Review Article

Implications of Methodological Approaches in Decision Theory: A Conceptual Synthesis with Emphasis on Heuristics

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Distinct theoretical frameworks have contributed to the development of Decision Theory, each offering specific insights into how decision-making occurs. This article aims to examine how methodological approaches across major frameworks in descriptive Decision Theory shape distinct perspectives on heuristics, intuition, and emotion, but with distinguished emphasis on heuristics. Methodologically, the study develops a conceptual synthesis that describes the core concepts of each framework and compares their methodological approaches and theoretical perspectives. The analysis begins with Bounded Rationality, as proposed by Herbert Simon, and then examines the Heuristics and Biases framework developed by Daniel Kahneman and Amos Tversky, Naturalistic Decision Making proposed by Gary Klein, Ecological Rationality advanced by Gerd Gigerenzer, and Neuroeconomics associated with Colin Camerer. The findings indicate that methodological approaches are not merely technical tools, but epistemic lenses that shape how cognitive mechanisms are identified, interpreted, and evaluated. Rather than reflecting purely theoretical disagreements, contrasting views on heuristics emerge from systematically different ways of observing and modeling decision processes. This article contributes to the literature by clarifying how methodological approaches shape theoretical perspectives in Decision Theory and by showing that different classes of heuristics (task-specific, general, and domain-specific) are associated with optimistic, skeptical, or more pragmatic views about the role and applicability of these mechanisms in decision-making.

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1. Introduction

Decision Theory is a multidisciplinary field that investigates how individuals and organizations make choices under uncertainty and complexity[1]. The field attracts the interest of psychologists, economists, management scholars, political scientists, statisticians, and researchers from diverse backgrounds[2][1]. It encompasses multiple theoretical frameworks that differ in both methodological approaches and theoretical perspectives.

Decision Theory can be broadly distinguished into *normative* and *descriptive*. Normative theory prescribes how decision-makers would choose under strict rationality, whereas descriptive theory seeks to explain how decision-makers actually make choices, including when they depart from rational standards[3][2][1]. This article focuses on the descriptive approach, which can be further divided into multiple theoretical frameworks that examine decision-making in more realistic contexts.

After Herbert Simon criticized the unrealistic way in which decision-making was represented in neoclassical economic theory[4], Decision Theory advanced significantly in describing how decisions are actually made. Since then, several theoretical frameworks have become established within the field. Beyond the body of work developed by Simon himself, which can be regarded as a specific theoretical framework in Decision Theory, other frameworks have also emerged, including Heuristics and Biases, Naturalistic Decision Making, Ecological Rationality, and Neuroeconomics.

The theoretical frameworks mentioned above have often been examined separately in studies that synthesize their main ideas (e.g., [5][6][7][8][9]). These frameworks remain influential, as they continue to be discussed in more recent literature (e.g., [10][11][12][13]) and empirically applied in specific contexts (e.g., [14][15][16][17]).

However, studies that examine these frameworks jointly, in order to provide a broader picture of the knowledge produced within the descriptive branch of Decision Theory, remain relatively scarce (e.g., [18]). More importantly, existing research has rarely examined how methodological approaches systematically shape theoretical interpretations of heuristics and other cognitive mechanisms. Few studies compare the methodological approaches of the major frameworks in the field and explain their implications for the perspectives of their most influential authors, which reveals a gap in the literature.

This article aims to examine how methodological approaches across major theoretical frameworks in descriptive Decision Theory shape distinct perspectives on intuition, heuristics, and emotion in

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decision-making, but with distinguished emphasis on heuristics. It advances Decision Theory by demonstrating that methodological approaches are not merely technical tools, but epistemic lenses that shape how heuristics are identified, interpreted, and evaluated. Rather than treating disagreements about heuristics as purely theoretical disputes, this study argues that they emerge from systematically different ways of observing and modeling decisions. By integrating insights from Bounded Rationality, Heuristics and Biases, Naturalistic Decision Making, Ecological Rationality, and Neuroeconomics, this article provides a unified discussion for understanding why contrasting perspectives on heuristics coexist within descriptive Decision Theory.

Methodologically, this article adopts a conceptual synthesis that describes the main concepts of each theoretical framework and compares their methodological approaches and theoretical perspectives[19]. Although the discussion draws on insights from Psychology, the article highlights authors whose contributions also have strong potential to inform research in Management and Economics: Herbert Simon (Bounded Rationality), Daniel Kahneman and Amos Tversky (Heuristics and Biases), Gary Klein (Naturalistic Decision Making), Gerd Gigerenzer (Ecological Rationality), and Colin Camerer (Neuroeconomics).

An insight that emerges from this conceptual synthesis is that the methodological approaches authors use to produce knowledge do not merely influence how decisions are studied, but fundamentally shape how cognitive mechanisms such as emotion, intuition, and, most notably, heuristics are conceptualized within Decision Theory. In this sense, methodological approaches do not simply reveal cognitive mechanisms; they help structure the theoretical boundaries within which such mechanisms become observable and interpretable. Consequently, these approaches shape the types of heuristics that authors identify and their effectiveness across different decision-making contexts.

This article contributes to the literature by clarifying how methodological approaches shape theoretical perspectives in Decision Theory. In addition, it shows that the different classes of heuristics emphasized by authors (task-specific heuristics, general heuristics, and domain-specific heuristics) are associated with different perspectives (optimistic, skeptical, or more pragmatic) regarding the application of these mechanisms. Finally, the article provides a review of the main theoretical frameworks discussed. Consequently, it also provides a basis for practical applications of theories that seek to understand and improve decision-making in real-world contexts, as exemplified by the Naturalistic Decision Making[20][21].

After this introduction, the article proceeds with a review of the selected theoretical frameworks in Decision Theory, emphasizing, for each of them, the most influential authors, main concepts and ideas, methodological approaches, and theoretical perspectives. It then discusses how the methodological approaches of these frameworks shaped the authors' perspectives on heuristics. Finally, the article presents the concluding remarks.

2. Theoretical frameworks in descriptive Decision Theory

This section reviews some of the main theoretical frameworks in descriptive Decision Theory. The framework associated with Herbert Simon is called Bounded Rationality, and it serves as a starting point in the literature. The section then examines the frameworks of Heuristics and Biases (Daniel Kahneman and Amos Tversky), Naturalistic Decision Making (Gary Klein), Ecological Rationality (Gerd Gigerenzer), and Neuroeconomics (Colin Camerer).

2.1. Bounded Rationality: Herbert Simon as a starting point

The framework of Bounded Rationality developed by Herbert Simon represents a starting point in descriptive Decision Theory, challenging the *homo economicus* doctrine that dominated neoclassical economics[5]. In 1978, Simon was awarded the Nobel Prize in Economic Sciences for his contributions to explaining how decisions are made in organizations. Simon argued that decision-making does not maximize outcomes, as proposed in neoclassical economics[4]. Instead, he introduced the idea that decision makers operate under bounded rationality and, faced with informational and computational constraints, seek solutions that are satisfactory rather than optimal[22][12].

Within the Bounded Rationality framework, psychological factors guide decision makers through *procedural rationality*[22]. The methodological approach of procedural rationality focuses on the decision-making process, including the heuristics, search procedures, and intermediate strategies considered by the decision-maker, rather than evaluating decisions primarily by comparing actual results with ideal or expected outcomes, as in *substantive rationality*[22].

In the Bounded Rationality framework, heuristics are defined as search strategies that simplify choice, enabling decision makers to find satisfactory solutions with computational efficiency[23][22]. Simon[22] focuses primarily on *task-specific heuristics*[1], although he also recognizes the existence of *general heuristics*[2].

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In turn, Simon understands intuition as rapid pattern recognition resulting from the fast and largely subconscious processing of information stored in long-term memory, while still preserving a degree of rationality. For this author, intuition is an important component of decision-makers' expertise and is particularly useful in dynamic environments. By contrast, he warns that emotions can divert decision makers from rationality and lead to poor outcomes[24]. In this sense, Simon held an optimistic view of intuition while maintaining a pessimistic view of emotion in decision-making.

Herbert Simon's methodological approach is strongly descriptive and oriented toward the procedural and computational analysis of choice strategies. He employed both empirical analyses of microprocesses in decision-making, often based on case studies, and computer simulation (artificial intelligence) as an investigative tool. His approach also involved examining the sequential steps of reasoning that led to a decision, which Simon frequently asked decision makers to describe verbally. Although some experiments appear in Simon's works, they did not constitute his primary methodological approach. Finally, Simon advanced the validation of decision models through computer simulation, a practice closely associated with artificial intelligence[5][23][25].

Because Simon's methodological approach focused on decision processes that could be described by decision makers themselves, he placed greater emphasis on relatively more structured and promising cognitive mechanisms in decision-making[25][26]. For this reason, Simon regarded *task-specific heuristics* and intuition as important mechanisms for effective decision-making[24][22]. Simon viewed bounded rationality not as a deviation from full rationality, but rather as an expression of an efficient process, in which the search for satisfactory solutions (rather than those optimal ones) represents the intrinsic and expected outcome of a limited capacity to access and compute information[22].

Overall, Simon's methodological approach shaped a view of heuristics and intuition as functional mechanisms in decision-making. By contrast, the Heuristics and Biases framework adopted experimental methods that highlighted systematic deviations from normative rationality.

2.3. Heuristics and Biases: foundations of Behavioral Economics

The theoretical framework known as Heuristics and Biases represents a critique of full human rationality and constitutes a central pillar of Behavioral Economics. The psychologists Daniel Kahneman and Amos Tversky are the main authors of this framework, whose collaboration was crucial for the formulation of its core concepts and theories[7]. They evidenced that people tend to rely on a limited set of *general heuristics* when evaluating probabilities and uncertain values, such as the Availability Heuristic, the

Representativeness Heuristic, and the Anchoring Heuristic. Although general heuristics apply to a wide range of judgment contexts under uncertainty, they lead to systematic and predictable errors, known as *cognitive biases*[27].

Within this framework, heuristics are understood as shortcuts or simplifications used in decision-making. These cognitive mechanisms are associated with the operations of *System 1*, a fast, automatic, and effortless mode of thinking that produces intuitive judgments, in contrast to *System 2*, which is slow, deliberate, and generates logical judgments. From this perspective, heuristics are seen less as efficient cognitive tools and more as mechanisms that often distort judgment and decision-making. By substituting complex probabilistic reasoning with intuitive judgments, heuristics systematically generate predictable patterns of bias[7]. The experimental focus shaped a theoretical perspective in which heuristics were conceptualized as sources of systematic error rather than adaptive cognitive strategies.

Within the Heuristics and Biases framework, intuition is understood as a fast and automatic mode of judgment that is generally unreliable and susceptible to systematic biases, except under very specific conditions. Intuition tends to be accurate mainly in stable environments with adequate feedback, but becomes prone to error in unpredictable contexts[28].

Emotion is closely linked to System 1 and acts as a moderating factor of *accessibility*, defined as the ease with which information stored in memory comes to mind. Emotionally charged stimuli spontaneously attract attention and, therefore, become more accessible. For example, because they evoke stronger emotions, changes in wealth are more salient and accessible than absolute levels of wealth, which System 1 naturally prioritizes in judgment. Moreover, individuals tend to experience gains and losses asymmetrically due to *loss aversion* [7]. Finally, the Affect Heuristic is directly related to emotion: it is a cognitive shortcut that relies on feelings as a basis for rapid evaluations, which may override deliberative reasoning and lead to suboptimal choices[29].

The methodological approach adopted by Daniel Kahneman and Amos Tversky is predominantly experimental. Their focus was on isolating and documenting systematic violations of normative rationality (biases) and inconsistencies in choice through experiments in which participants were presented with decision problems[30][31]. The authors conducted their investigations using protocols in controlled environments, in which participants (often students) were asked to solve probability judgment problems or make choices[32][33].

The methodological approach focused on identifying biases through experiments clearly shaped the perspective of Daniel Kahneman and Amos Tversky[33]. These authors adopted a skeptical view of heuristics in decision-making, as they found that such cognitive shortcuts systematically lead to errors[26]. By concentrating on mapping these biases, their methodological focus naturally led them to this perspective.

The experimental approach of the Heuristics and Biases framework led to a more skeptical perspective of heuristics and intuition, often viewed as sources of systematic error. In contrast, the Naturalistic Decision Making relied on field-based methods to examine how experts use intuitive processes effectively in complex and dynamic environments.

2.4. Naturalistic Decision Making: the search for expertise in real-world contexts

Naturalistic Decision Making (NDM) emerged as a theoretical framework aimed at explaining the behavior of decision makers in complex and dynamic operational environments[34][8]. The main author of this approach is Gary Klein, whose pioneering work focused on how experts (such as fire commanders and military personnel) make decisions under time pressure and with incomplete information. Klein introduced the Recognition-Primed Decision (RPD) as a central model of NDM, providing a foundation for the study of cognition in high-risk environments[20][35].

NDM also addresses intuition, heuristics, and emotion. The theoretical orientation of this framework emphasizes *domain-specific heuristics*[3] that often prove effective in real-world settings, rather than centering primarily on general heuristics. These specific heuristics are associated with pattern recognition processes that enable experts to interpret situations quickly and identify relevant information. They operate as context-sensitive strategies that support sensemaking and action under conditions of uncertainty and time pressure[21]. Intrinsically linked to this mode of decision-making, intuition reflects expertise grounded in a vast repertoire of tacit patterns that individuals acquire through experience. Accordingly, intuition functions as a valuable mechanism that allows experts to rapidly recognize the nature of a situation and retrieve a satisfactory course of action without the need for analytical deliberation or explicit comparison of alternatives[21][36].

In turn, emotions receive less explicit theoretical attention in Klein's framework than in dual-process models. Affective factors such as stress, time pressure, confidence, and gut feelings are embedded in analyses of expert performance, particularly within the Recognition-Primed Decision model. In this perspective, decision-makers often rely on emotional signals (such as unease or confidence) as diagnostic cues that guide rapid situation assessment and action selection[28]. These cues operate within a broader process of pattern recognition and context-sensitive judgment, as emphasized by NDM[21].

To capture the real-time nature of decision-making, NDM requires a descriptive, field-based methodological approach[35]. A central method is Cognitive Task Analysis (CTA), a set of techniques that researchers use to investigate expert performance in operational environments. CTA aims to elicit tacit knowledge, strategies, and mental models that experts employ, focusing on critical incidents and complex tasks[34][8]. This cognitive field research methodology prioritizes *ecological validity*[4] and examines macro-cognitive processes, such as sensemaking and option generation, rather than focusing exclusively on the outcomes of choice[37][38].

The methodological approach developed by Gary Klein and other NDM researchers shaped their theoretical perspective by enabling rigorous field research. Within this framework, systematic observation of experienced professionals in highly complex contexts revealed that effective decision-making depends on the ability to recognize situations[8]. Moreover, the descriptive orientation of Cognitive Task Analysis (CTA), by foregrounding the central role of experience and tacit knowledge, supported the development of models such as Recognition-Primed Decision (RPD). These models legitimize and integrate heuristics and intuition as essential cognitive mechanisms for successful performance in naturalistic environments.

The methodological emphasis of NDM on real-world contexts and expert performance supported an optimistic view of intuition and heuristics as components of expertise. In turn, Ecological Rationality adopted a different methodological approach, focusing on assessing the fit between cognitive mechanisms and environmental structures.

2.5. Ecological Rationality: the mind adapted to the environment

The main author of the Ecological Rationality framework is psychologist Gerd Gigerenzer. Together with his collaborators at the ABC Research Group (Center for Adaptive Behavior and Cognition), Gigerenzer proposed a reinterpretation of rationality. His perspective draws on Herbert Simon's notion of bounded rationality but goes further by arguing that ecologically rational behavior is adaptive and situated, emerging from the fit between the constraints of the mind and the informational structures of the environment[10][39][40].

A core concept of this theoretical framework is *fast-and-frugal heuristics*, which constitute a type of *domain-specific heuristics*. They are simple decision mechanisms that form what is known as the *adaptive toolbox*[41][42][40]. Rather than being regarded as sources of cognitive error, these heuristics are formally modeled as effective strategies for inference under uncertainty, exploiting available knowledge and even the absence of information, as in the case of the Recognition Heuristic[5][6][43]. In the field of Management, for example, studies have shown that simple heuristics can lead to more accurate decisions than those based on logistic regression, highlighting the value of frugality in uncertain environments (*e.g.*, [16]).

Within this framework, intuition is often understood not merely as the rapid and largely automatic application of ecologically rational heuristics, but also as a form of experience-based, environmentally attuned judgment that develops through repeated interaction with structured environments. Such intuition reflects the capacity to detect and prioritize relevant cues, to disregard irrelevant information, and to adapt decision strategies to the regularities of the context in which they are embedded. Rather than being opposed to rationality, intuitive judgment in this sense is viewed as a competent mode of cognition that emerges from learning, feedback, and the fit between cognitive tools and environmental structures[44][45].

Although Gerd Gigerenzer has devoted relatively limited attention to emotions, aspects of his work can be read as broadly compatible with Simon's[24] caution regarding their role in decision-making. In one of his studies, Todd and Gigerenzer[46] refer to Hanoch's[47] notion that emotions may impose bounded rationality by narrowing the set of options considered and directing attention toward specific parameters in evaluation.

The methodological approach of Ecological Rationality is characterized by rigor in the formal modeling and testing of heuristics, incorporating a detailed analysis of environmental structure[39]. This approach seeks to examine how the internal limitations of the mind align with the external constraints of the world, a relationship metaphorically compared to the two blades of a pair of scissors, which cut only when they work together[46][48].

This ecological validation is crucial: a heuristic is rational only if there is an optimal fit between its structure and specific environmental conditions, such as the distribution or validity of cues[6]. The methodology employs predictive performance tests on empirical data and large-scale computational simulations to identify the conditions under which simple heuristics outperform models that rely on more information and processing[16][48].

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Overall, Gerd Gigerenzer's methodological approach profoundly shaped his perspective. The formalization and testing of the predictive performance of simple cognitive strategies in uncertain environments revealed the less-is-more effect[10][39]. This line of research rehabilitated *cognitive frugality*[6], transforming it from a deficiency into an adaptive advantage. Within this framework, rationality is understood as the effective adaptation of the mind to the demands and structure of its environment.

The Ecological Rationality emphasized the adaptive value of heuristics in specific environments, highlighting their efficiency rather than cognitive biases. Meanwhile, Neuroeconomics introduced neuroscientific methods to investigate the neural processes underlying decision-making, enabling a biologically grounded perspective on cognitive mechanisms.

2.6. Neuroeconomics: neuroscience explaining economic decisions

The main proponent of the theoretical framework known as Neuroeconomics is Colin F. Camerer. Given his research trajectory, it can be argued that he sought to advance beyond Behavioral Economics, the field in which he began his career. Moving beyond purely psychological explanations, he integrated knowledge of neural mechanisms into economic decisions, contributing significantly to the consolidation of Neuroeconomics[49]. This framework transcends the limitations of earlier theoretical approaches that treated the brain as an impenetrable "black box," using neuroscience and theoretical models as mutually informative tools to understand how the brain implements decisions underlying behavior[49][50][51][52].

Neuroeconomics has the capacity to ground and expand models of human decision-making by incorporating mechanisms historically neglected by economic theory. One of the central ideas emphasized in this framework is that decision-making results from a fluid interaction among multiple brain systems[49][50]. Emotions are understood as *affective systems*[7] that critically influence decision-making and are essential for the effective functioning of the brain in everyday decisions. Disruptions to these systems, whether caused by brain lesions, stress, neurotransmitter imbalances, or the "heat of the moment," can lead to failures in the regulation of deliberate behavior[50]. The primary focus of Neuroeconomics is to investigate the biological mechanisms underlying decision-making processes, with particular emphasis on neural mechanisms.

A methodological approach that relies on multiple neuroscience tools strongly drives and shapes Colin Camerer's Neuroeconomics. The most prominent technique is functional magnetic resonance imaging (fMRI), which allows the measurement of brain activity in real time and provides *neural correlates*[8] of valuation, reward, and uncertainty. Beyond fMRI, the field benefits from studies involving patients with brain lesions and *peripheral physiological measurements*[9], such as s*kin conductance response* (SCR), which signals emotional or cognitive arousal, attention, and stress. It also draws on neurochemical studies in pharmacology that can causally modulate social behavior. Other relevant techniques within this approach include analyses of *animal models*[10] and *single-neuron recordings*[11][49][50][52].

Although its researchers still have much to explore, Neuroeconomics has examined the neural mechanisms involved in intuitive decisions, including those underlying specific heuristics. Using fMRI, Volz et al.[53] investigated the brain regions activated when decision-makers relied on the Recognition Heuristic[6], developed within the Ecological Rationality framework. Similarly, Skagerlund et al. [54] analyzed the relationship between the activation of specific brain regions and the use of the Affect Heuristic[29], commonly associated with the Heuristics and Biases framework. Therefore, the methodological lens of Neuroeconomics can meaningfully interact with concepts developed in other frameworks of Decision Theory.

Neuroscientific tools that enable the direct investigation of neural mechanisms provided the empirical foundation for Colin Camerer's theoretical perspective and contributed to the abandonment of the "black box" dogma. Accordingly, Neuroeconomics emphasized that economic theory must recognize how complex biological processes shape decision-making[51].

3. Implications of methodological approaches for perspectives on heuristics

Herbert Simon's methodological approach focused on understanding the mental steps and procedures that decision makers use to reach conclusions. He assumed that decision makers operate under bounded rationality; therefore, to understand how they make decisions, it was essential to analyze not only their performance in terms of correct or incorrect answers but also the processes through which they arrived at their choices. In this sense, the Bounded Rationality framework emphasized the study of decision-making as a sequence of mental processes that decision-makers could often describe themselves[25].

The methodological approach of Herbert Simon led him to focus primarily on *task-specific heuristics* [22], which decision makers could often describe[25]. These heuristics were subtly more structured and less impression-based than the *general heuristics* identified by Daniel Kahneman and Amos Tversky, which are often extremely rapid and sometimes difficult to verbalize. Therefore, it is understandable that Simon adopted a relatively more optimistic perspective on the use of heuristics in decision-making, given the comparatively more accurate character of the heuristics he observed in many task environments[26]. Simon also emphasized that heuristics contribute to efficient decisions in computational terms[23][22]. Thus, Simon's methodological approach shaped both the type of heuristics he identified and his relatively optimistic interpretation of their role in decision-making.

By contrast, Daniel Kahneman and Amos Tversky relied primarily on experiments as their methodological approach, a factor that shaped the perspective of the Heuristics and Biases framework[33]. In their analyses, the authors compared observed choices with presumed optimal responses derived from logic, probability, or statistical reasoning[7]. The experiments captured *general heuristics* that involved cognitive processes so rapid that they were typically highly intuitive and sometimes difficult for participants to describe. These general heuristics frequently led to cognitive biases. For this reason, Kahneman and Tversky adopted a more skeptical perspective on heuristics, emphasizing that such mechanisms tend to produce recurrent errors[26]. Thus, the methodological approach shaped both the type of heuristics they identified and their skeptical interpretation of their role in decision-making.

In contrast to the approach of Daniel Kahneman and Amos Tversky, Gary Klein pursued a distinct research focus. He examined the intuitive expertise of practitioners in action and argued that decision-making should be investigated in real-world settings rather than through simulated laboratory experiments. Klein concentrated on top-performing professionals in their domains and sought to understand how they reason and act in complex situations that require rapid response[34][8][28].

Indeed, this field-based methodological approach, which focused on expert performance, shaped an optimistic perspective on intuitive mechanisms in decision-making. Klein concentrated on *domain-specific heuristics*, which he generally linked to successful outcomes in expert settings. His view of intuition shares similarities with that of Herbert Simon, insofar as both authors emphasize the role of pattern recognition and experience in guiding decisions under uncertainty. Furthermore, both consider intuition to be a valuable component of decision-making[24][28]. Despite this, NDM researchers tend to question the use of highly formalized algorithms as the primary means of modeling and validating decisions in real-world situations[55], distancing themselves from frameworks that rely on this approach.

With its distinctive character, Klein's methodological approach shaped both the type of heuristics he emphasized and his optimistic perspective of their role in expert decision-making.

Gerd Gigerenzer's perspective on heuristics also contrasts with that of Daniel Kahneman and Amos Tversky. He has criticized their emphasis on heuristics as sources of recurrent errors in many experimental settings[56][13]. His methodological approach, based on computational simulations in which environmental factors play a relevant role, led him to argue that *fast-and-frugal heuristics* must fit their specific environments, since they are mental mechanisms that have evolved and been shaped by experience to operate effectively in particular contexts. These *domain-specific heuristics* are often associated with effective outcomes, in contrast to the recurrent errors often associated with *general heuristics* in the Heuristics and Biases framework.

It is reasonable to argue that Gigerenzer's perspective aligns in important respects with that of Simon[22]. The idea that human behavior resembles a pair of scissors, in which one blade represents the structure of task environments and the other the computational capacities of the agent, is a metaphor that Gigerenzer explicitly attributes to Simon[22]. Both authors treat specific heuristics favorably with regard to their role in problem-solving. Accordingly, the perspectives of Bounded Rationality and Ecological Rationality appear broadly compatible, although the latter provides a more detailed account of how environmental factors condition the effective use of specific heuristics. Several of Simon's concepts offer theoretical support for this extension[46].

Despite the criticisms directed at the Heuristics and Biases framework, some of its core ideas received empirical support from Colin Camerer's Neuroeconomics, which employs neuroscientific tools to generate evidence and ground theoretical claims. By showing that decision-making involves distinct neural circuits (including reward-related systems in the basal ganglia and the participation of the prefrontal cortex in executive and strategic functions) this methodological approach produced findings that are consistent with the multiple-systems model of the brain[49][50]. One idea reinforced by this evidence is the distinction between System 1 and System 2, which Kahneman[7] helped to popularize in Behavioral Economics.

Using neuroimaging methods from Neuroeconomics, studies have demonstrated relationships between the use of specific heuristics (characterized within different theoretical frameworks) and the activation of brain regions[53][54]. However, Neuroeconomics tends to adopt a relatively neutral position, as its primary emphasis lies in identifying the brain regions and neural processes that implement these mental simplifications rather than in evaluating their normative performance. Therefore, Camerer's methodological approach may promote a more pragmatic perspective on heuristics, distinct from both the skeptical perspective of Kahneman and Tversky and the broadly optimistic perspectives of Simon, Klein, and Gigerenzer.

Table 1 summarizes the methodological approaches employed in the Decision Theory frameworks examined, as well as the authors' perspectives on different classes of heuristics. This table shows that general heuristics tend to be associated with a skeptical perspective, whereas specific heuristics (task-specific or domain-specific heuristics) are associated with more optimistic perspectives regarding performance. Divergences among perspectives are likely, in part, because methodological approaches expose authors to different cognitive mechanisms, even though these mechanisms are often referred to generically by the same term (heuristics).

Theoretical framework	Emphasized author	Methodological approach	Focused heuristics	Perspective on the use of heuristics
Bounded Rationality	Herbert Simon	Analysis of procedural rationality	Task-specific heuristics	Optimistic (computationally efficient mechanisms)
Heuristics and Biases	Daniel Kahneman and Amos Tversky	Experimental methods	General heuristics	Skeptical (tend to generate recurrent errors in many experimental settings)
Naturalistic Decision Making	Gary Klein	Field studies, especially real-world contexts	Domain-specific heuristics	Optimistic (highly effective in expert contexts)
Ecological Rationality	Gerd Gigerenzer	Simulations incorporating environmental factors	Domain-specific heuristics	Optimistic (effective when aligned with environmental structure)
Neuroeconomics	Colin Camerer	Neuroscientific tools	All heuristics	More pragmatic

Table 1. Methodological approaches and perspectives on heuristics across Decision Theory frameworks

Source: Author's own elaboration.

More broadly, methodological approaches influence not only the identification of heuristics but also the standards by which they are interpreted and evaluated, thereby shaping theoretical perspectives within Decision Theory. Consequently, debates about heuristics reflect important methodological and epistemological differences rather than merely theoretical or empirical disagreements. Therefore, the long-standing contrast between skeptical and optimistic perspectives of heuristics should be understood as the expression of different analytical focuses and specific *modes of inquiry*[12], rather than as mutually exclusive theories.

Different methodological approaches make distinct cognitive processes more visible and salient. Experimental studies tend to foreground systematic biases; field research highlights skilled performance in real contexts; computational simulations emphasize mind-environment fit; and neuroscientific methods prioritize biological plausibility. Consequently, each tradition implicitly relies on distinct standards of evidence and justification. Therefore, these frameworks can be understood as various complementary perspectives rather than competing theories, each illuminating different aspects of bounded rationality.

4. Final remarks

One conclusion that emerges from this conceptual synthesis is that the methodological choices of different theoretical frameworks have important implications for the perspectives their authors adopt on key aspects of decision-making. Methodological approaches shape what cognitive processes become most visible and salient and influence how authors interpret intuition, emotions, and heuristics in the context of decisions.

Furthermore, a comparison reveals convergences and divergences in how these authors conceptualize aspects of decision-making. The divergences are understandable because different methodological approaches expose researchers to distinct cognitive mechanisms and standards of evidence. As discussed, the task-specific and domain-specific heuristics emphasized by Herbert Simon, Gary Klein, and Gerd Gigerenzer, which are often associated with efficient or effective performance in structured environments, are not the same as the general heuristics identified by Daniel Kahneman and Amos Tversky, which tend to generate recurrent errors in many experimental settings.

More broadly, this study suggests that methodological approaches do not merely reveal decision processes but also shape the concepts through which cognitive mechanisms are understood within Decision Theory. Consequently, understanding heuristics requires both theoretical comparison and explicit reflection on the epistemic lenses through which the authors observe them. Thus, debates about heuristics cannot be adequately assessed without considering the specific modes of inquiry that make particular cognitive mechanisms visible and legitimate as evidence.

Regarding the limitations of this article, not all existing theoretical frameworks within descriptive Decision Theory were addressed, nor would it be reasonable to attempt to exhaust them in a single study. This limitation reflects both the breadth of descriptive Decision Theory and the methodological and conceptual diversity that characterize the field. Moreover, several authors have made significant contributions within these frameworks beyond those emphasized here, and the decision to highlight only one author per framework may appear restrictive. However, this choice was intended to focus on the most influential figures in each framework in order to support research primarily in Psychology, Management, and Economics. It should also be considered that any arbitrary selection could have overlooked authors who made substantial contributions to their respective frameworks.

Therefore, scholars in these fields are encouraged to go beyond this conceptual synthesis and engage with the work of other authors. In particular, the literature on Neuroeconomics has expanded in a more dispersed and promising manner, offering fertile ground for future research.

To advance descriptive Decision Theory, future studies should investigate the integration between Neuroeconomics and other theoretical frameworks examined. Neuroeconomics can validate or refine the decision-making models developed within each framework. Particularly, the integration between Neuroeconomics and Naturalistic Decision Making appears promising and remains relatively underexplored, whereas the Heuristics and Biases framework has already received support from analyses of neural mechanisms.

Furthermore, Naturalistic Decision Making models can be more broadly applied to analyze and improve decision-making in Management, as illustrated by Lawani et al.[17]. Future studies can examine how training based on Cognitive Task Analysis (CTA)[57][58][59] may enhance situational expertise in corporate environments that have not yet been extensively studied, such as various activities within the financial sector.

Finally, in light of the growing recognition of human neurodiversity[60], investigating how neurodivergent brains process decisions under risk and uncertainty appears particularly promising. Future studies can expand the scope of decision-making analysis beyond neurotypical patterns, as subtly suggested by Camerer and Hare[61].

Footnotes

[1] *Task-specific heuristics* are practical rules adapted to solve a particular problem or perform a specific task. They are even more narrowly focused than domain-specific heuristics (discussed later).

[2] *General heuristics* are practical rules or mental shortcuts that operate across a wide range of situations and domains, without relying on specialized domain knowledge.

[3] *Domain-specific heuristics* are practical rules tailored to a particular field or domain of knowledge. They depend on specialized knowledge or experience acquired within that domain.

[4] *Ecological validity* is a type of external validity that assesses whether the findings of an investigation can be generalized to real-world contexts or natural environments.

[5] The Recognition Heuristic is a cognitive shortcut whereby, when one of two objects is recognized and the other is not, the recognized object is inferred to have a higher value on a given criterion. This "less-is-more" strategy relies solely on environmental familiarity, ignoring additional information, and can nevertheless yield quick and often accurate decisions, such as choosing a known brand over an unknown one.

[6] *Cognitive frugality* refers to the tendency of the mind to economize cognitive effort and resources in information processing.

[7] *Affective systems* refer to innate subcortical neural circuits in human brains that process primary emotions essential for survival.

[8] *Neural correlates* are the minimal and sufficient patterns of brain activity that occur together to generate a specific conscious experience or mental state, such as a perception, memory, or sensation. Neuroscientists map these minimal combinations of neural activity, in which neurons fire together in synchrony, that are necessary and sufficient for a given experience to occur (for example, perceiving a color or experiencing an emotion).

[9] *Peripheral physiological measurements* refer to physiological signals recorded outside the central nervous system, typically obtained from peripheral regions of the body. In practice, they involve the non-invasive recording of autonomic and somatic nervous system activity through body-mounted sensors.

[10] *Animal models* are non-human organisms (such as rodents and primates) used in neuroscience to investigate the neural and cognitive mechanisms underlying decision-making, learning, reward processing, and social behavior.

[11] *Single-neuron recordings* refer to techniques that measure the electrical activity of individual neurons in real time.

[12] *Modes of inquiry* refers here to the concrete research practices and empirical methods through which researchers generate and interpret evidence.

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