similar to the predictions realized by economists (Muth 1961, 316). This theory was a response to Simon's model of rationality bounded (Simon 1991, 270-1). Although later it will try to get closer to it (Sent 1997, 325). In Thomas Sargent's work *Bounded Rationality in Macroeconomics* (1993) he related the theory of

rational expectations with the model of bounded rationality and the studies on artificial intelligence of Simon, but without referring to the same thing.

According to the studies of Sent, Sargent tried to reconcile the model of bounded rationality with a neoclassical approach, but without abandoning most important claims of neoclassical economics. Simon's objective, as we have seen in this thesis, was to completely abandon the assumptions made by classical or neoclassical theory. Thomas Sargent, being unable to obviate the empirical reality of Simon's model, was forced to maintain it, while keeping also essential points of the neoclassical theory. According to Sargent, agents continuously review their limitations and errors in predictions about future events, and they do so in an aggregate way, thus eliminating those errors and being able to maximize their utility function: "A collection of agents was solving the same optimum problems by using the relevant economic theory and the solution of each agent was consistent with the solution of other agents" (Sent 1997, 327)

In this way, Sargent maintained the ideas of a utility function, maximization, and perfect rationality (to eliminate such errors):

The idea of rational expectations has two components: first, that each person's behavior can be described as the outcome of maximizing an objective function subject to perceived constraints; and second, that the constraints perceived by everybody in the system are mutually consistent. The first part restricts individual behavior to be optimal according to some perceived constraints, while the second imposes consistency of those perceptions across people. In an economic system, the decisions of one person form parts of the constraints upon others, so that consistency, at least implicitly, requires people to be forming beliefs about others' decisions, about their decision processes, and even about their beliefs (Sargent 1993, 6).

The theory of rational expectations defended by Sargent proposed the modification of the predictions to be able to eliminate possible errors. In this way, expectations are reviewed continuously taking into consideration the constraints to which rationality is affected. According to Sargent, individuals can carry out the possibility of neutralizing rational limitations by social learning and thanks to the imitation of norms of conduct. This increases the possibility to adapt to the environment in a beneficial. Sargent, in a version of an article written in 1975 on the hypothesis of the natural rate of unemployment (2001), claimed that he arguments that criticize the theory of rational expectations are not strong. Sargent defined this theory quite clearly, stating that individuals adjust their expectations to eliminate monetary illusions (2001, 65). These illusions are caused by our bounded rationality. What this adjustment does, in fact, was to remove the central axis on which Simon's rational model revolves. Sargent used it as a ladder to ascend to the ideal of maximizing proposed by neoclassical economics, disposing the ladder after using it. This involved the neutralization or disappearance of the rational limits. The critique of the assumption with which Sargent began, the maximization of the utility function, is eliminated by considering that subjects are able to match the predictions economists make: "public expectations are not systematically worse than the predictions of economic models" (Sargent, Fand and Goldfeld 1973, 431). This is not to say that subjects and their predictions will be free from errors, but mistakes are produced in a random way (Sent 2006, 7). The supposedly bounded rationality, according to the hypothesis of rational expectations and according to Thomas Sargent, is

reduced to an episode within the learning until the equilibrium is achieved. "Rational expectations are optimal expectations; they are formed on the basis of all information and knowledge available to an agent [...] this means that rational expectations are consistent with the predictions of the model that is used" (Klamer 1984, 269). According to this author (1984, 283), some authors point out this hypothesis as absurd, since it tried to affirm that the rational expectations of the subjects are going to resemble to such a complex model, which is also difficult to handle by some economists.

Sargent continued to defend the basic postulates of classical or neoclassical economics: in a rational decision, let us remember, we have a list of possible alternatives, we know the consequences of each one of them, and an evaluative comparison of them is made.

In Simon's model, agents do not consider alternatives, but have a determined process of generating them, being empirically impossible to consider "all alternatives". Subjects do not have the necessary cognitive ability to do so in order to maximize their decisions. Subjects use specific recipes in these decisions. Instead of postulating the maximization of a utility function, Simon defended a strategy based on satisfaction, as we have seen previously.

The model of complete rationality assumed that subjects could possess and use for their decisions all information without any kind of cost. According to this model, subjects were beings with Olympic abilities, but quite far from the empirical reality. George Stigler (1961) introduced the idea that to

make the model of mainstream economics more realistic, we had to take into account the costs of finding information. that was Sargent's approach. But this model cannot be considered within the framework of bounded rationality, it must be understood as a modified version of complete rationality. According to Klamer, many have accused the theory of rational expectations of a lack of empirical realism, since it is impossible for subjects to act consistently on complicated economic models: "The rational expectations hypothesis, some economists argue, is absurd: no agent is Able to form expectations consistent with a model that is elaborate even econometricians can hardly handle it" (1984, 283).

This implied that the problems individuals needed to solve became exponentially complicated. The theory maintained the postulate of optimization while adding psychological limits and restrictions that subjects must deal with. Gigerenzer claims that assumed restrictions are more complex than the ones postulated by neoclassical economics rational theory. "models of optimization under constraints tend to be more complex than models of unbounded rationality, depicting people in the image of econometricians" (Gigerenzer 2008a, 6).

According to Sargent (1993, 2), bounded rational agents are smarter than the theory previously thought. From the classical or neoclassical theory, individuals were omniscient, consistent, and they had no limits: they could optimize. From the coordinates of rationality under restrictions, they continue to optimize, but now from their bounded rationality.

3.3.7.2. The Concept of Limited Rationality in Thomas Sargent

According to Sent (1997), we can find crucial differences between the concept of bounded rationality used by Simon and the one proposed by Sargent. While the former attempts to break the foundations of mainstream economics by attending to the processes of rationality, the latter uses this notion of rationality to argue that subjects have the possibility of maximizing being capable of dealing with its rational boundaries. (Sent 1997, 326). Thus, according to Sent, the differences between Simon and Sargent can be summarized in three important points (Sent 1997, 333):

1. Simon's theory postulates a process for generating alternatives, without assuming that these are a fixed set.
2. According to Simon, cognitive limits and the difficulty in predicting the future are central to the choice of alternatives
3. While Simon opposes the idea of a subject who can maximize her utility function, Sargent reasserts himself in it, following the footsteps of neoclassical economics.

In fact, some authors like Gigerenzer (2008a, 6) criticize that the idea of maximization under constraints is even more complex to assume than the unlimited rationality that Simon criticized, since it turns subjects into econometrics experts. As Simon claimed in the third volume of *Models of*

Bounded Rationality, economists like Thomas Sargent who have borrowed the concept of "bounded rationality", have misused it:

Economists like Thomas Sargent who have paid the phrase 'bounded rationality' the compliment of borrowing it in titles of books or papers [...], miss the point of it when they continue to base their models on a priori hypotheses about behavior instead of grounding them in fact established by direct observation" (Simon 1997b, 3:xii).

The whole theory on which the concept of bounded rationality was based was obviated, since the processes of choice, the central axis of the empirical status of the model, was removed from the equation, looking only at the results of the election. Simon, in this regard, claimed that "instead of dealing with uncertainty by elaborating the model of the decision process, he would once and for all - if his hypothesis were correct - make process irrelevant" (1976b). That is, instead of dealing with rationality in a more realistic way by attending to how we behave (what Simon called procedural rationality), this theory focused only on its results (substantive rationality).

3.3.8. A Note about Gerd Gigerenzer

Although we will look more closely at the concept of ecological rationality developed by Gerd Gigerenzer, I aim at introducing in these following paragraphs a note on his approach to rationality. Gigerenzer's ecological rationality fits within the model introduced by Simon. Not only in regard to how we process information, but also how he understands the

relationship between the environment and the mind: very similar to the metaphor Simon used related to the edges of scissors.

Gigerenzer proposes a model of rationality similar to that of Simon, but focusing on the so-called "heuristics", one of them being the strategy of "satisficing". Simon's concept of "satisficing" is included in Gigerenzer's theory as a form of heuristic strategy (Gigerenzer and Brighton 2009, 130). To this end, he claims that people stop searching for other alternatives and choose the first one that satisfies a determined level of aspiration. Although "satisficing" is a specific type of heuristic strategy, this does not mean that this concept can also be conceived in a general way, that is to say, as a generic term that refers to strategies that ignore part of the information and participate in a minimum processing (Gigerenzer 2010, 535). Gigerenzer asserts (2008a, 50) that although these heuristic rules are similar to Tversky's theory of heuristics, as elimination-by-aspects (Tversky 1972), his theory differs and how we should interpret them: "heuristics are efficient cognitive processes that ignore information. In contrast to the widely held view that less processing reduces accuracy, the study of heuristics shows that less information, computation, and time can in fact improve accuracy" (Gigerenzer and Brighton 2009, 107).

Once we establish the impossibility of optimizing our decisions and we replace it with the idea of "satisficing", we obtain a more realistic description of our rational procedures. Heuristics, Gigerenzer argues, are a kind of shortcut to arrive at a satisfactory solution of a difficult problem, and not a pathological deficiency of our limited cognitive ability Tversky and Kahneman

would defend (Berg and Gigerenzer 2010, 157). Heuristics are adaptive tools of our ecological rationality (discussed later in this thesis). Gigerenzer's model of bounded rationality describes how decisions are reached instead of highlighting their outcome. To this end, he follows Simon's procedural rationality. Heuristic rules appear in the interconnection between bounded rationality and the structure of the environment. Individuals, by their lack of information, use this environment to arrive at satisficing decisions, as satisfactory as any other we may arrive using other means. "Heuristics, in contrast, can exploit evolved capacities naturally available to humans to find different solutions for a problem than a statistical calculus would" (Gigerenzer 2008b, 22). The ecological rationality of heuristics carried out by Gigerenzer studies the success or failure of certain strategies in particular environments (Gigerenzer and Brighton 2009, 107).

Gigerenzer's bounded rationality model is therefore similar to Simon's. The formal models of heuristic strategies are based on the frame of rationality developed by Simon, studying the rational principles of behavior in a realistic way (Gigerenzer 2008a, 50, 89), and concentrating on the processes, rather than from a normative or ideal approach. Gigerenzer states that his theory focuses on the description of processes leading to prescriptive consequences (2010, 530). Following Gigerenzer's approach, we can have a description of how we decide while having also a prescriptive theory about the best ways to do it. The objective, moreover, remains similar to that of Simon, Gigerenzer wants to continue introducing psychology in the studies of rationality and vice versa, a kind of "co-evolution" (Gigerenzer and Selten 2001, 1).

According to these coordinates, bounded rationality is presented as a critique to any form of optimization, the use of probability and the utility function. To do so, the theory specifies three types of processes: simple search rules, simple rules to stop searching, and simple rules for deciding.

Bounded rationality in Gigerenzer is understood as ecological. Its dimensions are not only found in our cognitive capacities, or in our organism, but are also found in the environment. Using Simon's scissors metaphor described above, in which one of the edges is the environment and the other our mind, bounded rationality is not in one of them, but in the two. The limitations (and the benefits) are given in the connection or in the necessary interaction between the two parts. In this way, both the idea of a complete rationality as well as the separation of the same with the environment in which it is developed are discarded. It is not only our limited cognitive ability, but the very complexity of the environment that the bounded rationality model supposes.

In this section I do not want to go any further into the philosophy of Gigerenzer, since it will be the subject of our study later. I just wanted to draw the way in which Gerd Gigerenzer speaks of bounded rationality. I will understand the more general framework of his ecological rationality and how it relates to nudge theory and the heuristic and biases research program.

3.3.11. Ariel Rubinstein

The theory of bounded rationality is explained by the economist and mathematician Ariel Rubinstein in his work "Modeling Bounded Rationality" (1998). The objective is the construction of models that serve as tools to explain economic phenomena that cannot be explained otherwise. In this way, starting from the idea that rationality is bounded, and separating from the complete rationality of the standard economics, Rubinstein relates a series of models in which he describes the tension between the model of perfect rationality and the observations made in experiments.

Rubinstein begins by defining the parameters of the rational actor that in the decision making process is first posed by what is possible, what he desires and, lastly, what is the best alternative according to desires and possibilities. According to Rubinstein, mainstream economics assumed that in rational individuals the process of discovering possible alternatives is something totally independent to the process of defining preferences (Rubinstein 1998, 7). This model presented an individual with complete rationality that had a clear knowledge of the problem she faced and of the alternatives that were presented. Preferences were well established and, because of her infinite ability to calculate, she could optimize her decision and show indifference between two logically equivalent alternatives. The action chosen by the individual, according to this model, would be the best possible given her knowledge derived from coherent inferences (Rubinstein 1998, 41).

According to Rubinstein (1998, 10), mainstream economics had not ceased to "apologize" for defending a model of rationality where the deciding agents were not very realistic, so perhaps, as claimed by this this economic approach, it should not be taken in literal way. He also claimed that mainstream economics focused on the behavior as it was connected to the outcome of decisions and not on the process that leads to it. So, although individuals do not behave according to the model of complete rationality, it can be assumed that they do it as *if* they are acting out with complete rationality. According to Rubinstein, this is epistemologically enough for the purpose of economics.

This author's critique of mainstream economics as unrealistic rests on three elements:

1. Our decisions depend on a frame of reference (the way in which a decision problem is presented and not the actual content). Rubinstein does not cite directly to Tversky and Kahneman (1974, 1981), but this connection is understood by the various references he makes of them in other parts of the text.
2. The tendency to simplify problems: to save resources, agents tend to simplify the problems they face in their decisions. According to Rubinstein, sometimes it is done to discriminate elements within these decisions based on specific rules.
3. The search for reasons: The third element of discordance with the standard theory of economics in terms of rationality is based on the idea that agents often act according to given reasons.

Sometimes the reasons are independent from the problem, sometimes they are personal. These are not opposed to rationality in general, but to the ideal of a complete rationality. Agents have reasons to act that are independently if their instrumental value.

According to Rubinstein, these three elements appear frequently in psychology and demonstrate how individuals have rational limits in their decisions (1998, 14), but the most important problem is the dependence of the frame of reference. From the moment that language itself can change the choice of two equivalent situations, we cannot speak anymore about symmetry or equivalence. That said, two logically identical alternatives are treated differently by the subject depending on the frame in which they are presented (eg, the way they are described, the order in which they are presented, etc.). Rubinstein asserts that the beauty of this is not found in how it contradicts complete rationality, but in the way it demonstrates the procedural element: "The beauty of this example is not its contradiction of the paradigm of the rational man, but its demonstration of a procedural element that often appears in the decision making" (1998, 19). Rubinstein argues that procedural rationality is the result of a reasoning strategy whereas irrationality is the result of an impulsive response in which thought does not intervene. This distinction conveys certain problems, especially in regard to the connection between the "impulsive response" and irrationality. One could argue that behavior, even if it is impulsive or emotional, does not necessarily have to be irrational. It looks like Rubinstein goes along the lines of Simon

when attaching irrationality to emotional responses like those that are the result of stressed out individuals (Herbert A. Simon 1987). But there are intuitive processes that are found in the internal parts of the brain, beyond the rationality of the cortex, which cannot be called irrational, but which respond to another type of rationality, closer to an ecological approach, as defended by Gigerenzer.

Game theory has the example of the ultimatum game (Gale, Binmore, and Samuelson 1994). In such game there are two players. The first player (the proposer) conditionally receives a sum of money and proposes how to divide the sum between the proposer and the second player (the responder), who chooses to either accept or reject the offer. As we have explained earlier in this thesis, the way players decide is affected by neurobiological processes (Sanfey et al., 2003), specifically the anterior (emotional) insula. In fact, it could be said that the part of the brain that activates before a bad smell is the same as the one that activates before an unfair offer. Part of our rejection of a low offer within the context of this game is due, in a way, to impulsive responses that we can not call simply irrational. In the same way, when a pianist plays a piece of Chopin, he cannot reason about the position of each finger on the piano keys and at what rate. The player simply follows her impulses (based on previous practices where deliberative processes have been a crucial part) in order to achieve the desired goal.

In Rubinstein's critique to standard economics, if rationality commits "errors", and these are part of behavior, economics should also be interested in them (1998, 22). With these words, he follows Simon's approach by making

the decisions a field studied by both psychology and economics. This mixture of psychology and economics characterizes any theorist who defends any type of model rationality opposite to the complete one.

According to Álvarez (2009, 192), Rubinstein insisted, as Amartya Sen did, that information is one of the central problems of any model of rationality based on its limitations: How to choose what to know becomes problematic for bounded rational individuals. Access to information may be restricted, it may not be free and it is costly to retain.

In this way, the model of bounded rationality will allow, according to Rubinstein (1998, 41), a theoretical framework to refer to deciding agents that systematically do not make "correct" inferences. In addition, within the *timing* of the decision, one can speak of a subject who, if she could anticipate the possession of information, she would be able to decide *ex-ante* (if she decides before having the information) or *ex-post* (if she waits to have the information). According to Rubinstein (1998, 52), within the model of complete rationality, these two moments are not distinguishable.

As for the amount of information, Rubinstein asserts that our intuition seems to favor the idea that the more information we have, the better. Although he also claims that in certain games, the lack of information can be a blessing. In this respect, Rubinstein notes that Gigerenzer's (2008b) idea of heuristic strategies in which choosing not to take into account all the information can help in the objectives of the decision. The maxim of "less is more" refers to the type of processes described here, since in this context the

important thing is not the amount of information that the subject owns, but how the subject decides not to use all the information for the achievement of her objectives. Rubinstein mentions that deciding what to know is a task of a subject with bounded rationality. As we will see later in the section devoted to ecological rationality, these shortcuts can be more effective than the unnecessary accumulation of information, which can lead to erroneous conclusions and undesired results. This is due to several factors, but above all to the "noise" that information carries with it and the cost of obtaining and keeping that information. As Rubinstein (1998, 87) states, the acquisition of information is not a free task, but an expensive one: from transmission to storage.

Memory is an important part of informational knowledge. Rubinstein (1998, 63) claims that this faculty may also commit errors. Memory is defined as the knowledge that the decision maker has about something he knew before. Lack of memory may be due to several factors, including some linked to communication between subjects. Thus, in a decision-making problem with a subject with perfect memory, she is able to remember what she did in the past and the consequences of these actions, whereas when there is lack of memory, this does not happen.

In *ex-ante* considerations, according to Rubinstein (1998, 70), we may have what we previously called dynamic or temporal consistency. In fact, within decision-making problems with perfect memory, a strategy is optimal if and only if it is consistent temporally speaking.

"Modeling Bounded Rationality" also includes criticisms to Rubinstein's work that Herbert Simon sent in a letter to the author after reading the book's preliminary version. Among them is the accusation about the lack of empirical support, experiments, and the idea that no more models are needed, but principles that may help us to explain empirical phenomena (Rubinstein 1998, 187-8). To this end Rubinstein responded that economics may also look for connections (not only principles) between concepts and propositions that appear within economic situations (191).

3.3.12. Final Remarks on Bounded Rationality

The above-mentioned authors represent a small fraction of those who have incorporated the model of bounded rationality into the structure of their theories. The common arguments are found in Simon's criticism of the assumptions of the full rationality postulated by mainstream economics. This was done thanks to the inclusion of psychology in the studies that social sciences about rationality, helping to empirically clarify the actual behavior of rational subjects and with the contribution of experiments.

The clarity with which we can see the limitations of human rationality in these experiments is so overwhelming that we can confidently claim that complete rationality does not appear within such experiments. We cannot deny that our rationality is bounded. So, what are the differences between the authors who follow the model? The differences are not to be found mainly in

the descriptive moment of the facts, that is, in the descriptions about the rational processes in the decision making. The points in which the authors differ are located at an explanatory level of these facts and in the inclusion of them within more complex theoretical frameworks. For example, while Gigerenzer and Rubinstein adhere to the bounded rationality model, the former does so from a general framework based on ecological rationality. Rubinstein, however, "simply" proposes models that can connect propositions and concepts within theory, obviating their ecological nuances and without providing a more general theoretical framework in which such a model fits. The differences between Thomas Sargent and the rest are more obvious since, as we have seen, they are at the heart of the model by stating, within its conclusions, the possibility of an unbounded rationality. There are differences also in regard to what irrational processes are or how we value decisions that come from our bounded rationality. We see, as I mentioned before, two very distinct approaches: one that sees rational limitations as something we have to overcome and with a negative value (this is the case of prospect theory or the case described by nudge theory); and another that sees our bounded rationality as inserted in an ecological environment with specific advantages (Gigerenzer).

The model of bounded rationality has been applied to many disciplines, not only those already seen here like economics, sociology, politics and psychology. Articles focusing on this model have been published in education (O. Lee and Porter 1993; Leron and Hazzan 2006), criminology (Copes and

Vieraitis 2009), mathematics and computer science (Elsadany 2010). They all revolve around the same idea and they are related to decision making.

3.4. Ecological Rationality

3.4.1. Introduction. The Legacy of Herbert Simon in the Heuristics and Biases Research Program and Prospect Theory.

The objective of the following pages is to summarize the theory of rationality of Tversky and Kahneman and how it is related to Simon's model of rationality. I aim at pointing out that although Simon was the antecedent of Tversky and Kahneman's approach, we can find essential differences in the way they dealt with the concept of heuristics and the use of optimization as a normative approximation.

As mentioned before, Herbert Simon's empiricism was the cornerstone of a movement that shifted how social scientists understood our rational processes. By introducing psychological factors and focusing on the

processes of rationality rather than outcomes, Simon made possible for other approaches to follow a more empirical model of rationality.

Other social scientists, therefore, followed Simon's path in introducing bounded rationality in their models to explain how we decide. This originated two different approaches: Some, like Tversky and Kahneman, conceive that our rationality is bounded and those systematic errors mean irrational aspects of it; and others, like Gerd Gigerenzer, who understood that our rationality operates in the context of an ecological frame, and some of those boundaries have to be conceived as ecological advantages if the environment of the decision is taken into consideration.

The first main approach started with the studies conducted by Tversky and Kahneman (Lewis 2016) on how rationality fails under certain circumstances. These authors find that people's judgements when deciding are unreliable and fall short of the standard normative ideals of rationality. This led to what today is known as prospect theory: a study of our heuristic and biases in decision making processes under risk or uncertainty (Tversky and Kahneman 1974; 1979; 1981, 1983). This conception assumes that our rationality has flaws and our objective, in order to become rational, is to eliminate such biases. Our rationality has to resort to shortcuts, called heuristics or rules of thumb, since we "suffer" from bounded rationality (human judgments are limited by available information, time constraints, and cognitive limitations). Heuristics, according to Tversky and Kahneman, sometimes are effective, but other times lead to errors: 'These heuristics are highly economical and usually effective, but they lead to systematic and

predictable errors in certain task situations (Tversky and Kahneman 1974, 1131).

Historically speaking, Tversky and Kahneman's project started as a way to map under the heuristic and biases program how our rationality deviates from the normative standard of expected utility. Then, they later introduced prospect theory, a behavioral economic theory that describes the way people choose between probabilistic alternatives that involve risk, where the probabilities of outcomes are known.

Gigerenzer argues that before Simon, economists assumed that people were motivated purely by self-interest (Gigerenzer and Selten 2001, 3). Simon's introduction of psychology in the study of rationality forced the rejection of that approach, positing at the same time that people are not optimizers.

Since we cannot optimize due to cognitive flaws, Tversky and Kahneman argued that our rationality is imperfect: we are basically irrational. To this end, they studied, for example, the effects of framing in our decisions: the frame in which the decision is given to the subject radically affects her choice; or how people show risk aversion or loss aversion when choosing, etc.

Tversky and Kahneman represented a pessimistic view of human rationality. Their heuristics and biases research program conceived that "people lack the underlying rational competence which make them prone to seriously counter-normative patterns of reasoning or biases" (Niiniluoto, Sintonen, and Woleński 2004, 132). In the pessimistic approach of prospect

theory, the errors were a natural part of our cognitive capabilities. People make mistakes because their reasoning is psychologically defective in a systematic way. To this end, understanding how we are systematically flawed can help us make better choices.

These errors, they posited, are easily encountered in experiments: "The presence of an error of judgment is demonstrated by comparing people's responses either with an established fact . . . or with an accepted rule of arithmetic, logic, or statistics" (Daniel Kahneman, Slovic, and Tversky 1982, 493).

Although Tversky and Kahneman argued that heuristics and biases are something that may separate us from a rational choice, they also acknowledged that in some instances heuristics can be useful: "Kahneman and Tversky have often acknowledged that heuristics are sometimes good and sometimes bad but have never gone a step further to specify when exactly" (Gigerenzer 2015, 375).

According to this, there are two different ways in which rationality can be understood as bounded. As John Davis claims, "two ways in which individuality can be said to be bounded, with one bound associated with Kahneman and Tversky's prospect theory and the 'new' behavioral economics and a second bound associated with Simon's evolutionary thinking and the 'old' behavioral economics" (Davis, 2015).

Simon conceived rationality as inserted in an environment, as co-dependent of the medium in which the subject has to decide. Our

rationality and the environment behave as the two blades of some scissors.

For prospect theory, as we will see, rationality is judged on its own.

For Kahneman and Tversky, individual choices are anchored in but not otherwise influenced by decision-makers' environment in that individuals' preferences are still subjectively defined and not shaped by the world. In contrast, for Simon the autonomous subjective utility function representation of the individual needed to be abandoned altogether [...] Prospect theory locates choice in the world in the sense that choice always occurs in specific circumstances, but in Simon's thinking the world contributes in a more significant way by influencing subjectivity as well since our preferences evolve as a result of our interaction with the world (Davis 2015, 82)

Prospect theory, therefore, is a behavioral economic theory that describes how people decide in situations of risk, when the probabilities are known. Accordingly, people do not judge the outcome of decisions, but the gains or losses using heuristics.

Their seminal paper (D. Kahneman and Tversky 1979) represented a critique of expected utility theory as a way to describe how we decide in situations of risk. Its objective was to criticize expected utility theory for its lack of empirical realism. This purpose was similar to the one Herbert Simon set in motion with his model of bounded rationality. But there was a main difference with Simon, expected utility theory is fine under a normative approach (Simon could not agree to this), but not as a way to describe how we decide: "Contrary to Simon, these researchers argued that there is nothing wrong with the theory of expected utility maximization but that the fault lies with people who do not follow it" (Frantz and Marsh 2016, 37).

Although suboptimal beliefs were not something that Simon had in mind, the idea that our rationality is bounded was common in both approaches. As I mentioned before, Tversky and Kahneman did propose that

our decisions should adhere to the normative ideal of maximization. Anything less would be an imperfect way to reason: "Their research introduced the idea that although rational individuals should adhere to the normative theories of logic, Bayesian updating, and expected utility calculation in their decision making, individuals in fact systematically and predictably deviate from these norms" (Heukelom 2014, 98).

An example of heuristic and biases can be found in how people tend to think that a sample of a group tends to be a representative of the population group in general.

To be clear, although Simon's perspective can be seen as the antecedent of Tversky and Kahneman's approach, there are some essential differences. I already mentioned Simon's rejection of keeping expected utility as a normative approximation. The other difference is found in the way they understood "heuristics": "It is therefore tempting to conclude that Kahneman and Tversky's use of the term somehow derived from Simon. But that would be a mistake [...] Simon used the term in a different way and is moreover not mentioned in Kahneman and Tversky's research of the early 1970s" (Heukelom 2014, 117). For Simon, heuristics were rules of thumb individuals used in order to decide. They are meant to satisfice (not to optimize) our decisions in situations where we do not have all information and our cognitive capability is reduced. On the other hand, Tversky and Kahneman's use of the term referred to a way of organizing the decision problem in order to simplify it. It is a way to make problematic decision more manageable:

in Kahneman and Tversky's account, the individual could not adjust his or her heuristics, as a person could in Simon's approach. The Simon individual might replace his or her initial aspiration price for selling the house with a

lower aspiration price when no bids reach the aspiration level. For Kahneman and Tversky, on the contrary, the heuristics are part of a given, unchanging biological makeup of the individual (Heukelom 2014, 118)

Prospect theory argued that people simplify the decision problem in order to have a better hand at it. This was called *editing phase*: "The editing phase consists of a preliminary analysis of the offered prospects, which often yields a simpler representation of these prospects. In the second phase, the edited prospects are evaluated and the prospect of highest value is chosen" (D. Kahneman and Tversky 1979, 274).

It was important for prospect theory to make sure that the normative approach and the descriptive approach were separated. Their objective was to provide a realistic description of how we decide while keeping maximization as a normative goal. The rules of how we have to use our rationality did not change in prospect theory. They were the same rules as those maintained by classical and neoclassical economics. The difference was that in the description phase, boundaries in the way we use our rationality were admitted.

That would be the main focus of those criticizing their theory. Tversky and Kahneman, simply put, thought that people were irrational. Their approach is being currently used by some policy makers and social scientists under the umbrella of *nudge theory* (Thaler and Sunstein 2009): "Kahneman and Tversky not only attracted a legion of followers in psychology but also inspired a young economist, Richard Thaler" (Fox 2015).

3.4.2. Gerd Gigerenzer: ecological rationality

Gerd Gigerenzer is a German psychologist who studies bounded rationality and heuristics in decision processes. He directs the Center for Adaptive Behavior and Cognition at the Max Planck Institute for Human Development. He is also the director of the Harding Center for Risk Literacy.

The focus of his research is bounded rationality and how, thanks to heuristics, we can act when our information about the environment we operate is limited. Heuristics, the shortcuts humans take to act when our rationality is limited, had been previously seen as a separation from the normative ideal standard of rationality. Gigerenzer's approach criticizes that view, arguing that we are not as irrational as the standard theory wants us to be. Our heuristics had to be understood within the environment where they should act. Gigerenzer, therefore, assumes Herbert Simon's position: Our rationality does not act independently of the environment or medium where it acts. Considering rationality of our cognitive capabilities independently will automatically force us to believe that we are irrational. As mentioned before, Simon's metaphor about an ant on the beach could give a great insight to understand the rationality of our behavior. We must also consider the environment in which individuals decide to explain why they behave in a certain way. Simon explained that if we observe the path of an ant on the beach from point A to point B, we will discover that it is not a straight line. It looks like the ant is behaving irrationally. It is only after we account for the structure of the environment that we can understand that what the ant is

doing is to go around the mountains of sand dealing with the obstacles it finds on her way: "In order to understand behavior, one needs to look not only the brain or mind but also into the structure of the physical and social environment" (Gigerenzer 2007, 76). Gigerenzer's ecological rationality, as Álvarez explains (2009, 185), is based on Simon's bounded rationality.

Gigerenzer develops Simon's idea about the relationship between the environment. Herbert Simon defended this idea in his seminal article *Rational Choice and the Structure of the Environment*:

A great deal can be learned about rational decision making by taking into account, at the outset, the limitations upon the capacities and complexity of the organism, and by taking account of the fact that the environments to which it must adapt possess properties that permit further simplification of its choice mechanisms (1956, 129).

According to Gigerenzer, minds can exploit the structure of the environment for their benefit. In a way, as Bryan Caplan posits, "ecological rationality is the ability to choose sensibly in your natural habitat" (2008, 11).

Focusing on the environment to understand the mind was something that started with Darwin and Brunswik: "More than 50 years ago, Egon Brunswik urged psychologists to study the texture of natural environments and the corresponding structure of cues the mind relies on to infer the state of its surroundings" (Todd & Gigerenzer 2007, 167). Gigerenzer, therefore, does not only based his findings and his rationality model on Simon's approach, he also used Egon Brunswik research on environmental psychology. Brunswik posited that we learn from cues in the environment.

Ecological rationality in a sense is critical of the idea that we should study behavior by attending to personality, cognition, the mapping of the brain or any other interior attributes we may have. Ecological rationality understands behavior as linked to specific environment. The program is descriptive as well as normative, since it also proposes best practices according to the environment. The idea is to exploit the environment with heuristics to better serve our decisions.

Gigerenzer's main objective, therefore, is to study and explain what he calls the "adaptive toolbox" of decision mechanisms of the mind and account for heuristics for inferences and preferences in an experimental and theoretical way (Todd & Gigerenzer 2007, 168) while at the same time studying the ecological rationality of decisions mechanisms. The normative approach was to understand what environments allow specific heuristics to have success or not.

As we saw in a previous section, the standard approach to good thinking was based on Bayes rules, that is, in order to decide correctly, individuals must follow the mathematical prescriptions of Bayes' rules or the maximization of expected utility.

In experimental settings and in real life, as I have been arguing throughout this thesis, individuals do not decide like that. Instead, they seem to make decisions using heuristics. When we make mistakes when deciding, it is not a problem with heuristics per se, rather we should look into how and when the heuristics are used. Heuristics are used in specific environments and they can lead to errors if they are not used in the correct setting. The

idea follows Simon's connection between the environment and our cognitive capabilities. This intrinsic connection force us to see that our heuristic processes cannot be removed and considered in isolation from the environments where they are being used.

In 1974 the *Dahlem Konferenzen* was created in Germany to promote the interdisciplinarity between sciences and to stimulate international cooperation between scientists. Within the *Konferenzen* itself, a special type of forum was started as a model for communication: The *Dahlem Workshop Model*, where ideas are discussed and debated in order to find gaps in knowledge. Gigerenzer and other authors formed a group and published a book: *Bounded Rationality. The Adaptive Toolbox* (2001). Their goal was to "promote bounded rationality as the key to understanding how actual people make decisions without utilities and probabilities" (Gerd Gigerenzer and Selten 2001a) following the ideas of ecological rationality developed by Gigerenzer himself.

Gigerenzer's ecological rationality model provides a framework in which bounded rationality is conceived as a *toolbox*, trying to understand in what way simple heuristics work within that toolbox. It aims at categorizing bounded rationality, from cognition to emotion, including social norms, imitation, etc (Gerd Gigerenzer and Selten 2001a)

Ecological rationality rests on the principles of bounded rationality and conceives the individual as neither capable of optimization, nor with the ability to calculate probabilities. Rationality cannot be optimization or optimization under constraints, as Thomas Sargent posits (Sargent 1993), since this would

understand bounded rationality as a form of optimization in disguise. Bounded rationality is not irrationality either (Gerd Gigerenzer and Selten 2001a). It is not a discrepancy between reason and the normative laws of probability (Gerd Gigerenzer and Selten 2001a). Gigerenzer argues, like Simon did, that any type of bias is produced in the cognitive blade of the pair of scissors, using the metaphor we mentioned before, where one blade is those cognitive capabilities, and the other one is the environment. Bounded rationality cannot be understood, therefore, as an inferior form of thinking. These cognitive limitations don't have to be disadvantages for our decision processes. They can be beneficial if learn how to exploit the environment in which those decisions take place: "A simple heuristic can exploit a regularity in the environment" (Gerd Gigerenzer and Selten 2001a).

Ecological rationality follows the processes of bounded rationality in regard to rules about searching, stopping the search and deciding. The use of heuristics, therefore, instead of relying in the classical approach of consistency and coherence, are fast and frugal. As Gigerenzer posits, "This ecological rationality -the match between the structure of a heuristic and the structure of an environment- allows for the possibility that heuristics can be fast, frugal, and accurate all the same time by exploiting the structure of information in natural environments" (Gerd Gigerenzer and Selten 2001a).

According to this, our bounded rationality is not a suboptimal or irrational behavior, but very practical one and as accurate, or even more, as the standard normative approach based on optimization, probability and bayes rules. Fast and frugal heuristics work, according to this theory, because

they are able to exploit the information of the environment in which the decision takes place.

Both, emotion and culture would play also an important role in our decisions since emotion, for example, may help us apply effective stopping rules when we search for alternatives. It allows us to go beyond the cognitive limitations and use the biological shortcuts that they represent. Ecological rationality sees our culture and the social norms and institutions in which we live as members of a specific society as a factor that may contribute positively in our decisions.

The view of emotions as not separated from cognition was something the Simon defended as well: "A behavioral theory of rationality, with its concern for the focus of attention as a major determinant of choice, does not dissociate emotion from human thought" (Herbert A. Simon 1983).

To this end, Gigerenzer understands emotions as one of those evolved capabilities that we have thanks to natural selection. Together with our culture, they help us learn better: "Flexible rules of thumb allow us to use imitation in an environmentally sensitive way" (Gerd Gigerenzer 2007a).

Brian Jones argues that emotions help us direct our attention to what is important: "Emotions highlight what is important; they are critical in setting priorities. More than that, they are critical in problem-space representation. Emotions act as the gateway to our short term memories." (Jones 2001).

Emotions may also help us in economic environments, as John Conlisk argues: "Some economists argue that inherited emotions and social norms (anger, embarrassment, sensitivity to relative position, loyalty, altruism) can

improve economic performance in ways outside the scope of standard theory. For example, loyal individuals cooperate better, and a person who involuntarily blushes at a lie is better able to win trust" (1996). Simon, distinguishing between emotions and intuition (1987), claimed that while intuitions can be beneficial, emotions may sometimes lead individuals to irrational behavior. The way some social scientists talk about emotions can be confusing, since they might sometimes refer to intuitions.

Emotions are a crucial part of our decision making process. From an empirical point of view, emotions cannot be disregarded, they are fundamental. According to Jonah Lehrer "When we are cut off from our feelings, the most banal decisions became impossible. A brain that can't feel can't make up its mind" (2009, 15).

Simon argued that we can only be rational about things that come to our attention. Emotions play an important role about that. Bounded rationality provided a way to go beyond the dichotomy between reason and emotion (Mumby and Putnam 1992). The view of rationality by the standard approach of classical and neoclassical economics tried to explain emotional disparities and incoherences as deviations. In order to be rational, it was argued, individuals must be coherent and consistent and emotions, since they are not a source of consistency, had to be "control". When our emotions guide our behavior, the standard economic approach considered them as a separation from the normative ideal of rationality. The bounded rationality model first and the studies on ecological rationality later on gave emotions another role. Ecological rationality see emotions in general and gut feelings in particular as

an effective way to behave if we are able to match them with the environment where they are in fact effective. That is the argument of ecological rationality. Since our cognition and our decisions cannot be segregated from the environment, it makes sense not only to understand how we decide, but also how is the environment in which our decisions take place. Emotions, therefore, are not a source of irrational behavior according to ecological rationality.

This also contradicted Tversky and Kahneman's approach, who saw emotions as a source for our bias and prejudice. Prospect theory posited that we are systematically bias. Emotions play a fundamental role in how we fall short from that ideal rationality that is prescribed by the standard theory. Ambiguity aversion, for example, is an emotional response the should be avoided and control. But for ecological rationality, ambiguity aversion has a specific function in a determined environment. In that environment, ambiguity aversion is beneficial:

Optimal foraging models also prove relevant for understanding the origins of other interesting "anomalies" in preferences that are consistent with prospect theory. For example, ambiguity aversion, whereby people prefer options with stated probabilities to those without them—even when both options hold the same expected value—can be explained from this perspective. Rode et al. (1999) suggest that people avoid unknown probabilities because they tend to co-occur with high variance in outcome (McDermott, Fowler, and Smirnov 2008).

Ecological rationality argues that there is no way to avoid emotions and that we need to check the environment in which they are efficient. A monistic approach about our decisions (like the one done by standard economics, in which rationality is only view "internally") doe not fully grasp the efficiency of

gut feelings and certain emotions since the environment in which they are effective is removed from the equation.

Analyzing the ideal individual prescribed by traditional economics leads us to a subject that lacks personality, emotion, etc. If, as economics wanted us to believe, we are self interested utility maximizers that optimize, all sign of emotions, values, and personality had to be removed. Only after that economy can explain the behavior of economic agents (Ng and Tseng 2008). Ecological rationality not only provides an empirical explanation of emotions and gut feelings and how they are part of real individuals that behave and decide, it also gives a normative approach to how our emotions may be effective depending of the environments in which they are used.

Standard economic models of human decision making (such as utility theory) have typically minimized or ignored the influence of emotions on people's decision-making behavior, idealizing the decision-maker as a perfectly rational cognitive machine. However, in recent years this assumption has been challenged by behavioral economists, who have identified additional psychological and emotional factors that influence decision-making (1, 2), and recently researchers have begun using neuroimaging to examine behavior in economic games (Sanfey et al. June 13 , 2003).

Mainstream economics argued that if optimization was able to predict and explain behavior, there was no need to include anything else (emotions, for example). That was Friedman's view as it is explained by Gigerenzer (Gerd Gigerenzer 2008b). But if we have to provide a realistic description of our decision processes, emotions have to be explained. In game theory, for example, in the ultimatum game, the use of emotions is crucial in order to understand some of the reasons of our behavior. It is the empirical need to

provide a realistic approach of economic decisions that pushes scientists to include emotions: "Therefore, not only do our results provide direct empirical support for economic models that acknowledge the influence of emotional factors on decision-making behavior, but they also provide the first step toward the development of quantitative measures that may be useful in constraining the social utility function in economic models" (Sanfey et al. June 13, 2003).

When emotions are included in the explanation of our decisions processes it is necessary to acknowledge that they may be decision shortcuts to help us survive, but for decision theory under the standard approach, they may also represent a problem, since they may separate decision makers from their utility maximization:

From the perspective of evolutionary psychology, the emotions are brain functions that are involved in survival: The emotions evolved because of their evolutionary success in maintaining the survival of the individual and the species. But reliance on the emotions in decision making may also lead us to make decisions in ways that are not beneficial to utility maximization (Levin and Aharon 2014)

Simon already warned us in *Reason in Human Affairs* (1983) that for an accurate description of our behavior under a bounded rationality model, emotions had to be explained. The role of emotions can be ecologically adaptive. "The emotions evolved because of their evolutionary success in maintaining the survival of the individual and the species. But reliance on the emotions in decision making may also lead us to make decisions in ways that are not beneficial to utility maximization" (Muramatsu and Hanoch 2005). As Simon posited, emotions help us direct our attention – they distract us from

our current thoughts and actions and drive our attention to activities that need our immediate attention. There is a clear role for emotions in learning. According to this, "an emotion amounts to a content- and domain-specific processing system that is activated if and when certain sensory and conceptual inputs are met" (Muramatsu and Hanoch 2005).

From the ecological rationality approach, and since this conception explains how some heuristics are practical for our decision making strategies according to the different environments, emotions will play a similar role. There will be specific conditions in which emotions will lead to effective behavior. Understanding this connection and the way emotions and cognition interact allows us to explain how rationality works in a more robust and empirical manner.

For ecological rationality, our emotions will activate specific processes enabling our heuristics. If these heuristics are matched with domain specific environments, they would be very effective: emotions act as "activators of domain-specific heuristic processes that lead to quick and adaptive decisions [...] When the detector system perceives an ecologically important threat or opportunity, a specialized emotion program will be activated" (Muramatsu and Hanoch 2005). In a way, emotions start information-processing activities that enable (and they are precedent of) actual decision making behavior. They emphasize cues in the environment by calling our attention towards them while stopping something else we are doing or thinking about. Emotions may precede cognitive activity, since our focus is directed to thee cue of the environment we should concentrate in.

Accordingly, emotions are not disruptive in our path towards rational behavior, they rather have a positive value (Etzioni 1999). The effectiveness of using the emotions as guiding our behavior is to make sure we realize the environment in which we are when we decide. That is what ecological rationality adds to the debate about the role of emotions in decision processes. Once we identify the environments in which specific emotional reactions are effective, we can explain and predict the best or most rational path for our actions.

Conceiving emotions as linked to heuristics (Szigeti 2012) allows us to use the ecological rationality model to prescribe effective behaviors. Heuristics are the cornerstone of ecological rationality since they may be used, under specific environments, to rational decisions under uncertainty. When Tversky and Kahneman started to use the term to talk about decision theory, they did it in a negative way, as something that would separate us from the ideal standard of rationality: "These heuristics are highly economical and usually effective, but they lead to systematic and predictable errors" (Amos Tversky and Kahneman 1975).

Gigerenzer's approach provided, as we saw before, a positive explanation under explicative and normative conditions of heuristics: they can be effective. Simon introduced this idea with satisficing. He considered that heuristics are a great way to decide when our rationality is bounded: "When people don't know how to optimize, they may very well be able to satisfice, to find good enough solutions. And good enough solutions can often be found by heuristic search through the maze of possibilities" (Herbert A. Simon 1991).

Heuristics are rules of thumb mechanisms adapted to the environment we live in and they "go beyond the information given" (Gigerenzer 2007). According to Bryan Jones, they simplify the decision process by allowing the problem space to be reduced to a manageable size and by simplifying the search for solutions (Jones 2001).

Heuristic processes can lead us to the same solution, or even better, than if we have full information about our decision. They are conceived as a type of behavioral shortcut to reduce some of the costs we get from obtaining and managing information (Jones 2001; Robles 2005) or strategies that help us "navigate" (Gerd Gigerenzer and Todd 1999) difficult and complex situations. This is even clearer in social environments, where our strategies to decide rationally are faced by other strategies by other agents with different purposes. Social environments are complex environments in which heuristics are and should be broadly used. Our decisions in social environments, for example, cannot be based only in observable behavior of other people, we must also consider information that is not available or that may be even impossible to gather (Gerd Gigerenzer and Todd 1999). Under these conditions, the idea of maximization is realistically impossible. We usually cannot optimize in complex social environments. The best way to behave is by using simple heuristics. Since the complex environments in which we have to decide don't allow us to maximize, the best strategy would be to use fast and frugal heuristics. These heuristics do not sacrifice accuracy, on the contrary, they are as efficient, or even more, than strategies that use more information or manage more complex calculations, like Bayesian statistics.

The ecological rationality of fast and frugal heuristics would be based in the correlation between these strategies and the specific environments they are matched with. Each heuristic has as a specific situation in which should be apply so it can be effective. Treating heuristics and biases on their own, without the environment in which they make sense, will move us away from a realistic approach to decision making. From the ecological rationality perspective, environments and strategies are matched to develop a normative theory about rationality without postulating an idealistic unreal olympian individual with full knowledge and infinite calculative capacity, or an individual that is basically an irrational fool. We not complex maximizers, but we are not idiots either.

Heuristics, therefore, serve to find out or discover developing strategies like "looking around" (Goldstein and Gigerenzer 2002) or choosing the most famous company when deciding what stocks we should have in our portfolio. Heuristics exploit the structures of the environment to develop efficient strategies for our decisions. This strategies have evolved, biological and psychologically speaking, and they are simple and powerful enough to be even more efficient that other types of strategies. The advantage is to use fewer cues from the environment, reducing the cost of deciding, and increasing the efficiency exploiting the environment itself in which our decision takes place. "Ecological rationality appears when the structure of boundedly rational decision mechanisms matches the structure of information in the environment" (Todd and Gigerenzer 2012). Accordingly, we are behaving

ecologically rational if our behavior is adapted to the structure of the environment, boosting our performance by exploiting it.

Fast and frugal heuristics are a mechanism built with rules to search and gather information about a specific problem and a solution; they also help us deciding when to stop searching for information, so we can be effective (Simon's aspiration levels). Heuristics will create simple decision strategies that considered the previous rules. They form a type of "adaptive toolbox", as Gigerenzer calls it, that evolution has shaped in our minds.

Heuristics can be divided in different classes depending on how they simplify the process of deciding:

1. Ignorance based decision making, like the recognition heuristics, which "exploits the basic psychological capacity for recognition in order to make inferences about unknown quantities in the world" (Gigerenzer and Goldstein 2011, 100).
2. one reason decision rules, which help us, for example, decide between choices by selecting the best alternative (take the best).
3. by elimination, which narrow the possibilities to a manageable decision environment.
4. satisficing, which help us narrow down possibilities.

Ecological rationality proposes, like the heuristic and biases program and prospect theory, that our rationality is bounded, but it does not think that this is an irrational behavior that leads to inefficient outcomes in our decisions. On the contrary, our bounded rationality may have evolved as an adaptive

strategy, beneficial and efficient. Heuristics could be an example of this efficiency. In the *less is more* scenarios, for example, "fast and frugal heuristics can turn missing knowledge into predictive information" (Plott and Smith 2008). Or, as K. Katsikopoulos claims (2010, 244), less information can lead to more accuracy.

Acquiring and keeping information may be costly when we have to decide in complex environments. Possessing some type of toolbox that helps us, with fast and frugal heuristics, may increase the efficiency even more than if we were to have all information. In situation where knowledge is scarce, heuristics help us to arrive at better decisions, considering the specific environments where we have to apply them. Goldstein and Gigerenzer assert that missing knowledge could be a tool to obtain predictive information:

Missing data are often considered an annoyance [...] Can a lack of knowledge be useful for making accurate inferences? It can be when using the recognition heuristic, a simple rule that exploits not abundant information, but rather a lack of knowledge [...] Following the heuristic, a person who has heard of Detroit but not Milwaukee would infer that Detroit is larger. For inferring which of two objects is greater on some criterion, the recognition heuristic is simply stated: If only one of a pair of objects is recognized, then infer that the recognized object has the higher value on the criterion. As opposed to an all-purpose tool like a linear model, the recognition heuristic is domain specific. Instead of being unboundedly rational, it is ecologically rational, that is, reasonable with respect to some environments but not others. There are domains in which the recognition heuristic will not work. A wise organism will only apply the rule in domains where recognition is strongly correlated with the criterion. (If this correlation is negative, then the rule should be reversed, and the unrecognized object should be chosen.) There are situations in which the recognition heuristic cannot be applied, for instance, when all objects are recognized. There are domains in which people will not apply it, for example, when they suspect that they are being asked a trick question. And there will be individual differences: different people use different heuristics at different times. Nonetheless, the very simple rule can make very accurate predictions from very little information, as we shall see (Plott and Smith 2008).

This adaptive toolbox emanates from an evolutionary approach in which the mind is conceived as composed by heuristics. While its study is descriptive and involves the analysis of the relationship of our heuristics with the environment, the study of ecological rationality is also prescriptive: it provides normative theories predicting the success or failure of these heuristics when they are applied to specific environments.

Heuristics are frugal in the sense that they ignore part of the information. They do not try to optimize: not only because of the impossibility of optimization as we have seen through the model of bounded rationality and the heuristic and biases research project, but also because it may be more efficient to ignore part of that information. Heuristics, instead of optimizing, they satisfice, in the Herbert Simon sense of the word. They find good enough solutions.

According to Gigerenzer (2008c) there are a series of misconceptions about heuristics, starting with the idea that they produce second best results. From an empirical perspective, in most scenarios optimization is impossible, so it is crucial to see in what way heuristics may be efficient. Although our minds do not rely on them because they are limited, it is possible that they represent an advantage, from an evolutionary perspective. He claims that they are useful not only in routine activities, but also in complex and very important scenarios (medical field, economics, etc). They are used by people with different cognitive capacities.

Gigerenzer asserts that heuristic models are able to predict and explain in a robust manner decisions we make (2008c). These models have

shown that more information does not always mean a better and more efficient outcome: some times, less is more (Gerd Gigerenzer 2007a).

Gerd Gigerenzer research shows a wide area of scenarios where heuristics may be applied and how robust this research is. Heuristics work in investment behavior (Gerd Gigerenzer 2008c), health care (Marewski and Gigerenzer 2012; Wegwarth, Gaissmaier, and Gigerenzer 2009), law (Gerd Gigerenzer and Engel 2006), in morality through our intuition (Gerd Gigerenzer 2008a).

The use of heuristics is also applied in the scientific world. When scientists conduct their research, formulate theories, etc. they also behave as satisficers and heuristic processes guide their behavior. They cannot maximize. In "Models of my Life", Herbert Simon maintained that scientists view discoveries as a problem solving scenario: "It views discovery as a problem solving; problem solving as a heuristic search through a maze; and heuristic search as the only fit activity for a creature of bounded rationality" (Herbert A. Simon 1991). These rules of thumb, as Gigerenzer calls them (2007), are not only used in simple scenarios of our daily lives, they are also used in complex situations like those faced by scientists. Heuristics are used not only for their simplicity, but also due to their efficiency. They are adapted mechanisms to the world we inhabit, even if this world or environment is a laboratory, a traffic jam, or a store. They are used (explanatory aspect of ecological rationality) and they should be used (normative approach) in those environments where they are effective. This simplification may be related, for example, to the elimination of alternatives to choose from:

An individual chooses among alternatives, not by comparing alternatives in all

their aspects at once, but rather by the heuristic of comparing alternatives one randomly chosen aspect at a time, eliminating alternatives along the way. Heuristics are rational in the sense that they appeal to intuition and avoid deliberation cost, but boundedly rational in the sense that they often lead to biased choices (Conlisk 1996).

For example, the recognition heuristics will not be effective if the person deciding is an expert on the matter that affects the decision. Understanding how these heuristics match specific environments is at the cornerstone of the normative approach of ecological rationality. Their effectiveness relies on that match with the environment. Heuristics are simple because they simplify the decision by limiting the problem space or the search of solutions (Jones 2001).

John Conlisk claims that most psychologists view heuristics as a source of bias (Conlisk 1996). Tversky and Kahneman share this negative approach, since they argue that these heuristics lead decision agents to systematic errors in rational behavior. While both tendencies (Tversky and Kahneman's heuristic and biases research project and Gigerenzer's ecological rationality) acknowledge the existence of bounded rationality and heuristics, they both see them in opposite directions, as mentioned in previous pages. Heuristics represent a challenge to rational choice, but it facilitates agents to arrive at choices (Conlisk 1996; Weyland 2006). In this facilitation, Gigerenzer claims that we increase efficiency and accuracy, while Tversky and Kahneman sustain a pessimistic approach: "people lack the underlying rational competence which make them prone to seriously

counter-normative patterns of reasoning or biases" (Niiniluoto, Sintonen, and Woleński 2004).

This pessimistic approach does not deny that heuristics may provide the right answer, they sometimes do. But in some scenarios, they do not. For ecological rationality and some evolutionary psychologists like Leda Cosmides and John Tooby, claim that understanding these scenarios or environments is the key to understand their effectiveness. They reject the pessimistic view of rationality "arguing that the evidence for human irrationality is far less compelling than advocates of the heuristics and biases tradition suggest" (Niiniluoto, Sintonen, and Woleński 2004). Ariel Rubinstein argues that our intuition may consider an advantage having more information, but in different scenarios that is not the case (Rubinstein 1998). Psychologists, like Egon Brunswik, joined those who believe that our heuristics can be successful by exploiting the resources of the environment (Gerd Gigerenzer 2002).

In ecological rationality, the exploitation of the environment is an adaptation. Sometimes, this adaptation can be related to how our mental processes represent information or how they adapt to the structure of information in a given environment, similar to how our vision is adapted to the slight spectrum of the sun. (Gerd Gigerenzer 2002).

3.4.3 Conclusion

During the last two sections, my attempt was to show in what way Herbert Simon's connection between the environment and our decisions was in part the basis for the research conducted by Tversky and Kahneman on the one hand, and Gerd Gigerenzer on the other one. The idea that our

capabilities to decide are shaped by the structure of the environment in which they take place has influenced much of the theoretical frame of the research conducted by current behavioral economists. That approach that connects environment and decisions will be constant in some of the different approaches to rationality, even if these approaches are immersed in debates about the meaning or essence of rationality (Richard Samuels, Stich, and Bishop 2002), like the conflict between the heuristic and biases research program and Gerd Gigerenzer, they all show commonalities based on ecological rationality and the connection fathered by Simon.

The next chapter will focus on the discussion between those perspectives. It will start with a revision of Simon's postulates with the objective of shedding light, not only on the debate about rationality, but also on Simon's influence in those current perspectives.

4. HERBERT SIMON, ECOLOGICAL RATIONALITY, AND NUDGE THEORY

4.1. Introduction

Standard economics presupposed a vision of rationality far from reality in which agents with an infinite capability to calculate were able to maximize in order to arrive at the best decision possible. Herbert Simon, criticized the lack of realism of this approach and claimed that individuals behave with bounded rationality (Herbert Alexander Simon 1982), and not with the perfect one prescribed by classical and neoclassical economics: when we behave, instead of maximizing, we satisfice. Simon's ideas were parallel to those of Amartya Sen. His "rational fools" (A. K. Sen 1977) concept described in similar terms the limitations of the standard theory of rationality. In order to provide a more realistic description of the decision processes in economic theory, Simon used psychology. This collaboration between both sciences originated a movement followed by other authors. In this line of thought, Tversky and Kahneman (1974), researched our heuristics and biases and argued that when deciding rationally, we fail to do so in a consistent and systematic manner. Nudge theory (Thaler and Sunstein 2009), continuing the steps of the heuristics and bias program research, claimed that we can exploit these "errors" to our benefit: we can "nudge" agents to achieve better outcomes in their decisions (judged by the own individuals) by affecting the choice

architecture or environment in which they have to decide. The goal, therefore, is to influence the motives, incentives and decision making of groups and individuals to increase the efficiency of our decision.

Nudge theory has been accused of being a type of manipulation under the consent of the people (Wilkinson 2012) or even without their consent, creating a problem to our autonomy with ethical consequences (Grüne-Yanoff 2012). Some also claim that nudges are not really efficient (Gerd Gigerenzer 2015).

Gerd Gigerenzer, using Simon's metaphor to understand our rationality as a pair of scissors (one blade is our cognition or mind and the other one the environment) posits that in order to increase the robustness of our theories about rationality we cannot forget or dismiss the role of the environment: exploiting the structures of the environment and matching them to our heuristic processes can be more efficient than having full information. To this end, Gigerenzer argues that ecological rationality does not only provide a more accurate description of our decision processes, but it also can give a normative approach.

This debate only occurs at an instrumental level. I claim that taking values into consideration when understanding decisions can shed new light, clarify, and enrich some of the arguments of the discussion in general and in regard to autonomy and efficiency in particular. We are not only bounded rational agents, we are also axiological (Weber 1978b). Our values are part of our decisions. As Raymond Boudon (2003) claims: we have reasons to do what we do.

Herbert Simon defended an empirical epistemology throughout his academic life (Hortal 2017). This empiricism took him to criticize the basic assumptions about rationality posited by the standard version of economics. Ever since Simon provided a model about rationality that gave a more realistic description of the decision processes of economic agents, a myriad of theories appeared following the same type of research approximation. During this same period, Hungarian born American psychologist George Katona researched the psychological foundations of economics claiming that: "economic processes stem directly from human behavior and that this simple but important fact has not received its due in modern economic analysis" (Katona 1951, iii). This was the beginning of what later was known as the behavioral revolution (Shiller 2005). Some (Angner E 2007) considered Simon and Katona as part of the "old behavioral economics". The new behavioral economics started with the work of Tversky and Kahneman. Prospect theory and the heuristic and biases research program conducted by these authors in the field of psychology viewed agents with limited rationality erring systematically. In their first research article Tversky and Kahneman wrote together (A. Tversky and Kahneman 1971) they examined these systematic errors in the "causal statistical judgements of statistically sophisticated researches" (D. Kahneman 2002, 450). The key concept they used in their research is "systematic". This regularity allowed the possibility of predicting and explaining these errors that cause our "separation" from better decisions.

Richard Thaler and Cass Sunstein (2009), following the line of Tversky and Kahneman in regard to our systematic errors and our irrationality, claim

that by altering the choice architecture in which agents decide, we would be able to increase the efficiency of those decisions and rational outcome. A nudge "is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives"(Thaler and Sunstein 2009, 6). *Nudging* people to achieve the best outcome, as it is considered by themselves, can be done if we understand our biases and the choice environment is altered accordingly. In nudge theory individuals are prone to make better decisions. No decision setting is neutral, someone or something must always act as a choice architecture. This makes a very powerful argument for nudges. Since something or someone must always organize the structure of the environment in which we decide, why not doing it with a purpose?

Gerd Gigerenzer shared with Thaler and Sunstein the same conceptual idea about our rationality: we are bounded rational agents. But he claims that bounded does not mean irrational. Bounded rationality is not irrationality, neither a type of optimization under constraints (Gerd Gigerenzer and Selten 2001b, 4). Although both perspectives are based on Simon's idea, they both differ in how that idea is interpreted. As Rüdiger Pohl explains (2012, 1), it is undisputed that our rationality makes mistakes and that our memory and cognitive capabilities are limited. Thaler and Sunstein, as Kahneman and Tversky did before, maintain that humans "predictably err" (2009, 8). This is known as the *pessimistic* approach (R. Samuels, Stich, and Bishop 2012). The *optimistic* view would be the one held by Gigerenzer and the ABC group. Andrea Polonioli explains:

Whereas the pessimistic view claims that people tend to systematically commit reasoning errors, the optimistic perspective offered by ABC tries to downplay the significance of the psychological findings supposedly revealing irrational behaviour by suggesting an 'adaptive thinking approach' to decision making that focuses on the goals behaviour can attain, rather than on the rationality of beliefs. In order to support this alternative view, ABC scholars have presented evolutionary arguments against the normative theories of decision and choice, suggesting that 'the bias lies not in the behaviour but in the normative criteria used', as 'organisms did not evolve to follow a mathematically tractable set of principles—rather, natural selection favoured decision strategies that resulted in greater survival and reproduction' (2016, 288)

The way we think, memorize, and decide has flaws. But it all depends with what type of ideal we are comparing our capabilities with. The following pages should clarify some aspects of the debate and the role of Herbert Simon.

4.2. Revisiting rationality

I aim here at explaining Herbert Simon's role in the debate between ecological rationality and nudge theory. The concept of rationality will be at the center of the dispute, not because of the disagreements about the concept itself (the different sides agree that our rationality is bounded) but about the meaning of that model. Although some authors (R. Samuels, Stich, and Bishop 2012; Polonioli 2012) have denominated the two perspectives as the heuristic and biases research program and the evolutionary psychology perspective, I find the terms "pessimistic" and "optimistic" more relevant for the type of analysis conducted here. Those terms have been widely used before (Richard Samuels, Stich, and Bishop 2002; Nichols and Samuels 2016).

What connects Simon's criticism of mainstream economics with the heuristics and biases research program and ecological rationality is the model of bounded rationality. Both sides of the debate have the chore claim, following the Simon's approach, that our rationality is bounded and they both conceive rationality under a means-end schema. That approach is not a separation from previous researchers: the instrumental view of rationality is considered the default view.

Here I argue that although both perspectives are based on the model of bounded rationality, the philosophical meaning of both theories is different: what it means for ecological rationality to be bounded confronts the view of the heuristic and biases research program. The following pages will clarify this point.

4.2.1. The standard approach.

In the following paragraphs I summarize some of the main points I made before about mainstream economics' view on rationality and Simon's criticism.

Nowadays it is evident that economic science has based its research and postulates on vision of human rationality that was far from the reality of human decisions. The rationality of mainstream economics was based on an agent that had an infinite cognitive abilities, unlimited memory and an impressive calculative power, all that to be used in order to maximize the outcome of our decisions:

We need to replace the global rationality of the economical man with a kind of rational behavior that is compatible with the access to information and the

computational capacities that are actually possessed by organisms, including man, in the kind of environments in which such organisms exist (Herbert A. Simon 1955, 99).

As mentioned before, Simon's empiricist approach (Hortal 2017) pushed for a revision of this model and forced the introduction of psychology to any research or theory conducted about our decisions as economic agents. Anything different would be an unrealistic description of how we really behave.

Broadly stated, the task is to replace the global rationality of economic man with a kind of rational behavior that is compatible with the access to information and the computational capacities that are actually possessed by organisms, including man, in the kinds of environments in which such organisms exist (Herbert A. Simon 1955, 99).

Once Simon started to provide a more empirical approach to the research conducted on these issues and introduced psychology as a science he criticized economics for its lack of evidence about the rationality model proposed in their theories. The type of rationality showed by the economic agent at the center of the decision theory of mainstream economics did not exist, it was a fantasy (Herbert A. Simon 1959, 272). Optimization is just an ideal, we can only satisfice: "The real economic actor is in fact a satisficer, a person who accepts 'good enough' alternatives, not because less is preferred to more but because there is no choice" (Herbert Alexander Simon 1996, 29).

Simon claimed that in order to have a realistic explanation about the way we decide we have to use a model of procedural rationality, rather than the substantive rationality approach of mainstream economics. Procedural rationality was born in psychology to describe the actual processes of our

behavior while the substantive view was held by economics (Herbert A. Simon 1976b, 130). Substantive rationality (used for the achievement of goals) is used, according to Simon, in simple situations when a clear decision can be made. In other complex situations, we use procedural rationality:

We expect substantive rationality only in situations that are sufficiently simple as to be transparent to this mind. In all other situations, we must expect that the mind will use such imperfect information as it has, will simplify and represent the situation as it can, and will make such calculations as are within its powers (Herbert A. Simon 1976b, 140).

The attention to the processes (procedural) rather than the outcomes (substantive) in Simon is linked to his Bounded Rationality, a term coined by Simon in 1957 in his work *Models of Man* (Barros 2010), but previously drawn in different articles (1955; 1956).

4.2.2. Revisiting the critique: Herbert Simon's Bounded Rationality

It is currently known and accepted that during the first half of the twentieth century economics as a science centered its theories on an individual that was capable of maximizing her rational decisions thanks to her infinite calculative and memory capabilities. It had to face the criticism from those, like Simon, who accused it of being empirically not grounded. Simon claimed that mainstream economics worked in a way that avoided empirical experimentation or, at least, considered it as a last resource:

Economists tend to start with some global theoretical assumptions as if they were handed down from the mountain by Moses, and then they reason from them. If the world doesn't fit the assumptions, or you have a hard time with the regression results, so much the worse for the world. Economists don't start at the other end of the discovery process with some new phenomenon out there, which they ought to explain, and then first try to find some descriptive explanations and then identify a mechanism that would produce this [...]

Economists are quick to defend the belief that humans are rational. But you can only determine whether certain behavior is rational if you study that behavior in the context of certain premises or assumptions about the environment in which the behavior takes place, or in the light of the goals that the individual is looking to achieve, and also the means for computing or calculating how the goals can be achieved (Herbert A. Simon and Bartel 1986, 19).

Simon's empiricism pushed his research to talk about procedural rationality which is the rationality used by psychologists (Herbert A. Simon 1976b) to explain our rational processes. Simon uses the term "classical" (Herbert A. Simon 1976a, 66) or "neoclassical" (Herbert A. Simon and Bartel 1986, 19) to criticize this type of mainstream economics that assumes an individual with certain non-existent capabilities in order to make a theory more "elegant", but failing to provide a realistic description of actual behavior.

Simon claimed that the use of psychology (or procedural rationality) increased after 1950's (Herbert A. Simon 1976a, 65) looking for a more realistic explanation of economic phenomena abandoning the rational postulate of mainstream (classical or neoclassical) economics. Once economics looked at individuals in the same way psychology did, they observed that their rational processes did not match with those claimed by the standard approach. To this end, Simon coined the term "bounded rationality" to highlight the limitations we have when deciding:

The term 'bounded rationality' is used to designate rational choice that takes into account the cognitive limitations of the decision-maker - limitations of both knowledge and computational capacity. Bounded rationality is a central theme in the behavioural approach to economics, which is deeply concerned with the ways in which the actual decision-making process influences the decisions that are reached (Herbert A. Simon 1990, 15).

A new way to practice economics appeared thanks in part of Herbert Simon's contribution. My objective is not to analyze in detail the criticism itself and in what aspects mainstream economics had empirical flaws. The main objective is to trace a line that will help us understand the role of Simon in today's debate between ecological rationality (or the evolutionary psychology approach) and the heuristic and biases research program as it is manifested in nudge theory. To this end, the next section will be devoted to understand the role of the environment in Simon's approach and how it affected any future research on bounded rationality. I claim that bounded rationality and the connection of our cognitive capabilities with the structure of the environment are both similar core claims in both perspectives of the debate. Their role in rationality and decision theory is considered similarly and it is parallel to Simon's explanation. Understanding Herbert Simon position about the role of the structure of the environment is necessary to see his influence in the debate. Let's see.

4.3. The controversy: Ecological Rationality and Nudge Theory

4.3.1. Simon and the role of the environment

Herbert Simon claimed that it was impossible to conceive our cognitive capabilities as separated from the environment in which they take place (H. A. Simon 1956). Organisms adapt the environments well enough to satisfice. In

general, we cannot optimize: "Since the organism has neither the senses nor the wits to discover an 'optimal' path, we are concerned only with finding a choice mechanism that will lead it to pursue a 'satisficing' path, a path that will permit satisfaction at some specified level of all of its needs" (H. A. Simon 1956, 270–71).

Simon claimed that the definition of rationality had to be extended to the environment what the knowledge we have about it. The environment in which we decide, therefore, belongs to our rationality and Simon considered it under to views (Herbert Alexander Simon 1982):

- The objective environment in which we live and decide
- Our subjective that we perceive and that it is the basis for our decisions

This distinction forced us to ignore if subjects are acting rationally or not since, as it will be explained later on, all economic actors have reasons to act in a specific way. The way we see this environment may be dramatically different from the actual world in which we have to behave: "the perceived world is fantastically different from the 'real' world. The differences involve both omissions and distortions and arise in both perception and inference"(Herbert Alexander Simon 1982, 2:342).

Part of the reason why we are boundedly rational agents, Simon posited, is that our perceptions act as filters of the environment. To our cognitive limitations Simon adds the limitations of the environment itself as it is part of our rationality, and "in complex situations there is likely to be a gap between the real environment of a decision (the world as God or some other

omniscient observer sees it) and the environment as actors perceive it" (Herbert A. Simon 1978, 8).

The environment, therefore, acts on our decision since our perception of it alters how the choice is presented. According to Simon, It will be the objective environment the one we adapt to:

The outer environment determines the conditions for goal attainment. If the inner system is properly designed, it will be adapted to the outer environment, so that its behavior will be determined in large part by the behavior of the latter, exactly as in the case of 'economic man'. To predict how it will behave, we need only ask, 'How would a rationally designed system behave under these circumstances?' the behavior takes on the shape of the task environment (Herbert Alexander Simon 1996, 12).

Simon best explained this with the metaphor about scissors I have been mentioning: "Human rational behavior (and the rational behavior of all physical symbol systems) is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor". According to this view, there is a match between our cognitive strategies and the structure of the environment. If we want to understand the behavior of an economic agent, it is not enough to look at the cognitive capabilities of the individual, we should also look at the structure of the choice environment in which she is deciding. Simon also uses the example of the ant on the beach sand. If we just look at the movements of an ant that goes from point *a* to point *b* without attending the sand she walks on, we will be considering her behavior rather irrational since she will not be taking a straight path. Considering the mountains of sand as one of the blades, would make us understand her choices. To this end, the path's complexity is not the

complexity of the ant's choices but how she responds to the environment (Frantz and Marsh 2016).

The implications of this approach are double fold: Descriptive and normative. In order to explain how rationality works we cannot dismiss the environment in which it takes place, so if we would also like to provide some type of normative theory about efficiency or about how to be "more" rational, our theory cannot forget the inclusion of the environment.

Herbert Simon's proposal conceived rationality as bounded due to internal and external factors. Simon claimed, to this end, that procedural rationality, the one described by psychologists, is the view that would best fit a realistic interpretation of our decision. A realistic description of our decisions allowed Simon to see that we cannot optimize, we satisfice: we cannot do the best, just good enough (due to these boundaries).

Bounded rationality will be the foundation of two different "cultures" of rationality (Katsikopoulos 2014): Tversky and Kahneman's heuristic and biases research program (with nudge theory as its current practical version), and Gigerenzer's ecological rationality (or the evolutionary psychology of Tooby and Cosmides).

Tversky and Kahneman, following Simon's perspective on bounded rationality, argued, in an opposition to mainstream economics, that we were prone to systematic deviations from rationality standards. Next section will consider this view.

4.3.2. Tversky, Kahneman, and the "systematic errors"

By the 1970's, it was already clear that classical and neoclassical postulates about rationality did not match the results of the experiments. Our rationality shows deviation from the standard normative procedure.

There are two different types of deviation:

- Individuals may have a subjective perception of the environment that, although making their behavior rational according to their values, the outcome is far from rational (or efficient). Decisions are rational since they are consistent with our values and view of the world, but they are "irrational" from an efficiency perspective. During the second half of the twentieth century Ward Edwards researched these types of deviations (Heukelom 2014, 87).
- Individuals may also fail to be rational when they do not have the capacity to process all information, and our cognitive abilities are limited. This was what Tversky and Kahneman's heuristic and biases research program showed. We systematically commit deviations due to our bounded rationality (A. Tversky and Kahneman 1974).

Amos Tversky and Daniel Kahneman claimed that the heuristics we use to assess probabilities about the occurrence of an uncertain event may lead us to systematic errors: Some of these heuristics are "economical and usually effective, but they lead to systematic and predictable errors. A better understanding of these heuristics and of the biases to which they lead could

improve judgments and decisions in situations of uncertainty" (A. Tversky and Kahneman 1974, 1131).

Hunter Crowther-Heyck claimed that Simon started a new paradigm in economics that was going to be followed by the Tversky and Kahneman's research:

Here Simon's legacy is like that of a grain of sand in an oyster: an irritant, yet to produce the pearl of a new paradigm. Perhaps his calls for an empirically based microeconomics will be heeded by more than a minority in the new millennium, and the awarding of the 202 Nobel Prize in Economics Daniel Kahneman, a psychologist very much in the mold of Simon, gives Simonians reason to hope (Crowther-Heyck 2005, 325).

The seed of Simon's criticism of mainstream economics germinated and starting in the seventies the new paradigm began to produce a body of research focused on showing how our rationality "fails" when matched to the standards prescribed by classical and neoclassical economics.

In their famous article from 1974, Tversky and Kahneman claimed that our rationality systematically err and that we could see it in how we use specific heuristics in uncertain situations. One of these heuristics was representativeness: we tend to believe that "a sample from a population must represent the population in its general characteristics" (Heukelom 2014, 114). When deciding, our bounded rationality has to rely on heuristics due to our limited cognitive capabilities and the complexity of the structure of the environment. We are not Bayesian utility maximizers and we do not use probability theory correctly. These heuristics, Tversky and Kahneman argued, lead us to biases and mistakes.

While Simon used the term heuristics as a mechanism to arrive at a satisfactory decision considering our capacities and the environment, for Tversky and Kahneman heuristics were an organizational tool to simplify decisions and making them more manageable. Heuristics, they posited, were not used to arrive at decisions but to make the decision scenario more manageable taking into consideration our bounded rationality.

Simon claimed that we could adjust our heuristics to "satisfice". According to his view, heuristics are "trial-and-error methods" that use to search for plausible alternatives for our decisions (McGuire, Radner, and Arrow 1972, 176).

The basic idea of Tversky and Kahneman is that heuristic processes are a type of mental shortcuts that may lead to errors in reasoning. Bounded rationality is found at the reason why we use them and at the effects of their use. Our bounded rationality uses shortcuts because it cannot deal efficiently with information. Our cognitive capabilities and memory are limited. Tversky and Kahneman claimed that heuristics, as a type of mental shortcut, are used to help us navigate within our limited capabilities. The use of heuristics lead to systematic deviations of the normative standard of rationality.

Our judgement operates many times under uncertain situations and it has to rely on "simplifying heuristics" (Gilovich, Griffin, and Kahneman 2002, 1). The heuristic and biases research program is the study of the systematic errors of judgement we commit when deciding due to our bounded rationality.

4.3.3. Nudging as a Libertarian Paternalistic Option

Policy makers, governments and other agencies around the world have been implementing the nudge theory approach to ensure that people's decisions are more efficient as judged by themselves. Latest Nobel prize in Economics winner Richard Thaler, together with Cass Sunstein published a well known book about them (Thaler and Sunstein 2009). Sunstein himself, as part of the Obama administration, was able to put into practice nudge theory as administrator of the White House Office of Information and Regulatory Affairs (OIRA). The United Kingdom created the Behavioral Insight Team or *Nudge Unit* with the same purpose: since we are not optimizers and we systematically fail to arrive at rational decisions, the intervention of choice architectures in a specific way may be desired to become more efficient. One of the ultimate goals would be to make people happier (Kosters and Van der Heijden 2015, 278). In their own words:

A nudge, as we will use the term, is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To Kosters and van der Heijden: Evaluating Nudge theory 279 count as a mere nudge, the intervention must be cheap and easy to avoid. Nudges are not mandates. Putting fruit at eye level [hoping that people then choose fruit over unhealthy alternatives] counts as a nudge. Banning junk food does not (Thaler and Sunstein 2009, 6).

Nudges can change the behavior of people in different ways: as financial incentives, as an access to relevant information, altering the order of products, the placement of signatures, etc. The idea is to set defaults on our decision environment without limiting the freedom to choose something else. If in a cafeteria the salad is positioned in front of the pizza, those people who want to have a healthy diet will have an easier time choosing that salad that if

the pizza is set in front. The oregano smell, the view of melting cheese, and the warm feeling will distract some people from their goal of healthy diet.

In order to defend the implementation of nudges, Thaler and Sunstein claim that the choice architecture cannot be neutral, that is, the salad or the pizza have to be placed somehow and one must be in front of the other one.

There are two different types of nudges according to the dualistic view of our cognition. Some authors (Daniel Kahneman 2011) propose the view that our cognition has a dual process, a combination of two systems. System 1 is automatic and related to intuition, while system 2 is more reflective. Kahneman calls them "fast and slow":

- System 1 operates automatically and quickly, with little or no effort and no sense of voluntary control.

- System 2 allocates attention to the effortful mental activities that demand it, including complex computations. The operations of System 2 are often associated with the subjective experience of agency, choice, and concentration (Daniel Kahneman 2011, 20–21).

According to this distinction there are two different types of nudges: Type 1 and type 2. The first type focuses on the system 1 of our cognition, on those automatic and quick reactions. An example of these types of nudges is found in the studies conducted by Wansink about the size of the dinnerware related to the quantity of food consumed and the satisfaction we got from it:

Consumers eat from plates and out of bowls without thinking how their size proportionally influences how much they serve and eat. The solution to our tendency to overeat from larger plates and bowls is not simply education. In the midst of hardwired perceptual biases, a more straightforward action would be to simply eliminate large dinnerware—replace our larger bowls and plates with smaller ones. Alternatively, use bowls and plates that contrast with the color of the food being served. For emphasis, it may be easier to change our

personal environments than to change our minds (Van Ittersum and Wansink 2011, 227).

The second type of nudges match our system 2 of cognition and they allow us to reflect in better decisions. One example is the sign we find on the streets of London that announce pedestrians to "look right". According to Sunstein, nudges are judged according to their efficiency:

In general, majorities prefer System 2 nudges to System 1 nudges, but for many people, the ultimate judgment depends on which is more effective. If people are asked to assume that System 1 nudges are more effective, majorities tend to favor them. At the same time, many people care about personal agency, and they will favor educative nudges unless they are given very strong reasons to think that noneducative ones are better on grounds of effectiveness (Sunstein 2017c, 9).

According to Sunstein we should view this dual system as a metaphor and not as related to specific parts of the brain: "The idea of System 1 and System 2 is designed as a metaphor to capture the distinction in a way that works for purposes of exposition" (2017c, 6). Thaler and Sunstein use this dual system as a tool to illustrate how of the brain works. "How can people be simultaneously so smart and so dumb? Many psychologists and neuroscientists have been converging on a description of the brain's functioning that helps us make sense of these seeming contradictions" (2009, 19).

Nudges can be very transparent, where the decision maker is aware the she is being nudged (seatbelt alarm), or not transparent at all (the size of the plate). Nudges can be used to increase the efficiency of the rationality decision maker as judged by herself, or they can be done to benefit a group

of people. Since nudges do not force people to act, the individual always has the choice to opt out. The success of nudges is measured, therefore, by the outcomes (Grill 2014). Nudges fall under an instrumental perspective of how rationality can be improved as judged by its effectiveness.

Nudges, therefore, at a public policy level are based on the assumption that "humans predictably err" (Thaler and Sunstein 2009, 8). Nudges are a very efficient way to avoid some of these rational errors without limiting the choices of the individuals. This is called "libertarian paternalism": nudges preserve liberty of choice while steering people to achieve either what they considered right (as judged by themselves) or what is right for a group (society, for example). Sunstein and Thaler argue that nudges will predictably modify the behavior of individuals to make their lives better (2009, 6).

The paternalistic side of the nudge is needed due to how our rationality systematically makes mistakes. A nudge, therefore, cannot be a mandate and no coercion can be involved (a ticket or a penalty is not a nudge).

Nudge theory acknowledges, like Tversky and Kahneman, that we have heuristics and these can be very useful, but they can also lead to systematic errors in reasoning (2009, 6). The argument to implement nudge theory in public policy is clear: since there is always going to be a choice architect that manipulates the environment, why not making sure that they why this choice architecture is presented benefits the individual? Sometimes individuals do not wish to having to choose. Nudge theory claims that imposing people to choose can be viewed as a form of paternalism.

Sometimes individuals like to have a good default option (Thaler and Sunstein 2009, 95).

The argument against nudging is also obvious: instead, why should we not educate people? Thaler and Sunstein claim that sometimes is not an adequate solution. Sometimes it just does not work (2009, 121–22).

Nudge theory can also be accused of opening the door to more profound interventions where government and other agencies would manipulate people's choice in a deeper way and out of the control of the individual. Thaler and Sunstein called this objection the "slippery slope" (2009, 235). But they dismiss it by arguing that what they propose preserves the freedom to choose: it is a libertarian theory where individuals can always opt out. Also, they claim, individuals cannot forget that some type of nudge is unavoidable. There is always a choice architect and the environment in which individual decide, sometimes, cannot be neutral. But as Grill (2014) explains, people are not worried about how the environment may affect their decisions, they are concerned about an individual or agency changing that environment to produce a specific outcome in their behavior. Thaler and Sunstein insist that nudges preserve freedom and they are efficient in improving the lives of individuals. They claim that there are two major arguments to defend nudges: they are unavoidable and they can be easily resisted (they do not restrict liberty). To this end, Grill also argues that the first argument have to be revisited:

Intended nudging is not unavoidable. As Thaler and Sunstein note (2009, 10), it can be avoided by randomizing between design alternatives, though this seems silly. Arguably, it can also be avoided by letting design decisions be

made on the basis of other things than behavioral effects, such as cost minimization or aesthetic concerns (Grill 2014, 143).

They also consider the possibility of nudging about something that is objectively wrong or bad for the individual or the group. Why should we not have mandates? (Thaler and Sunstein 2009, 248). The answer is simple: to protect the libertarian aspect of the theory. Individuals should be able to choose and it really would be a "slippery slope" having the government or an agency choosing for you what is right or wrong and ban it. They claim that mandates should be restricted to those scenarios where there is a wide agreement about. It is easier to arrive at compromises between sides with nudges and not with impositions, at a policy-making level.

As mentioned before, there are criticisms against nudges that are based on different levels: by arguing that they do not preserve freedom as much as they claim, that their paternalism is worrisome, and that they may not be an effective strategy. Tom Goodwin explained these criticism well in his article *Why We Should reject 'Nudge'*:

I have argued that nudge is deeply troubling: the concept of liberty on which it hinges precludes it from being empowering in any substantive sense and it also renders nudging inherently unfair. With respect to the paternalistic aspect of nudge, I argued that although we would be hard pressed to maintain that it constitutes a form of coercion, the fact that it seeks to exploit imperfections in human judgement suggests something quite manipulative. In more general terms, I argued that nudge is not effective in changing deeply ingrained behaviours (Goodwin 2012).

Other authors focused more on the argument that nudges preserve liberty, proposing that libertarian paternalism is not really libertarian:

"Libertarian Paternalism violates core liberal principles, first because it limits freedom, and secondly because it fails to justify these limitations in ways acceptable to liberal positions." (Grüne-Yanoff 2012, 635). In a way, he argues, that nudges can be manipulative since they exploit our bounded rationality and its 'deficiencies' instead of convincing with rational arguments.

I claim that what Grune-Yanoff criticizes is paradoxical, since he claims that instead of nudging, rational arguments should be used to convince individuals. He does not attend to the real reason why nudges are used, which is that agents lack the capabilities to be affected by those rational arguments he says we should use. Nudges are effective because people do not respond to rational arguments.

We must also consider the perspective that sometimes people do not want to have to choose, they rather would like to have effective default choices or to delegate to choice to someone else. Taking control of your decisions implies specific costs and and benefits that must be taken into consideration: "people sometimes want to relinquish control, because exercising agency is burdensome or costly." (Sunstein 2017c, 1).

That choice architecture is unavoidable and that it affects our decisions is a theory that was already expressed in a different way by Herbert Simon when referring to the pair of scissors to understand our cognition. Thaler and Sunstein, using the body of research provided by Tversky and Kahneman together with Simon's idea about the role of the structure of the environment, propose an efficient method to increase the happiness of the individual (or a group of them) about the outcomes their decisions. Although there are some

revisions about that aspect (Itai, Inoue, and Kodama 2016), nudge theory can be considered an utilitarian approach. The title of their book already includes the main thesis that nudges improve our decisions about happiness. Nudges aim at fighting our bounded rationality (Thaler and Sunstein 2009, 260), and people enjoy having them. According to Sunstein, people support nudges if they are in line with what the majority of people may think:

Existing evidence, including several nationally representative surveys, supports two general conclusions. First, there is a widespread support for nudges, at least of the kind that democratic societies have adopted or seriously considered in the recent past. Importantly, that support can be found across partisan lines. Second, nudges will not receive majority approval if they steer people in directions that are inconsistent with their interests or their values. (Sunstein 2017c, 17).

Individuals allow the possibility of being nudged when their preferences are not set or stable (Grill 2014) and the cost of deciding and taking control may be high. People may reject nudges that may seem manipulative or are against the will of the people: "People reject nudges that they regard as unacceptably manipulative. The subliminal advertising finding can be taken as support for this principle" (Sunstein 2017c, 30). The idea, as mentioned previously, is to set up choice environments respecting the autonomy of agents. Some authors (Grüne-Yanoff 2012) object that nudges are much more paternalistic and less libertarian than they present themselves and they still violate basic libertarian principles. According to this criticism, nudges are a non-transparent manipulation that interfere with the choice process limiting our freedom: "Libertarian Paternalism violates core liberal principles, first

because it limits freedom, and secondly because it fails to justify these limitations in ways acceptable to liberal positions" (Grüne-Yanoff 2012, 636).

Those defending the use of nudges claim that any type choice environment must always have a disposition of elements to choose from in a determined way. Neutrality is either non-existent or not desired: "anti-nudge position is a literal non-starter, because citizens are always influenced by the decision making context anyway, and nudging is liberty preserving and acceptable if guided by Libertarian Paternalism and Rawls' publicity principle" (Hansen and Jespersen 2013, 3). There must be, according to nudge theory, always a choice environment and since, as they claim, our rationality is systematically biased, why not try to set up that environment in a way that the outcome of our choices is the best possible one as judged by ourselves?

The foundation of this policy-making theory comes from behavioral insights and their attempt to explain how we fail in achieving desired goals when acting upon the rational information we may have about a possible situation. Since rationality fails in a systematic manner, a liberty preserving intervention of the choice environment may increase the satisfaction of the agent with the outcome of her decisions. Nudges, therefore, "seems to offer policy maker an effective way to influence citizens' behavior without restricting freedom of choice, imposing new taxation, or tax reliefs" (Hansen and Jespersen 2013, 4). Needless to say that any state manipulation may be judged as problematic, but what nudge theory presents with their libertarian paternalism approach is the the possibility of opting out since the choices are not limited, they are just organized in different ways. Ultimately there has to

be a demand for responsibility in the hands of the policy maker that is structuring the choice architecture since her intentions will affect the outcome of the decisions of agents. Judging nudges as mere manipulations is very simplistic since nudges are liberty preserving by nature. What authors like Hansen and Jespersen claim, for example, is while nudging may be described as liberty preserving in theory, it may not be such in practice since agents ultimately choose according to the wishes of the choice architect:

It seems inconsistent to claim that while nudging allows citizens, in principle, to choose differently, they will also be capable of doing so in practice. Insofar as nudging turns out to work by manipulating people's choices, it seems that citizens are not really free to choose differently, since behavioural change that comes about by nudging will occur, if not necessarily against the will of citizens, then at least without their active consent and knowledge (Hansen and Jespersen 2013, 12).

Attending to the literal non-starter principle of nudge theory, we are always nudged since our behavior is always dependent of the choice environment. This is the main point in Simon's theory of rationality as related to the structure of the environment. The main arguments that explain the relationship between the external environment and our decisions and how our rationality is bounded and not 'global' as mainstream economics prescribed are found in articles written by Herbert Simon in the 1950's: *A Behavioral Model of rational Choice (1955)* and *Rational Choice and the Structure of the Environment (1956)*. In those two essays Simon claims that in the decision theory that we use in economics we should be relying more in psychological approaches to understand our behavior (1955, 99–100) . He also posited that any model of rational choice should always include external factors from the

environment in which the agent has to choose from: the environment dramatically affects the decision of agents. In that same essay from 1955 Simon argued for the replacement of the global rationality of the economic man that was used by mainstream economics for their models, with a more empirical model that may take into account our limited rationality: how we access the information, our computational capabilities and "the kinds of environments in which such organism exists" (1955, 99).

Simon, when referring to our decisions, talked about adaptive behavior as a type of conjugated approach between our behavior and the environment in which we decide. Since our rationality is bounded, he claims (as all behavioral economists and their predecessors do) that we must behave approximately, relying on simplifications (heuristics). These simplifications are based on our inner characteristics and the structure of environment:

Now if an organism is confronted with the problem of behaving approximately rationally, or adaptively, in a particular environment, the kinds of simplifications that are suitable may depend not only on the characteristics – sensory, neural, and other – of the organism, but equally upon the structure of the environment. Hence, we might hope to discover, by a careful examination of some of the fundamental structural characteristics of the environment, some further clues as to the nature of the approximating mechanisms used in decision making. This is the line of attack that will be adopted in the present paper (1956, 130).

In 1969 Herbert Simon publishes the book *The Sciences of the Artificial* in which he uses a metaphor to describe our decisions and their relationship to the environment. Simon describes the behavior of an ant on the beach and its path and he concludes that "an ant, viewed as a behaving system, is quite simple. The apparent complexity of its behavior over time is

largely a reflection of the complexity of the environment in which it finds itself' (Herbert Alexander Simon 1996, 52).

Simon's models and theories about decision, bounded rationality and the role of the environment were the foundation of Tversky and Kahneman's heuristic and biases research program and all behavioral revolution that came afterwards, including nudge theory.

Considering this essential relationship between the environment and our behavior, nudge theory proposes to alter the decision theory rather than our inner behavioral system. Since they are both part of our decisions, the outcome will be affected.

Setting the emphasis in the structure of the environment, or at least in the connection between our behavior and the environment itself will be shared by the proponents of nudge theory, ecological rationality (Gerd Gigerenzer), the heuristic and biases research program (Tversky and Kahneman) and Simon's bounded rationality theory. It is a common line that can be traced back to Simon's above-mentioned articles and even to his book *Administrative Behavior* (Herbert A. Simon 1947 [1997]). Simon's work, although not entirely critical with the notions of classical and neoclassical economics, started to call our attention to processes that may affect our rational processes, bounding them due to cognitive capabilities. The model of the economic man of mainstream economics had to be replaced for a more realistic description: the administrative man. Chapter VII devoted to the role of authority sheds some light into what eventually will be the relation between the environment and our behavior. There Simon explains how the organization influences our

decisions: "Organizational influence upon the individual may then be interpreted not as a determination by the organization of the decisions of the individual, but as a determination for him of *some* of the premises upon which his decisions are based" (Herbert A. Simon 1997, 177).

Simon is not claiming that authority is a way to nudge people, he is highlighting the external and internal influences that may affect our decision processes (authority, training, efficiency, loyalty, etc.) This will be relevant above all if it is contextualized within Simon works and his research on how our behavior is the response to the structure of the environment. He mentions this connection at the end of chapter IV (Herbert A. Simon 1997, 85), where the anatomy of a decision is examined in order to provide a "realistic investigation of administrative behavior". In the process of researching decisions, Simon turns into the "environment" the surrounds the choice. The environment is seen as a set of alternative behaviors that lead to consequences. Nudge theory will expand this descriptive approach by adding a normative one on the premise that how these alternatives are presented affects our decisions, therefore, having a purpose in in how choices are presented may increase our efficiency when deciding. Herbert Simon first and Tversky and Kahneman later explained in what way our rationality is bounded. Nudge theory proposes that some of these boundaries can be exploited for our benefit if understand in what way the structure of the environment can be organized to produce more efficient behavior as judged by ourselves, in a liberty preserving manner.

4.3.4. The Pessimistic and the Optimistic Interpretations. The Two Cultures

Once researchers tried to provide a more realistic approach in order to describe how we decide, it became clear that our rationality was bounded by several factors. This view is shared by all the above-mentioned authors: Herbert Simon, Amos Tversky, Daniel Kahneman, Gerd Gigerenzer, Richard Thaler... they all claim that our rationality falls short of the ideal prescribed by classical and neoclassical economists. That they all categorize our rationality as bounded does not imply that they all share the same type of perspective about this matter. Some authors divide these perspectives into "pessimistic" and "optimistic", that is the case of Richard Samuels (Richard Samuels, Stich, and Bishop 2002). Following this line of thought, Andrea Polonioli (2012) posits that while Kahneman, Tversky, and nudge theory present a pessimistic view of our rationality, Gigerenzer and some within the school of evolutionary psychology defend a more optimistic approach. The difference is based on how rationality is perceived. Gigerenzer and evolutionary psychologists accuse nudge theorists and those behind the heuristic and biases research program of describing our behavior as mere irrational, while they claim that what it looks as irrationality, may be some evolutionary advantage that had to be match by a specific environment in order to be efficient. Biases are not something that separate us from effective decisions, they are shortcuts that we can apply to our decision process in specific environment to increase our efficiency:

According to this approach, our problem-solving mechanisms are not optimal, but are nevertheless quasi-optimal under 'natural' conditions, and the mere

fact that we systematically deviate from the norms of probability or of logic does not imply that we are not rational (Gigerenzer 1996). Put simply, provided that heuristics are fitness-enhancing behaviours, they should be considered as rational strategies and not as sources of cognitive pitfalls (Polonioli 2012, 136).

The natural interpretation, once researchers started to understand our decision processes, would be pessimistic since we can assume, as corroborated by the experiments conducted by Tversky and Kahneman, that we systematically err and that our rationality is not as rational as we previously considered. Once we include the environment into the equation, as it was explained in the previous paragraph, we see that in some scenarios these "irrationalities" can be very beneficial. That is the claim made by Gerd Gigerenzer's ecological rationality approach. But a deeper analysis of nudge theory will unveil that the view is very similar: exploiting our rational limitations to increase the efficiency of our decisions by altering the environment is like claiming that certain heuristics are advantages in certain environments. The difference, I argue here, is related to a philosophical view of the nature of rationality more than a difference of how rationality works. Both perspectives, pessimistic and optimistic, are based on a similar research program and a similar view of our rationality as bounded (originated in Simon). The idea that the distinction between both perspectives is only apparent was introduced by Samuels (Richard Samuels, Stich, and Bishop 2002). They both are based on a similar approach to bounded rationality. Some, like Gigerenzer, argue that the heuristic and biases research program possesses a vision of human decision making as irrational. Gigerenzer, on the other hand, claims that these errors are part of our ecological intelligence:

Visual illusions help us to understand how our brains work: Our brains have insufficient information about the world. Intelligence means going beyond the information given and making informed bets on what's outside. By making bets, every intelligent system makes "good" errors [...] Making such "errors" is not a flaw; without them we wouldn't recognize the objects around us. If a system does not make errors, it is not intelligent (Gerd Gigerenzer 2014, 47).

The division of systems employed by Kahneman as a metaphor about the way we think is also a topic of discussion within Gigerenzer's works. The idea in Gigerenzer's theory is that intuition (system 1 in Kahneman's metaphor) is not opposed to rationality:

Intuition is unconscious intelligence based on personal experience and smart rules of thumb. You need both intuition and reasoning to be rational. [...] Deliberate thinking and logic is not generally better than intuition, or vice versa. Logic (or statistics) is best for dealing with known risks, while good intuitions and rules of thumb are indispensable in an uncertain world (Gerd Gigerenzer 2014, 123–4).

Kahneman does not contradict this thesis, in fact, he provides a similar version describing the role of the two systems. He claims that system 1 (intuitive, automatic, etc.) and system 2 (rational, deliberative, etc.) must interact for an efficient thinking process. As he claims, they way they divide labor when thinking is very practical most of the time: "It minimizes effort and optimizes performance" (Daniel Kahneman 2011, 25).

The difference between both perspectives does not lie on their core claims, but in a philosophical interpretation of what they mean. This is clear when referring to visual illusions. Kahneman claims that these illusions are systematic errors made by system 1, since this system operates automatically and it cannot be turned off. These errors are difficult to prevent

and biases cannot always be avoided (Daniel Kahneman 2011, 25). Visual illusions seem to be an example of cognitive illusions. Gigerenzer, on the other hand, argues that those errors (like visual illusions) are an essential (and beneficial) part of our rationality: they are good errors and they cannot be considered as flaws: "Without them we wouldn't recognize the objects around us. If a system does not make errors, it is not intelligent. Visual illusions in fact demonstrate the success rather than the failure of cognition" (Gerd Gigerenzer 2014, 47).

Gigerenzer points out that those viewing these errors as flaws in the system do not believe in education and are opting for a type of paternalism where it will be more efficient to "nudge" people to do the "right" thing. The argument, Gigerenzer claims, misses the nature of human rationality.

Going back to Kahneman's approach, center of Gigerenzer's accusations, we his claims contradict that vision: Kahneman does not say that people cannot be educated. While having a pessimistic approach, as mentioned before, he does not mentioned that education is impossible. System 2 can provide vigilance about the visual illusions of system 1. We can learn about these illusions and follow the more deliberative system 2. We can be educated and resist illusions after recognizing them. "Errors can be prevented only by the enhanced monitoring and effortful activity of system 2. As a way to live your life, however, continuous vigilance is not necessarily good" (Daniel Kahneman 2011, 25). Kahneman believes that although education is possible, it may not be a good thing to try to monitor system 1

errors or cognitive illusions. We can learn how to "recognize situations in which mistakes are likely" (Daniel Kahneman 2011, 25).

Nudge theory uses this approach as a point of departure to make our lives easier, sharing the pessimism of Kahneman: after providing some examples of visual and cognitive illusions, he wrote that the "message of those examples is not encouraging" (Daniel Kahneman 2011, 25). That is why paternalism appears, without the restriction of freedom, in Nudge theory. Since it is not good (or practical) to be constantly vigilant about possible errors made by system 1, nudges provide an efficient mechanism that may increase the efficiency of our decisions (or at least, it may help system 2 to not be monitoring all the time).

Gigerenzer's optimism goes beyond the soft paternalism of nudges. He proposes that people don't have to be under the mercy of institutions or other people so they do not have to have a system 2 actively monitoring possible errors. Those institutions and people also have bounded rationality, conflicted interest and illusions that may affect how they nudge. He asserts that people have to learn how to think on their own and take responsibility for their decisions. People can learn about risks and uncertainty and governments, instead of investing in nudge units, should invest in people's knowledge and risk literacy.

4.3.5. Frequencies and the external validity argument

Gigerenzer's goal for education is sustained by research he conducted in which he and his ABC research group question the validity of the arguments provided by the heuristic and biases research program. One of

their claims is based on a possible miscommunication between the experimenters and the subjects when referring to probability: some may interpret plausibility instead. The criticism departs from the examples of conjunction fallacy provided by Tversky and Kahneman in some of their experiments (A. Tversky and Kahneman 1983). They showed that people cannot work with probabilities very well, since they consider the probability of "Linda being a bank teller and an active feminist" higher than "Linda is a bank teller". Gigerenzer claims that this is due to a miscommunication between the experimenter and the subject, since the subject may be considering not the probability, but the plausibility (Gerd Gigerenzer 2007b). In those experiments the information is presented without a context. Once content, context and representation is provided, the subject acquire a different perspective of the event (Hertwig, Gigerenzer - Journal of behavioral decision, and 1999 1999, 276). The problem is found in how some concepts may be polysemous, causing the miscommunication that is at the root of this fallacy. Subjects answering questions about the probability of Linda are inferring a non-mathematical meaning of the concept 'probability' (Hertwig, Gigerenzer - Journal of behavioral decision, and 1999 1999, 293). This is what Polonioli called the 'interpretation argument' (2012).

The criticism against the findings of the heuristic and biases research program has a second point: Gigerenzer and other authors assert that the experiments that demonstrate our 'irrational' behavior cannot be generalized to the real world. According to Polonioli, the external validity argument was previously used by Donald Campbell:

History, maturation, testing, instrument decay, regression, selection, and mortality. In general, the simple or main effects of these variables jeopardize the internal validity of the experiment and are adequately controlled in standard experimental designs. The interactive effects of these variables and of experimental arrangements affect the external validity or generalizability of experimental results. Standard experimental designs vary in their susceptibility to these interactive effects (1957, 297).

Polonioli (2012) asserts that within economic literature the heuristic and biases research program has been criticized because of the type of monetary incentives used and the type of subjects selected for their experiments. The accusation highlights that the setting of the experiment may not represent the 'target system', and this difference may be causally relevant.

The work of Gigerenzer on this second criticism focuses on the distinction between probabilities and frequencies, making those cognitive illusions disappear:

Bayesian algorithms are computationally simpler in frequency formats than in the probability formats used in previous research. Frequency formats correspond to the sequential way information is acquired in natural sampling, from animal foraging to neural networks. By analyzing several thousand solutions to Bayesian problems, the authors found that when information was presented in frequency formats, statistically naive participants derived up to 50% of all inferences by Bayesian algorithms (G. Gigerenzer and Hoffrage 1995, 684).

Gigerenzer's goal, as mentioned above, would be to educate people rather than to nudge them, by providing them with an understanding of how to cope with risk and uncertainty. According to this, single probability events should be reformulated by using frequency statements; natural frequencies

should be used instead of conditional probabilities; and the use of relative risks should be complemented with absolute risks.

Gigerenzer's view is that our biases are not really biases, but good errors that can be avoided by subtle manipulations. Our rationality has evolved to operate in natural environments and not in laboratories.

Polonioli (2012), in reference to the rationality debate between the pessimistic and the optimistic approach, concludes that the arguments provided by Gigerenzer are not robust enough and that the momentum gained by field experiments provide stronger arguments to maintain Tversky and Kahneman's approach:

Contrary to what is claimed by ABC, frequency formats do not always make cognitive illusions disappear and probability formats are representative designs. Of course, this does not automatically license pessimistic conclusions about human rationality. It merely means that Gigerenzer's external validity argument cannot be exploited in order to justify more optimistic interpretations, and that support must be found elsewhere. In demonstrating this, this paper provides only indirect support for the pessimistic view (Polonioli 2012, 146).

As I mentioned before, some authors (Richard Samuels, Stich, and Bishop 2002) sustain that the dispute is apparent and if we attend to the essence of both perspectives, the similarities are more relevant than the differences:

(...) contrary to appearances, there is no substantial disagreement between evolutionary psychologists and advocates of the heuristics and biases program over the extent of human rationality. On a number of different readings of what the dispute is supposed to be, neither research program denies the core claims of the other and, in many cases, it is clear that they should and do endorse each other's core claims. Finally, we briefly focused on some of the points of disagreement that remain once the illusory dispute has disappeared. Though there are some important issues dividing

evolutionary psychologists and advocates of the heuristics and biases program, there is also a surprising degree of consensus. Moreover, and this has been our central theme, they do not really have any deep disagreement over the extent of human rationality (R. Samuels, Stich, and Bishop 2012, 220–21).

4.4. Nudging or Educating

Tversky and Kahneman's research program is the theoretical foundation of nudges. At a policy-making level, Gigerenzer's criticism will be directed to Sunstein and Thaler's nudges since their approach is based on the idea that we governments should invest in educating citizens about risk and uncertainty rather than paternalistically manipulate their choice environment. In a Kantian philosophical approach (Gerd Gigerenzer 2014, 15), Gigerenzer links knowledge and freedom arguing that risk savvy citizens must be the pillars of a free society. He believes that type of 'risk school' would be needed in order to increase risk literacy. Allowing government to nudge instead of educating would undermine the effort to educate citizens and to empower them. Nudges will facilitate the rise of citizens that are not going to think on their own waiting to be nudged into doing the right thing (Gerd Gigerenzer 2014, 245).

Gigerenzer main ideas against nudges and in defense of education and risk literacy are expressed in the article *On the Supposed Evidence for Libertarian Paternalism* (2015). There he claims that nudge theorists have a vision of human rationality in systematically flawed making impossible for individuals to be educated. Facing that impossibility, policy makers only choice would be to steer people's behavior by altering their choice environment. Their justification is based on the supposed irrationality of our

decisions. Gigerenzer claims that this is a misunderstanding of our behavior and that there is no evidence about such impossibility to educate people.

The problems about nudges cited by Gigerenzer do not stop in the lack of evidence, they are also related to the conflict of interests the choice architect may have when manipulating the environment to affect the outcome of our decisions. He does argue against nudges per se, but against their justification and the program of libertarian paternalism and their pessimistic attempt to show the hopelessness of educating people. Instead, a benevolent choice architect is needed to engineer a nudge to steer behavior.

Gigerenzer argues that the evidence that our rationality is systematically flawed comes from a lack of understanding to the ecological aspect of rationality. Studies have also shown that people can learn about statistics with the help of visual and numerical representations. The alternative would be to educate people about risk and uncertainty (Gerd Gigerenzer 2014).

A study conducted by Gigerenzer and Sedlmeier (2001) concluded that it is easier to teach students with frequencies than to do it with probabilities: "Bayesian computations are simpler to perform with natural frequencies than with probabilities, and there are evolutionary reasons for assuming that cognitive algorithms have been developed to deal with natural frequencies" (Sedlmeier and Gigerenzer 2001, 380). With this type of training even kids can learn how to make predictions that are consistent with Bayes' rules. What Gigerenzer claims is that people can learn about Bayesian rules and that

there is no evidence that supports that we are unable to learn, as posited by the heuristics and biases research program (Gerd Gigerenzer 2015).

Gigerenzer's criticism is centered on the views that libertarian paternalism has on heuristics as leading to biases or mistakes. An example is cited by Thaler and Sunstein (2009) when referring to representativeness heuristics. They argue that the use of such heuristic process leads people to confuse random fluctuations with causal patterns. Every heuristic has a bias associated to it. According to Gigerenzer, libertarian paternalists believe that the use of heuristics lead to systematic errors in our rationality. But a quick look at the texts by libertarian paternalists provides enough support that they do not think that radically, that is, heuristics for nudge theorists, usually work well: according to Sunstein (2014, 33), these shortcuts generally work well, but sometimes they misfire. The differences between Gigerenzer and libertarian paternalists are not as deep as Gigerenzer himself thinks. Sunstein claims in a very clarifying statement that "heuristics tend to have 'ecological rationality', in the sense that they make sense in the settings where they are usually applied" (Cass R. Sunstein 2014, 33). Gigerenzer would subscribed this notion word by word. The differences stay at a policy-making level since both perspectives would advocate for two different course of actions that respond to two philosophical views of similar events: the pessimistic (nudge theory) and the optimistic (education). According to Gigerenzer, we should be teaching about risk and uncertainty while we also teach experts how to communicate about them (Gerd Gigerenzer 2014, 14). We also need to teach financial literacy to make sure that people are not exploited (Gerd Gigerenzer

2014, 256) and health statistics (2014, 177), among many other things. Gigerenzer is not against a little bit of nudging, but as a general policy, he claims that coercing and nudging people like a herd of sheep instead of making them competent is not a promising vision for democracy" (2014, 261). While libertarian paternalism claims that it is very difficult to educate people, or at least that is what Gigerenzer posits when arguing the opposite: "the claim that we are hardly educable lacks evidence and forecloses the true alternative to nudging: teaching people to become risk savvy." (Gerd Gigerenzer 2015, 361). Nudges, he asserts, are opposed to education, and Gigerenzer's main criticism focuses, not on them, but in their justification. Nudges are based on the idea that we are irrational, so the intervention of a paternalistic figure is needed, with no room to any other alternative (Gerd Gigerenzer 2015).

Nudges rest on the assumptions that we are not easily educable, and that the choice architect who manipulates the environment is a benevolent agent with accurate knowledge about the future outcomes of people's decisions. Gigerenzer claims (2015) that there is not evidence about the first assumption and that those choice architects sometimes are not free of self interest and/or ignorance (sometimes they do not understand scientific evidence). The outcome of nudging can have negative consequences towards people's best interest when that is the case. The example cited by Gigerenzer comes from the field of medicine: breast self-examination. Some nudges were put in place to increase these type of examination, while "randomized trials

found no evidence that self-examination actually reduces breast cancer mortality" (Gerd Gigerenzer 2015, 377).

Nudging people according to this perspective is way to treat them as children. While nudging does not see any alternative to their proposals, Gigerenzer defends an educational approach, providing a sustainable solution. We are already nudged by corporations and governments will find very difficult to compete with those nudges. The solution (Gerd Gigerenzer 2014, 256) has to be different: his proposal is based on the investment of risk savvy citizens "that can make informed decisions themselves" (Gerd Gigerenzer 2015, 380).

4.5. A Note About Autonomy

The issue of autonomy in choice theory has been discussed widely by Amartya Sen and other authors. Providing an extensive analysis of it may separate this thesis from its main objective, but neglecting the issue would not be fair since it is a central aspect of criticism and defense of libertarian paternalism. The main idea of the following lines, therefore, is to provide an introduction within the theoretical frame of libertarian paternalism of those aspects that are related to the autonomy of the agents when they are influenced by nudges. From those advocating that type of intervention, the main benefit of nudges rest on the idea that are liberty preserving (Thaler and Sunstein 2009, 5): since nudges can be resisted, they do not pose any limitation to our freedom. But some other author see that nudges are not as libertarian as posited. Nudges may be liberty preserving when considering the

amount of choices agents have in front of them before deciding, but some authors question them in regard to the way they may affect the autonomy of individuals by shaping those choices (Hausman and Welch 2010).

Autonomy is the control that agents have about their evaluation and choices. "In valuing the 'autonomy' of a person, it is not adequate to be concerned only with whether she receives what she would choose if she had the opportunity to choose; it is also important that she actually gets to choose herself" (A. Sen 1997, 753).

The debate is centered around the type of influence nudges may have in our freedom and/or autonomy as previously defined. Is there any way that the manipulation of choice may be an intromission in our autonomy since we lack some of the control in our decisions? When a choice architect manipulates an environment is because she envisions some type of outcome from the agents. In that sense, nudges are paternalistic: they influence our behavior by organizing the choice environment.

Libertarian paternalism is a relatively weak and non-intrusive type of paternalism, because choices are not blocked or fenced off. In its most cautious forms, libertarian paternalism imposes trivial costs on those who seek to depart from the planner's preferred option. But the approach we recommend nonetheless counts as paternalistic, because private and public planners are not trying to track people's anticipated choices, but are self-consciously attempting to move people in directions that will promote their welfare (Cass R. Sunstein and Thaler 2003, 1162).

Their perspective rests on the assumption that agents are not able choose in their own interest all the time. In order to help them do so, nudges are used as an efficient, liberty preserving method. Since governments and

institution (choice architects) must start somewhere in organizing the environment, nudges are unavoidable:

But governments, no less than cafeterias (which governments frequently run), have to provide starting points of one or another kind; this is not avoidable. As we shall emphasize, they do so every day through the rules of contract and tort, in a way that inevitably affects some preferences and choices. In this respect, the anti-paternalist position is unhelpful—a literal nonstarter (Cass R. Sunstein and Thaler 2003, 1165).

Other authors dismissed that claim arguing that there are scenarios where neutrality can be achieved in the choice environment. We can increase its neutrality, according to Barton and Grüne-Yanoff, with education, training or better design (2015).

Libertarian paternalists argument rests on the unavoidable of a certain manipulation of the choice environment, providing an instrumental approach to the arrangement of choices. They manipulate it to improve the outcome of agent's decisions as judged by themselves. But that is also problematic, according to some authors, our act of choice cannot be considered as an statement subject to consistency (A. Sen 1993). When nudges are introduced it is assumed that we are being inconsistent with our welfare or our previous or future self.

Since organizational decisions are inevitable, nudge proponents dismiss the paternalistic discussion:

We can abandon the less interesting question of whether to be paternalistic or not, and turn to the more constructive question of how to choose among the possible choice-influencing options. To this end we make two general suggestions. First, programs should be designed using a type of welfare analysis, one in which a serious attempt is made to measure the costs and benefits of outcomes (rather than relying on estimates of willingness to pay).

Choosers should be given more choices if the welfare benefits exceed the welfare costs. Second, some results from the psychology of decision making should be used to provide ex ante guidelines to support reasonable judgments about when consumers and workers will gain most by increasing options. We argue that those who are generally inclined to oppose paternalism should consider these suggestions uncontroversial (Cass R. Sunstein and Thaler 2003, 1166).

Libertarian paternalists, applying the theoretical frame provided by Tversky and Kahneman, posit that framing effects cannot be avoided, the manner in which information and choices are presented is fundamental. We need to understand, according to this perspective, the reality of human cognition and under what circumstances it is bounded. Nudges are efficient, they claim, because they understand those limitations and the role of the environment in our decisions. Accordingly, this type of paternalism cannot be avoided since the environment in which agents decide will always influence their decision. Governments, agencies, institutions, cafeterias, etc. must always present their information in a specific way. Doing it without limiting the choices and with the intention of increasing the chances that agents will act in a way that may be beneficial for them is at the heart of libertarian paternalism. This impossibility to avoid paternalism is even more clear when those institutions have to present some type of default option or rules. In some scenarios it is even more beneficial for the individual and more liberty preserving when the choice of not having to choose (default) is presented in the choice environment. Sometimes it is costly having to evaluate options and decide and it may be in the interest of the individual to sacrifice autonomy.

Nudge theory claims that non-libertarian paternalism is not a viable factor since it is a desired to have freedom of choice. Preserving choices is

an essential part of it. But sometimes having more choices does not mean a higher degree of freedom (A. Sen 2002, 606).

It is also possible that the anticipated effect of the nudge backfires if the agent is aware she is being nudged. As Sen explains:

In considering the importance of freedom, it must also be noted that sometimes the chooser may react forcefully to the nature of the menu itself. If, for example, we decide that our freedom of choice is being wilfully curtailed by some "authority" (e.g., by preventing us from reading newspapers it does not approve of), we may react by making choices in the "contrary" direction (e.g., not read the authority's favored newspaper, even if we would have had no objection to reading it otherwise) (A. Sen 1997, 754, footnote 26).

The objections can be based on the argument that if certain choices are objectively bad for agents, why having them? The answer provided by libertarian paternalists rests on the argument that freedom of choice has an intrinsic value which is better to have.

The other argument against nudges, as previously discussed, considers them as radically affecting our autonomy if nudges are not based on rational influence: "Their freedom, in the sense of what alternatives can be chosen, is virtually unaffected, but when this "pushing" does not take the form of rational persuasion, their autonomy—the extent to which they have control over their own evaluations and deliberation—is diminished" (Hausman and Welch 2010, 128). The argument about autonomy posits basically that nudges represent a challenge to our autonomy because they affect our behavior bypassing our reason. Some Nudges take advantage of non-rational elements in our decision process (Wilkinson 2012), so in order to preserve autonomy, only rational influence should be accepted. Against that position

some (Grüne-Yanoff and Hertwig 2016) argue that nudges may even allow individuals to fully express their autonomy, since they seek to affect people's behavior to make them better off as judged by themselves: "much nudging is also required on ethical grounds, in part because some nudges actually promote autonomy, in part because some nudges enable people to devote their limited time and attention to their most important concerns" (C. R. Sunstein 2015, 413).

Nudges per se do not respect autonomy or they do not represent a challenge to it, it all depends on the type of nudges and how they are applied. In order to have autonomy, informed choices are needed and there are nudges that respect and enhance that type of information. Also, according to Sunstein (2015, 438), if nudges are to improve biased decisions, they help promoting autonomy:

Insofar as nudges respect freedom of choice, they are, along an important dimension, preserving people's autonomy. Once choice architects coerce people, they are no longer merely nudging.' 20 But if they are focused on autonomy, skeptics might again emphasize that the problem of coercion cannot be entirely avoided with some nudges. We have seen that because of the power of inertia, people might accept (passively) a default rule even though they have no enthusiasm for the outcome that it produces, and would reject that outcome if they focused on the issue involved (2015, 439).

One of the most important aspects governments and institutions must take into consideration while trying to respect the autonomy of individuals is the attempt by these institutions to inform those they are trying to nudge that they are in fact seeking to alter their behavior. Libertarian paternalists policies have to be open and clear about their intentions: "publicity is important. One important way to protect against abuse and to respect autonomy is to make

sure that the government actually inform people of efforts to shape their choices" (Hausman and Welch 2010, 135).

The case is that there are transparent nudges and non-transparent nudges. A transparent nudge would have the information about their intentions and how the intervention will be done. A non-transparent nudge hides all that information to the individual subject to the nudge (Hansen and Jespersen 2013).

The issue about transparency is crucial to understand in what way individuals' autonomy can be affected by nudges. Most authors claim that transparency should be a requirement for nudges. Individuals should be aware of any type of intervention destined to modify the choice environment of their behavior, and by that, their actual behavioral outcomes. According to Luc Bovens (2009), transparency may affect the effectiveness of nudges: "It should be noticed right away that Bovens' claim that epistemic transparency is in conflict with the efficacy of nudging is not a direct claim as to nudging being psychological manipulation" (Hansen and Jespersen 2013, 19). On the other hand, there are authors that challenge such perspective arguing that transparency may not affect them at all: "The empirical part is that nudges often or always work best, or only work at all, when they are covert—i.e. when nudges do not know they are being nudged. Claims to this effect are typically unsubstantiated" (Grill 2014, 155).

There is a debate about the essence of nudges in regard to transparency. For example, according to Till Grüne-Yanoff words (2012), nudges are a non-transparent manipulation that limit people's degree of liberty

based on non-transparent supposed biases. Martin Lodge and Kai Wegrich (2016) also claim that nudges are in essence non-transparent tools. But according to Sunstein, some of these objections are not accurate. There are nudges that are clearly transparent, like default rules and disclosure policies (C. R. Sunstein 2013).

Choice architects should always aim for transparency in order to preserve autonomy and to eliminate any type of ethical complain or objection: "Some nudges are objectionable because the choice architect has illicit ends. When the ends are legitimate, and when nudges are fully transparent and subject to public scrutiny, a convincing ethical objection is less likely to be available" (C. Sunstein 2015, 1). One of the main thesis of Sunstein in that essay is that transparency should be a safeguard for nudges. Nudges should be transparent and accountable. The reason behind is their capability to be avoided. If nudges are liberty preserving it is due to the fact that individuals can choose not to follow them. In order to respect that and allow nudges to be non-irresistible, they have to be transparent (Barton and Grüne-Yanoff 2015).

The problem of autonomy has also been discussed from the neuroscience perspective (Felsen and Reiner 2015). Surprised about how absent neuroscience has been from the debate about nudge theory, these authors decided to publish a paper about it to provide a framework to understand how nudges work, but excluding their research from any type of ethical consideration. I consider here their findings about how nudges may affect the autonomy of individuals. Considering autonomy as a "graded phenomenon", Felsen and Reiner seek how some nudges may increase or

decrease autonomy. What they claim is that different nudges affect our autonomy in different degrees, but we cannot make the mistake of having some type of unrealistic approach about how we decide or how autonomous our decisions are:

...if it is true that autonomy depends on the capacity to make decisions free from covert external influences, and the evidence from neuroscience supports only a diminished form of this capacity, then it is worth considering whether the high value with which we regard autonomy may be misplaced. While it of course does not follow from this line of reasoning that nudges are ethical (Felsen and Reiner 2015, 476).

5. AXIOLOGICAL RATIONALITY IN BOUNDEDLY RATIONAL AGENTS.

5.1 Introduction

In the previous section the theory of libertarian paternalism and its nudges were discussed. I claimed that nudges were, in part, based on some of the ideas of Herbert Simon. In this analysis, I also clarified some aspects of the debate about the notion of rationality that comes from this theory and I compared it to the idea of rationality defended by Gerd Gigerenzer and his ecological approach. While there are some differences about the essence of rationality in itself, they both are based on a notion of rationality that cannot be conceived as separated or independent from the environment. While nudge theory was based on the pessimistic view of Tversky and Kahneman, Gigerenzer's approach has a more optimistic perspective since he does not conceive those biases as problematic. They are positive adaptive mechanisms that increase the efficiency of our decisions in specific environments. During this analysis the role of values was not explored.

This section will be centered on the notion of axiological rationality and its connection to Herbert Simon's idea of bounded rationality that we have been exploring during all previous pages. To this end, I will analyze parts of the work of Raymond Boudon (1998a; 2000; 2001) in regard to values while returning to what Max Weber called 'expressive' rationality. This intersection between bounded and axiological rationality will follow the work of Javier

Echeverría y J. Francisco Álvarez (Javier Echeverría 2001, 2002; 2003; Álvarez Álvarez 1992, 2002, 2003, 2007; Javier Echeverría and Álvarez Álvarez 2008). The main objective, therefore, will be to draw a connection between the main claims from these authors and the libertarian paternalists thesis in order to clarify if 'nudges' may represent a challenge (or not) to our bounded axiological rationality.

During the previous section, the issue of autonomy was addressed; in this section I will examine the role of values in our decisions when individuals are being nudged by a choice architect. Taking into consideration that we are boundedly rational individuals that also exhibit axiological rationality, I aim at shedding light into the manner in which nudges affect our expressive rationality.

I will start by exploring how our emotions are affected by nudges and how those emotions may be part of our axiological rationality. To this end, I will be using the bounded axiological rationality (BAR) model advanced by Álvarez and Echeverría in their work from 2008. Once that model is presented, it will be used to give a new perspective to nudges and to the discussion between the pessimistic and the optimistic view of rationality. The main objective will be to see if the axiological part of our rationality is compromised or not and if this creates any ethical problem to nudges.

5.2 Nudges, emotions and axiological rationality

In this thesis I previously discussed different types to understand our rationality specifying, like Nozick did, that the instrumental perspective was the default view of rationality. Rationality in most authors we have seen is conceived as an instrument that may lead us from means to ends. But as we saw before, that is not the whole picture: our rationality can be understood under different frames. One of them is Weber's axiological rationality: sometimes when we behave we do not do it because we would like to obtain a desired consequence but because we believe that the specific action is the right thing to do. As Boudon claimed (1998a), we are rational because we have reasons to believe in a specific thing or to act in a specific manner. Sometimes we act in a determined manner because we have strong reasons to believe that that is the right thing to do, regardless of the consequences. Considering rationality merely under an instrumental frame, Boudon posits, will impede us to explain certain aspects of our rational decisions that cannot be categorized under a means-end schema. People behave sometimes not according to the consequences of their behavior, but according to the principles or values they sustain. People have reasons to do what they do according to their viewpoint and their knowledge of the circumstances. The definition provided by Boudon is the following:

The Theory of ordinary rationality I propose to derive from Weber's work rests finally upon a basic principle I propose to call the *cognitive equilibrium principle*. It says that people believe that X is true, acceptable, good, legitimate, etc. as soon as they have the feeling that X rests upon a set of acceptable reasons (Boudon 2012, 18).

His definition is very similar to the one provided by Amartya Sen: "Rationality of choice, in this view, is primarily a matter of basing our choices – explicitly or by implication – on reasoning that we can reflectively sustain if we subject them to critical scrutiny" (A. Sen 2009, 180).

The idea of rationality of Boudon and Sen is very similar to the one proposed by Gigerenzer in its criticism of Tversky and Kahneman, and consequently, the one that lies beneath nudge theory. The heuristics and biases research program accepts that the norms of rationality follow a type of logical structure from which we deviate in a systematic manner. Gigerenzer, as I explained in previous pages, criticizes this view and claims that we should have a more ecological perspective about how our rationality should work. Those biases are not errors but evolutionary advantages.

Boudon presented us a notion of rationality that was parallel to the one drawn by Gigerenzer and with criticisms that can be considered very similar: "Whilst, to the best of my knowledge, Boudon and Gigerenzer do not cite each other, their conceptions of human rationality are in fact strikingly similar" (Manzo 2014, 534).

Axiological rationality has also similarities with Herbert Simon's procedural rationality (Javier Echeverría and Álvarez Álvarez 2008, 175). Simon conceived that rationality can be substantive and/or procedural. Substantive rationality is oriented to the achievement of goals, while procedural is the "outcome of deliberation" (Herbert A. Simon 1976a, 66–67).

According to Boudon, Tversky and Kahneman's description of biases is close to a 'black box' (Boudon 1998b), or as Gigerenzer sees them, as mere labels too vague to be robust explanations about our decision processes:

The heuristics in the heuristics-and-biases program are too vague to count as explanations. They are labels with the virtue of Rorschach inkblots: A researcher can read into them what he or she wishes. The reluctance to specify precise and falsifiable process models, to clarify the antecedent conditions that elicit various heuristics, and to work out the relationship between heuristics have been repeatedly pointed out (Gerd Gigerenzer 1996, 593–4).

When people act, according to Boudon, they do not only do it for instrumental reasons, they also do it for cognitive or axiological reasons. They show what Álvarez called that expressive rationality that gives sense to the world, that makes the world intelligible to us (Álvarez 1992, 82). This type of ordinary rational theory might shed some light, for example, on the reasons why we vote when it is not rational in a instrumental way. Boudon eliminates the 'black boxes' other theories have when they lack the explanation about what people do. Those black boxes are an example of Tversky and Kahneman's heuristic and biases (verbal labels, according to Gigerenzer). According to Gianluca Manzo (2014), Boudon's 'ordinary rationality' is very similar to Gigerenzer's 'ecological rationality'. Boudon, critical with the heuristic and biases research program, sustains that we cannot interpret those biases as causes neither we can characterize our behavior as irrational when it is biased according to Tversky and Kahneman's view. Boudon focuses on the reasons why individuals have erroneous beliefs denying that

that type of behavior is irrational. Boudon defends a rationalistic view of error, instead of the irrational (pessimistic) view (Demeulenaere 2014).

This faces an important problem: Boudon claimed that biological and psychological reasons of our behavior had to be avoided to not reintroduce black boxes within the explanation of our actions, so a type of acceptance between the different types of explanations have to be sought (Sánchez 2014).

Gigerenzer can provide the conjunction of both approaches with his ecological rationality in the sense that he asserts that there are reasons to why people behave in certain ways. With this, Gigerenzer's idea of rationality is closer to the idea sustained by Boudon and his criticism of rational choice theory as a model based on egotistic and instrumental behavior to explain why we do what we do:

Rational choice theory suffers from a major shortcoming: it is doomed to explain the objectives, values and beliefs of people by postulating the existence of conjectural causes operating in the back of their minds. Rational choice theorists call generally these conjectural causes frames or frameworks. But the same explanatory scheme can be found behind many other notions as mentality (as in the example of Lévy-Bruhl's primitive mentality), habitus, etc. Some social scientists treat these causes as mere data, while others propose to derive them from psychological, social or biological mechanisms that are themselves in most cases highly conjectural (Boudon 2012, 17).

The criticism of the notion of frames (the same 'frames' researched by Tversky and Kahneman) resembles the criticism developed by Gigerenzer and his ABC group. We have beliefs, according to Boudon, and those beliefs are, sometimes, the reason of our decisions. Reducing all our decisions to an

instrumental perspective produces the appearances of those black boxes Boudon criticizes. Behaving in purely egotistic and instrumental way will make us the type of rational fool described by Sen (1977).

Boudon, Sen, and Gigerenzer have a very similar view about rationality and they share some of the viewpoints that criticize the basic assumptions of rational choice theory and the heuristic and biases research program. It is yet to be seen if this criticism may carry to nudge theory. Since we have reasons to do what we do, are nudges a way to manipulate those reasons and steer our behavior to a mere instrument that would satisfy our goals? Are nudges a way to remove our axiological rationality or are they an instrument to preserve it? That is a difficult question to answer because of its broadness. There are many different types of nudges: default rules, information nudges, etc.

Libertarian paternalists claim that it is impossible to remove nudges since the choice architect will always have to decide an environment in which individuals must decide: "manipulation is unavoidable; no matter how options are presented, they frame our choices and behavior" (Roeser 2012, 1037).

Let's consider a hypothetical scenario: recycling. An individual does not recycle because she believes that recycling will not make a difference. She has reasons to do what she does. There are cognitive and instrumental reasons. But she also thinks that environmental issues are important and we should limit the damages humans cause to the environment, but the cost of recycling is too high for her to do it. It is obvious that a society would benefit for nudge to increase the amount of materials recycled, specially if the individuals involved agree that recycling should be done. According to this

perspective, a nudge that may facilitate recycling should be desired since it would reduce the cost or increase the cost of her trying to separate materials for recycling. Increasing the size of the recycling bin and reducing the trash (landfill) one may do the trick. She does not have to be aware that she is being nudged and it is not a rational persuasion either. Her cognitive reasons are still intact ("recycling will not make a difference"), but now she does recycle because finding space for trash is more costly than to separate materials. In this scenario, nudges alter the reason why she increases the amount of recycling material (no space), but they do not replace cognitive rationality or her values (axiological rationality).

Some nudges do change our values. Companies that manufacture high fructose corn syrup have tried to change its name to 'corn sugar' to manipulate the perspective individuals have about their product and its chemistry. "Corn sugar" sounds like a natural product while 'high fructose corn syrup' sounds like a chemical product. The FDA sent a letter requesting companies to cease the use of the term 'corn sugar' to refer to that product. Changing it could have been considered a nudge that would have alter the values of consumers in regard to this product.

The case is similar with labels referring to trash as "landfill". That may allow people to change their cognitive rationality since they will be getting information that also tackles their emotions about where the trash will go.

I claim that the issue rests on the relationship between the different aspects of rationality. Sometimes rationally explaining how things work in an attempt to alter people's cognitive rationality is not enough or it does not work

at all. That is the premise of nudge theory: education sometimes does not work. "There is a great deal of evidence that giving people strong arguments to change their minds often fail to work when people are motivated to reject the evidence. In fact, those who are motivated to reject the claims may become more entrenched in their views than previously. This is known as the backfire effect" (Levy 2017, 495).

Considering issues related to vaccination, we may find people with reasons to believe that vaccination is dangerous. According to Boudon, if they do not get the vaccines, they have cognitive reasons to do so. Their behavior is not irrational. The argument, within the rationality debate, is if they should be educated and/or nudged to receive those vaccines. In a sense, both alternatives are trying to change people's reasons and actions. Rejecting the use of vaccines, from an instrumental perspective may be viewed as irrational, but not from Boudon's perspective. Individuals have reasons to believe what they believe, and they are acting accordingly, but they are not irrational, may be they are ignorant or they are showing some type of risk aversion that do not allow them to see the benefits of vaccines.

Understanding the reasons why people behave in specific way, or at least accepting the idea that people may have reasons to do what they do in the Boudon's sense will shed some light in what type of policy-making technique we should use to change their behavior towards accepting something as objectively beneficial as vaccines without limiting their autonomy. Some have argued that bypassing people's autonomy should be accepted when referring to vaccines:

At least in the case of pediatric vaccination, some autonomy-undermining nudges may be morally justified. This is because parental autonomy in pediatric decision-making is not as morally valuable as the autonomy of adult patients, and because the interests of both the vaccinated child and other members of the community can sometimes be weighty enough to justify autonomy-infringing pediatric vaccination nudges (Navin 2017, 43).

Even if specific nudges affect the autonomy of individuals, this perspective will defend their use due to the objective benefit of vaccines. But the use of nudges responds to the impossibility to educate people about certain behaviors. It is based on the idea that people cannot learn. Under a different view, the other possibility would be to understand the reasons why some people reject the use of vaccines without relying on the black box of irrational behavior. This perspective is in line with Gigerenzer's view: policy makers should either educate or mandate (if benefits are objectively clear). Accordingly, the goal should not only be for people to do what is right (instrumental) but to understand and value what is right (cognitive and axiological rationality). Having a monistic view of rationality that rests just on instrumental principles affect the type of policies to implement. The approach of Tversky and Kahneman assumes a rationality that is merely instrumental. This theoretical frame is the basis of nudge theory, which also considers only the instrumental approach.

A more complete view of rationality, one that comprehends different aspects may provide a deeper understanding of why people do what they do and should be able to develop policies that take that approach into consideration.

I am not rejecting here the use of nudges, but I claim that the theory of rationality they rest on is incomplete. A broader view of our rationality should

include not only an instrumental means-end schema, but also an axiological angle, in line to what was defended by Javier Echeverría and José Francisco Álvarez (2008).

According to their perspective, people behave using both aspects of rationality (axiological and instrumental). They both are a type of conjugated concepts or using their metaphor, rationality can be described as a fabric in which the warp is the axiological rationality and the weft is the instrumental one. They both would be acting in a "single communicative situation" (Javier Echeverría and Álvarez Álvarez 2008, 175). Since the instrumental and axiological approach constitute the fabric of our rational processes, neglecting one or the other one would generate problems when trying to account for the way people decide. A narrow version of rationality based merely on instrumental principles would not be able to explain certain amount of phenomena within our decisions. A broader notion that incorporates axiological principles would allow to provide explanations about conducts that otherwise might seem irrational, generating the 'black boxes' Boudon was criticizing.

I claim that the libertarian paternalist perspective which advocates for the use of nudges in policy-making, although effective, rests on a narrow version of rationality that does not allow for the comprehension of specific behaviors that can only be explained attending to axiological principles. Attending only to the outcome of our decisions (substantive rationality, in Simon's terms) is not enough. A complete policy-making approach would have to consider not only the outcome, but the process itself. Sometimes,

when individuals act in a specific way, they have reasons for doing so. It is important that any type of policy-making approach take people's expressive rationality into consideration when trying to influence their behavior. Nudges, when needed, should tackle both aspects of rationality, not only the instrumental one. If people's cognitive axiological rationality (in Boudon's terms) is based on false predicaments in a way that they affect negatively the life of the individuals, governing agents should try to change, not only the outcome of people's behavior, but also their axiological rationality. This is the approach of Gigerenzer when he highlights education.

Nudges are an efficient tool and I do not think they should be avoided. I think we should make sure that, when possible, and considering that both aspects of rationality sometimes manifest themselves in our decisions, nudges affect the outcome and the process. There are educational nudges that help people understand more about their choices. The obnoxious beep that our cars produce when we are not wearing the seatbelt are an example of nudges that are efficient that serve as a reminder to what to do. Supplementing that with an educational perspective that may help us understand how seatbelts are beneficial would be a comprehensive approach, since it will be considering both aspects of our rational behavior, while it assumes a realistic view: people are boundedly rational.

The Center for Disease Control (CDC) of the government of the United States provides campaign to increase the use of seatbelt among drivers. They use educational tools to affect our cognitive axiological rationality. The

following paragraph shows the information that the CDC presents to drivers in order to educate them about the use of seatbelts:

What Do We Know? Most drivers and passengers killed in crashes are unrestrained. 53% of drivers and passengers killed in car crashes in 2009 were not wearing restraints. Seat belts dramatically reduce risk of death and serious injury. Among drivers and front-seat passengers, seat belts reduce the risk of death by 45%, and cut the risk of serious injury by 50%. Seat belts prevent drivers and passengers from being ejected during a crash. People not wearing a seatbelt are 30 times more likely to be ejected from a vehicle during a crash. More than 3 out of 4 people who are ejected during a fatal crash die from their injuries. Seat belts save thousands of lives each year, and increasing use would save thousands more. Seat belts saved almost 13,000 lives in 2009. If all drivers and passengers had worn seat belts that year, almost 4,000 more people would be alive today¹⁴.

In order that to affect also our instrumental rationality (the outcome of our behavior) nudges are used:

- cars use beeping sounds to remind us about the use of seatbelts
- Government created a advertising campaign with the catchy phrase "Click it or ticket"
- You would be fine and would have to pay a fee if caught without not wearing the seatbelt.
- On the roads there are reminders of the use of seatbelts that are clear and precise: "Buckle up, it is the law"

In 1981 only 11% of drivers used seat belts in the USA ("Policy Impact: Seat Belts | Motor Vehicle Safety | CDC Injury Center" n.d.), in 2010, the number raised to 85% of total drivers. Drivers today are not only changing the

¹⁴ <https://www.cdc.gov/motorvehiclesafety/seatbeltbrief/index.html>

outcome of their decisions, they also understand, from an axiological cognitive perspective, the benefits of wearing a seatbelt in a car.

5.3 Nudges Vs Nudges

The main argument used by libertarian paternalists to promote the use of nudges at a public policy level rest on the unavoidable principle. There is always going to be a determined choice architecture. It happens whenever we go to the store, we buy a car, we eat in a restaurant, or we cross the street. The environment is organized in specific way. Companies, for example, use nudges in order to promote specific type of consumer behavior. Some grocery stores, for example, may nudge their customers into buying specific products by placing them at eye level. Some food industry companies may include green labels in order to nudge potential buyers about the ecological qualities of the product they are trying to sell. At every level, people are being nudged. Nudges sometimes are beneficial for them, but sometimes they go against their wellbeing.

Since nudges are part of our daily life and the choices we make, I claim that it is important to develop strategies in order to recognize them. Whether they come from companies trying to sell products or government agencies trying to care about our wellbeing or about the wellbeing of the society as a whole.

The responsibility of companies and corporations is attached to their profit, not to people's benefit directly. Being able to recognize that is an essential part of our lives as citizens. Having government agencies that care

about how their citizens make conscious and autonomous decisions according to cognitive values that are evidence based it is fundamental for any democratic society.

There are nudges that may benefit people by helping them behave the best possible way as judged by themselves, and there are nudges that might damage the wellbeing of people. These damaging nudges hide behind the same libertarian paternalistic principles used to defend public nudges that may be beneficial. The both argue that ultimately individuals always have the capacity to decide. Nudges are, by nature, liberty preserving. But one thing that we have learned thanks to Herbert Simon is that our rationality is bounded, as bounded as the rationality of the choice architect. Being aware that nudges are part of our lives and how to identify them should be part of the education we received. Governments and institutions should nudge individuals at a policy-making level to benefit them, but whenever their cognitive axiological rationality has already understood the issue.

Tversky and Kahneman's pessimistic perspective about the impossibility to educate individuals in certain scenarios cannot be the cornerstone of public policy approaches. Nudges and education should complement each other.

Since, as I mentioned above, individuals show two versions of rationality (instrumental and axiological), it is important that both aspects of rationality are affected by public policy makers and governing bodies when trying to benefit their citizens. Considering the metaphor used by Echeverría and Álvarez about rationality as a fabric thread where weft and warp represent

the axiological and the instrumental aspect, I claim that nudges should only complement educational initiatives. If we only consider the instrumental view of rationality and we develop only initiatives that affect the way we behave but not our axiological rationality, we will be neglecting an essential part of our development as citizens and a fundamental part of every democratic society to be composed of informed citizens with the capability to use their critical rationality.

We are bounded rational individuals and our decisions will reflect those boundaries. Being aware and understanding how our rationality is bounded may allow us to make more autonomous decisions and learn ways in which we can manage the information we are presented with in order to make decisions that respond to the values we have and that may bring us the desired benefits we expected.

Considering genetically modified organisms as an example, I argue that there may be conflicted opinions about the damage or benefits of these type of products. Companies and corporations promote their use. In the USA, the government agency that regulates them said that there are no health issues related to their consumption or production, according to their website¹⁵.

To avoid issues, the government does not force labels related to genetically engineered foods (purposeful desinformation), since according to their views (cognitive axiology) credible evidence has demonstrated that foods from the GE plant varieties marketed to date are as safe as comparable, non-GE foods" (paragraph takes from that same website). According to the

¹⁵ (<https://www.fda.gov/Food/IngredientsPackagingLabeling/GEPlants/ucm461805.htm>).

USA government, the fear of some citizens in regard to GE products is completely irrational. Should the government, therefore, nudge our instrumental rationality in order to make sure we do not only consume non-GMO (or non-GE, as they like to call them) protecting our interest and the interest of the companies that commercialize them? That approach is being battled in different states in the country. California, for example, in their proposition 37 (a ballot measure voted in the state elections of November 2012) argued that the citizens of that state had the right to know which of the foods or organisms for sale are GE or have GE components. In order to provide that information, there had to be a mandate to label all GE products. The California Attorney General claimed that it would be an unnecessary cost for companies and for the state, since it had to regulate them. Those opposing the proposition (big corporations like Monsanto or Coca-Cola) donated almost 30 million dollars to defeat it (vs the 6 million dollar raised to defend mandatory labeling).

Proposition 37 was defeated by less than 3% difference in voters. Companies and government did not want any label informing citizens about GE organisms. This a complex case in which both government and corporations do not want to inform consumers and citizens since they consider that that information would trigger an alarmist reaction based on irrational behavior.

Now, consider someone that does not want to consume GE organisms, but is being forcefully nudged (with lack of information) to go against her will (axiological rationality).

The role of companies and their motives are clear. Government's role should also be clear in regard to the education of their citizens. By attending only to the instrumental aspect of rationality, if that is case, governments would be neglecting part of their functions in a democratic society, which is to educate people in order to be autonomous in their decisions. Almost in a Kantian approach, individuals should emerge from their self-imposed immaturity and governments should participate in that task. But that is something that can only be done by understanding the rationality of their citizens in a comprehensive manner: not only from an instrumental view, but also from a bounded axiological rationality perspective. We are bounded rational individuals that also exhibit an axiological rationality.

5.4. Bounded Axiological Rationality and Nudges

Nudges, as I argued in the last section, should be based on the consideration that our rationality is not only instrumental, but also axiological, and, of course, bounded. Accordingly, I follow the main thesis proposed by Echeverría and Álvarez (2008, 173). Using this approach I claim that such model to understand rationality should be the theoretical frame for nudges, and not a model based merely on an instrumental view of rationality that conceives our boundaries as imperfections the make us irrational. This perspective is ultimately based on the idea that there is a perfect rationality to which our behavior should approximate. Since this is extremely difficult, the use of nudges is justified.

I here claim, following the model of Echeverría and Álvarez in regard to rationality as bounded and axiological, and combining it with Gigerenzer's idea that education should be preferred over any other type of policy, that nudges should not be the preferred type of policy approach, since our rationality operates beyond the instrumental approach. It is because we exhibit an axiological rationality that education should be preferred to nudges, but it is also due to the fact that our rationality is also bounded, that nudges might be an efficient complement or collaboration tool. Nudges should be used to make sure, once people understand the choices, that decisions are going to be beneficial for the individual and according to her autonomous will, in a liberty preserving manner.

But there cannot be a liberty preserving nudge if individuals lack the understanding and do not share the values (axiological) on which that decision is based. Values here are an important filter, as Echeverría and Álvarez claim, they "orient our perception... The subject selects what he desires and rejects in the environment, the subject values the information" (2008, 179).

As Simon posited in his model of bounded rationality, in our decisions we cannot consider all information provided by the environment. At that moment is when our values act by being "proactive filters... The choice of the possible courses of action occurs before the choice of means (Javier Echeverría and Álvarez Álvarez 2008, 179).

Neglecting the idea that people based their decisions in a plurality of values may affect the type of policies agencies configure in order to interfere

with their decisions. Simon's notion of procedural rationality, as we mentioned before, captures a more realistic and comprehensive view of how individuals decide. This approach is not only in line with the main thesis argued by Echeverría and Álvarez, it is also the foundation, together with his optimistic view of human rationality and how it is connected to the environment, of Gerd Gigerenzer's ecological rationality and his attitude towards education as the main intervention in order to intervene people's behavior. Accordingly, the intervention is not only at the behavioral level (instrumental approach) but also at the axiological one.

This view understands rationality as having different "motors" interacting in a single motion. Rationality is bounded, and comprehends axiological and instrumental components. As Álvarez posits, individuals should have the opportunity to behave rationally, but not according the goal oriented rationality understood by mainstream economics, but by the comprehensive approach that considers the possibility of the individual to be autonomous and to express her doubts about her preferences until the last moment. This possibility becomes impossible when individuals are considered as strict maximizers. The inclusion of the axiological element should be the basis for any type of theory of rationality or public policy that tries to affect the way people decide. It is not enough to alter simply the outcome of people's decisions (substantive rationality, in Simon's terms) since all axiological components would be neglected. We are not the type of "rationals fools" criticized by Sen. That is the goal of non educational nudges that merely look for a change in behavior. Nudges should be educational, when possible. If

they are merely instrumental and they only try to manipulate the outcome of our behavior it is because that has being an attempt to educate people about that specific decision.

Considering the example of "seatbelts", policies that are created by governmental agencies should not only be focused on making sure people wear them, they should also invest in education and educational nudges in order to affect all components of our rationality. Understanding how seatbelts save lives at a cognitive level makes individuals share the importance of their use as a value. That value motivates decisions, but since our rationality is bounded, instrumental nudges can be a great resource to modify our behavior to comply with what we really want (wear the seatbelt since we understand the it saves lives in case of accidents).

If schools want to decrease the amount of junk food consumed by students, they should be tackling rationality in a comprehensive approach. Using the example of a nudge described by Thaler and Sunstein in their book (2009), it is not enough (as we see the role of government agencies) to just alter the behavior of students by placing the salad or vegetables at eye level in the cafeteria and placing the pizza on the top shelf. A more comprehensive approach should be demanded, one that may also educate students. According to Tversky and Kahneman first, and Thaler and Sunstein later on, in their pessimistic view of rationality, these types of attempts to educate people to make rational choices sometimes do not work. An optimistic view of our bounded rationality that is also comprehensive should have a double approach when designing policies (an instrumental and an axiological).

Herbert Simon's bounded procedural rationality is at the foundation of the type of rationality approach I am proposing in these lines. His procedural approach opens the door not only to the two different bounded rationality theories (the pessimistic and the optimistic), but also to the bounded axiological rationality. This last approach, since it represents a more comprehensive theory of rationality, should be the theoretical frame for any type of policy intervention. It would consider nudges as instruments of behavioral change only after educational initiatives are in place. Only an optimistic theory of rationality that understands (bounded) rationality as axiological would allow this type of approach.

6. CONCLUSIONS AND POSSIBILITY FOR FUTURE

RESEARCH

This dissertation has been a proposal to recuperate the relevance of Simon's work in today's debate about rationality. In my opinion, Simon's legacy, while understood and accepted, has been broadly neglected from the literature concerning these issues. It is not only because I think that he deserves to get credited for some of the initial moments of the behavioral revolution in social sciences, but above all, because bringing Simon back into the debate can clarify the different positions in it.

Herbert Simon's work did not only centered around bounded rationality. There are major parts of his work in regard to artificial intelligence that are not present in my work. In my line of research, therefore, I had to discriminate to

make sure the objective was attainable and clear. My main goal was to draw a theoretical line that passed through the main assumptions of mainstream economics about rationality, Simon's critical response the lack of realism of that view, Simon's legacy in the different ways to understand how rationality is bounded, and the role of Simon's in the current debate about the pessimistic and optimistic versions of bounded rationality. Each part of the debate has a policy-making perspective attached to it. While the pessimistic view focuses on the inevitability of our irrationality, claiming for the use of nudges to be more efficient, the optimistic approach maintains the idea the individuals can be taught and they can learn about decisions in situations of risk and uncertainty. This debate was mainly held under an instrumental frame of understanding rationality. An axiological approach, although present in parts of Gigerenzer's work, was absent from the main claims. Part of my proposal, therefore, was the introduction of the model of bounded axiological rationality advanced by Echeverría and Álvarez in the debate. Once the axiological axis was part of the equation, a different approach about the role of education and nudges was needed.

Instead of either or, I propose the complementarity between education and nudges, but in a specific order. The relevance of axiological rationality and the idea that when individuals act in a specific manner, they have reasons for doing so, forced us to consider education as a first mechanism: to make sure those values match the decisions that individuals make. People should be cognitively aware of the decisions they are making. But, attending to the research conducted about rationality and considering how bounded it is and

how easily fails to accomplish its goals, nudges should be used as a secondary mechanism. While education should be focused on the axiological aspect of rationality, to affect also the instrumental one, nudges would complement that instrumental approach to increase efficiency. The question, therefore, changed: instead of asking if policy makers should nudge or educate, we should be asking if they should nudge after the educative approach. Although individuals are not as irrational as the pessimistic version thinks, their rationality is in fact, as Simon acknowledge, bounded. Having mechanisms in place, like nudges, may help education to increase the instrumental efficiency of decisions. But nudges cannot be a substitute for the axiological part of our rationality. If people are nudged to consume genetically engineered food because policy makers think that there is nothing wrong with it, we have to make sure that people agree with that perspective. If the matter is in dispute, then all information needed should be provided. Nudges are merely an instrumental tool that leaves the axiological component of our decisions out of the picture. For that reason, education should be the primordial mechanism to influence people's behavior. As individuals, we are being nudged constantly by companies, corporations, institutions, other people, etc. to affect the outcome of our decisions for their benefit. Governments should make sure that their citizens are well informed about the choices they are making or the should be making. All the attempts by different governmental institutions to nudge citizens must be only come after a primary educational approach. Rationality is not only instrumental, is also axiological and bounded.

Simon's criticism of the substantive approach proposing a procedural understanding instead resembles my proposal, but for Simon, rationality was instrumental, it was that "set of skills or aptitudes we use to see if we can get from here to there - to find courses of action that will lead to the accomplishments of our goals. Action is rational to the degree that it is well adapted to those goals. Decisions are rational to the extent that they lead to such action" (Simon 1993, 393). Simon, although accepting a procedural approach, neglected an axiological view of rationality. My proposal here was to complement Simon's view with Echeverría and Álvarez's model shedding some new light to the rationality debate.

There are several lines of research opened that might depart from this dissertation, above all, an analysis of the use of algorithms to remediate some the consequences of our bounded rationality. It is known, for example, that hungry judges provide longer sentences to criminals. When their stomachs are full, their sentences become shorter. Algorithms are being used to decide the length of sentences to avoid these types of issues or biases. But algorithms can also be biased. Algorithms decide the interest rate people have to pay in a mortgage, if they are more susceptible to leave their job or to stay, if they should receive a longer sentence for a criminal act, if you are a good or a bad teacher, etc. An algorithm may decide your salary, or the amount of time you are willing to wait in the phone when calling a company. People design those algorithms, but people are boundedly rational and they may carry their biases the algorithms they design. The MIT Technology Review mentioned in an article written by John Maeda from July 2017 that

"opaque and potentially biased mathematical models are remaking our lives—and neither the companies responsible for developing them nor the government is interested in addressing the problem". Cathy O'Neil, the author of *Weapons of Math Destruction*, highlights the risk of algorithmic bias and claims that although algorithms are replacing human processes, they're not being held to the same standards. A line of research that addresses the connections between the rationality debate, our biases, and the use of biased algorithms can provide interesting results from a policy-making perspective or from the field of ethics. Especially when our bounded rationality now is been affected by the information provided by "many minds", or "crowd expertise", a connection that Álvarez (2016) has already explored but that may provide interesting and fruitful research possibilities when connected to the use of algorithms or even when considered under the perspective of libertarian paternalism.

7. BIBLIOGRAPHY

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