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OF TURKU

HEURISTICS AND BIASES IN ORGANIZING

Conceptual Tools for Examinations of
Cognitive Biases in Organizational Routines

Lauri-Matti Palmunen



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Cognitive Biases in Organizational Routines**

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SUMMARY

The rationality of judgment and decision-making processes has a long pedigree as a central topic in organization studies. Traditionally, organization studies have depicted human rationality as bounded and studied the relationship between boundedly rational individuals and the internal organizational environment. However, recent analyses of the bounded rationality concept suggest it is sometimes used imprecisely, which undermines those organizational theories that build upon it. Further, recent analyses propose the need for renewing the relationship between an individual's bounded rationality and the structure of the internal organizational environment by using contemporary concepts such as heuristics, cognitive biases, and organizational routines.

Consequently, the main research objective of this dissertation is to identify potential entry points of how to conceptually link heuristics and biases to such features of an internal organizational environment as organizational routines. I seek to achieve this main research objective by using a non-empirical research strategy, which means that I choose to service and refine academic tools instead of applying them in some empirical context. The main research objective is achieved through a cumulative effort that is presented in two parts. Part I introduces the academic tools that have helped me to create and achieve more detailed research objectives, which are discussed in Part II in the form of three essays.

The three essays demonstrate the following findings. Essay 1 presents a taxonomy that clarifies the conceptual ambiguity related to bounded rationality and its three contemporary descendants: heuristics and biases (HB), natural decision making (NDM), and fast and frugal (FF) theories. Essay 2 presents a categorization of articles that demonstrates how the different antecedents of HB, NDM, and FF theories affect both the discipline and the level in which a specific theory is applied in management and organization studies. Essay 3 presents a model of the microfoundational dynamics of organizational routines, which creates possibilities for combining constructs related to HB theory with constructs related to organizational routines.

The three essays contribute to the main research objective in the following ways. Essay 1 improves the construct clarity of bounded rationality and offers tools that scholars can use to map and reflect their own conceptualizations of bounded rationality. Essay 2 demonstrates specific mechanisms that link heuristics and biases to organizational-level phenomena and provides an initial version of a theory of organizational-level heuristics and biases. Essay 3 demonstrates how various structures retain different amounts of endogenous variance in organizational routines and provides a detailed analysis of the constructs that relate to

the microfoundational view on routines. In aggregate, the contributions of Essays 1–3 demonstrate how the interaction between an individual's decisions and mental models and organizational routines can either intensify or mitigate the effects of heuristics and biases.

Keywords: bounded rationality, cognitive bias, decision making, heuristic, heuristics and biases, organizational routine

TIIVISTELMÄ

Päätöksenteon rationaalisuus on ollut pitkään keskeinen osa organisaatiotutkimusta. Perinteisesti organisaatiotutkimus on kuvannut ihmisen rationaalisuuden rajoittuneeksi ja keskittynyt tutkimaan rajoittuneesti rationaalisten yksilöiden ja sisäisen organisaatioympäristön välistä suhdetta. Viimeaikaiset rajoittuneesta rationaalisuudesta tehdyt tutkimukset osoittavat tämän käsitteen käytön olevan epätarkkaa, mikä heikentää rajoittuneen rationaalisuuden käsitettä hyödyntäviä teorioita. Lisäksi viimeaikaiset tutkimukset huomauttavat, että rajoittuneesti rationaalisten yksilöiden ja sisäisen organisaatioympäristön välistä suhdetta kuvaavaa tutkimusta olisi syytä uudistaa käyttämällä nykyaikaiselle organisaatiotutkimukselle olennaisia käsitteitä, kuten heuristiikat, kognitiiviset harhat ja organisaatioiden rutiinit.

Edellä mainittuihin syihin nojaten väitöskirjani päätavoite on tunnistaa sellaisia yhtymäkohtia, jotka mahdollistavat heuristiikkojen ja kognitiivisten harhojen liittämisen käsitteellisesti osaksi sisäisen organisaatioympäristön, esimerkiksi rutiinien, tutkimusta. Pyrin saavuttamaan tämän päätavoitteen hyödyntämällä ei-empiiristä tutkimusstrategiaa. Toisin sanoen pyrin huoltamaan ja uudistamaan tutkimuksissa käytettäviä työkaluja sen sijaan, että käyttäisin niitä jossain tietyssä empiirisessä ympäristössä. Kirjan rakenteen osalta tutkimuksen päätavoite saavutetaan kahdessa osassa. Ensimmäinen osa esittelee ne tutkimuksissa käytetyt työkalut, jotka auttoivat minua luomaan tarkemmat tutkimustavoitteet. Keskustelen tarkemmista tavoitteista, ja vastaan niihin, tutkimuksen toisessa osassa, joka koostuu kolmesta esseestä.

Esitän esseissä seuraavat tulokset: Ensimmäinen esse esittelee taksonomian, joka selvittää alkuperäisen rajoittuneen rationaalisuuden ja sen kolmen nykyaikaisen muodon – HB-, NDM- ja FF-teorian – välillä vallitsevia käsitteellisiä epäselvyyksiä. Toisessa esseessä luokittelen tutkimusartikkelit kategorioiden, jotka havainnollistavat kuinka HB-, NDM- ja FF-teorioiden ennakkolettamat vaikuttavat sekä siihen tieteenalaan että systeemiseen tasoon, jossa kutakin teoriaa on sovellettu organisaatiotutkimuksissa. Kolmannessa esseessä esitän mallin niistä mikrotason osatekijöistä, joista organisaatioiden rutiinit koostuvat. Malli auttaa yhdistämään organisaatioiden rutiinien osatekijöitä yksilöiden heuristiikkoihin ja kognitiivisiin harhoihin.

Nämä tulokset edistävät sekä päätavoitteeseen vastaamista että muita tutkimuksia seuraavin tavoin: Ensimmäinen esse täsmentää rajoittuneen rationaalisuuden käsitettä ja tarjoaa työkaluja, joiden avulla muut tutkijat voivat pohtia ja kartoittaa omia käsityksiään rajoittuneesta rationaalisuudesta. Toinen esse sekä tarjoaa alustavan version organisaatiotason heuristiikkoja ja harhoja

käsittelevästä teoriasta että havainnollistaa niitä mekanismeja, jotka liittävät heuristiikat ja harhat organisaatiotason ilmiöihin. Kolmas essee havainnollistaa kuinka erilaiset rakenteet säilyttävät eri määrän organisaation rutiinin synnyttämästä muutoksesta ja tarjoaa yksityiskohtaisen analyysin niistä käsitteistä, jotka liittyvät organisaatioiden rutiinien mikrotason tarkasteluun. Lopuksi, yhdistämällä esseiden sisältö, tämä väitöskirja havainnollistaa kuinka yksilön päätösten ja mentaalisten mallien suhde organisaation rutiineihin voi joko vahvistaa tai heikentää heuristiikkojen ja kognitiivisten harhojen vaikutuksia.

Avainsanat: heuristiikka, heuristiikat ja harhat, kognitiivinen harha, organisaation rutiini, päätöksenteko, rajoittunut rationaalisuus

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After devoting many years to this project, a study of cognitive biases, which became a textbook example of the sunk-cost fallacy, I must plead guilty to another cognitive bias. Anything I write here is subject to the availability heuristic, which distorts my mind toward recent and vivid memories and away from memories that are distant and dull. Hence, although in hindsight this project feels solely positive, I must force myself to mention that writing a doctoral dissertation is mainly a gray, lonely, and tedious exercise. This project sturdily anchored me to the inner journey, one of two journeys we go through in life. During this inner journey, I was many times underconfident, sometimes overconfident, and, like all doctoral students, I was trained to avoid the confirmation bias. The other journey, the outer one, complements the inner journey. During my outer journey, I was extremely lucky and received multilevel help from various individuals, groups, and organizations. I would like to thank them next.

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In Patterinhaka, Turku

10 February 2019

Lauri-Matti Palmunen

*I dedicate this work to everyone who has trained themselves
to see the beauty of losing streaks.*

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1 INTRODUCTION

“About 13.5 billion years ago, matter, energy, time and space came into being in what is known as the Big Bang. The story of these fundamental features of our universe is called physics. About 300,000 years after their appearance, matter and energy started to arrange as complex structures, called atoms, which then combined into molecules. The story of atoms, molecules and their interactions is called chemistry. About 3.8 billion years ago, on a planet called Earth, certain molecules combined to form particularly large and intricate structures called organisms. The story of organisms is called biology. About 70,000 years ago, organisms belonging to the species Homo sapiens started to coordinate even more elaborate structures called cultures. The subsequent development of these human cultures is called history. Three important revolutions shaped the course of history: the Cognitive Revolution initiated history about 70,000 years ago. The Agricultural Revolution made the Cognitive Revolution more efficient about 12,000 years ago. The Scientific Revolution, which started only 500 years ago, has made the Cognitive Revolution so efficient that it may well end history and start something completely different.” (Harari 2015, 3.)

1.1 Background

It is difficult to describe the story of the most profound parts of the human past without using terms related to the word “organize.” In dictionary definitions of this word, four themes are common: 1) form (a number of people), 2) coordinate the activities of (a person or group), 3) arrange, 4) make someone or something more efficient (Oxford Thesaurus of English). Themes 1 and 2 refer to a type of interaction in which one person or several people have the ability to affect the behavior of one or more people. Themes 3 and 4 refer to the process of making something more efficient. Consequently, the form/coordinate and arrange/efficient dimensions of organizing are deeply rooted in the biological, mental, and social aspects of humanity.

When focusing on the Scientific Revolution, one can notice that about 140 years ago, a branch of philosophy detached from its mother discipline. This branch is psychology, which is defined as the scientific study of behavior and mental processes. About 70 years ago, in the 1950s, several psychology scholars published studies that initiated cognitive psychology. These inaugural cognitive

psychology studies made testable inferences about human memory (Miller 1956), perception (Broadbent 1958), problem-solving (Newell, Shaw & Simon 1958), and communication (Chomsky 1959). An overarching theme in the results of these studies was the limitations of various aspects of human cognition.

One of the early cognitive psychology scholars, Herbert Simon, compared these results with the rational choice model, which was the prevailing theory of human decision making at that time. Simon called this comparison bounded rationality. He defined bounded rationality as a departure from the rational choice model by emphasizing individuals' limited attention, limited memory, limited knowledge, and partial preferences (Simon 1997). Simon continued to develop the bounded rationality model. In a later form of bounded rationality, he introduced the satisficing concept that complemented the previous idea regarding limited human cognition. Further, Simon understood bounded rationality as an inseparable part of organizing. Arguably, one of his most important contributions was to demonstrate how bounded rationality relates to performance programs—automatic and fixed organizational responses to certain stimuli—that are organized in accordance with the hierarchical structure of the organization (Simon 1956). Later, Simon described this union between human rationality and the structure of the internal organizational environment with a scissor metaphor: *“Human rational behavior...is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor.”* (Simon 1990, 7).

Simon's scholarly works, combined with the works of two other scholars from the Carnegie Mellon University, James March and Richard Cyert, are currently considered classics in organization studies (Simon 1947; March & Simon 1958; Cyert & March 1963). This so-called Carnegie School has remained relevant and influenced the disciplines of economics, psychology, and sociology within and outside management and organization studies (Simon 1997, 120). In management and organization studies, the most notable fields influenced by the Carnegie School are institutional theory, population ecology, organizational economics, evolutionary economics, and organizational learning (Argote & Greve 2007, 340–341), which consider bounded rationality a taken-for-granted first principle (Porac & Tschang 2013, 250), and arguably concentrate on the blade of structure of task environments in the scissors metaphor. The other blade—the computational capabilities of the actor—has had the most notable influence outside management and organization studies, in cognitive psychology, in which an individual's bounded rationality theory has been developed further into three theories that compete with each other; heuristics and biases (HB), natural decision making (NDM), and fast and frugal (FF) (HB cf. Kahneman 2011, 236; NDM cf. Lipshitz, Klein & Carroll 2006, 918; FF cf. Gigerenzer, Czerlinski & Martignon 2002, 560–561).

Although contemporary research has successfully sharpened both blades, very little attention has been paid to the proverbial handle, which is arguably the most profound tenet of the Carnegie School: the integration between an individual's bounded rationality and the structure of the internal organizational environment. Indeed, the explicit need for renewing this integration by incorporating post-Carnegie developments in individual's bounded rationality theory has been advocated (Cohen 2007, 506; Gavetti, Levinthal & Ocasio 2007). Similar calls to integrate an individual's cognitive capabilities and an internal organizational environment have been suggested in reviews of intuition in organizations (Akinci & Sadler-Smith 2012), behavioral strategy (Powell, Lovallo & Fox 2011), and cognition in organizations (Hodgkinson & Healey 2008).

The rather general research gap considering the integration between individual's bounded rationality and the structure of an internal organizational environment has generated more specific questions that remain unanswered. Management and organization theory-building has failed to produce theories about phenomena between HB, NDM, or FF and the structure of the internal organizational environment. Bingham and Eisenhardt (2014, 1701) advocate an integrative view of heuristics across various theories. Such theories should take meaningful account of social interactions or organizational complexity (Hodgkinson & Starbuck 2008, 9). Similarly, Loock and Hinnen (2015) propose that scholars lack a detailed understanding of heuristics in organizations and call for future studies on the antecedents, processes, and consequences of social or shared heuristics in organizations. Whereas Bettis (2017, 2632) notes that we know very little about the use of heuristics in a strategic context, Vuori and Vuori (2014) demonstrate the limited compatibility of FF heuristics in a strategic context. In addition to heuristics, another understudied phenomenon is the question of how the concept of cognitive bias—that exists in the individuals who constitute organizations—applies to an organization, whether in the aggregate or as a unique social actor (Barney & Felin 2013, 142).

1.2 Main research objective and method

In this dissertation, I seek to respond to the above-mentioned calls by examining the relationship between an individual's bounded rationality and organizing. The premise of this examination is the Carnegie School's thesis regarding the relationship between an individual's bounded rationality and performance programs. I take this relationship as a given but substitute the bounded rationality and performance program constructs with two constructs that have evolved from these original constructs since the Carnegie School published its main work. Specifically, I substitute the bounded rationality construct with the heuristics and biases

construct and the performance program construct with the organizational routine construct. Consequently, the main research objective of this dissertation is to identify potential entry points of how to conceptually link heuristics and biases to such features of an internal organizational environment as organizational routines.

I seek to achieve this main research objective by utilizing a non-empirical research strategy. Generally, a novel contribution of any non-empirical work can arise from modifying multiple elements of an existing theory, from an alternative way of looking at reality or at prior research, or from integrating previously distinct research streams (Whetten 1989, 492–494). The main contribution of this dissertation comes from integrating previously distinct research streams: While the HB-theory is the leading descendant of bounded rationality in current cognitive psychology, Nelson and Winter's (1982) reinterpretation of performance programs as organizational routines is the leading descendant of performance programs in current management and organization studies. Yet, studies that integrate these contemporary understandings of the Carnegie School's most profound tenets remain rare. Further, by integrating these research streams, this dissertation creates a new way of looking at reality, which demonstrates the relationship between various cognitive biases and organizational routines.

By utilizing a non-empirical research strategy, I choose to service and refine academic tools instead of applying them in some empirical context. For academics, models and theories are like a box of working tools used for solving problems in the world. Similar to any serviceman, also academics need to balance the weight of the toolbox and the complexity of tools with the usefulness and simplicity of the tools. Consequently, academic work is a constant interplay between simpler and more complex theories that compete for success. Success is determined by other academics who weigh whether it is worthwhile to sacrifice a theory's convenience for additional complexity (Whetten 1989, 490).

Furthermore, theories can be categorized by their level of generality. Similar to variously sized concrete, material problems, also academic problems require differently sized tools for different problems. Whereas more specific academic problems require smaller theories that are bounded in space, time, or both, general theoretical statements are relatively unbounded in space and time (Bacharach 1989, 500). This general–specific continuum of theories, along with the simple–complex continuum of theories, is illustrated in Figure 1.

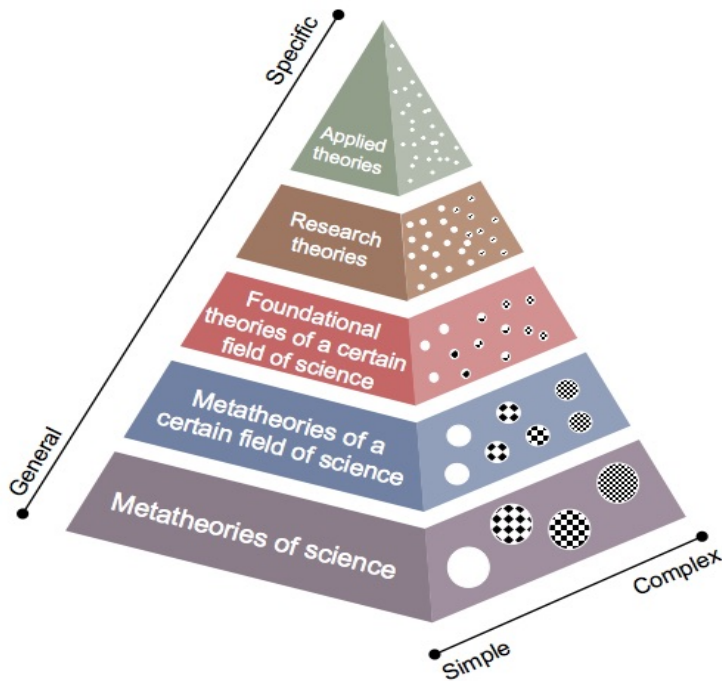


Figure 1 A toolbox of theories (Adapted from Kallio 2006, 523)

When this study's premise regarding the relationship between an individual's bounded rationality and performance programs is considered in light of the general–specific continuum presented in Figure 1, it is noteworthy that different theories concerning human rationality are foundational theories on which organizational research theories are built. Hence, various organizational theories share the foundational belief (Fumerton & Hasan 2010) that they are based on *some* model of rationality. Consequently, the Carnegie School's theory concerning performance programs was built on a more general theory about an individual's bounded rationality. Similarly, it appears reasonable to assume that contemporary theories regarding organizational routines develop differently depending on whether they are based on HB, NDM, or FF theory about bounded rationality.

Further, when this study's premise regarding the relationship between an individual's bounded rationality and performance programs is considered in light of the simple–complex continuum presented in Figure 1, it is notable that both of these theories can be categorized on the simple end of the continuum. For example, Simon (1997) commented on the simplicity of bounded rationality in the fourth edition of *Administrative Behavior*. According to Simon, bounded rationality meant merely those common sense reasons—an individual's limited attention, limited memory, limited knowledge, and partial preferences—that separate individuals from the omnipotent economic man described by the rational choice

model. Later theories—namely HB, NDM, and FF—that have developed bounded rationality further, are more complex than the original bounded rationality. Thus, in Figure 1, they can be located more towards the right side on the same layer of abstraction than the original bounded rationality.

However, the evolution of theories does not, and should not, occur from simple to complex. Rather, it is a constant dance between simple and complex. Fairly recently, one academic tool has managed to reduce the complexity of HB, NDM, and FF theories and increase the quality of the dialogue between them (see Kahneman & Klein 2009). This tool is called a dual-processing theory of the human mind. The dual-processing theory separates two distinct cognitive processes of the human mind, namely System 1 and System 2. System 1 includes cognitive processes that are fast, automatic, and unconscious. System 2 is a label for cognitive processes that are slow, deliberative, and conscious. (Evans 2008.) Recently, the dual-processing theory has been utilized successfully in explaining many cognitive biases that were originally found in the 1970s and 1980s (Kahneman 2011).

1.3 Detailed research objectives and structure

The main research objective—to identify potential entry points of how to conceptually link heuristics and biases to such features of an internal organizational environment as organizational routines—is achieved through a cumulative effort that is presented in two parts. Part I introduces the academic tools that have helped me to create and achieve more detailed research objectives. These more detailed research objectives are discussed in Part II, which is presented in the form of three essays.

Essay 1 concentrates on clarifying the conceptual ambiguity related to bounded rationality and its three contemporary descendants: heuristics and biases (HB), natural decision making (NDM), and fast and frugal (FF) theories. Specifically, the objective of Essay 1 is to deconstruct the bounded rationality concept and reconstruct it in a contemporary form. Essay 1 contributes to the calls, which have raised the general issue of imprecise references to bounded rationality (Gavetti et al. 2007; Miller 2008), by providing detailed examples of such inaccuracies from the organizational literature. In other words, Essay 1 examines the simple–complex continuum on the third layer in Figure 1 and demonstrates how misunderstandings of this more abstract layer create problems on the fourth, more specific layer of organizational research theories. Overall, Essay 1 presents a conceptual taxonomy that clarifies the relationship between bounded rationality and its descendants and serves as an academic tool for future organizational theories that build upon the bounded rationality concept.

Essay 2 utilizes the conceptual taxonomy created in Essay 1 by exploring contemporary management and organization studies that have built upon bounded rationality's descendants. Specifically, the objective of Essay 2 is to examine the antecedents, disciplines, and levels used in highly ranked management and organization journal articles that have utilized HB, NDM, or FF theories. In other words, Essay 2 examines the general-specific continuum in Figure 1 from the second to the fourth layer. As a result, Essay 2 presents a categorization of articles that demonstrates how the different antecedents of HB, NDM, and FF theories affect both the discipline and the level in which a specific theory is applied in management and organization studies. Particularly, group and organizational-level studies applying HB theory remain rare. Overall, Essay 2 serves the main research objective by demonstrating the limits for what is already known and contemplating various possibilities for the absence of organizational-level heuristics and biases theory.

Essay 3 concentrates on the organizational routines, which are part of the main research objective. It aims to bridge the gap—found in Essay 2—between HB theory and organizational-level studies by answering the recent calls for research on the micro-level origins of routines (Abell, Felin & Foss 2008; Felin & Foss 2005; Felin & Foss 2009; Gavetti 2005). Hence, the purpose of Essay 3 is to construct a model of the microfoundational dynamics of organizational routines. As a result, Essay 3 presents a model that combines the constituent components—individuals, processes and interactions, structure and design—of organizational routines (Felin, Foss, Heimeriks & Madsen 2012) with the major dynamics—variation and selective retention—that shape organizational routines (Pentland, Feldman, Becker & Liu 2012). By concentrating on the microfoundational dynamics of organizational routines, Essay 3 creates possibilities to combine constructs related to HB theory with constructs related to organizational routines. Consequently, the cumulative contributions of Essays 1–3 identify potential entry points of how to conceptually link heuristics and biases to such features of an internal organizational environment as organizational routines.

The remainder of Part I is structured as follows. Chapter 2 introduces four tools related to the study of human cognitive machinery: a framework for understanding the components of decision making, mental models, the dual-processing theory, and general models used in studies of human cognition. Chapter 3 demonstrates the original studies on cognitive biases and combines these with contemporary dual-processing theory-driven explanations of the reasons cognitive biases occur. Chapter 4 discusses elements that separate organizational decision making from individual decision making. Chapter 5 introduces the methodological choices—including the non-empirical research strategy and ontological and epistemological assumptions—that underlie this dissertation. Additionally, Chapter 5 presents summaries of three essays that constitute Part II of this re-

search. Finally, Part I ends with Chapter 6, which discusses the cumulative theoretical contributions, as well as the limitations, of the whole dissertation.

2 HUMAN COGNITIVE MACHINERY

Human cognitive machinery can be presented as a series of stages in an information-processing sequence. During this sequence, various entities receive information from a previous stage, process it, and deliver it to the next stage. The exact nature and order of these stages are unknown, but generally, we process information first through lower cognition stages, such as perception, pattern recognition, and memory, and later, through higher cognition stages, such as decision making, mental models, and thinking. (Solso 1988, 5–6; 386.) Although higher cognition depends on the processes of lower cognition, this chapter does not attempt to discuss this relationship or introduce each component of our cognitive machinery. Instead, this chapter introduces four tools that scholars of cognitive psychology utilize in their pursuit to understand human cognitive machinery. These four rather general tools enable us to gain a better understanding of the more specific theories that I will present in Chapter 3. Consequently, the purpose of this chapter is to introduce terminology of human cognitive machinery that enables a further discussion of systematic errors in higher cognition.

2.1 Components of decision making

When we make a decision, we choose an action among various possibilities—what to do or not do. Our decisions are based on beliefs about what actions will achieve our goals and evidence that helps us determine the likelihood that we will achieve our goals. In its simplest form, a decision may involve only a single goal, two possibilities, and strong beliefs and evidence about which of the two possibilities will best achieve the goal. For example, if my goal is to stay dry, and I believe that my umbrella helps me to stay dry, and I have strong evidence that it will rain, I choose to take an umbrella with me. Decisions can also be complex and contain a search for multiple possibilities and goals with uncertain beliefs and evidence. (Baron 2008, 5.) For example, when I make a decision where to live next, I have many goals related to the possible apartment. These goals include factors such as price, size, the neighborhood, and design. The goals determine for what types of evidence I attempt to search. Evidence can consist of more certain propositions, such as, “the price is 200000 Euro,” and imagined and more uncertain scenarios, such as “how the layout of an apartment will affect the

family dynamic,” arguments, examples, and observations. These basic components of decision making are illustrated in Figure 2.

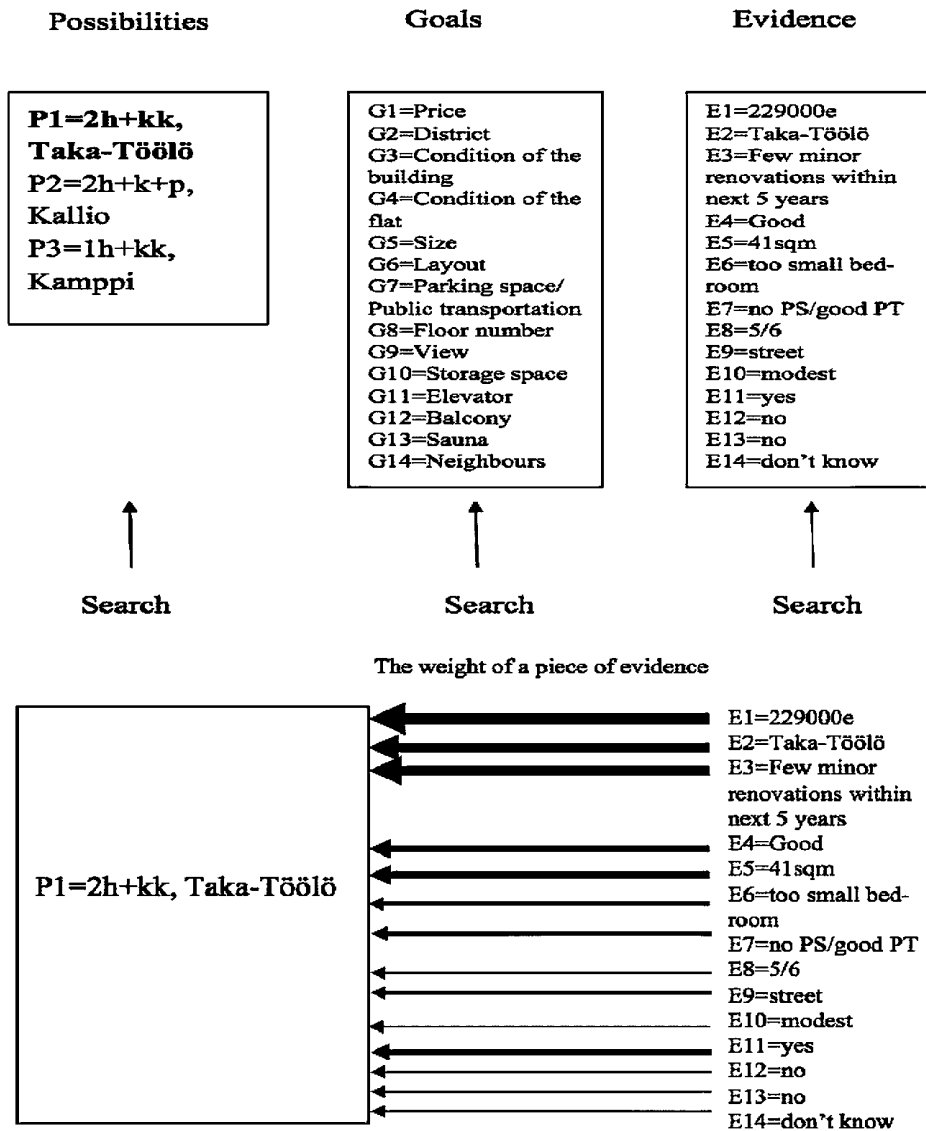


Figure 2 Components of a decision to buy an apartment

Figure 2 demonstrates a situation in which a person is making a decision to buy an apartment. She has three options, which are located in Taka-Töölö, Kallio, and Kamppi. She has 14 goals, which she uses as criteria to evaluate the apartments. The 14 goals determine what evidence is sought and how it is used. In Figure 2, only one piece of evidence per goal is presented, but there could be more evidence per goal.

The lower part of Figure 2 illustrates a process called judgment. Judgment is an essential component of decision making. Every decision implies some judgment, but not every judgment is followed by a decision (Lewis 2016, 251). Judgment means a process in which each possibility is strengthened or weakened as a choice on the basis of a specific set of evidence and goals. As a goal becomes more important, more weight is given to a piece of evidence. (Baron 2008, 8.; Priem, Walters & Li 2011, 556.) Consequently, a person making a judgment is assigning probabilities: how desirable, likely, or risky something is (Lewis 2016, 251). In this example, the person gives the most weight to price. Together, all the weight combined form her judgment about the desirability of this particular apartment.

Decisions depend on beliefs and goals, but these components of decision making can also be understood as outcomes of a decision-making process. A belief is an outcome of a decision about how strongly to believe something, or which of several competing beliefs is true. A goal is an outcome of a decision that affects future decisions. When we make decisions about our goals, we try to bind our future actions. Hence, it is possible to make decisions about beliefs and goals without knowing what decisions they will affect in the future. (Baron 2008, 6.) For example, the 14 goals in Figure 2 are the outcome of previous decisions about the desirable aspects of an apartment. During these previous decision-making processes, the 14 goals were among possibilities that might have contained other possible goals (e.g., the distance to the nearest grocery store), which were rejected and are not presented here. Furthermore, during these previous decision-making processes, some sets of more personal and valuable goals have been used as criteria. The person might have personal goals, for example, “living as ecological as possible” or “to present a successful image of myself.”

Accordingly, our beliefs and goals have a layered, onion-like structure that affects decision making in the following ways. First, the inner layers that are closer our personality affect decision making by triggering a relevant set of goals for a particular decision, e.g. public transportation or district in Figure 2. Second, these inner layers affect the importance of a certain goal, and hence, how much weight is given to evidence related to this certain goal. Third, the set of goals for a particular decision probably have many sub-goals. These sub-goals are goals that, if achieved, will help to achieve the main goal. (Haslam & Baron 1994, 35.) In my example, the 14 approved goals might have many sub-goals that are not presented in Figure 2. The “district” goal might have such sub-goals as aesthetic value or safety. At the end of my example, all of the more personal goals (which are decisions she made in the past) and beliefs she had, affected the decision to buy an apartment (a decision that she made right now). Consequently, these causal relationships among beliefs and goals (Rehder 2003) form the cognitive structures that individuals use both as a value base (Adner & Helfat 2003, 1021) and

to narrow the search for a relevant set of possibilities, goals, and evidence for each decision (Gavetti & Levinthal 2000, 117). Furthermore, decisions have the ability to modify old cognitive structures or format new ones (Solso 1988, 420). Scholars have labeled these structures variously as belief systems, causal maps, cognitions, cognitive frames, decision rules, judgment policies, mental models, and schemas (Priem et al. 2011, 554). Hereinafter, I will refer to these cognitive structures as mental models and discuss them next.

2.2 Mental models

The origins of the mental model concept can be traced to Craik (1943), who postulated the idea that individuals have, in their minds, a model of how the world operates. This model is a simplified representation of reality that allows people to interact with the world (Jones, Ross, Lynam, Perez & Leitch 2011). Multiple disciplines have adopted the concept and proceeded to develop their own terminology (Rouse & Morris 1986), which has caused conceptual confusion in management and organization research (Gary & Wood 2011, 570; Priem et al. 2011, 554). However, management and organization research has gathered substantial evidence that mental models influence decision making in the organizational context by producing different understandings of the same objective business environment (Gary & Wood 2011; Gavetti 2005; Kaplan & Tripsas 2008; Porac, Thomas, Wilson, Paton & Kanfer 1995; Tripsas & Gavetti 2000). A mental model has been variously defined as a mechanism for perceiving the world (Johnson-Laird 1983; Johnson-Laird 1989), a mechanism for meaningful explanations (Clarke & Mackaness 2001; Kieras & Polson 1985), and a prediction mechanism for alternative scenarios in the world (Collins & Gentner 1987; Senge 1990).

According to the perception definition, a mental model can be seen as a mental diagram containing mental images that are similar to the images formed during perception, thus corresponding to their real-life counterparts (Doyle & Ford 1998; Johnson-Laird 1989). Specifically, Johnson-Laird (1989, 488) defined a mental model as a mental representation that meets three conditions. First, its structure corresponds to the structure of the situation that it represents. Second, it can consist of elements corresponding only to perceptible entities, in which case, it may be realized as an image. Third, it contains symbols that are fixed rather than variable. Relating to this definition of mental models as a mechanism for perceiving the world, previous studies have shown that experts and novices have different perceptions, which further affects their decision making. Novices tend to pay attention to details and focus on making sense of the complete situation, whereas experts have a more selective perception (Kranich 2012). Boschker,

Bakker, and Michaels (2002) found that expert rock climbers were better able to perceive climbing possibilities than novices when looking at a climbing wall.

In addition to perceiving, mental models can be utilized for explaining. Mental models can explicate relevant knowledge content, as well as the relationships between knowledge components (Webber, Chen, Payne, Marsh & Zaccaro 2000). The form of explanations is related to the complexity of a mental model; novices begin with verbal, analytic knowledge and gradually move to levels where knowledge becomes more programmed or intuitive (Dreyfus & Dreyfus 1986; Eason & Wilcockson 1996). For instance, Boshuizen, Schmidt, Custers & Van De Wiel (1995) found that medical students applied formal scientific knowledge in their decisions, whereas experts relied more on detailed mental models containing extensive amounts of information from their previous experiences of patients' problems.

Mental models can also be seen as predictors of future states. According to Senge (1990), mental models not only influence how we understand the world but also how we take action. People may carry around quite different mental models, which then determine the quality of their decisions (Morecroft 1992). Indeed, previous research has found that mental model accuracy is predictive of individual performance (Kraiger, Salas & Cannon-Bowers 1995; Rowe & Cooke 1995; Davis & Yi 2004; Mathieu, Goodwin, Heffner, Salas & Cannon-Bowers 2005). Mental models contain information about causality and can give rise to judgments of causality. Furthermore, mental models may be altered in response to new information and can be mentally operated to simulate the likely outcomes of our decisions (Bowlby 1982). Over time, people will develop a set of prototypical situations in their memory. By matching the patterns of the current situation with the prototypical situations, people can instantly recognize known classes of situations. (Endsley 2006.)

To demonstrate how the mechanisms of perception, explanation, and prediction operate in our mental models, look at Figure 3 below.



Figure 3 A demonstration of mental model operations

By merely glancing at Figure 3, you utilized a broad range of mental model operations: You perceived two cars on the left and a man on the right. You perceived that the man is bold and that he is angry. In addition to these perceptions, you formed causal relationships among the objects. You formed an explanation of the earlier moments in the photo of the cars and automatically created a causal connection in which the crashed cars are the reason for the man's anger. Furthermore, on your initial glance, you can predict that the man will say some unkind words, probably in a loud voice. Finally, your mental model about operations of the world informs you that the man could take even more severe actions than shouting obscene words. (Kahneman 2011, 19; 50.) All of these mental model operations occurred automatically, quickly, and unconsciously. To compare these automatic operations with deliberate ones, glance at the following Figure 4.

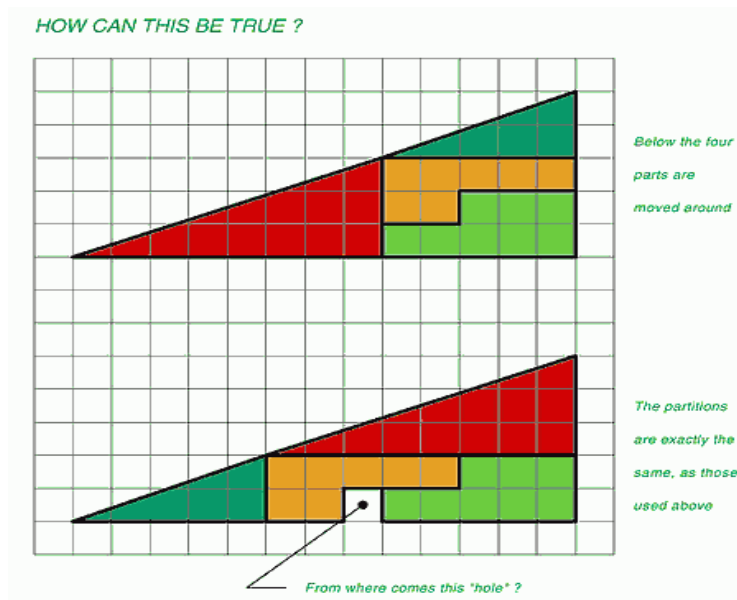


Figure 4 A violation of your mental model

Again, a series of automatic mental activities occurred at first glance. You perceived two triangles that contain two smaller triangles and two rectangles. You used your innate skill of pattern recognition and combined that perception with mathematical skills you have learned. These mathematical skills inform you that something is wrong. You feel confused. Figure 4 does not match with any of your mental models. Specifically, it is a violation of your belief that the total surface area should not change if you change the order of the components in that area. Your confusion ends your automatic mental activities and alerts you to deliberately ponder the problem. The violation is evidence against your belief, and

based on this, you could make various decisions. For example, you may decide to start a search for further evidence. You may decide whether you want to revise your previous belief. Or, you may decide to forget this problem and continue reading.

The example presented in Figure 4 is instructive for at least two reasons. First, it demonstrates how our decisions and mental models can be operated both automatically and deliberately. Second, it introduces the idea that our decisions and mental models can be compared against some standard, which reveals the possible differences between the standard and our thinking. I will discuss these two issues in the next two sections.

2.3 Dual-processing theory of higher cognition – Systems 1 and 2

Scholars of higher cognition—decision making, mental models, thinking, reasoning and social judgment—have created many theories about the dual-processing nature of our cognitive machinery. Although some studies have attempted to combine these theories into a more general level dual-process theory (e.g., Evans 2003), it appears that all of the attributes proposed in various theories cannot be successfully mapped to the two kinds of processing (Evans 2008). However, almost all of these theories agree on a distinction between cognitive processes that are automatic, fast, and unconscious, and those that are deliberative, slow and conscious. Different scholars have given various names for these processes, but recently, System 1 was established as a name for the automatic, fast, and unconscious process, and System 2 was established as a name for the deliberative, slow, and conscious process. (Evans 2008, 256.)

System 1 operates what is normally called intuitive thinking. It functions automatically and quickly, with minimal or no effort and no sense of voluntary control. Some of the capabilities of System 1 include innate skills of perception that we share with other animals, for example, object recognition and orient attention. Other mental processes become automatic through practice, such as reading, making associations (e.g., “What is the capital of France?”), and understanding nuances of social situations. Many of these practiced mental processes are completely involuntary. You cannot refrain from understanding simple sentences in your own language or avoid knowing the answer to $1+1=$. These automatic operations of associative and nondeclarative memory are the core of System 1. Other capabilities of System 1 include mental models that are acquired only by experts via prolonged specialization, for example, identifying strong chess moves. (Kahneman 2011, 19–22.)

System 2 is the one we identify with when we think of ourselves. This reasoning self has beliefs and goals, and it makes conscious decisions. System 2 allo-

cates attention to the effortful mental activities that demand it. The demand comes often from System 1. For example, when you look at the following problem; $17 \times 24 =$, System 1 tells you it is a multiplication problem. However, it does not offer an answer and therefore it alerts System 2. With System 2 you can make a decision between two possibilities: whether or not to solve the problem. If you engage in the computation, a sequence of steps will occur. First, you search your long-term memory for a mental model for multiplication and then implement it. Processing the computation takes effort: you need to hold numbers in working memory and remember the intermediate result. In addition to stressing your mind, the computation also stresses your body: muscles tense up, blood pressure and heart rate rise, and pupils dilate. (Kahneman 2011, 20–21.)

Consequently, we pay a biological price for using System 2. The more we use System 2 during the day, the more difficult each operation becomes. This mental depletion affects our decision making in two ways. The first way affects our judgment by hindering our ability to evaluate possibilities. However, the second way is more radical: we stop making decisions and settle on the status quo. (Vohs, Baumeister, Schmeichel, Twenge, Nelson & Tice 2008.) To protect us from this mental depletion, System 2 usually stays in a low-effort mode. Hence, only a fraction of its capacity is used, and it adopts the suggestions of System 1 with minimal or no modification. As demonstrated in Figure 4 above, System 2 is mobilized when System 1 detects a violation of the mental model it maintains or when a question arises that it cannot answer. This cooperation between Systems 1 and 2 is highly efficient: it minimizes effort and optimizes performance. (Kahneman 2011, 24–25.)

Generally, the cooperation between Systems 1 and 2 works well. When we are awake, both systems are active, and System 1 continuously generates impressions, intuitions, intentions, and feelings for System 2. System 1's models of familiar situations are accurate, its short-term predictions are accurate as well, and its initial reactions to challenges are appropriate. System 2 has some ability to change the way System 1 functions. The first way is to program the normally automatic functions of attention and memory. For example, when waiting for a friend at a busy train station, you can set yourself at will to look for a blond woman and increase the likelihood of detecting your blond haired friend from a distance. The second way is to acquire skills, such as driving a car, through prolonged practice, which are initially processed by System 2 but, over time, become processed by System 1. However, the cooperation between Systems 1 and 2 fails in specified circumstances. (Kahneman 2011, 23.) As an example of such failure, see Figure 5 below:

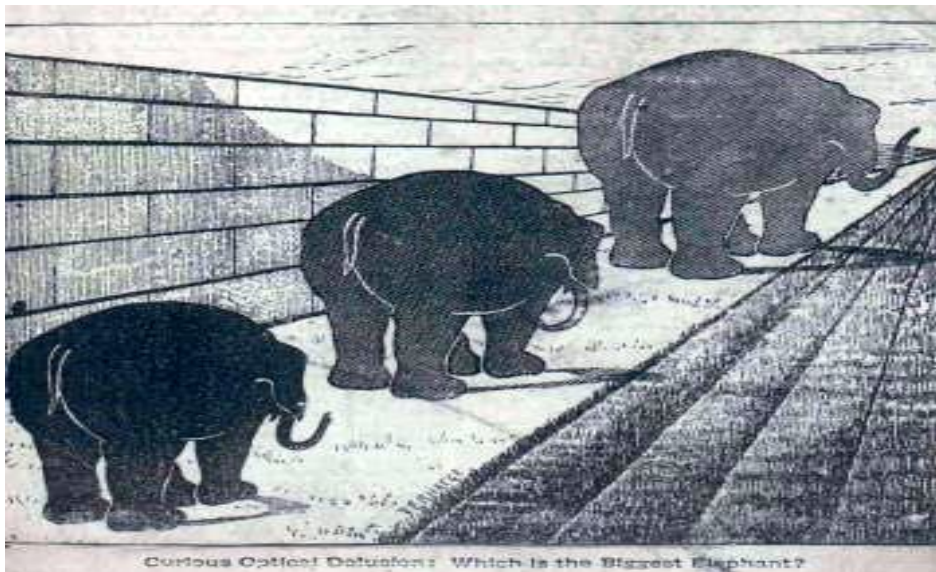


Figure 5 Optical illusion

Figure 5 presents an optical illusion in which the elephant in the top right corner appears to be bigger than the elephant in the bottom left corner. This is the impression that System 1 produces. There is no need for System 2 to interfere: the picture does not offer excessively complicated information to System 1 nor violate any mental model. However, if you have seen this illusion before and measured the elephants with a ruler, your System 2 has a belief that the elephants are identical in size. Although you know that the elephants are equally sized, you still see them differently. System 1 cannot be turned off, and it continues producing this optical illusion. To resist the illusion, you must have learned that it exists. (Kahneman 2011, 26–28.)

2.4 General models in the studies of human cognition

If you did not readily change your belief that the elephants in Figure 5 are different sizes and made a decision to search for more evidence, you probably took a ruler and measured the elephants. In this case, you compared your own mental model against a normative model. Normative models, along with prescriptive and descriptive models, are the three general models used in studies of human cognition (Bell, Raiffa & Tversky 1988).

Descriptive models are theories of how people normally think, for example, how we solve logic problems or how we make decisions. Prescriptive models are simple models that “prescribe” or state how we ought to think. They are designs

or inventions, whose purpose is to bring the results of actual thinking into closer conformity to the normative model. Many of the descriptive and prescriptive models are expressed in the form of heuristics. Normative models are standards that define thinking that is best for achieving the thinker's goals. For decision making, the normative model consists of the policy that will, in the long term, achieve these goals to the greatest extent. Such a model takes into account the probability that a given act (e.g., leaving my umbrella at home) will bring about a certain outcome (e.g., getting wet) and the relative desirability of that outcome according to the decision maker's personal goals. (Baron 2008, 31–33.)

3 HEURISTICS AND BIASES APPROACH

The previous chapter introduced the various components of decision making, mental models, Systems 1 and 2, and the general models that scholars use in the study of thinking. Furthermore, the previous chapter illustrated optical illusions that are systematic errors in perception, which is a stage of lower cognition in our cognitive machinery. Similar to systematic errors in lower cognition, our higher cognition may also contain systematic errors. Consequently, the purpose of this chapter is to introduce such errors in our decision making and mental models and illustrate how these errors are caused by the design of our cognitive machinery, usually a failed cooperation between Systems 1 and 2.

3.1 Heuristics

The word “heuristic” comes from the same ancient Greece root as eureka (Wordinfo 2014), where the verb “heuriskein” means to find (Groner, Groner & Bischof 1983, 1). Its modern explanation was coined by George Polya, who defines the term heuristic as *“reasoning not regarded as final and strict but as provisional and plausible only, whose purpose is to discover the solution of the present problem”* (Polya 1945, 115). The heuristic article in the Oxford dictionary of psychology remarks that the concept can be traced to the work of Herbert Simon, who suggested that human decision makers with bounded rationality use heuristic procedures (Colman 2006, 670). However, unlike Polya, Simon did not use the “heuristic” term; he used the term “satisfice” instead. Simon defined “satisfice” as follows: to *“decide on and pursue a course of action that will satisfy the minimum requirements necessary to achieve a particular goal”* (Oxford Thesaurus of English; Simon 1956; Simon 1997, 118–120). Thus, according to these definitions, heuristics are decision-making strategies deliberately implemented by System 2 (Kahneman 2011, 98).

Later, in the early 1970s, the “heuristic” term was introduced into psychology by Amos Tversky and Daniel Kahneman (Colman 2006, 670). Tversky and Kahneman proposed their own perspective of Simon’s bounded rationality, according to which, decision making was not only simpler than rational models demanded but also categorically different. This categorical difference emerged as three general-purpose heuristics that automatically substitute stages of higher cognition with stages of lower cognition. (Gilovich & Griffin 2002, 2.) Initially,

Tversky and Kahneman did not have the conceptual tools to fully understand these three heuristics. The heuristics seemed to capture some of the mind's automatic data processing operations, which often appeared to be useful but were also capable of generating systematic errors. Tversky and Kahneman had difficulty separating the errors from the heuristics that produced them: the errors enabled them to offer at least a partial description of the heuristics. (Lewis 2016, 188; 193.)

Since these initial studies, the idea of looking for errors in higher cognition and explaining them by using heuristics came to be known as the heuristics and biases approach (Baron 2008, 54). The heuristics and biases approach distinguished between two agendas, which present our cognitive machinery in a positive and negative light. The positive agenda demonstrated the three heuristics (i.e., representativeness, availability, and anchoring and adjustment) Tversky and Kahneman had found. Although they used the term "heuristic," their concept did not have the aspect of deliberate System 2-type decision making that was present in the earlier definitions of "heuristic." In contrast, their "heuristic" concept described the automatic operations of System 1. The negative agenda associated each heuristic with a set of biases: departures from the normative rational theory that served as the markers of the underlying heuristics. (Gilovich & Griffin 2002, 3.)

Differences between the heuristics and biases approach, bounded rationality and, the classical model of rational choice can be compared using the components of decision making that were introduced in Section 2.1. The classical model of rational choice asserts that an individual always knows all the possibilities, which are "given" to him. He also has all the goals, which will guide him to create a perfect utility-ordering for all the possibilities. In addition, he has evidence that helps him see the future consequences attached to each possibility. (March & Simon 1993, 519; note that they use different terminology.) Simon's bounded rationality asserts that the search for possibilities, goals, and evidence and the ability to make inferences are limited by our cognitive capacity. The heuristics and biases approach agrees that the search for possibilities, evidence, and goals and the ability to make inferences are limited by our cognitive capacity, but the approach is more concerned about *how* they are limited. Consequently, representativeness, availability, and anchoring and adjustment are theories that demonstrate how memory and pattern recognition automatically substitute our deliberate search in decision making and mental models. I will introduce the theories of these three heuristics next.

3.1.1 *Representativeness*

According to the representativeness heuristic, “*the subjective probability of an event, or a sample, is determined by the degree to which it first is similar in essential characteristics to its parent population; and second reflects the salient features of the process by which it is generated*” (Kahneman & Tversky 1972, 431). Subjective probability is a numerical measure of the personal strength of a belief in a certain proposition (Baron 2008, 103). Success in a new job, the outcome of an election, or sports betting odds are examples of subjective probabilities. Kahneman and Tversky (1972) argued that people form subjective probabilities by using automatic pattern recognition to compare a proposition to some mental model in their minds. For example, how closely does Donald Trump resemble my mental model of the president of the United States of America, or does Usain Bolt match my mental model of the next gold medal winner of the 100m race at the Olympics? People have some idea of a parent population—the U.S. presidents and gold medal winners—and they compare the specific case to the parent population (Lewis 2016, 183).

Kahneman and Tversky’s (1972) thesis was that in many situations, an event A is judged to be more probable than an event B whenever A appears more representative than B. This automatic mechanism of the mind is often useful, but it can also produce systematic errors. For example, the representativeness heuristic works well when you judge whether people with a PhD are more likely to subscribe to *The New York Times* than people who ended their education after high school. However, the representativeness heuristic misleads when you judge whether a person reading *The New York Times* on the New York subway is more likely to have a PhD or does not have a college degree because there are many more nongraduates than PhDs on the New York subway (Kahneman 2011, 151.) In other words, people tend to assign too much weight to the visible evidence (e.g., a person reading *The New York Times*) and too little weight to the invisible, pre-known evidence (e.g., there are many more nongraduates than PhDs) when forming their beliefs.

3.1.2 *Availability*

According to the availability heuristic, “*a person evaluates the frequency of classes or the probability of events by availability, i.e. by the ease with which relevant instances come to mind*” (Tversky & Kahneman 1973, 207). Vivid, recent, or common facts and incidents are more retrievable from memory than dull, distant, or rare facts and incidents. Consequently, the former type of evidence tends to be over-weighted, and the latter type of evidence underweighted, because the

availability heuristic piggybacks on highly efficient memory retrieval processes when people are forming their beliefs (Gilovich & Griffin 2002, 3). For example, a judicial error that happened to you will weaken your faith in the legal system more than a similar error you read about in a newspaper (Kahneman 2011, 130).

The availability heuristic seems to involve both Systems 1 and 2: the ease with which instances come to mind is dependent on System 1, but this is replaced by a focus on content when System 2 is engaged. This activation of Systems 1 and 2 depends on conditions. Conditions such as engaging in another effortful task at the same time or a feeling of being powerful will predispose the ease of retrieval. (Kahneman 2011, 134–135.) The availability heuristic produces errors in which memory retrieval is a biased cue to the actual frequency, because people tend to seek out and remember the dramatic cases, or because of the broader world's tendency to call attention to examples of a particular type (Gilovich & Griffin 2002, 2).

3.1.3 *Anchoring and adjustment*

In a heuristic called anchoring and adjustment, people estimate their judgments by adjusting some initial value. This adjustment is typically insufficient and thus different initial values yield different estimates (Tversky & Kahneman 1974, 1128). Tversky and Kahneman did not fully agree on the exact mechanism behind this heuristic. Tversky supported the idea that the anchoring and adjustment heuristic is a deliberate strategy for estimating uncertain quantities (Lewis 2016, 192.) Later studies found evidence that supports Tversky's view about a deliberate strategy: people first assess whether the initial value is too high or low and then adjust their estimate incrementally but end prematurely when they have doubts whether they should continue the adjustment or not (LeBoeuf & Shafir 2006; Epley & Gilovich 2006; Epley & Gilovich 2001). Thus, according to this theory, System 2 operates the anchoring and adjustment heuristic.

Kahneman supported the idea that anchoring is based on what he called suggestion: the automatic association created by the anchor (Kahneman 2011, 122). This phenomenon came to be known as a priming effect in later studies that demonstrated how the anchor evokes a certain mental model from memory, and this mental model disturbs later information (Mussweiler & Strack 2000; Jacobowitz & Kahneman 1995). For example, the anchor question, "*Is the average price of German cars more or less than 80000€,*" evokes mental images of Mercedes and Porches, and the anchor question, "*Is the average price of German cars more or less than 30000€,*" associates to Volkswagens. Therefore, the question that activates a certain mental model biases the answers. (Kahneman & Klein 2009, 521–522.) According to this theory, System 1 operates the anchoring

and adjustment heuristic. In summary, the anchoring and adjustment heuristic is not a unitary phenomenon but the product of both Systems 1 and 2 (Epley & Gilovich 2006, 317).

3.2 Cognitive biases

The negative agenda of the heuristics and biases approach was to create theories that specify the conditions under which heuristics depart from normative models. According to the heuristics and biases approach, the gap between descriptive and normative models indicates that human cognition is characterized by systematic irrationalities, also known as cognitive biases (Bell et al. 1988). Using the terms related to components of decision making (see Section 2.1), a cognitive bias can be defined as a systematic error in our decision making that hinders our ability to reach our goals (Baron 2008, 61). In their various comparisons of descriptive and normative models, Kahneman and Tversky concluded that people often fail to anticipate regression to the mean, fail to give sufficient weight to the sample size in assessing the importance of evidence, and fail to take full advantage of base rates when making predictions. Their three heuristics offered an explanation of when and why such cognitive biases occur. Thus, the positive and negative agendas blend together; the identification of particular biases is important, but it also illuminates the underlying processes of judgment. (Gilovich & Griffin 2002, 4.)

The detection of cognitive biases with descriptive and normative models can be illustrated with the following problem: “*All families with six children in a city were surveyed. In 72 families the exact order of births of boys (B) and girls (G) was GBGBBG. What is your estimate of the number of families surveyed in which the exact order of births was BGBBBB?*” (Kahneman & Tversky 1972, 432–433). Many people answer less than 72, even if they believe that boys and girls are equally likely to be born. They compare the second sequence, which contains only one girl, to typical sequences created by their mental models. Here, this heuristic comparison of “how similar is this sequence to a typical sequence?” is the descriptive model of people’s probability judgment. Because the sequence GBGBBG appears to represent the outcome of a random process better than BGBBBB, the former is judged to be more likely. However, that heuristic leads to bias because the type of similarity that people’s mental models create is irrelevant in this case. In fact, if people believe that boys and girls are equally likely, their best guess should be exactly 72 because the two sequences are equally likely. Using a theory of probability, it can be proved that the rule “all sequences of equally likely events are equally likely to occur” always works. Consequently, the theory of probability is the normative model in this example. (Baron 2008, 31–33.) Similar discrepancies between descriptive and normative models, which

limit our ability to reach our own goals, are known in various forms. I will introduce an array of these cognitive biases next.

3.2.1 *Base rate fallacy*

The base rate fallacy is a cognitive bias created by the representativeness heuristic. The representativeness heuristic (i.e., the estimate of how probable it is that an object is similar to its parent population) produces errors when people ignore other relevant attributes than the similarity. Arguably, in the clearest example of such errors (Kahneman & Tversky 1973), the researchers asked the first group of subjects to estimate the proportion of students in nine fields: business administration, computer science, engineering, humanities and education, law, library science, medicine, physical and life sciences, and social sciences. These estimates are called base rates. The highest base rates in the experiment were humanities and education (20%) and social sciences (17%). The lowest base rates in the experiment were library science (3%) and computer science (7%). This means that if people needed to estimate the field of a random student, their best guess would be humanities and education, whereas library science would be the worst guess.

The second group of subjects was asked to read the following personality sketch and rank the fields from 1 to 9 based on how similar the description is to the typical student in that field: *“Tom W. is of high intelligence, although lacking in true creativity. He has a need for order and clarity, and for neat and tidy systems in which every detail finds its appropriate place. His writing is rather dull and mechanical, occasionally enlivened by somewhat corny puns and by flashes of imagination of the sci-fi type. He has a strong drive for competence. He seems to have little feel and little sympathy for other people and does not enjoy interacting with others. Self-centered, he nonetheless has a deep moral sense.”* (Kahneman & Tversky 1973, 238.) Computer science and engineering received the highest ranks, whereas humanities and education and social sciences received the lowest ranks. This did not surprise the researchers since the sketch was written to fit the stereotypes of computer science and engineering.

The third group of subjects was asked to read the sketch and rank the fields based on the probabilities of Tom W. being a student in each of the fields. The result was that the rankings were almost identical with the second, similarity group, and the probabilities were not related to the base rates. Consequently, instead of basing their beliefs on base rates, people judge probabilities based on their beliefs about the similarity between the new information and their existing mental model (Kahneman & Tversky 1973.) However, later studies demonstrated that instructions to activate System 2-type thinking manage to reduce the base

rate fallacy (Schwarz, Strack, Hilton & Naderer 1991; Alter, Oppenheimer, Epley & Eyre 2007).

3.2.2 *Conjunction fallacy*

The conjunction fallacy is another widely recognized cognitive bias created by the representativeness heuristic. The conjunction fallacy was found in a similar personality sketch experiment to the base rate fallacy: “*Linda is 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 anti-nuclear demonstrations.*” After reading this sketch, the subjects were asked to rank the following scenarios by their probabilities:

“Linda is a teacher in elementary school.

Linda works in a bookstore and takes Yoga classes.

Linda is active in the feminist movement.

Linda is a psychiatric social worker.

Linda is a member of the League of Women Voters.

Linda is a bank teller.

Linda is an insurance salesperson.

Linda is a bank teller and is active in the feminist movement.” (Tversky & Kahneman 1983, 297.)

The surprising result of this experiment was that the probability of Linda being a bank teller and active in the feminist movement was ranked higher than the probability of Linda being just a bank teller. This result violates the normative model of logic since the conjunction of two events (i.e., bank tellers who are active in the feminist movement) cannot be more probable than one of the events (i.e., bank tellers). The conjunction fallacy remained persistent even when, after reading the sketch, the subjects were only asked “*Which alternative is more probable? Linda is a bank teller/Linda is a bank teller and is active in the feminist movement.*” (Tversky & Kahneman 1983, 299.)

Finally, after several experiments, a condition that reduced the effects of the conjunction fallacy was found. Two groups of subjects were shown two different formulations of the same estimation problem. The first formulation of the problem was, “*A health survey was conducted in a sample of adult males in British Columbia, of all ages and occupations. Please give your best estimate of the following values:*

What percentage of the men surveyed have had one or more heart attacks?

What percentage of the men surveyed both are over 55 years old and have had one or more heart attacks?” In this formulation, 65% of the answers demonstrated the conjunction fallacy. However, when the text was slightly modified to the

following, only 25% of the answers demonstrated the conjunction fallacy: “*A health survey was conducted in a sample of 100 adult males in British Columbia, of all ages and occupations. Please give your best estimate of the following values:*

How many of the 100 participants have had one or more heart attacks?

How many of the 100 participants both are over 55 years old and have had one or more heart attacks?”

The reason for this significant decrease in the effects of the conjunction fallacy appears to be that concrete classes (how many of the 100 participants) evoke different mental models in which different relations and rules are more transparent than in abstract classes (what percentage). (Tversky & Kahneman 1983, 308–309.) Later studies demonstrated that this kind of concrete and spatial image in the mind helps people comprehend that one class is completely included in the other (Hertwig, Benz & Strauss 2008; Hertwig & Gigerenzer 1999; Mellers, Hertwig & Kahneman 2001). Furthermore, the conjunction fallacy can be reduced by formal instructions (Agnoli & Krantz 1989).

3.2.3 *Gambler’s fallacy*

The gambler’s fallacy, sometimes known as the law of averages, is a third well known cognitive bias created by the representativeness heuristic (Baron 2008, 151). The latter part of the representativeness heuristic’s definition—*the subjective probability of an event, or a sample, is determined by the degree to which it reflects the salient features of the process by which it is generated*—is apparent in such random sequences that appear to be different from the salient features of the process by which they are generated. For example, nine blacks in consecutive spins of a roulette wheel may lead players to think that the next spin is more likely to be red than black because people expect the occurred sample to be representative of a typical random sequence in which blacks and reds are more evenly distributed. (Tversky & Kahneman 1974, 1125.)

The gambler’s fallacy also works in the opposite direction. This reversed form was found in the study, in which the scholars demonstrated how the widely held belief among basketball fans—that after few consecutive successful scoring attempts, basketball players get into the zone in which they are less likely to miss a shot—is only a misperception of random sequences. (Gilovich, Vallone & Tversky 1985.) A few successes are enough to be seen as representations of causalities in randomness because the outcomes do not appear as random events. These different sides of the gambler’s fallacy indicate that people constantly simplify the world around them by creating false causalities in their mental models. (Burns & Corpus 2004; Sundali & Croson 2006.)

3.2.4 *Hindsight bias*

The hindsight bias is a cognitive bias that can be primarily attributed to the availability heuristic (Baron 2008, 53). The hindsight bias was identified by Fischhoff and Beyth (1975), who asked subjects to estimate the probabilities for various possible outcomes of President Nixon's surprising visits to Peking and Moscow in 1972. The possible outcomes included statements such as, "*The U.S.A. will establish a permanent diplomatic mission in Peking, but not grant diplomatic recognition. President Nixon will meet Mao at least once. The U.S.A. and the USSR will agree to a joint space program.*" (Fischhoff & Beyth 1975, 7–8.) After Nixon's trips, Fischhoff and Beyth asked the same subjects to recall the probabilities they had estimated for each possible outcome. The results demonstrated how the subjects significantly overestimated the probabilities of events that had actually occurred. Furthermore, the subjects underestimated the probabilities of events that had not occurred. At the time of this writing, in March of 2018, global politics has created an equally interesting research setting in which the US President, Donald Trump, and the supreme leader of North Korea, Kim-Jong-un, have agreed to meet each other. It is an instructive demonstration of hindsight bias to contemplate the possible outcomes of this meeting and compare them to the actual outcomes.

Later hindsight bias studies demonstrated that people appear to have significant difficulty reconstructing past beliefs and understandings that have changed in their mental models (Marks & Arkes 2010; Roese & Vohs 2012). This difficulty leads to the tendency in which people revise their past beliefs in light of what actually happened. For example, before a soccer match, you estimate that both teams have about an equal probability to win the match. After the game, you know the result: the home team won by a landslide. After the game, the home team is much stronger than the away team in your revised mental model, and your view of both the past and the future has been altered by that new perception. The hindsight bias leads to situations in which the quality of a decision is assessed by the positive or negative outcome rather than the quality of the thinking process. (Kahneman 2011, 201.)

3.2.5 *Narrative fallacy*

The narrative fallacy is another cognitive bias that can be primarily attributed to the availability heuristic. The narrative fallacy is our propensity to construct explanations, stories, and theories that prevent us from seeing the raw facts. In other words, the biased stories of the past shape our expectations. For example, read the text in Figure 6

A BIRD IN THE
THE HAND IS WORTH
TWO IN THE BUSH

Figure 6 An example of the narrative fallacy (Taleb 2010, 66)

Did you see something unusual in the text? If not, then read it again. The propensity to construct explanations, stories, and theories belongs to the domain of System 1; it occurs automatically and with no sense of voluntary control. It is impossible to see something without any interpretation. You need the effortful mental activities of System 2 to suppress the possible explanations. Thus, not explaining is an act similar to any other willed activity. In Figure 6, the extra word “the” is easy to overlook because our propensity for imposing meaning blocks our awareness of the details. The other side of this propensity is that it is easier to remember information as narratives than as non-narratives. For example, the statement, “*The king died, and the queen died,*” is more difficult to remember than the statement, “*The king died, and then the queen died of grief.*” Although the latter sentence contains more information than the former, its narrative form makes it easier to retrieve from memory. (Taleb 2010, 70.)

The hindsight bias plays a major part in the narrative fallacy: it is easier to remember facts from the past that fit our narratives than facts that do not appear to play a causal role in our narratives. As we maintain our mental models through which we make sense of the world, we constantly change the stories of past events to fit the new information. (Taleb 2010, 71.) Finally, the constantly changing stories in our mental models end up as concrete rather than abstract, assign a larger role to talent, stupidity, and intentions than to luck, and focus on the most memorable moments rather than on the countless events that failed to happen (Kahneman 2011, 199).

3.2.6 *Anchoring bias*

The anchoring and adjustment heuristic produces an anchoring bias. The anchoring bias is the human propensity to rely too heavily on the first piece of information offered. This reliance on the first piece of information offered (i.e., an anchor) is problematic since the research has demonstrated that random anchors are as effective as informative anchors (Tversky & Kahneman 1974, 1128). Random anchors remain effective even when they influence experienced profession-

als. In their experiment, Englich, Mussweiler, and Strack (2006) demonstrated how random anchors influence the sentencing decisions of legal judges. Judges anchored their sentencing decisions on a given sentencing demand and assimilated toward it even if they randomly determined this demand themselves by throwing a pair of loaded dice. Judges who were exposed to the high anchor gave the average sentence of 8 months, which was higher than the average sentence of 5 months given by judges who were exposed to the low anchor (Englich et al. 2006, 194). This result is in line with previous studies that demonstrate the anchoring bias in legal decisions (Chapman & Bornstein 1996; Hastie, Schkade & Payne 1999; Englich & Mussweiler 2001).

3.2.7 Confirmation bias

The confirmation bias is defined as “*the seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand*” (Nickerson 1998, 175). It was initially introduced by Wason (1960), who asked subjects to guess the rule that generated the following three-number sequence: 2, 4, 6. Subjects were instructed to suggest additional three-number sequences, to which the experimenter answered yes or no depending on whether the suggested rule was consistent with the rule to be discovered. Subjects’ first hypothesis was usually “successive even numbers,” and they tested this by generating additional sets of successive even numbers. The same trend continued with other hypotheses: the subjects attempted to confirm their rules rather than refute them. For this reason, only a few subjects were able to discover the correct rule, which was “numbers in ascending order.” (Wason 1960, 130; 138–139.)

This bias towards seeking confirmation later became arguably the most widely known and accepted among the cognitive biases (Evans 1989, 41). Nickerson’s (1998) review of the confirmation bias studies demonstrated that the confirmation bias has been recognized in such real-world contexts as policy-making, medicine, judicial proceedings, and science. However, the question of the extent to which the confirmation bias can be modified by education and training remains understudied (Nickerson 1998, 211).

3.2.8 Sunk-cost fallacy

The sunk-cost fallacy is the decision to continue an endeavor, in which an investment has been made, although another endeavor with better consequences is available (Kahneman 2011, 345). Once you have determined that the best course of action for the future is to change plans, the time, effort, and money you have

spent in the past do not matter at all. Sticking to an inadequate plan will not make your earlier decision the right one. This position subverts one's own goals and, therefore, is biased. (Baron 2008, 305–307.) The sunk-cost fallacy was first demonstrated experimentally by Arkes and Blumer (1985), who asked subjects to answer the following question:

“Assume that you have spent \$100 on a ticket for a weekend ski trip to Michigan. Several weeks later you buy a \$50 ticket for a weekend ski trip to Wisconsin. You think you will enjoy the Wisconsin ski trip more than the Michigan ski trip. As you are putting your just-purchased Wisconsin ski trip ticket in your wallet, you notice that the Michigan ski trip and the Wisconsin ski trip are for the same weekend! It's too late to sell either ticket, and you cannot return either one. You must use one ticket and not the other. Which ski trip will you go on? \$100 ski trip to Michigan or \$50 ski trip to Wisconsin?” (Arkes & Blumer 1985, 126.)

Only 46% of the subjects chose the Wisconsin trip (Arkes & Blumer 1985, 127). Later studies suggest that different mental models cause the sunk-cost fallacy. In this example, people think the two trips as separate events, which makes them feel that they would waste less money by taking the more expensive trip. However, if they had integrated the two mental models, they would feel that they have spent \$150, and the choice was between the more enjoyable and less enjoyable trip (Baron 2008, 305.)

3.2.9 *Framing*

The framing effect is a cognitive bias in which logically equal statements evoke different reactions depending on how the statements are presented. It was initially introduced in the *Science* article by Tversky and Kahneman (1981). In the article, the authors demonstrate the results of the following experiment:

“Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved.

Which of the two programs would you favor?”

The majority (72%) of 152 respondents chose Program A. The second group of respondents received the same story with a different formulation of the alternative programs:

“If Program A is adopted, 400 people will die.

If Program B is adopted, there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.

Which of the two programs would you favor?"

In this alternative formulation a majority, 78% of 155 respondents chose Program B. (Tversky & Kahneman 1981, 453.) Since these initial experiments were conducted, framing has become a widely accepted and ubiquitous concept both in social sciences generally and, more specifically, in management and organizational research (see Cornelissen & Werner 2014 for a review). Research on the framing effect demonstrates how totally irrelevant features of the situation can control decisions due to the way in which System 1 creates different associations for different frames of the same situation. The phrase, "200 people will be saved," evokes more positive feelings than "400 people will die." A solution for mitigating the framing effect would be using System 2 to reframe the situation. However, reframing requires mental energy, and hence, most of us passively accept decision problems as they are framed. (Kahneman 2011, 363–367.)

3.2.10 Overconfidence and underconfidence

The overconfidence effect is a cognitive bias in which people place too much trust in their own beliefs, usually regarding probability estimations. Originally, the effect was identified by Adams and Adams (1960), who asked subjects to estimate some probability and then indicate their level of confidence in the estimation. When subjects thought they were 100% certain, they were actually correct only 80% of the time. Furthermore, when subjects thought they were 80% certain, they were actually correct only 55% of the time. However, when the actual probabilities were between 0% and 20%, subjects underestimated their confidence. Since the initial studies, this overconfidence/underconfidence effect has been replicated in numerous studies (see the review from Lichtenstein, Fischhoff & Phillips 1982) and is illustrated in Figure 7.

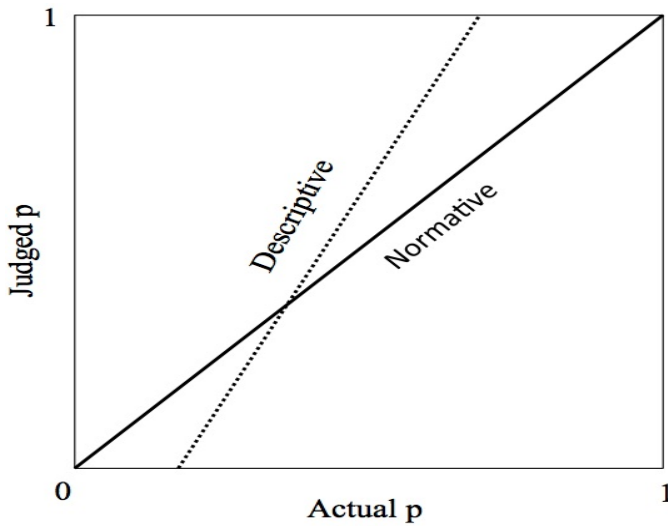


Figure 7 Overconfidence/underconfidence -effect

Figure 7 demonstrates how people underestimate the accuracy of their estimations (descriptive, dotted line) when the actual probability of the outcome is low. In a normative model, the accuracy of the estimations is equal to the actual probabilities (normative, straight line). Hence, the descriptive line is below the normative line, indicating underconfidence, when people see no chance for an outcome that has a small chance to materialize. However, when the actual probability is higher, people are too confident about the outcome. Hence, the descriptive line is above the normative line, indicating overconfidence, when people perceive too big chance for an outcome that has a good chance to materialize. In summary, studies demonstrate how people's confidence is biased towards the two extremes (Lichtenstein et al. 1982).

According to Kahneman (2011, 84–87), the reason people's confidence is biased towards the two extremes can be found in the operations of System 1. System 1 is unaffected by both the quality and the quantity of the evidence. The confidence that people have in their beliefs is correlated on the quality of the story they can tell about what they see. System 1 fails in accounting for the possibility that critical evidence is missing. Consequently, people naturally tell a story about why something is either true or untrue but fail to properly weigh the probabilities between these two extremes.

3.3 Interfaces of the heuristics and biases approach

The heuristics and biases approach has influenced many disciplines outside cognitive psychology, including economics, medical diagnosis, legal judgment, in-

telligence analysis, finance, and statistics (Kahneman 2011, 8). These interfaces with other disciplines demonstrate effects that heuristics and biases have on the world outside of our cognitive machinery. By observing these effects, we can also discuss heuristics and biases in other objects than individual human beings. For example, we can observe the effect of an overconfident architect as errors in the building she has designed. Similar to the physical world, we can observe the effects of heuristics and biases on non-physical objects, such as policies, the stock market, and the sports-betting market. For example, the favorite-longshot bias is a well-known cognitive bias that affects the horse race market (Sobel & Raines 2003; Williams & Paton 1997). Furthermore, we can observe how these physical and non-physical objects, which are affected by heuristics and biases, affect our mental models. The effects between heuristics and biases in our mental models and heuristics and biases in cultural and physical objects are illustrated in Figure 8.

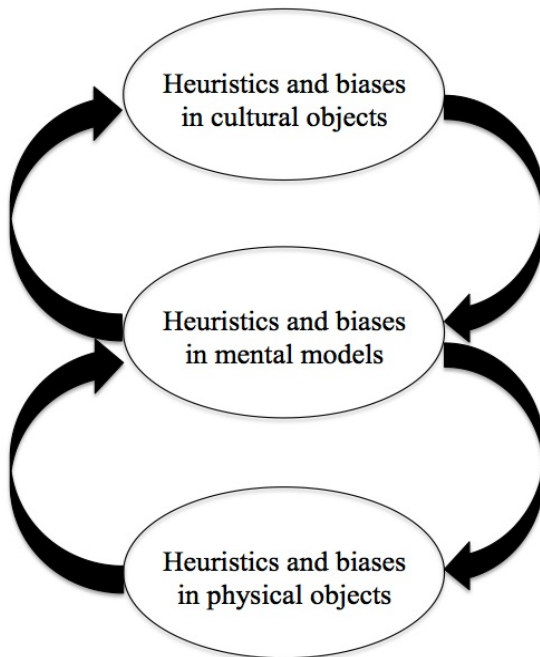


Figure 8 Effects of heuristics and biases

Several studies have investigated how heuristics and biases affect cultural objects, such as media and public policies, and how these objects, in turn, affect our mental models. Fischhoff, Slovic, and Lichtenstein (1977) found that people overestimate the likelihood of causes of death that are well-publicized in media and underestimate less newsworthy causes. Their examples included the overestimation of accidents, homicide, and childbirth versus the underestimation of

strokes, suicide, and appendicitis, respectively (Fischhoff et al. 1977, 562–563). In their more comprehensive follow-up study, Lichtenstein, Slovic, Fischhoff, Layman, and Combs (1978, 570) demonstrated how newspapers present a biased view of reality. Together, these studies demonstrated a cycle effect in which individuals' estimates of causes of death are biased by the media, but the media itself is also shaped by public interest, which guides editors to present more extensive coverage of interesting viewpoints. Furthermore, editors and reporters are subject to the same biases as the public (Stocking & Cross 1989), which amplifies the cognitive biases that take our mental models farther from being accurate copies of reality.

This bias-amplifying cycle between our mental models and cultural objects has also been found in public policy studies. Kuran and Sunstein (1999) coined the term “availability cascade,” which depicts a chain of events that begins with media reports of a minor event and results in public panic and large-scale government intervention. In availability cascades, a story about risks catches the public's attention and creates anxiety and worry. These negative feelings become a story in media, which produces even more public concern. Hence, in availability cascades, identifiable social mechanisms interact with individuals' availability heuristics, which generate widespread mistaken beliefs that may last indefinitely and produce wasteful and detrimental laws and policies. (Kuran & Sunstein 1999.) In the Finnish context, the case of the Talvivaara mine could offer an interesting research setting for further availability cascade studies.

Although heuristics and biases in cultural objects may exist indefinitely, the effects of heuristics and biases in physical objects likely have a shorter life expectancy. In the physical world, we understand our limitations and build objects around them, such as steps, elevators, and bridges. When these objects fail, and if these failures are partly caused by cognitive biases, we can detect the biases in our mental models reasonably easily. However, when we design cultural objects such as health care, retirement plans, and the stock market, we do not easily receive such feedback that demonstrates biases in our mental models. In other words, whereas feedback mechanisms from cultural objects appear to trigger our System 1, feedback mechanisms from physical objects appear to trigger our System 2.

In the management and organization context, few studies have investigated how heuristics and biases affect cultural and physical objects and how these objects, in turn, affect our mental models. Roberto (2002) presented a conceptual analysis in which he demonstrates how three heuristics and biases (i.e., availability, overconfidence, and sunk-cost fallacy), combined with failures of physical objects and problems in the team culture, contributed to a climbing disaster on Mount Everest. Staw (1997) expanded his original individual-level studies (Staw 1976; 1981) on the escalation of commitment, also known as a sunk-cost fallacy,

to social, organizational, and contextual levels. Social determinants of the sunk-cost fallacy include the need to justify one's actions to others, save face, and protect others. Organizational determinants include institutional inertia that prevents changes to such cultural objects as long-standing policies, rules, and procedures. Additional organizational determinants of the sunk-cost fallacy include organizational politics problems in which those directly employed by a project are likely to resist its dismantling. Contextual determinants, which are forces larger than the organization itself, include situations in which governmental and political bodies held organizations to a losing course of action. (Staw 1997, 202–205.)

Furthermore, in the management and organization context, the hindsight bias creates a malicious loop between individuals' mental models and organizational determinants used to evaluate the quality of decisions (Tetlock 1985). In the organizational context, individual decision makers take roles (e.g., CEOs, financial advisers, or medical doctors) in which they act as agents for other people's decisions. The hindsight bias makes a proper evaluation of these agents' decisions extremely difficult because it leads evaluators to assess the quality of decisions by whether the outcome of a decision was good or bad rather than whether the decision-making process was valid. (Kahneman 2011, 203.) Let us assume I am an odds compiler whose validated track record is 2000 bets with 5% ROI on a constantly moving bank. When I suggest that you invest money on one bet, your evaluation of my skills are more positive than reality if the bet happens to win and more negative than reality if the bet happens to lose. This outcome and the feeling it creates function as such substantial stimuli for System 1 that System 2 cannot properly consider the statistically significant track record (Baron & Hershey 1988). For this reason, agents whose decisions are evaluated with hindsight are prone to develop cultural objects that make their decision-making processes more explicit. For example, when malpractice litigation became more common in the US, medical doctors began to order more tests, referred more cases to specialists, and applied conventional treatments even when they were unlikely to help. These procedures protected the doctors more than they helped the patients, which created potential conflicts of interest. (Kahneman 2011, 204.)

4 ORGANIZATIONAL DECISION MAKING

The previous chapter introduced various heuristics and biases and discussed their relationships with social and market forces, which emerge from interactions between our mental models and cultural objects. Although heuristics and biases research has a long pedigree, these interactions between heuristics and biases and cultural objects have arguably remained mostly overlooked in the organizational context. Consequently, the purpose of this chapter is to broaden the perspective and discuss issues that the organizational context brings to decision-making studies in general. In the words of Rousseau (2011), *“We can never surpass psychologists at understanding individual mental processes nor hold advantage over sociologists in accounting for social forces or economists in explicating large-scale market forces. But no field but ours has the multilevel acumen to interpret well organizational phenomena, their internal and external relationships, and the behavior and experience of people therein.”* (Rousseau 2011, 432.)

Organizational decision making can be considered from various perspectives. Many of these perspectives relate to special characteristics that separate organizational decision-making studies from studies of behavioral decision making without any particular context (Shapira 1997, 4). Organizational decision-making studies and behavioral decision-making studies can both be tracked in the same sources, namely the pioneering work by Simon (1947) and the Carnegie School’s subsequent work (March & Simon 1958; Cyert & March 1963). Arguably, the most likely reason for the shared roots is that Simon treated individual and organizational decision making similarly. Simon proposed ideas that are general for all types of decision making, but he did not clarify a distinction between individual and organizational decision making (March 1978, 859). Hence, to discuss the various perspectives that separate organizational decision making from decision making in other contexts, I will first consider the basic components of the term “organizational.”

4.1 Components of the term “organizational”

Poole and Van de Ven (1989) provide a useful framework for understanding the basic dimensions that are captured in the term “organizational.” In their framework for organizational analysis, they propose that the basic organizational di-

mensions are deterministic structural forms and voluntaristic action generation at individual and collective levels. This framework is illustrated in Table 1.

Table 1 The basic dimensions for organizational analysis (Poole & Van de Ven 1989, 570)

	Structural forms	Action generation
Collective level	Industry structure	Industry action
	Organization design	Board of directors committee
	Division/Department	Task force management committee
Individual level	Roles and positions	Individual

Action generation and structural forms are related to the methodological individualism-holism debate in the social sciences. This debate seeks answers to the question, “*To what extent may, and should, social scientific explanations focus on individuals and social phenomena respectively?*” (Zahle & Collin 2014, 2). Researchers widely concur that methodological individualism means that social phenomena must be explained by showing how they result from individual actions. Hence, this interpretation means that actions generate structures and processes. Conversely, methodological holism means that structures and processes precede individual actions, and thus, the structural forms cannot be reduced to individual actions (Heath 2014). The same idea is presented in Duesenberry’s epigram that, according to March (1997, 9), has become a part of organizational studies’ folklore: economics (and, by analogy, psychology) focuses on how people make decisions, while sociology (and, by analogy, anthropology and political science) focuses on how they do not have any decisions to make (Duesenberry 1960, 233).

The other dimension in Poole and Van de Ven’s (1989) framework suggests that the term “organizational” can refer to both individual and collective levels. On an individual level, the term can refer to a person’s actions in the organizational context. Such actions could be, for example, a manager’s decisions. (Shapira 1997, 4.) However, the term “organizational” can also refer to roles, positions, or professions in which the structural form manifests on an individual level. In addition to these meanings on the individual level, the term “organizational” can refer to various groups in the organization or to the whole organization. Similar to the individual level, these collective levels can be divided into action generation and structural forms. Action generation at the group level means, for example, interaction patterns and the creation of collective norms, which both influence and are influenced by structural forms, such as the structural division and resources among subunits. The same intertwined dynamic is present at the organizational level when, for example, the strategic decisions of the directors’ executive committee both influence and are influenced by the organization’s structure. (Poole & Van de Ven 1989, 570.)

Instead of subscribing to any fixed position in their framework, Poole and Van de Ven (1989) propose that the dynamics between action–structure and individual–collective co-exist in organizations. Other organizational scholars have also proposed frameworks in which action generation and structural forms are seen as dynamic organizational forces (Crossan, Lane & White 1999; Powell et al. 2011), and some studies have clarified the dynamics between individual and collective levels in organizations (Aguinis, Boyd, Pierce & Short 2011; Crossan et al. 1999; Griffin 2007; Hitt, Beamish, Jackson & Mathieu 2007). Consequently, the term “organizational” and, more broadly, organizational studies, are ambiguously balanced between action–structure and individual–collective.

One ramification of organizational studies’ action–structure and individual–collective dynamics is that these dynamics are reflected in the general themes that separate organizational decision making from decision making in other contexts. While journal articles have concentrated on detailed organizational decision-making problems, a few books have aimed to categorize the detailed issues into overarching themes of organizational decision making. March’s *A Primer on Decision Making: How Decisions Happen* (1994) lists four themes that shape organizational decision making: choice-based versus rule-based decisions; clarity versus ambiguity; instrumental versus interpretative decisions, and autonomous actors versus systemic properties. Shapira’s *Organizational Decision Making* (1997) presents five themes: ambiguity, longitudinal context, incentives, repetition, and conflict. Hodgkinson and Starbuck’s *The Oxford Handbook of Organizational Decision Making* (2008) proposes six persistent themes: rationality, the heuristics and biases approach, mental models, fast and frugal heuristics, politics, and interpretation. In addition to these six established themes, Hodgkinson and Starbuck (2008) propose three nascent themes: the naturalistic decision making approach, intuition, and emotions. When combined, these themes depict a comprehensive view of organizational decision making. However, as Baur (2013, 565) notes, this great diversity of themes makes it difficult to form a clear overall picture. Consequently, I will do two things that aim to improve the clarity of this chapter.

First, I remove themes from the discussion that can be categorized to the individual–action category in the framework presented in Table 1. This will leave out the following themes: rationality, the heuristics and biases approach, fast and frugal heuristics, the naturalistic decision making approach, intuition, and emotions. By removing these themes from this chapter, I do not intend to imply that they are somehow unimportant for organizational decision making. In contrast, these themes form foundational theories or premises for other organizational decision-making studies. Hence, I will return to these themes later in this study and devote Essay 1 to this discussion. Meanwhile, in this chapter, I will only discuss

themes that do not exist in studies of individual decision making but exist in organizational decision-making studies.

Second, I aim to organize and discuss the remaining themes based on the dual-processing theory of higher cognition. According to March (1994), organizational decision making can be categorized as choice-based and instrumental on the other hand and rule-based and interpretive on the other. In choice-based and instrumental forms, organizational decision making is implicitly understood mostly as a System 2 type of activity: the deliberative evaluation of different possibilities based on goals and evidence. I discuss this type of organizational decision making next, in Section 4.2. Often, cooperation between Systems 1 and 2 is present in organizational decision making. Specifically, the domain of roles and positions can be presented as cooperation between Systems 1 and 2, which I will address in Section 4.3. However, in rule-based and interpretive forms, organizational decision making appears as interpretations of situations. In these situations, a set of social expectations related to one's role needs to be fulfilled by following rules that are interpreted by matching an appropriate mental model related to the situation. (March 1997, 10.) Consequently, organizational decision making can be understood also as a System 1 type of activity. I will elaborate this in Section 4.4.

4.2 System 2 in organizational decision making – hierarchy

System 2 is apparent in the classical studies of organizational decision making. Arguably, the first comprehensive attempt to study organizational decision making came from the Carnegie School, whose premise was to place decision making at the center of organization studies (Gavetti et al. 2007, 523). A corollary of this premise was the proposition that a scientifically relevant description about an organization is the one that can tell what decisions each member of an organization makes and what affects her decisions (Simon 1982, 76, 78). Consequently, an understanding of goals becomes key to understanding decisions, and an understanding of decisions becomes key to understanding organizations.

In this Carnegie School model of organizational decision making, goals form a hierarchy in which each level in an organization is a goal related to the levels below and a mean related to the levels above. An organization's structure often correlates directly to its goals. For example, the main goal of a fire department is to reduce the damage caused by fire. To achieve this goal, it has two sub-goals: to prevent and extinguish a fire. These two sub-goals are visible in its organizational structure, which consists of a fire safety department and a department of firefighters. (Simon 1982, 102.) Furthermore, these two departments are means related to the fire department's goal of reducing the damages caused by fire.

The Carnegie School's seminal analysis has been complemented by recent studies. Jacobides (2007) addresses organizational structure and how the division of labor affect individuals' decision making in organizations. Specifically, Jacobides (2007) demonstrates how the organizational structure's hierarchy allows individuals to focus their attention on limited aspects of reality. He proposes that organizational structure provides the mental models through which individuals perceive their world. Thus, the way each organization is structured shapes an ecology of distinct mental models that exist at the level of the organizational subunit (Jacobides 2007, 457). This relationship between hierarchy and an individual's mental models in organizational decision making is illustrated in Figure 9.

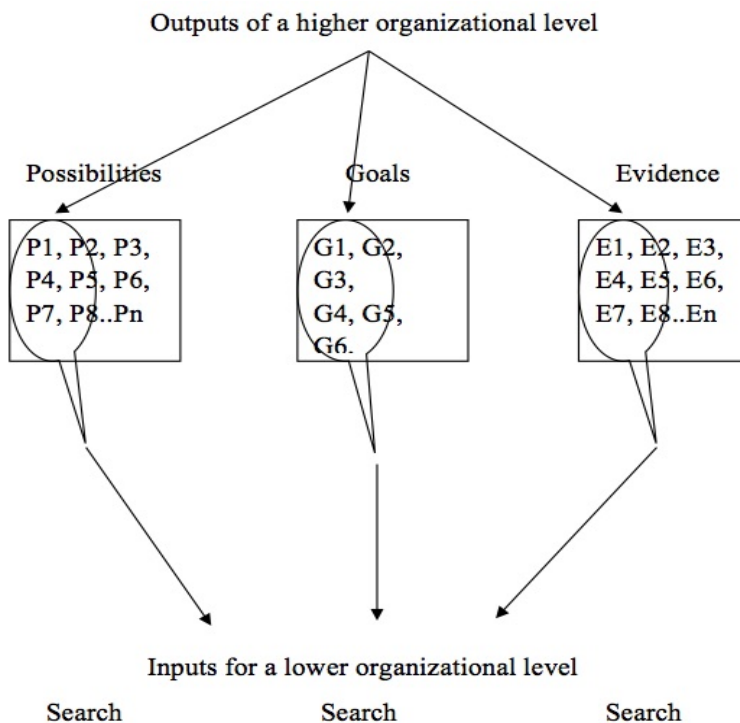


Figure 9 Hierarchy and mental models in organizational decision making

In Figure 9, the outcomes of the decisions made at the higher level in the organizational hierarchy have created a mental model that limits the sets of possibilities, goals, and evidence that are searched in decision-making processes at the lower level in the organizational hierarchy. The same principle can be applied in reverse order: an individual on the lower organizational level can create a limited decision-making environment for a higher organizational level.

In addition to searches for possibilities, goals, and evidence, hierarchy affects the judgment part of decision making. Studies on economic architecture have demonstrated how the organizational structure's hierarchy reduces two potential errors in judgment: the acceptance of an inferior possibility and the rejection of a superior possibility. Hierarchical structures in which a possibility needs to be validated by successive hierarchical ranks before approval tend to reduce the likelihood that an inferior possibility will be adopted. However, a flat hierarchical structure tends to minimize the likelihood of rejecting a superior possibility. (Christensen & Knudsen 2004; Knudsen & Levinthal 2007; Sah & Stiglitz 1986.)

Siggelkow (2011) conceives organizations as systems of interdependent decisions. According to his results, the eventual decision made by top management arose from the interplay of many decision makers distributed throughout the organization. Hence, organizational structure is one of the key components that top managers can utilize to affect how decisions are made within organizations. (Siggelkow 2011, 1130.) Diefenbach and Sillince (2011) studied different types of organizational structures and concluded that a formal hierarchy is prevalent in all of them. Their categorization is presented in Table 2.

Table 2 Types of organizations and their formal hierarchy (Diefenbach & Sillince 2011, 1520)

	Bureaucratic /orthodox organization	Professional organization	Representative democratic organization	Hybrid/postmodern organization	Network organization
Main concept of the system	Bureaucracy, rules, managerialism	Professionalism, managerialism	Managerialism, representative decision-making processes	Managerialism, projects and teams	Autopoiesis, decentralized co-ordination and decision making
Formal principle of hierarchical order	Principle of rule-bound line management	Principle of seniority, principle of professional autonomy	Principle of formal hierarchical representation	Principle of direct and indirect line management	Principle of autopoietic structures and processes
Formal hierarchical order via	Offices at different levels, line of command-and-control, line management	Rules and order of the profession, line management	Line management, committees	Line management, formal projects and teams	Emerging formal functions and tasks within the network
Formally higher and lower ranked individuals	Master and servant, superior and subordinate	Senior and junior, professional and support staff, superior and subordinate	Representatives and represented, superior and subordinate	Superior and subordinate, leaders and members of projects or teams	Network-coordinator/ Facilitator and members

According to Diefenbach and Sillince (2011), the term “hierarchy” has mostly been interpreted as formal hierarchy in management and organization studies. In

these studies, “formal hierarchy” is used almost as a synonym for “organization.” organization means hierarchy and hierarchy means organization. As illustrated in Table 2, a hierarchy can be understood as the vertical integration of official positions within one explicit organizational structure, in which each position is under the control and supervision of a higher position. Hence, a formal hierarchical order can be defined as an official system of unequal person-independent roles and positions that are linked via lines of top-down command and control. (Diefenbach & Sillince 2011, 1517.)

4.3 Cooperation of Systems 1 and 2 in organizational decision making – roles and positions

As a consequence of a formal hierarchy, the official roles and positions of all organizational members are defined and distinguished from each other (Zeitlin 1974, 1090). While a position is a person’s occupation that shows her rank in an organizational hierarchy, a role is a set of social expectations associated with a given position (Ashforth & Fried 1988, 307). Expected social relationships and interactions between occupants of positions are the province of role theory. Roles focus on interactive social phenomena, and a complementary role, for example, manager to subordinate, is necessary for role-governed behavior to occur. (Gioia & Poole 1984, 457.)

Cooperation between Systems 1 and 2 is present in the domain of roles and positions. Viewed from the organizational decision making perspective, roles and positions affect to which part of the environment individuals attend their mental models, as well as which individuals participate in particular decision-making processes. (Jacobides 2007, 457.) The results of Marengo and Pasquali’s (2012) study demonstrate that the structure of allocating decision rights is a very powerful control mechanism in organizations. Hence, it is reasonable to say that roles and positions add clarity and structure to decision making: complex decisions can be distributed to less complex parts (Yue 2013) that are more easily processed by boundedly rational individuals (March & Simon 1958).

However, it is equally reasonable to say that roles and positions create political conflicts and ambiguity, which hinder organizational decision making (Shapira 1997, 5). The individual’s goals and the goals of the role that the individual plays in the organization do not always match, which creates additional ambiguity in decision making: which goals should be adhered to in the decision? Swalm (1966) presented an example of a large firm’s manager who declined to pursue a project that had an equal chance of either making a gain of \$300,000 or losing \$60,000 for his company. Swalm hypothesized that social pressure related to the fear of losing made the manager reluctant to pursue the project. In the

same study, several other respondents stated that despite knowing their decisions were not in the best interests of the organization, they felt their decisions to be in their own best interests as aspiring executives. (Swalm 1966.)

Incentives may contribute to the question of whether the roles and positions create clarity or ambiguity in organizational decision making. Kahneman and Lovallo (1993) illustrate how the frequency of performance reviews affects the individual manager's decisions. In their example, performance reviews occur at predictable points, and the value of the firm's outcomes since the last review determines the manager's outcomes. Furthermore, performance is evaluated with the utility function, in which the credit for gaining 2.5 units for the firm is equal to the blame for losing 1 unit. With this utility function, the manager would not pursue a business possibility that offers an equal probability to win 2 units or to lose 1 unit. However, if the performance review can be deferred after two similar business possibilities, the compounded utility of 4 units creates an incentive to make these business decisions. (Kahneman & Lovallo 1993, 23.)

Similarly, the results of Ethiraj and Levinthal's (2009) study demonstrate how imposing a multitude of weakly correlated performance measures leads to a performance freeze because individuals are unable to identify decisions that would improve the organization's performance across the full array of goals. This applies to even simpler types of organizational structures in which an organization is comprised of independent employees. The effect is increased in more complex organizations in which the organizational structure and the roles and positions are more prominent than in simpler types of organizations. (Ethiraj & Levinthal 2009.)

The same dilemma about clarity and structure versus conflicts and ambiguity is also present on collective levels. In his study, Pondy (1982) argues how organizational decision making differs from individual decision making because it has a problem of how collections of individuals make complex decisions in the face of ambiguity not only in information but also in goals (Pondy 1982, 309). Even if the goals are clear, various groups in organizations may need to compete with each other for the control of limited resources (Miller & Wilson 2006, 471). In one of the most comprehensive studies of organizational goals, Cyert and March (1963) argue that the existence of unresolved conflicts among the contradicting goals of different roles and coalitions is a key feature of organizational decision making. Political power considerations between groups often determine organizational decisions rather than inferences made based on the available evidence about the situation (Walter, Kellermanns & Lechner 2012). Similarly, Guler (2007) determined how intra-organizational politics between groups, as well as coercive and normative pressures from co-investors and limited partners, influence whether organizations decide to continue or terminate investments, regardless of the expected returns on these investments.

Many of the negative aspects that the roles and positions and collective political conflicts create are condensed in Cohen, March, and Olsen's (1972) garbage can model of organizational decision making. According to this model, organizational decisions occasionally resemble a garbage can into which people can dump their goals, possibilities, and solutions. The idea is the same as in the metaphor "if the only tool you have is a hammer, then every problem looks like a nail." Hence, transient individuals and groups in organizations are waiting for decision-making situations in which they could contribute their pre-existing goals, possibilities, feelings, and problems (Cohen et al. 1972, 1).

4.4 System 1 in organizational decision making – rules and repetition

System 1 is apparent in two themes of organizational decision making: in interpretative, rule-based decisions and in repetitive decisions. Interpretative rule-based decisions are specified by standard operating procedures, professional standards, cultural norms, and institutional structures linked to conceptions of role fulfillment. According to March (1997, 17) much of the organizational decision making reflects the automatic way in which people seek to fulfill their roles. In role fulfillment, people match situations and identities, which requires three types of interpretations. First, decision makers classify situations into distinct categories associated with identities or rules. Second, decision makers have a mental model of their personal, professional, and official identities, and they evoke particular identities in particular situations. Third, decision makers do what they see as consistent with their identity in the given situation. Based on these interpretations, decisions are often made without deliberately contemplating preferences and consequences. Hence, actions are based on rules, routines, procedures, practices, identities, and roles, and they reflect mental images of proper behavior. (March 1997, 17.)

Organizational decision making is often repetitive. Repeated decisions, such as those made by a loan officer who decides whether to approve consumer housing loans, are based on rules that are either given by the organization or learned after multiple iterations of similar decisions (Shapira 1997, 5). These repetitive decisions are an extreme example of how the organization limits sets of possibilities, goals, and evidence that are searched in decision-making processes. Through repetition, the searches become redundant as the automatic System 1 supersedes the deliberate System 2. Together, individuals and organizations develop repertoires of programs of action suited to different situations. In these situations, a relatively simple stimulus from an organizational environment sets off an elabo-

rate program of activity without any apparent search for possibilities, goals, and evidence. This can occur both on the individual and the collective level.

On the individual level, a performance program economizes an individual's mental models by removing search and inference processes that recur in a certain situation. The individual or someone else in the organization has already completed the thinking process. In similar situations, there is no need re-determine which of the possible decisions activates the right behavior for the situation. Depending on the degree to which a certain performance program is institutionalized, there might even be restrictions, either socially constructed or written in manuals, to not re-think or question the performance program. (March & Simon 1993, 522; 527; Simon 1982, 124–128.)

On the collective level, organizational units can perform tasks that are based only on received stimuli. Such collective actions are often outside the control of individual managers or those that participate in these tasks because substantial inertial forces channel organizational participants' activities. (Jacobides 2007, 457.) An often-cited example of this is Allison's (1971) study that demonstrated how the Cuban missile crisis was defined by automatic stimulus-response patterns inherent in US' and USSR's government and military.

Consequently, from the organizational decision-making perspective, the autonomous actors versus systemic properties dynamic can be defined based on the size of the sets of possibilities, goals, and evidence the individual's role allows her to search. This allowance can be conceptualized as a continuum from limitless search possibilities operated by System 2 to System 1-governed routinized behavior in which no search is conducted.

5 METHODOLOGICAL DECISIONS

This chapter introduces the methodological decisions I have made in this research. Like all decisions, methodological decisions depend on beliefs and goals. Methodological beliefs concern ontology, a foundational belief in a particular nature of reality, and epistemology, a belief in a particular way of creating and distributing knowledge. Furthermore, methodological decisions are guided by the goals of the study. Because the goal of this study is to examine a phenomenon between the existing theories in domains of an individual's bounded rationality and organizational routines, this study utilizes a non-empirical research strategy. To explicate why a non-empirical research strategy is apt for this research goal, I first need to consider the elements that constitute a theory.

5.1 What constitutes a theory?

Answering the question, "What constitutes a theory?" is not an easy task, especially in management and organization studies. Management and organization studies do not agree on whether a model and a theory can be distinguished, whether a typology can be called a theory, whether the strength of a theory depends on how interesting it is, and whether falsifiability is a prerequisite for the very existence of a theory (Sutton & Staw 1995, 371).

Although the form of a theory is ambiguous, it is fairly clear that the purpose of a theory is to organize the complexity of natural or concrete events and communicate this organization clearly to others. Hence, a theory can be understood as a system of constructs and variables in which the constructs are related to each other by propositions, and the variables are related to each other by hypotheses. (Bacharach 1989, 496; 498.) Whereas constructs and variables are answers to the question of *which components* should be considered parts of the explanation the theory gives, propositions and hypotheses are answers to the question of *how* the components are mutually related (Whetten 1989, 490–491). These components and their relationships are illustrated on the right side of Figure 10, which complements Figure 1 by exemplifying the components, complexity, and layers of a theory.

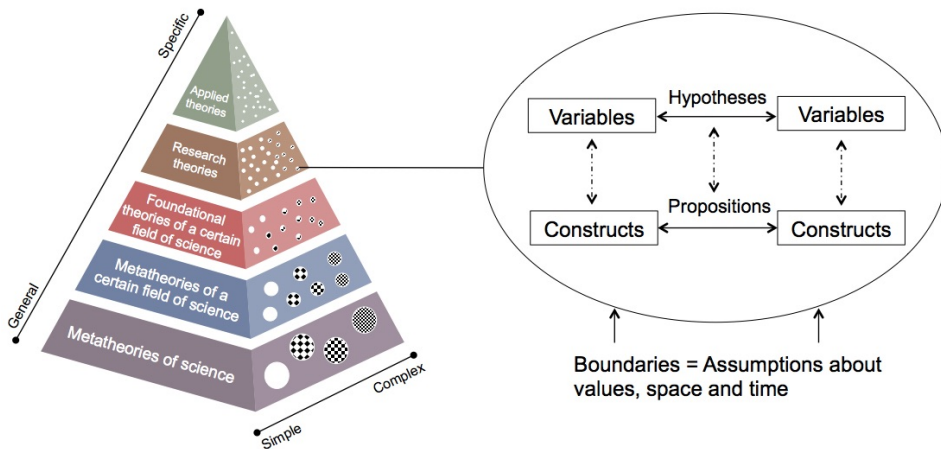


Figure 10 Components, complexity, and layers of a theory (Adapted from Bacharach 1989, 499; Kallio 2006, 523; Whetten 1989, 490)

Furthermore, the right side of Figure 10 illustrates how constructs and variables relate to different levels of abstraction and complexity in a theory. Constructs may be defined as *"terms which, though not observational either directly or indirectly, may be applied or even defined on the basis of the observables"* (Kaplan 1964, 55). A variable may be defined as *"an observable entity which is capable of assuming two or more values"* (Schwab 1980). Thus, a construct may be viewed as a broad mental configuration of a given phenomenon, while a variable may be viewed as an operational configuration derived from a construct (Bacharach 1989, 500). Consequently, a theory has inherent layers of abstraction between constructs and variables. Moreover, the number of constructs and variables define the complexity of a theory. The correct level of complexity is determined by comprehensiveness (i.e., are all relevant constructs and variables included?) and parsimony (should some constructs and variables be deleted?) (Whetten 1989, 490).

In addition to different levels of abstraction and complexity, a theory contains tradeoffs between its outer limits: how general or specific a theory is (Weick 1979). Usually, these limits can be found by examining how the theory can answer who, where, and when questions (Whetten 1989, 492). Whereas more general theories are relatively unbounded by both space and time, more specific theories are bounded by either or both space and time. Generalizability requires a higher level of abstraction, which means the theory sacrifices the level of detail needed to fit a specific situation (Bacharach 1989, 500). Consequently, different theories can be compared based on their level of abstraction. This comparison can be understood as a continuum from grand theoretical statements that are abstract and lack observational details but relatively unbounded by either or both

space and time to empirical generalizations that are rich in detail but strictly bounded by either or both space and time (Bacharach 1989, 500). Such a continuum is illustrated on the left side of Figure 10.

The left side of the pyramid in Figure 10 presents Kallio's (2006, 523) typology of the layers of scientific theories. The term "metatheories" on the two lowest layers refers to theories in the philosophy of science that discuss ontology and epistemology. They can be discussed both in relation to science in general and to a specific field of science. Foundational theories of a certain field of science, which are on the third layer, present foundational beliefs concerning the object of the research (Fumerton & Hasan 2010). Kallio mentions rationalism and humanism as examples. The fourth layer, research theories, is built upon the third. For example, various HRM theories have emerged from the humanistic perspective. The fifth layer consists of mundane theories put in practice by consultants and instructors. (Kallio 2006, 522–524.)

5.2 Philosophy of this research

5.2.1 *Ontology – How the nature of reality is understood in this study*

Ontology is the philosophical study of the nature of reality. Hence, a certain ontology is a foundational base for a set of concepts and categories in a subject area. The ontology shows the properties and the relationships between concepts and categories. (Oxford Thesaurus of English.) Previously, in this study, I discussed the effects that heuristics and biases in mental models have on physical and cultural objects (see Figure 8 in Section 3.3). Profoundly, such effects and the possible existence of heuristics and biases in other objects than human beings are ontological questions. Consequently, next, I will discuss how the nature of reality is understood in this study.

In this study, the nature of reality is understood as a three-world ontology proposed by Karl Popper (1978). In Popper's ontology, the nature of reality is divided into three worlds that are called "world 1," "world 2," and "world 3." World 1 is the physical world that consists of, for example, stones and stars, plants and animals, and various forms of physical energy. World 2 is the mental world that consists of, for example, our thoughts, feelings, decisions, perceptions, and memories. World 3 consists of the products of the human mind, such as art, language, stories, songs, technologies theories, and social institutions. Most of these world 3 objects are embodied as physical objects and, hence, also belong to world 1. Furthermore, each world can be subdivided into categories in various ways: World 1 can be divided into living things and non-living things, world 2

can be divided into conscious and subconscious processes, and it is possible to divide world 3 into categories such as fiction and science. (Popper 1978, 144–145.)

The three worlds are interconnected. World 2 emerges as an evolutionary product from the organisms in world 1. Similarly, world 3 emerges as an evolutionary product from world 2. In both cases, the emerging world affects the world from which it emerged. World 3 not only informs our minds in world 2 but also largely creates them. For example, the full consciousness of self is anchored in learning a language. Indeed, we shape our tools, and thereafter, our tools shape us. An example of how world 2 affects world 1 could be a feeling of pain in world 2 that causes us to seek a solution for ending the pain in world 1. (Popper 1978, 166–167.) Finally, world 3 objects, such as scientific theories, can exert a causal effect upon physical things in world 1. In this effect, world 2 (e.g., a scientist's subjective understanding of the objective theories) acts as an intermediary between world 3 and world 1. (Popper 1978, 154; 156.)

Popper's three-world ontology can be viewed in terms of the nominalism-realism dimension widely used for positioning various ontologies in organization studies (see Burrell & Morgan 1979, 3). Three-world ontology is incompatible with subjective nominalism but compatible with realism (Niiniluoto 1999). The compatibility with realism relates to the belief that the social world outside our mental models is a real world with relatively immutable structures that exist as empirical entities. This social world's existence is as concrete as the physical world's (Burrell & Morgan 1979, 4.) Three-world ontology differs from the extreme end of realism in the nominalism-realism dimension, which postulates that the social world is prior to the existence and consciousness of any individual (Niiniluoto 1999).

5.2.2 Epistemology

Epistemology is the study of knowledge and justified belief. It is concerned with relating the creation and distribution of knowledge in particular areas of inquiry. (Steup 2016.) The epistemological view is connected to the ontological view. Since the ontological view of this study understands the social world as an external, objective reality, the epistemological view of this study focuses on an analysis of relationships and regularities between the various elements of world 2 and world 3. Hence, the epistemological concern is to define and identify the elements in which these relationships can be expressed. Consequently, the concepts, their measurement, and the identification of underlying themes become important methodological issues. This type of epistemology seeks regularities and causal

relationships between the constituent elements in the object of the study. (Burrell & Morgan 1979, 2–4.)

Popper's three worlds are useful for understanding the object of this study. The object of this study is to examine the interplay between world 2 and world 3. Specifically, I am interested in the interplay between cognitive biases and organizational structures, such as policies, routines, and rules. This type of interest in the interplay between world 2 and world 3 is not new in organization studies. The classic organization studies texts from the Carnegie School have demonstrated how individuals' bounded rationality relates to performance programs organized in accordance with the hierarchical structure of the organization (Simon 1947; March & Simon 1958; Cyert & March 1963). Consequently, organization studies have generally embraced the ontological foundational belief (Fumerton & Hasan 2010) that some model of an individual's judgment and decision-making processes provides a basis for building further organizational theories (Cabantous, Gond & Johnson-Cramer 2010).

5.2.3 The methodological path of this study

In Section 5.1, the purpose of a theory was defined as “*to organize the complexity of natural or concrete events and communicate this organization clearly to others.*” This purpose can be achieved with many different research strategies. Arguably, the most profound difference among various research strategies is the choice between an empirical and a non-empirical research strategy (Koppa 2010). In an empirical research strategy, a researcher observes some natural or concrete event and organizes the complexity by either confirming or creating a new theory about this event. In a non-empirical research strategy, a researcher does not observe some natural or concrete event directly. However, she organizes the complexity either by clarifying constructs in existing theories (Ahonen & Kallio 2002, 16; Suddaby 2010) or creating a new theory by bridging the gap between two or more different theories, thus explaining something between the domains of previous theories (Bacharach 1989, 511). Consequently, a theory can be either a new, specific area on the map of the empirical universe (a single white dot in Figure 10) or a clearer and more connected area on the map of the empirical universe (a connection between two or more dots in Figure 10).

Because the purpose of this research is to examine a phenomenon between the existing theories in the domains of an individual's bounded rationality and organizational routines, this research utilizes a non-empirical research strategy. Similar to empirical research strategies, non-empirical research strategies can also be divided into more specific strategies. In Figure 11, research strategies in management and organization studies are first divided into empirical and non-empirical

strategies. Empirical strategies are further divided into quantitative and qualitative research strategies, and finally, at the bottom of the typology, an example of a research method related to quantitative and qualitative research strategies is given. There are naturally many more research strategies and research methods than the examples given in Figure 11. However, the purpose of Figure 11 is to illustrate how both the research strategy chosen in this study (i.e., construct analysis) and the main research method chosen in this study (i.e., interpretative construct analysis) can be positioned in comparison to research strategies and methods that are arguably more well-known in management and organization studies.

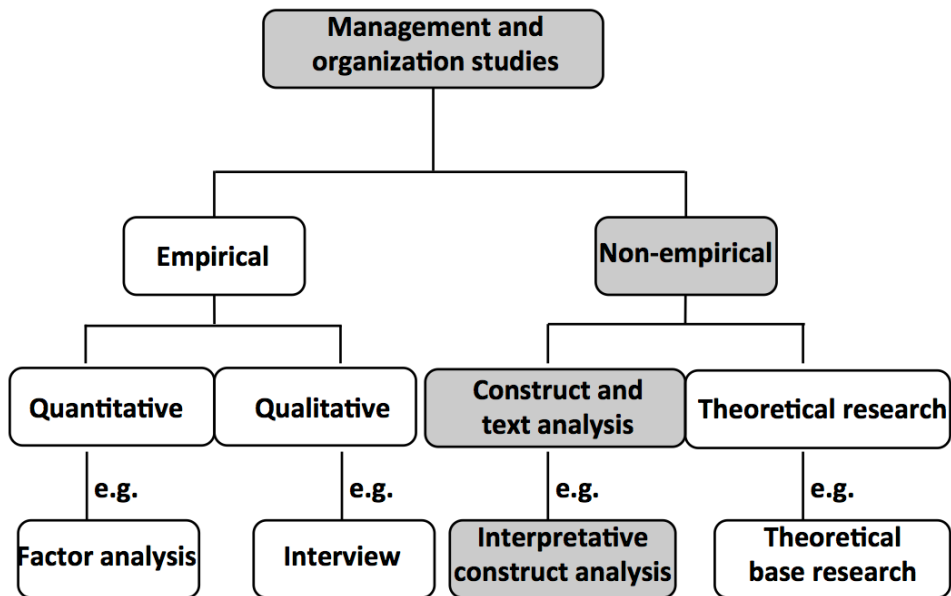


Figure 11 Typology of research strategies (Adapted from Kallio 2006, 518)

In Figure 11, the grey boxes illustrate the methodological path of this study. Along with other studies that do not contain first-hand empirical data, this study can be categorized as non-empirical. In non-empirical studies, the argumentation is usually based on the scholar's thinking processes that are presented in the form of either or both analysis and synthesis (Kallio 2006, 520). These thinking processes are hermeneutical, which means the scholar's understanding evolves and improves iteratively during the study. During the study, the scholar interprets, connects and categorizes information constantly. Hence, the research questions are not finalized until the later stages of the study, when the scholar comprehends what is possible to cultivate on the chosen research topic. (Kerssens-van Drongelen 2001.) In practice, communicating this inner thinking process as openly and transparently as possible is virtually the only way to enhance the study's objectivity (Kallio 2006, 529).

Non-empirical research strategies can be divided into more specific strategies. This study can be categorized among “construct and text analysis” research strategies. This category contains two types of sub-strategies. The first type concentrates on analyzing either single constructs or connections between constructs (i.e., theories), while the second type is focused on texts and discourses. This study utilizes the first strategy. Hence, this study aims to clarify the existing constructs and, if needed, aims to create new constructs. This type of construct analysis research strategy is especially important when competing paradigms exist in a specific research area, and the same terms are used with different meanings. (Kallio 2006; Poole & Van de Ven 1989; Suddaby 2010.) The results of the construct analysis research strategy can be both descriptive and prescriptive (Neilimo & Näsi 1980, 32).

Various methods can be used in construct analysis. Although the differences between non-empirical methods are not as clear as the differences between empirical research methods, a method of analysis is common to all types of construct analyses. (Ahonen & Kallio 2002, 59–60.) In this method, constructs and theories are deconstructed into smaller pieces, which are seen as fundamental to the construct. These fundamental pieces are then examined and used to gain more specific knowledge about the phenomenon by forming possible reconnections, categorizations, and reconceptualizations. (Ahonen & Kallio 2002, 77.)

In this study, the main research method is interpretative construct analysis. According to Takala and Lämsä (2001), interpretative construct analysis goes deeper than normal construct analysis. In interpretative construct analysis, the analyzed construct is interpreted as part of the original context, whereas, in normal construct analysis, the analyzed construct is taken out from the original context. Hence, in normal construct analysis, it is possible to separate an individual construct from a wider theory and concentrate on analyzing this specific construct. In interpretative construct analysis, however, the construct is always interpreted as part of the theory. (Takala & Lämsä 2001.) Consequently, in this study, the bounded rationality construct is not analyzed separately, but as part of a wider administrative theory. In the original context, bounded rationality—an individual level psychological quality—was inseparable from performance programs—organizational level sociological quality—organized in accordance with the hierarchical structure of the organization (Simon 1956).

5.3 Conducting this study and summaries of the essays

When this main idea developed by the Carnegie School is viewed in light of components of a theory (see Figure 10 in Section 5.1), it notably contains two constructs (i.e., bounded rationality and performance programs) and propositions

regarding the relationship between these constructs. According to Takala and Lämssä (2001), a successful interpretative construct analysis produces a fruitful reinterpretation of an existing theory. Consequently, this study is compiled from three essays that focus on different parts of the Carnegie School's theory. These parts and their relations to Essays 1–3 and to the overall discussion of this dissertation in Chapter 6 are presented in the top part of Table 3. The bottom part of Table 3 demonstrates the motivation, methods, reinterpreted contemporary constructs, and core contributions of Essays 1–3 and Chapter 6.

Table 3 Theory development in this study

	Essay 1	Essay 2	Essay 3	Chapter 6
Original construct	Bounded rationality	Relationship between bounded rationality and performance programs	Performance programs	Administrative theory
Part of a theory	Construct	Proposition	Construct	Proposition
Motivation	Paradox	Integration	Paradox	Calls for Neo-Carnegie theory
Method	Interpretative construct analysis	Integrative theory building	Construct analysis	Interpretative construct analysis
Contemporary construct	Heuristics and biases	Multilevel theory	Organizational routine	Heuristics and biases in organizing
Core contributions	-Improves the construct clarity of bounded rationality -Offers tools that scholars can use to map and reflect their own conceptualizations of bounded rationality	-Provides an initial version of a theory of organizational-level heuristics and biases -Demonstrates specific mechanisms that link heuristics and biases to organizational-level phenomena	-Provides a detailed analysis of the constructs that relate to the microfoundational view on routines -Demonstrates how various structures retain different amounts of endogenous variance in organizational routines	-Demonstrates how the interaction between an individual's decisions and mental models and organizational routines can either intensify or mitigate the effects of heuristics and biases

Essay 1 concentrates on the bounded rationality construct. As suggested by the guidelines of interpretative construct analysis (Takala & Lämssä 2001), the beginning of Essay 1 investigates the origins of the bounded rationality construct. Then, Essay 1 proceeds to demonstrate how the study of individuals' bounded rationality has forked into two incompatible agendas (Gigerenzer 1991; Gigerenzer & Selten 2001; Kahneman 2011). According to the "positive" agenda, an individual's bounded rationality does not contain cognitive biases, and the "positive" agenda denies the very existence of the cognitive bias phenomenon. (Gigerenzer 1991.) In contrast, the "negative" agenda acknowledges the existence of the cognitive bias phenomenon (Kahneman 2011). Both agendas are well-founded and supported in contemporary cognitive psychology.

This type of situation presents a paradox for the theorist because each side seems valid, yet they are, in some sense, incompatible or difficult to reconcile. (Poole & Van de Ven 1989, 565.) By “paradox,” Poole and Van de Ven (1989) mean tensions and oppositions between well-founded, well-reasoned, and well-supported alternative explanations of the same phenomenon. Paradoxes inherent in human beings and their social organizations have been recognized as sources for significant advances in management and organization theory (Quinn & Cameron 1988). Building on this insight, Poole and Van de Ven (1989) propose a possible strategy for theory building: looking for theoretical tensions or oppositions and using them to stimulate the development of more encompassing theories. This strategy requires an exploration of the tradition of the theoretical debate surrounding important issues, an identification of alternative or opposing theories or explanations, and the discovery of ways of relating, contraposing, or integrating them. (Poole & Van de Ven 1989, 563.)

Consequently, the purpose of Essay 1 is to study the construct clarity (Suddaby 2010) of the bounded rationality construct. According to Suddaby (2010), the essence of construct clarity comprises four basic elements. First, definitions are important. Construct clarity involves the skillful use of language to persuasively create precise and parsimonious categorical distinctions between concepts. Second, construct clarity requires the author to delineate the scope conditions or contextual circumstances under which a construct will or will not apply. Third, the theorist must not only offer clear conceptual distinctions but also show their semantic relationship with other related constructs. Finally, the theorist must demonstrate a degree of coherence or logical consistency of the construct in relation to the overall theoretical argument she is trying to make. (Suddaby 2010, 347.)

By following these instructions, the results of Essay 1 propose that the paradox between the “positive” and “negative” forks of bounded rationality have created conceptual gaps in organizational theory building. It is conceptually impossible to acknowledge certain phenomena, such as cognitive biases, with the “positive” agenda, and with the “negative” agenda, it is conceptually possible, but unlike the “positive” agenda, the “negative” agenda has focused on individuals instead of a relationship between individual rationality and organizational context. Together, the results of Essay 1 improve the construct clarity of bounded rationality and contribute to other studies by offering tools that scholars can use to map and reflect their own conceptualizations of bounded rationality.

Essay 2 focuses on the relationship between bounded rationality and performance programs. Recent studies have noted that the once important relationships between these constructs have been lost and are in need of renewing (Cohen 2007, 506; Gavetti et al. 2007). Similar calls for integration between an individual’s cognitive capabilities and the internal organizational environment have been

suggested in reviews concerning intuition in organizations (Akinci & Sadler-Smith 2012), behavioral strategy (Powell et al. 2011), and cognition in organizations (Hodgkinson & Healey 2008).

These calls for integration are responded to in Essay 2 by applying a method for integrative theory building in which mesa elements—antecedents or endogenous constructs—of a theory are integrated with the meta information about the disciplines and levels in which that theory is applied. Essay 2 builds on Essay 1, in which the mesa elements were analyzed. Meta information about the disciplines and levels comes from the research data collected by reviewing 10,386 articles from 13 top-tier management and organization journals published between 2005 and 2014. In this group, 111 articles that utilized contemporary versions of bounded rationality were recognized and used as the research data.

This data is analyzed in Essay 2 using the principles for integrative organizational theory building (Aguinis et al. 2011; Kozlowski & Klein 2000; Mathieu & Chen 2011; Molloy, Ployhart & Wright 2011; Rousseau 2011). First, the mesa elements of HB, NDM, and FF approaches were compiled from psychological journals in which these approaches have been developed and from books written by the initiators of these approaches. Second, the data articles were categorized based on their underlying disciplines (i.e., psychology, economics, and sociology). Third, the data articles were categorized based on their underlying systemic level (i.e., individual, group, organizational, and market). Fourth, possible differences in central terminology were investigated. The results of these analyses are propositions that demonstrate how different values in the mesa elements of HB, NDM, and FF approaches affect both the discipline and the level in which a particular management and organization phenomenon is studied. Group- and organizational-level studies of the HB approach remain especially rare. In summary, the purpose of Essay 2 is to enhance integrative theory building of bounded rationality's contemporary descendants by examining the mesa elements, disciplines, and levels used in the management and organization studies that involve HB, NDM, and FF approaches.

As a result, Essay 2 discusses three possibilities that may explain the scant amounts of organizational HB theory building: 1) Cognitive biases do not exist on the organizational level. 2) The complexity related to multilevel studies has blurred the normativity required for the theory building of organizational level HB. 3) The antecedents of the HB theory make it less attractive for multilevel studies than the NDM and FF theories. The results of Essay 2 contribute to previous research by outlining an initial version of a theory for organizational-level heuristics and biases, which demonstrates specific mechanisms that link heuristics and biases to organizational-level phenomena.

Essay 3 concentrates on the organizational routine construct whose origins can be tracked to the performance program construct. An organizational routine has

emerged as a key construct in many subfields of management and organization studies. Various fields, including strategic management (Felin & Foss 2005) and organization theory (Salvato & Rerup 2011), have gained new insights by utilizing the routine construct. Despite advances in multiple fields, the literature on routines remains riddled with paradoxes (Abell et al. 2008; Becker 2004; Becker 2008; Felin & Foss 2009). Arguably, the paradox between action and potential action, the paradox between the individual and the collective level, and the paradox between stability and change are the most significant hindrances that deter the theoretical development of the routine construct (Becker 2008). Recently, studying the micro-level origins of routines has been proposed as a robust candidate for answering the obstacles related to the theoretical development of the routine construct (Abell et al. 2008; Felin & Foss 2005; Felin & Foss 2009; Gavetti 2005). Specific calls propose a need to investigate the relationship between an individual's habit system and organizational routines (Cohen 2007; Cohen 2012) and a need to scrutinize the relationship between automaticity, experience-based intuition, and cross-level linkages in organizations (Gavetti et al. 2007).

Consequently, in Essay 3, a construct analysis is conducted by comparing the similarities and differences between heuristic, script, habit, and expert intuition constructs and their relationship to the other microfoundational elements of routines. Hence, Essay 3 demonstrates a model of the microfoundational dynamics of organizational routines. By showing the constituent components and their relationships, this model enhances our understanding of organizational routines' microfoundation. Specifically, Essay 3 contributes to previous research by both providing a detailed analysis of the constructs that relate to the microfoundational view on routines and demonstrating how various structures retain different amounts of endogenous variance in organizational routines.

Finally, the results of Essays 1–3 are combined into an overall discussion in Chapter 6. An overarching theme in all of the three essays is updating the main constructs used in the Carnegie School's administrative theory with constructs used in contemporary management and organization studies. Then, the updated constructs are analyzed to identify constituent elements upon which further management and organization research builds. However, although the main constructs of the Carnegie School's administrative theory are updated, the overall logic of the theory remains untouched. Hence, the combined result of Essays 1–3 is a reinterpretation of the Carnegie School's insight concerning bounded rationality and performance programs.

The main contribution of this reinterpretation is that it creates conceptual tools that enable other scholars to study previously understudied phenomena, such as how the cognitive bias construct, which relates to the individuals who constitute organizations, applies to an organization, whether in the aggregate or as a unique social actor (Barney & Felin 2013, 142). In mapping these understudied phenom-

ena, it is instructive to examine paradoxes related to the organizational routine construct. The paradox between the individual and the collective level and the paradox between stability and change indicate that the organizational routine construct captures something from all of these elements. Indeed, as presented in Table 1 in Section 4.1, organizational constructs can be mapped using the individual–collective level and stable structures–personnel actions as the axis of the map (Astley & Van de Ven 1983).

In contemporary organizational studies, cognitive biases are most actively discussed in the literature of strategic cognition. Because, in the strategic cognition literature, an individual manager is the object of the research, strategic cognition can be mapped on the personnel actions side. The strategic cognition literature concentrates on studying how cognitive biases affect managers' strategic decisions. One stream of strategic cognition concentrates on modeling the strategic thinking process while the other concentrates on applying the results of heuristics and biases research in studies conducted in environments authentic to managers. (For strategic cognition, see Barnes 1984; Schwenk 1984; Starbuck & Mezias 1996; Hodgkinson, Bown, Maule, Glaister & Pearman 1999; Mezias & Starbuck 2003; Arnott 2006; Santos & Garcia 2006; Certo, Connelly & Tihanyi 2008.)

However, although strategic cognition research has studied cognitive biases in the organizational context, they have neglected the structural forms side of the map. Hence, in the following chapter, cognitive biases are discussed in the organizational context in the same manner used for strategic cognition, but instead of concentrating on personnel actions, the focus is on the interplay between the individual and structural forms of organization in the same way as the Carnegie School's administrative theory. The creation of a precise vocabulary of established biases enables scholars to diagnose the possibility that a certain cognitive bias could exist in the structural forms of an organization, for example, in routines, roles, and positions. Furthermore, it can be determined only after this vocabulary exists whether cognitive biases end up in the organizational level or organizing is a method that manages to prevent cognitive biases. As Hempel (1965) pointed out, the vocabulary of science has two basic functions: (a) to adequately describe the objects and events being investigated and (b) to establish theories by which events and objects can be explained and predicted. Consequently, this study builds an analytical vocabulary that enables researchers to study cognitive biases in organizations in a fundamentally new way.

6 DISCUSSION AND CONCLUSIONS

The relationship between an individual's bounded rationality and the structure of an internal organizational environment is one of the classic insights of management and organization studies. According to this notion, organizing manages to reduce the effects of bounded rationality by creating automatic performance programs that substitute the need for individual decision making whenever possible, and in other cases, by limiting the complexity of individual decision making (Simon 1947; March & Simon 1958). This classic insight has given a profound impetus to the study of cognitive limitations and the study of organizing (Argote & Greve 2007). Naturally, we know significantly more about both of them than 70 years ago when the insight was initially published.

However, the passage of time does not create solely positive effects in academic research. Over time, bounded rationality has evolved into three different psychological theories that disagree on the ways in which an individual's rationality is bounded (Kahneman 2011, 236; Lipshitz et al. 2006, 918; Gigerenzer et al. 2002, 560–561). The greatest disagreement concerns the existence of cognitive biases. Although competition between theories is not negative per se, it creates ambiguity and misunderstandings in management and organization studies that draw from these theories. Hence, recent studies have noted the need for clarifying the bounded rationality construct (Miller 2008; Gavetti et al. 2007). Similarly, during its evolution from performance programs to organizational routines, the organizational routine construct has created many ambiguities that, according to researchers, deter its theoretical development (Abell et al. 2008; Becker 2004; Becker 2008; Felin & Foss 2009). Furthermore, researchers have suggested that studies have failed to combine the developments in the studies of cognitive limitations with the developments in the studies of organizational routines (Cohen 2007; Gavetti et al. 2007), which is a significant gap in current research. Consequently, one of the classic insights of management and organization studies has arguably remained under-researched for decades.

Against this backdrop, the main research objective of this dissertation was *to identify potential entry points of how to conceptually link heuristics and biases to such features of an internal organizational environment as organizational routines*. The present discussion and conclusions chapter draws on the specific theoretical insights and contributions of the three essays. Essay 1's objective was to deconstruct the bounded rationality concept and reconstruct it in a contemporary form. Essay 2's objective was to examine the antecedents, disciplines, and levels

used in highly ranked management and organization journal articles that have utilized HB, NDM, or FF theories. Essay 3's objective was to construct a model of the microfoundational dynamics of organizational routines. More detailed discussions and conclusions of the individual essays' contributions can be found in the essays themselves (see Part II). Meanwhile, the remainder of this chapter discusses the essays' relationships to each other, contemplates how they contribute to the main research objective, and considers the limitations of this dissertation. Finally, when these considerations are combined, they provide ideas for future studies.

6.1 Theoretical contributions

Arguably, the harshest yet most important question related to any academic work is, "Why does this matter?" My main research objective implies that the relationship between heuristics and biases and organizational routines is worth studying. The first part of the motivation and meaningfulness of studying this relationship arises from the calls for such research. These calls can be categorized from abstract and general to specific and detailed. The most general calls have proposed the need to integrate an individual's cognitive capabilities and the internal organizational environment in reviews about intuition in organizations (Akinci & Sadler-Smith 2012), behavioral strategy (Powell et al. 2011), and cognition in organizations (Hodgkinson & Healey 2008). Further calls have specified an individual's cognitive capabilities to concern bounded rationality by emphasizing the need to update the Carnegie School's insight regarding the integration of an individual's bounded rationality and the structure of an internal organizational environment with the relevant post-Carnegie developments (Cohen 2007, 506; Gavetti et al. 2007). A more specific call proposes that management and organization theory building has failed to produce theories that recognize phenomena between individuals' heuristics and biases and social interactions and complexity related to the internal organizational environment (Hodgkinson & Starbuck 2008, 9). Specifically, scholars have addressed the need to investigate whether cognitive biases apply to an organization in the aggregate or as a unique social actor (Barney & Felin 2013, 142). Similarly, Loock and Hinnen (2015) suggest that scholars lack a thorough understanding of heuristics in organizations and call for future studies on the antecedents, processes, and consequences of shared heuristics in organizations.

However, considering that these calls have been made within the last ten years and the relationship between heuristics and biases and organizational routines is meaningful, it is reasonable to ask why such studies have not emerged? After all, insights concerning the relationship between bounded rationality and perfor-

mance programs have been widely recognized since the 1950s (March & Simon 1958), the notion of heuristics and biases has been well known since the 1970s (Tversky & Kahneman 1974), and organizational routines have been studied since the 1980s (Nelson & Winter 1982). Given the amount of time that has passed and the consequential lack of studies, it is sensible to assume that perhaps a meaningful phenomenon between heuristics and biases and organizational routines does not exist.

Yet, hints implicating such existence are scattered in distinct research streams, which I have discussed in various parts of the dissertation. As I compile them here, they form the second part of the meaningfulness of studying the relationship between heuristics and biases and organizational routines. First, the convincing rise of behavioral economics has produced theories that demonstrate how heuristics and biases can aggregate to the market level and, thus, also exist in social entities other than individuals. Traditionally, an organization is understood as a social entity that exists between individuals and markets (Williamson 1975), so it is reasonable to suspect that this entity might include heuristics and biases. Second, although a comprehensive theory of heuristics and biases in organizations has not been created, some organizational forms of individual biases have been suggested. For example, scholars have discussed the organizational determinants of sunk-cost fallacy (Staw 1997) that was introduced in Sub-section 3.2.8 and overconfidence and underconfidence (Kahneman & Lovallo 1993) that were introduced in Sub-section 3.2.10, but such works remain rare. Third, studies have demonstrated how cognitive biases survive through socialization and adhere to professional roles that individuals play in organizations. For example, in a comprehensive study, in which the subjects carried their daily professional activities in a normal environment where the stimuli were neither selected nor restricted by the researchers, scholars concluded that the professionals were subject to cognitive biases in every domain (Koehler, Brenner & Griffin 2002). Fourth, previous research has shown how the regularities of tasks and domain characteristics affect the likelihood of cognitive biases' existence. The likelihood is smaller in domains where professionals make decisions about static matters that do not involve the evaluation of human behavior. In contrast, the likelihood is greater in domains where professionals must evaluate changing targets that usually involve human behavior. (Shanteau 1992; Kahneman & Klein 2009.) Together, these four reasons indicate the existence of heuristics and biases in organizing.

Given these reasons, the lack of studies investigating the relation between heuristics and biases and organizational routines resembles the Fermi paradox that points out the contradiction between high probability estimates and the lack of evidence for the existence of extraterrestrial civilizations. The HerBi paradox suggested here points out the contradiction between reasons why heuristics and biases could exist in organizational routines and the lack of studies demonstrating

the existence of such creatures. Consequently, one of the main theoretical contributions of this dissertation demonstrates that the academic community has lacked the conceptual tools needed to study heuristics and biases in organizational routines. Furthermore, it provides reasons why this lack of necessary tools has occurred. These reasons are discussed in more detail in Essays 1 and 2, but combined, they form a novel contribution that I elaborate on next.

There are two main reasons why the academic community has lacked the conceptual tools needed to study heuristics and biases in organizational routines. The first reason is the bounded rationality construct does not have enough explanatory power. Bounded rationality can explain heuristics and their relationship to organizational routines but not biases and their relationship to organizational routines. The deconstruction in Essay 1 explains how the bounded rationality construct and its most loyal disciple, FF theory, are missing the concept of System 1 and relying solely on System 2. According to these views, System 2 first provides boundedly rational yet satisfactory heuristics, which can be operated on later by System 1. Conversely, HB theory can demonstrate how an individual's System 1 cannot help dealing with bounded information as if this information were everything they need to know. Thus, HB theory has the explanatory power to acknowledge the possibility that System 1 could provide boundedly rational heuristics that, systematically, do not reach the satisfactory level. The acknowledgment of this possibility appears to be missing from traditional examinations of the relationship between bounded rationality and organizational routines.

The second reason for the lack of conceptual tools is revealed in the results of Essay 2, which demonstrate how group and organizational levels are rarely addressed in management and organization studies that utilize HB theory. Essay 2 proposes that the explanation for this is the way in which the different antecedents of HB, NDM, and FF theories affect both the discipline and the level in which a particular theory is applied in management and organization studies. Apparently, the antecedents of HB theory make it less attractive for multilevel studies than NDM and FF theories. More specifically, the complexity related to multilevel studies has hindered the theory building of organizational level heuristics and biases. To my knowledge, this hindrance in heuristics and biases theory building has not been recognized previously in other studies. Consequently, the path dependencies related to HB, NDM, and FF theories seem to affect the formation of organizational theories. Unlike the research traditions of FF and NDM theories, which have noted the relationship between individual rationality and the organizational context, the research tradition of HB has focused mainly on individuals and ignored the possible social ramifications. Together, these two reasons for the lack of conceptual tools help explain the underlying reasons for the gener-

ally noted imprecise use of the bounded rationality construct and improve its construct clarity (Suddaby 2010) in management and organization research.

When the results of Essay 3 are added to this discussion, they create a platform for examining how heuristics and biases relate to various parts of the micro-foundational dynamics of organizational routines (see Figure 3 in Essay 3). The entry point for possible heuristics and biases into the organizational routine can be found in decisions and coordination structures. Various forms of coordination structures, such as rules, incentives, and constraints, are fertile soil for framing, hindsight bias, and narrative fallacies to spread in organizational routines. The iterative nature of organizational routines makes these cognitive biases visible. As an illustrative example, we can combine framing bias with the soccer game routine discussed in Essay 3.

The rules of soccer award three points for a win, one point for a draw, and zero points for a loss. These rules create an incentive for both teams to take significant risks in the closing stages of the game. Hence, a draw situation in the final minutes could be framed as a decision problem between a 100% possibility for one point or a 50% possibility for three points. Though the expected utilities are one point versus 1.5 points, most people are loss averse and choose the smaller utility. This type of loss aversion is well documented in behavioral economics and, hence, does not offer anything new or surprising here. However, the iterative nature of organizational routines changes the framing in this soccer game routine example. The English Premier League team plays 38 games in one season. If we assume that 27% of 38 games (i.e., 10 games) have a draw situation in the final minutes, the expected utilities are 10 points versus 15 points, which can be framed as a decision problem between a 100% possibility for 10 points or a 30% possibility for less than 10 points and a 70% possibility for more than 10 points. In this example, iterations make the latter option more probable. Consequently, iterations of the routine make a framing bias more visible.

After many iterations of such a routine, the outcome could be a biased environment in which a specific cognitive bias or a combination of cognitive biases is visibly institutionalized. It is likely that descriptions of biased environments already exist, but management and organization studies have lacked a proper framework to analyze them. *Moneyball – The Art of Winning an Unfair Game* (Lewis 2003) is one example of such a description. Moneyball describes how the wisdom, which was accumulated in professional baseball over the course of the 20th century, was based on subjective and often incorrect intuitions. During the evaluation, coaches, managers, and scouts focused on such subjective factors as the players' appearance. They also paid too much attention to statistics that measure vivid performances, such as batting (i.e., runs batted in and a player's batting average) and stolen bases. They paid too little attention to dull and grey (as opposed to vivid) statistics, such as on-base and slugging percentages. This is

a pure example of a representativeness heuristic in which information that is more accessible biases the judgment. This cognitive bias was institutionalized in that environment and remained for a century until Oakland's team began to question the evaluation routine and built its squad while relying on more objective and rigorous statistics. Eventually, Oakland's approach changed the routine in which other team's coaches, managers, and scouts build their teams. This means that for many generations, new workers entered a biased environment and learned this bias.

Finally, I attempt to combine the main idea of this research and the results of Essays 1–3 into the following Figure 12.

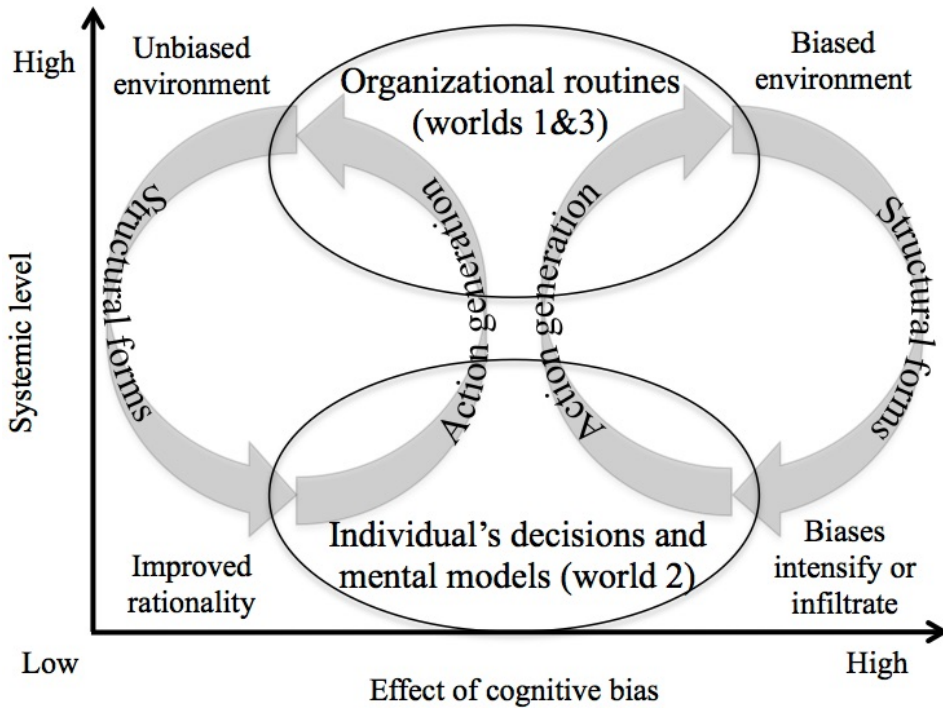


Figure 12 Cognitive biases in organizing

Figure 12 simplifies the main propositions of this research in a visual form. First, starting from the lower circle in the middle, our cognitive machinery is bounded in explicitly named ways, which affects our decisions and mental models. Essay 1 aims to analyze various constructs used by scholars to study how our cognitive machinery is bounded. Consequently, Essay 1 creates a vocabulary that can be utilized as a tool that improves our understanding of various theories of bounded rationality. Arguably, the greatest difference among the theories of bounded rationality is how they concern the existence of cognitive biases. Theories that do not acknowledge the existence of cognitive biases can be positioned

on the left in the circle, and theories that acknowledge the existence of cognitive biases can be positioned on the right in the circle.

Second, our cognitive machinery is a distinct ontological entity (world 2 in Popper 1978) that emerged from the physical world (1) and created the social world (3), which are depicted together as socio-material ensembles (see Orlikowski 2007) in the upper circle in the middle of Figure 12. These socio-material ensembles, such as organizational routines and markets, are constantly interacting with our cognitive machinery: our cognitive machinery is able to generate actions that affect socio-material ensembles, and socio-material ensembles form structures that affect our cognitive machinery. This interaction is depicted with cyclic arrows in Figure 12. Essay 2 aims to study this interaction, which can occur in various systemic levels, for example, groups, organizations, and markets. Consequently, Essay 2 creates a tool that improves our understanding of how various theories of bounded rationality interact with theories that discuss the world outside of our cognitive machinery.

Third, the interaction between two entities presented in Figure 12 may intensify or mitigate the effects of heuristics and biases. Over time, heuristics and biases can be retained in organizational routines, which may intensify their effects or infiltrate new individuals' mental models. Contrary to such biased environments, organizational routines may mitigate the effects of heuristics and biases. In these cases, the unbiased environment makes our mental models more accurate and, thus, improves individuals' rationality. Both options appear possible, and hence, it is reasonable to assume that the direction of the effect depends on each individual case. Furthermore, in the same individual case, some people can have an explicit goal to pursue as accurate mental model as possible, whereas other people can have goals, such as entertainment or happiness, which may conflict with the goal of gaining as accurate model of the world as possible. For example, some people who participate in the betting market might aim to form the most accurate probability estimations as possible, whereas others might seek entertainment value. Essay 3 attempts to illustrate how, in such situations, different structures retain different amounts of the endogenous variance in organizational routines. Additionally, Essay 3 presents a tool that improves our understanding of how the automatic part of our cognitive machinery interacts with constituent components of organizational routines.

6.2 Limitations and recommendations for further research

After immersing myself in the study of bounded rationality and cognitive biases for many years, I have observed myself display several cognitive biases. From this experience, I have learned that I am likely blind to the most severe limita-

tions of this work. My bounded rationale is that the main weakness of this study can be tracked to the dynamics between the general–specific and simple–complex continuum of theories, which is illustrated at the beginning of this study in Figure 1. Although I have operated on these dimensions, I wish my endeavor had been more systematic. I have detected general-level inconsistencies that affect more specific-level theories but did not produce actionable measures that would help others improve the existing theories. The results of this dissertation are more general ideas about what might be wrong or missing than instructions for fixing a problem or finding something that is missing.

Consequently, further research could develop and extend the results of this study. An empirical method is likely needed to specify how cognitive biases are mitigated or intensified in organizations. Relatedly, the corners of Figure 12 offer four different paradigms that could be elaborated with empirical observations. Also, a historical approach would be interesting: Has the passing of time managed to reduce or intensify the possible effects of cognitive biases in organizations? Conversely, what will happen in the future? Does the rise of artificial intelligence and transhumanism eventually extinguish all cognitive biases or are these just other World 3 creatures into which biases are able to infiltrate?

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