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Behind Behavioral Economic Man: The Methods and Conflicts Between Two Perspectives

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Keywords: behavioral economics methods, Kahneman and Tversky, Gigerenzer and the ABC Research Group

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Abstract:

This work analyzes the methods of research in decision-making of behavioral economists Kahneman and Tversky (K&T) and one of their main critics, Gigerenzer and the ABC Group. Our aim was to explain differences between these two approaches of BE by examining the procedure used by them to search for the cognitive processes involved in choice. We identified similarities between K&T and the mainstream economics methods that may explain some of the differences with their critics' approach. We conclude with a discussion of how advances in BE, such as Nudges and Choice Architecture may take advantage of complementarities in these perspectives.

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1 Introduction

Human behavior is a fundamental component of economics and is usually described and interpreted by the Rational Choice Theory (RCT). From Bernoulli to Kreps, the RCT has assumed many different forms and undergone a lot of change in its long history. One key aspect (Sen 2002, 2009) of RCT is the use of logical constructions to describe man as a rational decision maker¹. In this view, choices and preferences must be consistent and follow regularities (e.g. completeness and transitivity, α and β (Sen 1971)) and statistical norms (e.g. independence, bayesian updating) while it avoids the use of any motivations or psychological aspects to describe the choice. Giocoli (2003) argues that the evolution of the concept of rationality in economics in the first half of the twentieth century can be analyzed in terms of an "escape from psychology". This "escape" is related to the efforts from early neoclassical economists trying to dispose of mental variables and psychological process from choice theory, which were regarded as a theoretical fragility because they were not empirically testable.

However, after World War II, RCT was confronted by an alternative theory of decision making. Herbert Simon drew insights from psychology, computer science, management and economics to propose the concept of bounded rationality (Sent 2000, 2004; Mirowsky 2002). Simon used psychology's methods and concepts to criticize RCT and was one of the pioneers in the field of Behavioral Economics (BE) (Heukelom, 2014; Sent 2004). This dissatisfaction with RCT was shared by other economists who used insights of cognitive psychology and computational models to build and test alternative economic theories in the 1950s and the 1960s². Sent classified these early contributions as "old" BE, because they were distanced from mainstream economic theory and therefore were never widely accepted by other economists. In the 1970s, the work of the psychologists Daniel Kahneman and Amos Tversky (K&T) was also a

¹ Sen(2002, 2009) divides the RCT in two aspects. Consistency and Selfishness. Here, we focus in the Consistency aspect.

² Simultaneously, psychologists as Ward Edwards and Duca Luce were advocating reforms in Decision Theory.

landmark for Behavioral Economics. K&T were critic to the RCT as well and argued that it was not able to properly describe behavior. They searched for choice “anomalies” and cognitive explanations for those behavioral “deviations” and claimed to create a descriptive theory (Kahneman & Tversky 1979) for human behavior. It can be argued that K&T paved the way to a less critical approach of BE, which Sent (2004) called “new” Behavioral Economics and that was later incorporated into mainstream economics (Heukelom 2011, Geiger 2016).

Since the 1980s there has been criticism of the new BE approach based on the concepts developed by the psychologist Gerd Gigerenzer (GG) and colleagues from the Center for Adaptive Behavior and Cognition (ABC Research Group). GG and his group claim to be based on the original meaning of bounded rationality proposed by Simon, and oppose the way K&T have shifted research in BE (Gigerenzer 2015, Gigerenzer and Selten 2001, Gigerenzer 1996, Gigerenzer 1991). This alternative perspective has casted doubt on the empirical findings and interpretation of new BE and has been gaining momentum recently (Katsikopoulos, 2014).

How did these cognitive psychologists develop such different perspectives on how psychology informs economics? Gigerenzer has stressed the conceptual differences with K&T theories throughout his work, but we propose that the distinct methods applied by them may explain their main divergences. By method we mean the procedure used to search for the cognitive processes and the research questions by each author. Therefore, the purpose of this article is to understand Gigerenzer’s criticism of new BE by comparing the methods of these two perspectives of BE. We are going to identify the methods applied by K&T and GG and the ABC Group and then compare them.

This paper will be divided into three parts. The first part will analyze the work and methods used by K&T. We sketch the historical evolution of K&T’s theories while calling attention to the methods used by K&T. Generally, they focus on choices before describing the cognitive process. We are going to argue that even though there are changes in the description of the cognitive process during this evolution, this choice centered method remains the same. The second part will analyze the work and method used by GG and the ABC to confront it with K&T. We will describe what GG and ABC propose, as well as their methods, and show its similarities with the Human Problem Solving proposed by Hebert Simon. Their method searches for realism in description of the cognitive process. Thus, they focus on the process and the take behaviors³ as consequences of simple rules of thumb. We conclude this part by reviewing Gigerenzer’s critiques on K&T works in the light of his method. The last part will compare these two methods with RCT. We will argue that K&T’s methods have more similarities with economical practice and theory. This partially justifies the incorporation of the new BE by the mainstream theory as Heukelom (2011), Sent (2004), and Geiger (2016) argue. We also argue that despite the fact that K&T and GG have different constructions and interpretations of human behavior, new applications of BE, like Nudges and the Choice Architecture, may find a complementary relationship between their work.

³ Behaviors are viewed as a whole, that is, not as multiple static choices.

2 Amos Tversky and Daniel Kahneman

The measurement of the utility and choices involving probabilities, risk, and uncertainty were a central issue in Decision Theory and RCT after the 40s. On one hand, there is the development of many different models such as the works of von Neumann and Morgenstern (1944) and Savage (1954). On the other hand are the works trying to measure the utility in real situations and test these theories done by researchers such as Coombs (1958, 1959) and Davidson (1957, 1959)⁴. In 1954 and 1961 Ward Edwards published two seminal articles advocating the behavioral decision research as a new field in psychology (Phillips & von Winterfeldt, 2006). Amos Tversky was embedded in this environment as a graduate student of Ward Edwards and Clyde Coombs.

Kahneman and Tversky started working together searching for how the mind processes statistical data. Inspired by such an environment, their work analyzed situations similar to those in RCT. They tested situations involving statistical thinking and were able to observe many real choices involving this feature. Once they had the observed choices, they examined their patterns and did two things: 1) compared it with the statistical norms and RCT. 2) searched for the internal processes by correlating the patterns in the answers of the statistical questions with precise features from different questions. From 1, K&T described their Biases, the systematical deviations from the RCT's predictions and descriptions. From 2, K&T described their Heuristics, the internal processes for statistical data. This will be better illustrated in section 2.1.

The search for better descriptions and descriptive models for behaviors is a key aspect of their agenda. In the early 70s, they developed possible psychological explanations for many choices and in 1979 they created the Prospect Theory, which attempted to directly discuss RCT. Prospect Theory is made to be a descriptive model in the sense that it is able to address many behavioral anomalies not encompassed by RCT. In section 2.2 we discuss that Prospect Theory emphasizes this description of the patterns of choices and it does not describe the mental processes. In the 90s Kahneman incorporated the Dual System in his theory. This dual system explains that there are two types of cognition, one fast and effortless, the other slower and requiring effort. Although this theory changes many aspects of the cognitive processes (and consequentially, the behavior), we are going to discuss in section 2.3 that this change is an adaptation in order to better describe new observed behavior.

2.1 Heuristics and Biases

The collaboration between K&T started in the 70s. Their main findings were summarized in 1974 in a paper that described three possible heuristics used by the human mind. In order to understand the method used by K&T, we are going to describe and analyze two experimental procedures used to understand and describe two of the heuristics, Representativeness and Availability.

⁴ Heukelom scrutinizes this environment in his book and argues that: "Tversky's work on the representational theory of measurement and on decision theory came together in his experimental work on behavioral decision research"(Heukelom, 2011:100).

The **Representativeness Heuristic** suggests the people define “the subjective probability of an event, or a sample, is determined by the degree to which it: (i) is similar in essential characteristics to its parent population; and (ii) reflects the salient features of the process by which it is generated.” (Kahneman & Tversky, 1972, p.430). In their 1982 classical experiment, they described Linda to XX subjects, as a “31 years old, single, outspoken and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice and also participated in antinuclear demonstrations.” (Kahneman & Tversky, 1983, p.287)

Then, they asked the subjects to order 8 possible characteristics of Linda, from the most to the least probable of being her. From these 8 possibilities, 3 are especially important:

1-Linda is active in the feminist movement

2-Linda is a bank teller

3-Linda is a bank teller and is active in the feminist movement

K&T reported that 85% of the experimental subjects described 1 as more probable than 3, and 3 as more probable than 2. This result breaks a statistical norm by reporting that a single event (2) is less likely to happen than this same single event added by another (3). In this same experiment, K&T divided the subjects into two groups. In one group, they asked the probabilities as described above. The other group was asked to order these descriptions in order of resemblance with Linda, i.e. ordering from the option which is Linda's “most representative” one to the “least representative”. The results showed a 0.99 correlation between the answers of the two groups. This is observed as a strong evidence that the process of statistical reasoning and the search for resemblance and representativeness have related aspects and might be similar

The **Availability Heuristic** suggests that people “assess the frequency of a class or the probability of an event by the ease with which instances or occurrences can be brought to mind” (Kahneman & Tversky, 1974 p.1127). That is, events that people remember more easily are usually seen as more probable than they actually are. In 1973, K&T did an experiment in which they gave subjects 60 seconds to write seven letter words with the 3 last letters being ING. To subjects in another group they gave the same 60 seconds to write seven letter words that had N as the penultimate letter (_N_). The average numbers of words produced by the first group was 6.4, while in the second procedure the average was 2.9. This indicated that people recorded more easily words ending with (ING) than words ending with (_N_). Then, using two different groups, they asked one group to guess how many words would it be possible to find in four pages of a novel with the ending (ING) and the other group was asked the same question but with words ending with (_N_). The subjects answered that the four pages would have more words ending with (ING) than ending with (_N_). Once again, this is a mistake compared with the RCT and K&T correlated this mistake with a precise feature, in this case the memory.

Similar results were described in similar experiments (Kahneman & Tversky 1972, 1973, 1982) and such errors were systematically reported, collaborating with the notion of biased choices. The correlation between such errors and precise features were observed systematically, collaborating with the heuristics.

Firstly, the heuristics are obtained by the high correlation between choices and precise features. The heuristics proposed by K&T are meant to be descriptive as it is expected that the observation of these features (resemblance and memory) would be good indicatives for the actual choices. This observed behavior plays key role in the method as it is both the initial point to identify the heuristics and the ending point, that is, what the heuristics aim to describe. Secondly, the only behavior observed by K&T was regarding the choices/answers, which are the only important behavior for the RCT. The choice is perceived in a static perspective and not as procedure. The information and questions are given, and the subject only has to answer. In this sense, the heuristics describe a direct relation between question (set of options) and answers (choices). Lastly, it is important to notice that the biases of these two described heuristics are related to how people judge probabilities. This is a key issue for RCT and will take a crucial importance in the development of their work.

2.2 Prospect Theory

K&T created the Prospect Theory in 1979 using choice anomalies similar to those described during the Heuristics and Biases Program. The stated purpose of Prospect Theory is to describe behavior: “This paper presents a critique of expected utility theory as a **descriptive model** of decision making under risk, and develops an alternative model, called prospect theory.”(Kahneman & Tversky, 1979, p 263, bold added by the authors). To develop and justify their model, they reported many experimental results in situations with risk. Each of the experiments are used to describe biased choices that deviate from RCT (in the expected utility theory version) and that they want to incorporate to the model. Differently from the Heuristic and Biases program, they do not search for new heuristics to explain behavior, and they do not even use the previously described heuristics. To understand the process behind Prospect Theory, they distinguish two phases of the choice process: the first is an Editing Phase (or Framing Phase), which consists of a preliminary analysis of prospects and it is when a person mentally changes the problem to make it simpler and easier to evaluate (i.e. individuals use heuristics). The second is the Valuation Phase when the edited prospects are evaluated and the prospect of highest value is chosen (a static and maximizing process, similar to those in RCT). K&T described many possible processes of what could happen during the Editing Phase. For instance, they describe the combination and cancellation of similar prospects. However, no formal theory is proposed: “Framing (Phase) is controlled by the manner in which the choice problem is presented as well as by norms, habits, and expectancies of the decision maker.” (Kahneman & Tversky (1986), p.S257) “Although **no formal theory of framing is available**, we have learned a fair amount about the rules that govern the representation of acts, outcomes, and contingencies.” (Kahneman & Tversky (1992), p.298, emphasis added by the authors).

These processes are only possible explanations of why many deviations may occur. Therefore, the theory is more able to represent and describe the identified patterns in the choices than to explain or describe the process of choice itself. That is, the heuristics and processes used by the agent here are not the focus, although there are many intuitions about how it occurs. The description of observed choices in risky situations lead to a function as the one described by the Prospect Theory and it does not try to describe why the agent would have a certain preference order, but it tries to describe regularities in the description of the choices (outcomes).

Katsikopoulos argues in a similar way:

"That is, optimization is not meant to describe the underlying psychological processes, only their outcome. This neglect of process dominates the idealistic modeling of bounded rationality as well. It may seem odd to argue that, say, prospect theory does not model processes, but it indeed does not in the sense that prospect theory does not specify how exactly it can be that a person would manage to nonlinearly weight probabilities, calculate nonlinear utilities and integrate the two (note that there are elements of a process in prospect theory, as in its initial stage of setting a reference point). I am aware that behavioral economists routinely call their models process models, but if one takes the definition of a cognitive process seriously, this is not so." (Katsikopoulos, 2014, 365)

In 1986 K&T published a paper that summarized everything they had found so far. They claim:

"The thesis of the present article is that, in spite of these a priori arguments, the logic of choice does not provide an adequate foundation for a descriptive theory of decision making. We argue that the deviations of actual behavior from the normative model are too widespread to be ignored, too systematic to be dismissed as random error, and too fundamental to be accommodated by relaxing the normative system. We first sketch an analysis of the foundations of the theory of rational choice and then show that the most basic rules of the theory are commonly violated by decision makers. We conclude from these findings that the normative and the descriptive analysis cannot be reconciled. A descriptive model of choice is presented, which accounts for preferences that are anomalous in the normative theory." (Kahneman & Tversky, 1986, p. 252)

They try to show and conclude that new models, which try to be more descriptive, should be used since there are many systematical deviations in real choice. Thus, the findings of BE should be taken seriously and models like Prospect Theory that comport better **descriptions of human behavior** should be incorporated.

It is important to clarify two points before continuing. The purpose of Prospect Theory and many other aspects of K&T's work is to be descriptive. Some authors, such as Katsikopoulos(2014) may argue that K&T are not describing behaviors, but rather patterns in behavior (or biases). Although this might be what Prospect Theory and K&T actually do, K&T express their desire in describing actual behavior (as exposed in their quotes in this section). Another important point to be considered is the context. The behavior that K&T want to describe is similar to the static (set and choice) models of RCT. This fact alone would be enough to lead to critiques on the capacity of K&T's work to describe behavior. Although this will be partially discussed in the next section, this is not the main focus of the present paper.

Kahneman continued his search for better heuristics and descriptions of the human's behavior. Recently, his works (e.g: Kahneman 1993, 1997, 2000, 2006) were extended to new errors of evaluation that will not be discussed in this work. Another discussion added by Kahneman is the Two Systems of Cognition, which is extensively described in his Nobel's Lecture, and changes in the mental processes presented in his theory, as we will describe in the next section.

2.3 Two Systems

In 2002/2003 Kahneman introduced a new perception to human mind in his theory: the dual-process of the mind. The division of the mind has a long history and goes even before Psychology was an autonomous field⁵, but the recent approach of the dual-process may be associated to the beginning of the cognitive school in the 1960's and 1970's (Frankish and Evans (2009)). The dual-process theories have different forms but the basic idea distinguishes two distinct processing mechanisms, each with a different procedure. In Kahneman's work this division is named System 1 and System 2. Usually, one of the processes (Kahneman's System 1) is characterized as “fast, automatic, effortless, associative, and often emotionally charged; they are also governed by habit, and are therefore difficult to control or modify” and the other (System 2) as “slower, serial, effortful, and deliberately controlled; they are also relatively flexible and potentially rule-governed”(Kahneman, 2003, p.1451).

During the heuristics and biases research program, K&T discussed bias in the decision's process as a direct relation between question (set of options) and answers (choices). K&T did not separate an intuition and reason, but in Kahneman(2003) and Kahneman and Frederick (2002) this changed. In their Dual-Process Theory, they “suppose that the System 1 quickly proposes intuitive answers to judgment problems as they arise, and System 2 monitors the quality of these proposals, which it may endorse, correct, or override” (Kahneman and Frederick 2002,p.268).

This alters partially the argument constructed in the Heuristic and Biases program. In the program the notion of the bias refers to a mistake that happens in the perception (of probability, outcome, or object) and in the choice at the same time, a direct relation between question (set of options) and answers (choices). In the Dual System theory, even if there are agent failures in perception, the choice bias only happens when the System 2 also fails in correcting it. These two systems create a dynamic perception of heuristics and bias. Firstly, it differentiates two kinds of heuristics, one intuitively used by System 1, and the other deliberately used by System 2. In the first process, System 1 makes a heuristic-based impression and System 2 may alter it or not. In the second process, in the absence of a good answer of System 1 and failing to identify a proper answer, System 2 may adopt an approximate answer. Secondly, this modification gives more importance to the process of how a heuristic is used.

Although the adoption of the Two-Systems might be seen as Kahneman giving a greater importance to the choice process itself, it is much influenced by behaviors described in new experiments. During the 90s many critiques (e.g. Gigerenzer (1991, 1996)) and experiments described situations in which subjects used the heuristic consciously and/or did not commit biased choices. In this sense, Kahneman's theory was not able to offer a good description for choices. For example, Kahneman and Frederick (2002 p.279) describe that calling attention to the neglected variable may reduce biased choices. While this would not fit the previous rule approach, the Dual System makes the model able to fit the new data. Thus, the incorporation of the Dual System and this change in the process was required to better describe observed choices, though not to understand the process by itself.

⁵ For example, Plato division of the soul in reason, spirit and appetite in “The Republic”.

2.4 General discussion

K&T's work is one of the main pillars of Behavioral Economics. The authors studied the actual human behavior and used experimental data to describe behavior and understand how people make decisions. The results were compared to RCT's normative suggestions and, with these comparisons, they classify systematic errors and choice biases. Incorporating these concepts, behavioral economists are trying to construct new models based on a more descriptive view of human behavior. It is important to notice that the notions of "irrational" behavior, errors and biases very present in the work of K&T can only be understood as mistakes compared with the RCT. Even though RCT claims to be a description of human rationality, the idea of rationality in the recent interpretation of RCT is very narrow and associated only with choice consistency (Giocoli, 2003).

K&T focus on the **description of choice in static situations similar to those in RCT** is seen in all their program and the development of Prospect Theory (1979, 1992) is a good example of this. From the Heuristic and Biases Program to the Prospect Theory, their theories are used to describe behaviors. This is strongly understood by their method, which first observes the behavior, then use it to infer the cognitive process that leads to it and create theories to return to the behavior. The incorporation of the Dual-Process Theory does not alter the method. It might contribute to the understanding of the process that leads to errors and, in addition, it incorporates important aspects in the heuristic's processes showing how the ambient influences errors and how people can surpass biased choices. This method is extremely important in the comparison with RCT and will be discussed in section 4. However, the dual-system may have been incorporated to describe "new observed behaviors" and partially respond the critiques, notably those of Gerd Gigerenzer (GG)⁶, who is the subject of the next section.

3 Gerd Gigerenzer and the ABC Research Group

Gerd Gigerenzer is a psychologist and prominent critic of the K&T's works, who also studied the use of bounded rationality and heuristics in decision making. GG's critiques started in a series of publications during the 80s and 90s (for example and direct confrontation, 1991 and 1996). Gigerenzer's agenda is inspired by Herbert Simon's bounded rationality and centered on cognitive limitations and its interaction with the environment of choice, which he calls ecological rationality. He suggests that people's heuristics are actually adaptive tools that can only be interpreted understanding the environment where they are used. This different perspective focuses in the choice process and choice is not perceived as a static observed behavior but as a progressive procedure that interacts with the environment. Gigerenzer and colleagues at the Center for Adaptive Behavior and Cognition of the Max Plank Institute for Human Development in Berlin have used these concepts to help people make better (ecologically rational) decisions. They have been discussing legal theory and the processes of making law (Gigerenzer & Engel 2006), helping finance players and businessmen make better predictions with their intuition (Gigerenzer 2007) and ameliorating risk literacy among

⁶ Gigerenzer is cited many times in Kahneman and Frederick (2002).

doctors and patients (Gigerenzer & Muir Gray, 2011). Katsikopoulos (2014, 371) argues that GG's approach of bounded rationality is gaining momentum in fields such as engineering and management.

In the next section we are going to describe the method used by Gigerenzer. We will briefly explain the idea of rationality for Gigerenzer and describe his method by showing what Gigerenzer and his co-workers propose and by analyzing some heuristics they have described. We also describe similarities between Gigerenzer's method and Herbert Simon's propositions as in the methodology of Human Problem Solving (Simon and Newell (1971)).

In general, Gigerenzer concerns with K&T theory can be described in three levels (Vranas (1999)): empirical, methodological and normative. On the normative level, it would be improper to identify some biases as "errors" or "irrationalities". On the empirical level, Gigerenzer argues that some of the biases described by Kahneman and Tversky can disappear or be considerably reduced depending on the context. On the methodological level, the heuristics described by Kahneman and Tversky are formulated vaguely. Recently, Gigerenzer (2015) and Berg and Gigerenzer (2010) describe the new BE that followed the tradition of K&T as a continuity of the "as-if" hypothesis by arguing that BE does not describe the process and lacks psychological realism. In Section 3.3, we review these critiques by confronting the methods used by GG and K&T.

3.1 Fast and frugal heuristics

Gigerenzer's work analyzes the bounded rationality as an ecological rationality. A real decision process cannot be described by a fast maximization in a set of almost incalculable outcomes, it has to be simple, fast and frugal to fit the real world problems. Gigerenzer and Selten (2002, 8) describe that bounded rationality "consists of simple step-by-step rules that function well under the constraints of limited search, knowledge, and time — whether or not an optimal procedure is available". Gigerenzer and Selten qualify such rules of thumb as heuristics, which are the basis of their bounded rationality approaches. These heuristics have three important features (Gigerenzer and Selten 2002, 7): simplicity, efficacy and domain-specificity. Heuristics are simple because they need to be compatible with decision-makers' limited knowledge and computational capability. Heuristics can be effective because their simplicity enables fast, frugal and accurate decisions. Heuristics are domain-specific because they work in a group of situations – they are adaptations to certain environmental problems that were evolutionary selected, differently from the "all-purpose" optimization of man-made calculus. The authors stress the interdisciplinary aspect of the research on bounded rationality and the potential of this concept to disciplines like economics, psychology and animal biology (Gigerenzer & Selten 2002, 11).

On this basis, Gigerenzer and Todd (1999) propose a research program that is guided on four main lines:

- "(a) designing computational models of candidate simple heuristics,
- (b) analyzing the environmental structures in which they perform well,
- (c) testing their performance in real-world environments,
- (d) determining whether and when people really use these heuristics." (Gigerenzer and Todd (1999) p.19

Their program gives great importance to the formulation of a decision, i.e. the processes by itself. In this approach, firstly one has to describe each process of a heuristic, then search for environments and questions to which the heuristic could be applied, and finally conclude by using empirical data to evaluate if this heuristic may be really used. Gigerenzer's method is similar to Herbert Simon's Human Problem Solving. Simon, among others, developed a method to investigate actual processes of decision making called Human Problem Solving. In 1971, Simon and Newell described the method to perform these searches in 11 steps⁷ that are compatible with the four main lines of the fast and frugal heuristics research program.

Heuristics are specific processes, each one depending on the structure of the environment. However, Gigerenzer stresses three classes of processes of bounded rationality general approaches: simple search rule, simple stopping rule and simple decision rules⁸. They are all "simple" because they do not rely on computation of probabilities, optimal weights

⁷ Simon and Newell (1971) proposed the following strategy for the search for how humans solve problems:

“1. Discover and define a set of processes that would enable a system capable of storing and manipulating patterns to perform complex nonnumerical tasks, like those a human performs when he is thinking.

2. Construct an information-processing language, and a system for interpreting that language in terms of elementary operations, that will enable programs to be written in terms of the information processes that have been defined, and will permit those programs to be run on a computer.

3. Discover and define a program, written in the language of information processes, that is capable of solving some class of problems that humans find difficult. Use whatever evidence is available to incorporate in the program processes that resemble those used by humans. (Do not admit processes, like very rapid arithmetic, that humans are known to be incapable of.)

4. If the first three steps are successful, obtain data, as detailed as possible, on human behavior in solving the same problems as those tackled by the program. Search for the similarities and differences between the behavior of program and human subject. Modify the program to achieve a better approximation to the human behavior.

5. Investigate a continually broadening range of human problem-solving and thinking tasks, repeating the first four steps for each of them. Use the same set of elementary information processes in all of the simulation programs, and try to borrow from the subroutines and program organization of previous programs in designing each new one.

6. After human behavior in several tasks has been approximated to a reasonable degree, construct more general simulation programs that can attack a whole range of tasks—winnow out the "general intelligence" components of the performances, and use them to build this more general program.

7. Examine the components of the simulation programs for their relation to the more elementary human performances that are commonly studied in the psychological laboratory: rote learning, elementary concept attainment, immediate recall, and so on. Draw inferences from simulations to elementary performances, and vice versa, so as to use standard experimental data to test and improve the problem-solving theories.

8. Search for new tasks (e.g., perceptual and language tasks) that might provide additional arenas for testing the theories and drawing out their implications.

9. Begin to search for the neurophysiological counterparts of the elementary information processes that are postulated in the theories. Use neurophysiological evidence to improve the problem-solving theories, and inferences from the problem-solving theories as clues for the neurophysiological investigations.

10. Draw implications from the theories for the improvement of human performance—for example, the improvement of learning and decision making. Develop and test programs of application.

11. Review progress to date, and lay out a strategy for the next period ahead. Two heuristics will be described in the next section to elucidate it.” (Simon and Newell(1971), p.146)

⁸ “1. Simple search rules. The process of search is modeled on step-by-step procedures, where a piece of information is acquired, or an adjustment is made (such as to increase running speed to keep the angle of gaze constant), and then the process is repeated until it is stopped.

2. Simple stopping rules. Search is terminated by simple stopping rules, such as to choose the first object that satisfies an aspiration level. The stopping rule can change as a consequence of the length of search or other information(...). Simple stopping rules do not involve optimization calculations, such as computations of utilities and probabilities to determine the optimal stopping point.

3. Simple decision rules. After search is stopped and a limited amount of information has been acquired, a simple decision rule is applied, like choosing the object that is favored by the most important reason — rather than trying to compute the optimal weights for all reasons, and integrating these reasons in a linear or nonlinear fashion, as is done in computing a Bayesian solution.” (Gigerenzer and Selten in Gigerenzer and Selten (2001) p.8)

or Bayesian solutions as the description of a Maximization in RCT (Gigerenzer and Selten 2002, 8). This general description is also similar to some of Simon's propositions⁹.

Gigerenzer and his co-workers try to describe heuristics similar to programming codes to design, analyze and test their heuristics. Goldstein (2009,163) explains that: "When developing the models in the book *Simple Heuristics That Make Us Smart* (Gigerenzer, Todd, and the ABC Research Group 1999), our research group was guided by the maxim 'if you can't write it as a simple computer program, it's not a simple heuristic'. While coding something is not a high hurdle (anything can be written as a program with enough assumptions), and while not all computer programs clarify matters (e.g. complex neural networks which remain opaque even to their creators), the rule turned out to be valuable in practice. Not only did it lead to models that were more precise, but the maxim led to accidental discovery as well."

For exemplify how a heuristic on the Gigerenzer's model is, we will describe two possible heuristics: "Recognition" and "Take the Best".

Recognition Heuristics proposes that:

"If one of two objects is recognized and the other is not, then infer that the recognized object has the higher value. For instance, a person who has never heard of Dortmund but has heard of Munich would infer that Munich has the higher population, which happens to be correct. The recognition heuristic can only be applied when one of the two objects is not recognized, that is, under partial ignorance. Note that where recognition correlates negatively with the criterion, "higher" would be replaced with "lower" in the definition." (Goldstein and Gigerenzer in Gigerenzer and Todd (1999) p. 41)

"Take the Best" Heuristic is described in four steps:

"Step 0. If applicable, use the recognition heuristic; that is, if only one object is recognized, predict that it has the higher value on the criterion. If neither is recognized, then guess. If both are recognized, go on to Step 1."
"Step 1. Ordered search: Choose the cue with the highest validity that has not yet been tried for this choice task. Look up the cue values of the two objects."
"Step 2. Stopping rule: If one object has a positive cue value ("1") and the other does not (i.e., either "0" or unknown value) then stop search and go on to Step 3. Otherwise go back to Step 1 and search for another cue. If no further cue is found, then guess.
Step 3. Decision rule: Predict that the object with the positive cue value has the higher value on the criterion." (Gigerenzer and Goldstein, 1999 p. 79 and 81)

After designing heuristics as programming codes they test in which environments these heuristics did particularly well. For example, Gaissmaier & Marewski (2010) described that the recognition heuristic did particularly well in predicting federal and state elections in Germany. Serwe & Frings (2006) reported that collective recognition of amateur players turned out to be a good predictor of the 2004 Wimbledon tennis matches. Gigerenzer and Goldstein (1999) described the "Take The Best" as a good heuristic to choose which city is bigger .

The heuristics in Gigerenzer's program describe the process itself, not general regularities of the observations nor important aspects of a decision. Once described, as we explained in the method above, Gigerenzer and his co-workers search for environments that these heuristics may be applied to and then search for evidence of people using this kind of mental process. That is, they look for possible processes before analyzing behaviors. In this sense, the motivation behind the choice is extremely important and it is fundamental to understand the behavior. Although the

⁹ Simon (as in 1978 (p.67)) also divided a rational decision making in three: 1- Identification and listing alternatives, 2- the determination of all consequences resulting from each alternative, 3-the comparison of the accuracy and efficiency of these consequences.

behavior is the expected result of the process, they are not the main focus: processes of decision making is centerpiece of the analysis.

3.2 Gigerenzer's critiques of K&T

K&T's work described a human being using heuristics that constantly led to deviations from RCT. In these perspective these deviations may be described as errors and biases. In contrast, Gerd Gigerenzer argues that heuristics are not bad and actually often lead to good choices. But if humans are most of the time good decision makers, how is it possible that Kahneman and Tversky work has described it in different ways?

As mentioned before, Gigerenzer's critiques are divided into 3 blocks: normative, empirical and methodological. All blocks are strongly connected; they are divided in this way for better understanding.

On the Normative Level:

There are two different aspects of the critique on the normative level. The first one is about certain statistical concepts by itself. Gigerenzer argues that there are cases in which the statistical norms can not be applied or have more than one interpretation. For example, using a frequentist point of view (i.e. the probability of an event is equal to the relative frequency of event's occurrence on an infinite sequence of random selections from the relevant universe), he argues that there is no appropriate norm for single-case judgments because single-case probabilities are meaningless. Thus, asking "what is the probability that Linda is a bank-teller" would not make any sense. From this perspective, some "deviations" may not be seen as errors because there is no such thing as right answers. This critique is well discussed in the literature (e.g. Vranas, 1999) and is strongly correlated with the second aspect.

The second one is about the generalization of the RCT and use of its interchangeably normative description in real-life situations without appropriate adaptations. According to Gigerenzer, theories, such as RCT and some statistical theories often oversimplify environment and behavior, bypassing important aspects (Gigerenzer and Todd, 1999). For example, some of these theories reduce uncertainty to a risk situation, or confuse the outcome of the behavior with the process itself. In such oversimplified analysis, heuristics might be seen as flawed but understanding heuristics in their correct environment and process could change this perception. Moreover, models as RCT do not reflect the complexity of human behavior, as they are centered in the observation of static choices, and describe it as a maximizing process that demands too much computational capabilities, thus being psychologically unreal.

Gigerenzer goes beyond: since RCT is not a good description and prediction of behavior, even its adaptation, as proposed by the Prospect Theory, would not lead to better models since the processes described in these models are not fit to the reality of a decision process. In this sense, Gigerenzer argues that the human's bounded rationality should not be a discrepancy between human reasoning and the statistical norms and others forms of optimization used in RCT and that the studies should rethink these norms and aim to really understand the mind. This is reflected by the different

methods presented: K&T aim to describe choice and compare it to RCT. The RCT is a clear and easy criteria of comparison for K&T, as they part from observed choices that are the outcome of RCT`s models. Gigerenzer`s approach focuses rather in the process and cannot be easily compared to RCT. RCT is described as an "as-if" process and (usually) static choices. Processes that are unrealistic and too demanding for anyone to undertake properly.

On the Empirical Level:

Gigerenzer argues that K&T`s conclusions are problematic because almost all conclusions from their work are based on static laboratory experiments and not on observations of behavior in natural environments. The artificial environment of a laboratory-based experiment can cause the heuristics used by the human mind to look erroneous, as the controlled laboratory setting destroys the environment's irregularities. To exemplify the artificiality of a laboratory experiment, Gigerenzer points that "limited search is a central feature of fast and frugal heuristics: not all available information is looked up, and consequently, only a fraction of this information influences judgment. (In contrast, laboratory experiments in which the information is already conveniently packaged and laid out in front of the participants eliminate search, and in line with this experimental approach, many theories of cognitive processes do not even deal with search.)" (Gigerenzer and Goldstein in Gigerenzer and Todd(1999) p. 77). He suggests that some experiments used in K&T's works are not transparent and use incorrect statistical interpretations (as pointed above). For example, it is possible to decrease the rate of biased answers by making the questions more "transparent" or more similar to a real world environment (e.g. Kahneman and Tversky(1983) against Fiedler(1988) apud Gigerenzer(1991)) Again, the different methods exemplify this critique. RCT is usually observed as static choices, i.e. choices are observed by direct questions isolated from each other.

K&T discuss with RCT and argues that observing isolated choices in a laboratory would be enough for this. Gigerenzer defends that to describe the process of real decision making as a whole one can not just rely on isolated observations. The process cannot be interpreted by the moment of choice since it is a complex process, which can change depending on the situation. In this sense, the experiment procedure and small changes in the environment could yield great differences to the results¹⁰.

On the Methodological Level:

Gigerenzer argues that K&T describe their heuristics using vague words. Words like "representativeness" make nearly any result be viewed as consistent with one (or more) of these heuristics and make these explanations hardly testable by adopting this immunizing stratagem. In this sense, the Heuristics described by K&T do not describe well-defined steps at the same time that they invoke big features of a cognitive process, such as memory and association, as the main features of their cognitive process. K&T created their heuristics to be able to describe the choice and thus their heuristics are rules from features to behaviors, direct relations between the set of the options and

¹⁰ As K&T describe as framing effects.

the choice. The test for heuristics and model is its capacity to describe behavior. Their model and heuristics are more concerned with fitting the data than with properly describing the process.

Gigerenzer's method is the search for the description of the processes and they have to be expressed in a precise way in order to be tested. This key concern makes the processes deeply analyzed in order to understand if they are actually possible. Besides that, their heuristics are deeply connected with the environment of choice and can not be analyzed by isolated choices and direct rules.

In these perspective, it is no surprise that Berg and Gigerenzer (2010) and Gigerenzer (2015) describe the Behavioral Economics that followed the tradition of K&T as a continuity of the "as-if", by arguing that BE does not describe the process and lacks psychological realism. Berg and Gigerenzer argue that the Prospect Theory was a modification in the probability as it had been proposed by Bernoulli, with the utility made as a readjustment of the theory: "In prospect theory, behavioral economics has added parameters rather than psychological realism to model choice under uncertainty" (Berg and Gigerenzer (2010) p.41). In their view, Behavioral Economics is neoclassical economics in disguise.

3.3 General discussion

Gigerenzer's heuristics differ from the descriptions adopted by K&T . While K&T used their experiments to define heuristics by describing isolated choices, being necessary generalizing and direct. Gigerenzer searched for a definition of process to then test in several possible environments that this process could be applied. Gigerenzer and his co-workers only analyze actual behavior after scrutinizing the possible processes. Gigerenzer uses his definitions of heuristics to analyze how a decision is made, and not just its outcomes. Thus, for Gigerenzer, "models of bounded rationality describe how a judgment or decision is reached (that is, the heuristic processes or proximal mechanisms) rather than merely the outcome of the decision, and they describe the class of environments in which these heuristics will succeed or fail" (Gigerenzer and Selten in Gigerenzer and Selten (2001) p.4).

Furthermore, Gigerenzer's concept of rationality differs from that of RCT, which is the comparison criteria of K&T. In Gigerenzer's perspective, rationality is not about being able to maximize an utility function (or act as "if it"), nor about how to follow norms of statistics and logic. Rationality is about being able to make good decisions in real-life (where information is incomplete, events are not independent from each other, time and energy are scarce). Thus, Gigerenzer denies RCT, while K&T are trying to reform it.

The difference between describing the processes and the choice can lead to some confusion. RCT and Prospect Theory are theories based on descriptions of the outcomes (possible or real ones), and the formulation of the process are just in the background ("as if" in RCT or K&T heuristics and editing phase in Prospect Theory)., RCT and Prospect

Theory might describe similar aspects as Gigerenzer does.¹¹ For example, Gigerenzer's "Take the Best" heuristic is a process that often leads to a lexicographical ordering. Lexicographical ordering are complete and transitive and its outcomes could be described by "complex mathematical model" like a multi-utility function (and even easier formulations if the set is not uncountable). Yet, the oversimplification and generalization of RCT theories might really ignore an important aspect: context matters, and the sole analysis of the outcome may not show the complexity of a decision process.

4 RCT, K&T and Gigerenzer

The methods of K&T and Gigerenzer differ in their interpretations and identifications of the processes. K&T's discussion is the identification and analysis of patterns in observed behaviors and using it to identify what could be internal mental processes and models that better fit the description. The Prospect Theory is claimed to be a descriptive theory and the general processes are left aside, while it keeps the maximization processes in second stage and it does not describe cognitive processes during the editing phase. Even when the processes take a more central place, as in the development of dual-process, Kahneman does not describe the process but adapts their rules to better fit new data.

Differently, Gigerenzer tries to understand the process by itself and observes the outputs as consequences. He developed the notion of ecological rationality and argues that a behavior and decision have to be understood with relation to our limited cognition and the environment. This interaction creates requirements and restrictions that can be identified and understood. To study this, Gigerenzer's method, first describes a possible decision process giving great importance to the computability and the choice as a greater processes, as the subject has to search for options while deciding what to choose and then search for situations where it could be used. Only after scrutinizing the possible processes, Gigerenzer analyzes actual behavior as a reflection of the heuristics.

The fundamental importance of the environment for Gigerenzer, which is not directly present in K&T's early works, is a representation of how these two agendas have different descriptions of man and notions of what rules internal processes of decision making?. For example: in K&T Linda's experiment, individuals reported likelihood (probability) and similarity (representativeness) in the same way. This would suggest that people use the same internal process in both situations. In Gigerenzer's approach an important aspect is how and why a person may identify two different objects as similar¹² in a certain situation, since in different situations a she may report them differently¹³. Thus, what is an explanation of behavior for K&T may not explain it for Gigerenzer.

In general, Kahneman argues that: "Theories in behavioral economics have generally retained the basic architecture of the rational model, adding assumptions about cognitive limitations designed to account for specific

¹¹ This is discussed by Katsikopoulos(2014) and exemplified by Katsikopoulos & Gigerenzer (2008) and Drechsler, Katsikopoulos, & Gigerenzer (2014).

¹² This kind of question is studied by Tversky in others papers, e.g. 1977, however, it is not incorporated in their general descriptions of heuristics.

¹³ For example, when asking with frequency instead of probability or changing the eyebrows of a smile (Tversky (1977))

anomalies. For example, the agent may be rational except for discounting hyperbolically, evaluating outcomes as changes, or a tendency to jump to conclusions.

The model of the agent that has been presented here has a different architecture, which may be more difficult to translate into the theoretical language of economics.”(Kahneman, 2003, p.1469)”. Nevertheless, in a Behavioral Economics's perspective much of this discussion stays in the background since adapting psychological concepts to economy can be complicated. Kahneman wrote:

“(…)psychological theories of intuitive thinking cannot match the elegance and precision of formal normative models of belief and choice, but this is just another way of saying that rational models are psychologically unrealistic” (Kahneman, 2003, p.1449)

In this sense, much of the human perspective from K&T and Gigerenzer are not incorporated in mainstream economic theory. Economic theories use the RCT as a theory for behavior. RCT may assume many forms, but the idea of internal consistency is a central one. As Sen pointed out:

“The rationality of behaviour **is identified with a requirement that choices from different subsets should correspond to each other in a cogent and systematic way**. Various conditions of internal consistency have been proposed in the literature, but the one which seems to command most attention in formal economic theory is *binariness*, **which requires** that the choices from different subsets can be seen as maximizing solutions from the respective subsets according to some binary relation R (often interpreted as ‘preference’, for example, xRy standing for ‘x being preferred or indifferent to y’). Or, to put it another way, rational behaviour, in this interpretation, amounts to our ability to find a binary relation R over the universal set of alternatives such that the choice from any particular subset of that universal set consists of exactly the R-maximal elements of that subset. Richter (1971) calls this ‘rationalizability’. In other formulations – still within the general approach of internal consistency – the condition of rationalizability has been relaxed, demanding only a part of the kind of consistency that binary maximization must entail. On the other hand, in some other formulations, the demands have been made stronger than that of maximization according to a binary relation by requiring further that the binary relation in question be an ordering, satisfying both completeness and transitivity.” (Sen(2008)) (Bold added by the authors)

Binariness, as Sen describes, is an implicit relation observed from different choices. When it is used as a possible description of behavior, *Binariness* is actually creating requirements. For example, when RCT proposes that the preferences are transitive and complete, this is not a process for a choice, this is not the choice by itself, this is a logical and mathematical relation that characterizes the choice. In this perspective, RCT analyzes and creates possible choices, but it does not define a decision process, leaving it to the “**as if**”.

Mainstream Economic theory is based on interpretation of outcomes, not on why and how these outcomes are created. A utility function does not give reasons why someone chooses an option in instead of the other and certainly not how. “(…)there is no such independently defined function at all, and the binary relation that is precipitated by the choice function is a reflection of choice rather than a determinant of it.” (Sen(2008)). Most of RCT's theories observe choices as isolated from the environment and from the motivations behind the choice. Generally, the only input is the consumption set (set of options) and the only output is the choice. In this sense, the description of heuristics, of K&T or Gigerenzer, may elucidate how the decision process occurs, but it is not a central concern for RCT and general economic discussion.

In this perspective, when Gigerenzer proposes heuristics like Take-The-Best, he is describing the process in which the ordering of the preferences was produced. However, given the outcomes that the process generates, they may be described by “complicated mathematical formulas”, such as those of RCT. Nevertheless, his rejections to the norms of logic and statistics to describe what he wants to describe can be correct. The decision process that leads to the

outcomes can be much more complex than the outcomes could show. For example, an individual who always chooses exactly the opposite of what she has to do for the pursuit of her goals may produce a consistent behavior, described as a continuous, transitive and complete preferences, but this preference relation would describe exactly the opposite of their real preferences (Sen, 2008)¹⁴.

K&T's focus in the description of the choices are in direct confrontation with the RCT and criticize it. However, at the same time, by observing regularities and patterns in isolated questions and describing heuristics as direct rules from features to choices, they are adapting the consumption set and creating space to a reform in RCT's theories. Even the dual-system, which is a psychological adaptation to describe new behaviors can be problematic in the economical point of view: During his Nobel Lecture, Kahneman argue that:

“Theories in behavioral economics have generally retained the basic architecture of the rational model, adding assumptions about cognitive limitations designed to account for specific anomalies. For example, the agent may be rational except for discounting hyperbolically, evaluating outcomes as changes, or a tendency to jump to conclusions. The model of the agent that has been presented here (dual system) has a different architecture, which may be more difficult to translate into the theoretical language of economics.”(Kahneman, 2003, p.1469)

Any simple adaptation of the processes in the RCT is more "difficult to translate into the theoretical language of economics.". In this sense, a critic that says: "the RCT does not describe behavior" can be answered by "let's change our models to incorporate this new behaviors". If a critic says "the RCT does not describe motivation or the decisional processes", it is way more complicated. K&T are more easily incorporated by mainstream theory by describing choice patterns and rules from features to choices

4.1 Advances in Behavioral Economics

Camerer and Loewenstein(2004) highlight this method as the one used by (new) Behavioral Economics:

“Early papers established a recipe that many lines of research in behavioral economics have followed. First, identify normative assumptions or models that are ubiquitously used by economists, such as Bayesian updating, expected utility, and discounted utility. Second, identify anomalies—i.e., demonstrate clear violations of the assumption or model, and painstakingly rule out alternative explanations, such as subjects' confusion or transactions costs. And third, use the anomalies as inspiration to create alternative theories that generalize existing models. A fourth step is to construct economic models of behavior using the behavioral assumptions from the third step, derive fresh implications, and test them. This final step has only been taken more recently but is well represented in this volume of advances.” (Camerer and Loewenstein (2004) in Camerer , Loewenstein and Rabin (2004) p.7)

That is, (new) BE usually parts from economical models (with RCT normative assumptions), identifies anomalies (i.e. observe behavioral patterns) and adapts models to incorporate these anomalies to make it more descriptive in the sense of fitting to the data. There is not a search for the motivations for these anomalies, only a “painstakingly rule out alternative explanations”, i.e, showing that these anomalies are really anomalies, not just others economical factors that was not incorporated before. For example, hyperbolic discounting (as Berg and Gigerenzer(2010) also argue) is used to describe the present bias and preference reversal that occurs with questions with different delays to the consequence, altering the usual exponential illustration of this kind of behavior. However, people do not really use a hyperbolic formula to compute future outcomes and arguing that people have a tendency to be time-inconsistent is not an explanation of how choices are made, it is rather a description of the usual perceived outcome. The hyperbolic models

¹⁴ This could be a problem of epistemic rationality, but not economical rationality.

are just adaptations to better incorporate these phenomena, as the Prospect Theory is an adaptation of Expected Utility to incorporate many phenomena, such as loss aversion, certain effect, relative evaluation and others. In this method, the search for the processes and the motivations behind the choice does not take any importance. Also, it can be noticed that this method is very similar to the applied by K&T in the Prospect Theory, observe systematical choices behaviors that do not fit economical theory, and create/adapt the theory in order to properly describe it.

Gigerenzer's theories that focus on the processes and the interaction of choice and environment are hard to be translated to mainstream economic models, as some concepts of K&T like framing effects and dual-system are too. Economy Theory usually do not control the environment in which it will be applied and tries to be general. If the music that is playing in the supermarket at the moment that you are choosing the wine you will buy (North, Hargreaves and Mckendrick (1997)), or if the "number of your social security interferes" in how much you would pay for a bottle of wine (Ariely (2008)), what could be theorized about the wine demand? Should these variables be incorporated in a model? Would it be a theory or a case-based debate? Simplification of the environment and generalizations are necessities of economic models. K&T, by describing heuristics using "vague words", is making it more general and closer to economic theory than Gigerenzer's approach does by trying to understand the process.

Nevertheless, new areas of BE like Choice Architecture and Nudges may change this view and find complementarities in Gigerenzer and K&T's findings¹⁵. Choice Architecture and Nudge are two concepts created by Richard Thaler and Cass Sunstein and popularized in their 2008 book. These concepts consist of studies of different ways in which choices can be presented and how this impacts consumer decision-making. As Richard Thaler and Cass Sunstein point out:

"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 count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not." (Richard Thaler and Cass Sunstein (2008), p. 6)

In this perspective, the process and formulation of preferences are of central importance. The preference relation between objects are not predetermined as transitive and complete and it is possible to adapt the context to redefine it. When Gigerenzer (2014) suggests that hospitals and physicians should use frequencies instead of probability to improve diagnostic (like the discussion of the reduced of biased answers in Linda's experiment), it can be argued that Gigerenzer is describing a nudge. When Gigerenzer's co-workers Eric Johnson, Mary Steffel and Daniel Goldstein (2003) discuss opt-in and opt-out as "possible techniques that they believe would result in better outcomes" as well. These recommendations are different frames for the same questions, these suggestions changes the preferences not by a restriction, not by a prohibition, just by a change in the psychological perception.

New economical perspectives are shifting the usual questions made by economists, and the notion of fixed preferences as a description of behavior may not be enough for these new perspectives. The possibility to change the

¹⁵ Gigerenzer might disagree (as discussed in Berg and Gigerenzer (2010)) since Nudges are observed as normative norms to guide people to more "rational choices" (closer to RCT). He denies RCT and he prefers the term "educate people" instead of "nudge".

environment of a choice to alter the preferences ordering are issues to be further studied and improved, and many psychological theories still need to be adapted and incorporated. In this perspective, both approaches, K&T and Gigerenzer, give many insights on how we can start doing this.

5 Conclusion

Although K&T propose possible heuristics explanations for human processes, their focus on the description and identification of choice's patterns made their agenda easily confronted with RCT and incorporated by Economics. The usual modern BE is being constructed building on this perspective, changing the models to describe different deviations and regularities in the outcomes. The motivations and real process behind a choice (described by the “as-if” in RCT and the heuristics in modern BE program) are not a central concern in mainstream research program and, in this sense, heuristics are used just as a rhetorical explanation, a substitute with more psychologic base to the “as-if”. Gigerenzer (and the Human Problem Solving of Hebert Simon) centering his research in how and why a decision is made can lead to interesting analyses of the outcome and to improvement of understanding of the importance of the environment to the decision process. Yet, their concerns and methods differ significantly from RCT and what is now the method used in the bigger part of the modern BE.

However, when economical practice and theory finds itself in the situation that it can design the moment and situation of choices (like Nudges), why and how a preference is constructed becomes a central aspect and these two different theories can become complementary. Here, both Gigerenzer's description and formulation of the process giving great importance to environment, and K&T's behaviors descriptions showing errors and biases and their heuristics and dual system thinking, can be used to interpret how “preferences are made”. Thus, when the preference is not a black box, even if K&T and GG have different concepts and approaches to the human being, both theories may help policy makers to understand how to design different environments of choice that can influence behavior.

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