Herbert Simon's bounded rationality

Its historical evolution in management and cross-fertilizing contribution

Matteo Cristofaro
Department of Management and Law, Faculty of Economics, Università degli Studi di Roma Tor Vergata, Rome, Italy

Abstract

Purpose – The purpose of this paper is to investigate the historical advancements attained on the bounded rationality concept in management research, considering the key influencing discoveries in related fields. Understanding the cross-fertilization that has occurred is the first step to go beyond the current knowledge on bounded rationality and to face its challenges.

Design/methodology/approach – The adopted method is historical. This research approach helps to explain the evolution of a widespread concept in a scientific field and, particularly, to identify the parallel influencing advancements made in related domains.

Findings – Investigation of the irrational forces of human reasoning is at the centre of today's research agenda on rationality in organizations, claiming to be an extension of the original bounded rationality concept. In this regard, scholars should commit themselves to build a more holistic approach to the investigation of human rationality, conjointly applying socio-biological and behavioural perspectives to explain the real behaviour of people in organizations and society. This reconnection will also help to overcome the inner limits of some "fashion of the month" streams that have yet to demonstrate their contribution.

Originality/value – This is the first study that offers an overall historical evolution of the bounded rationality concept which considers both management research and developments in related fields. The historically educed lessons learned are at the basis of the concluding recommendations for future research.

Keywords Management history, Management research, Bounded rationality, Cross-fertilization

Paper type General review

Introduction

Simon (1947) in his watershed work *The Administrative Behaviour* strongly questioned the concept of *perfect rationality* that dominated both common and scientific knowledge until the middle of the twentieth century. According to classical and neoclassical economists, a rational individual has unlimited cognitive capabilities, and his choice of behaviour is focused on maximizing his own expected utility (Walras, 1883). On the contrary, Simon, influenced by the works of positivist psychologists such as Freud and by Barnard's (1938) fallacious man, highlighted the innate biological and rational bounds that let individuals deviate from the rational behaviour of classical economic models (Simon, 1955, 1956; March and Simon, 1958). Simon's redefinition of human rationality, commonly known as *bounded rationality*, recalibrated the whole scientific literature concerned with human reasoning, including the management field and its later history (Kalantari, 2010; Kerr, 2007, 2011).

Journal of Management History
Vol. 23 No. 2, 2017
pp. 170-190

1751-1348
DOI 10.1108/JMH-11-2016-0060

The author would like to thank Professor Gianpaolo Abatecola for his wise guidance, and to express his sincere appreciation for the beneficial comments given by the Editor Professor Bradley Bowden and by Professor Anthony Gould.

Due to the different disciplines involved, from its origins in the bounded rationality idea (Simon, 1947, 1957), this perennial concept has continuously evolved, thanks to cross-fertilization between natural science and social science scientific sub-fields concerned with the investigation of human reasoning (Kahneman, 2003; Gintis, 2006; Callebaut, 2007). For instance, thanks to Simon's initial contribution in 1947, psychologists in the 1970s led research programmes on the hidden rules that govern our mind, i.e. heuristics(Tversky and Kahneman, 1973, 1974). Analysis deepened 20 years later in management research to identify what erratically drives executives' decision-making (Hammond *et al.*, 1998). Simon's (2005) idea that the fitness of an organism to the environment depends on the adaptation of its decisions to environmental changes was also later studied by biology theorists (Gintis, 2006), psychologists (Gigerenzer and Gaissmaier, 2011) and neuroscientists (Pascual-Leone *et al.*, 2011) to explain, respectively, organism behaviours, the use and the adaptation of heuristics to the environment and brain modification depending on the stage of the human lifespan.

However, despite the various theoretical and empirical works published on bounded rationality over the past seven decades, scholars have highlighted that a work focused on how this concept impacted management research is both missing and needed – principally, to understand the concept's major developments before moving beyond them (Selten, 1999; Gavetti, 2012). The main goal of this contribution is, therefore, to investigate the chronological advancements of bounded rationality undertaken in the management literature, considering in depth the main discoveries in its related domains (e.g. economics, philosophy, sociology, psychology and brain science). The method adopted for this work is historical. This research design is suitable for explaining the evolution of a key concept in management history (Murphy *et al.*, 2006; Dahlgaard-Park and Dahlgaard, 2007; Abatecola *et al.*, 2012), but, more particularly, for identifying its cross-fertilizing effect among different scientific domains (Akinci and Sadler-Smith, 2012). From that, the major purpose of this paper lies in: offering the key turning points and interdisciplinary linkages of the bounded rationality concept over the past seven decades and proposing historically informed recommendations for future research on bounded rationality that may illuminate the way forward.

The paper's structure is the following. First, the initial conceptualization of bounded rationality is offered to the readers of *Journal of Management History*. Second, the advancements of the bounded rationality concept in management research and its progression in related fields are detailed by decades (i.e. 1960s-1970s; 1980s-1990s; 2000 onwards). Third, a comprehensive view of the evolution of the discussed theories and historically informed recommendations for future research on human rationality is provided.

1947 onwards: Herbert Simon and the "bounded rationality" concept

Prior to Simon's doctoral thesis in 1947, the dominant idea of complete rationality came from the adoption of normative methods to the study of economic decisions, which postulated rules as to how people *ought* to make choices. The resultant man – also called *homo economicus* (Walras, 1883) – chooses alternatives in a decision task according to a simple norm: maximizing his own expected utility. For example, a consumer who has to decide how to allocate his own US$20 daily budget will choose the option that maximizes his satisfaction. From this traditional conceptualization of individual rationality, other normative approaches were later derived such as the game theory (Von Neumann and Morgenstern, 1944). In particular, game theorists, assuming perfect rational individuals act to obtain the best possible payoff (i.e. the satisfaction in pursuing a strategy), tried to

model cooperation and conflict mechanisms occurring among competing parties. This approach was subsequently applied to economics and management to explain the equilibria reached in conflictual or cooperative business situations. For example, the well-known *prisoner's dilemma* was used to explain firms' behaviour in oligopolies. Two firms, with equal market shares and high prices for their products, have to make a decision on their future pricing strategy with no opportunity to communicate. According to game theory, the two firms usually choose not to cooperate but to pursue self-interested strategies (lowering prices), even if the cooperation strategy (maintaining high prices) would be more beneficial for both. The incongruity of the firms' behaviour is given by their supposed perfect rationality, which pushes firms towards self-interested preferences.

Among this proliferation of rational-based theories, Simon's conceptualization of bounded rationality was a breakthrough event that brought scholars to a whole reconsideration of human reasoning. Simon, in particular, refuted Adam Smith's rationalism and Jeremy Bentham's utilitarianism. According to Simon (1947), at the base of the real human behaviour, there are three restrictions on cognition: incompleteness of information; difficulty in the anticipation of the consequences of future actions; and scarce knowledge of all possible human behaviours. Behind these limitations are mainly the restricted computational capacities, access to information and physical constraints that are innate in humans (Simon, 1955, 1957). In sum, Simon's individual is boundedly rational – he has limited cognition and operates in a social environment which affects his decisions. As a cumulative effect of bounded rationality, people make "satisficing" rather than "optimal" decisions. In other words, the chosen alternative in a decision situation meets a given need (or a threshold) that does not maximize the expected utility.

The Simon satisficing concept was largely derived from the Freudian assumption that humans act illogically because of their mind's automatic processes (Simon, 1978a, 1978b), and from the *fallacious man* of[1] Barnard (1938), who uses illogical intuition to make decisions. However, Simon (1987) noted that Barnard's fallacious man was (wrongly) conceptualized as an exception rather than the normal condition of a human being in an organization. Nevertheless, other scholars, in the following decades, used the term *irrationality* to identify the non-logical behaviour of men in organizations, apparently not understanding Simon's original redefinition of human rationality. For instance, Becker (1962) (critically cited by Simon in his Nobel Prize speech) claimed that individual irrational behaviour is the *standard response* at the base of utility maximization decisions of individuals.

Simon's actual understanding of bounded rationality can be explained in the following example. A financial investor asks a beginner trader to make a decision – within a few minutes – about an investment in shares. The trader clearly knows that he should look at companies' and shares' performances to make that decision, but he will usually be sufficiently satisfied, because of time constraints, to follow the strategy applied by more experienced traders. Even if the trader would have a tendency towards rationality, he applies a satisficing strategy based on the trust he has in his colleagues, without executing his own analysis.

Simon's original bounded rationality concept, in sum, sits on the fine line between rationality and irrationality. Significantly, his pioneering studies on the roots of erratic human behaviour, conditioned the entire subsequent evolution of the studies on human rationality in management research and related fields. A chronological synthesis of the major key advancements is provided in Figure 1.

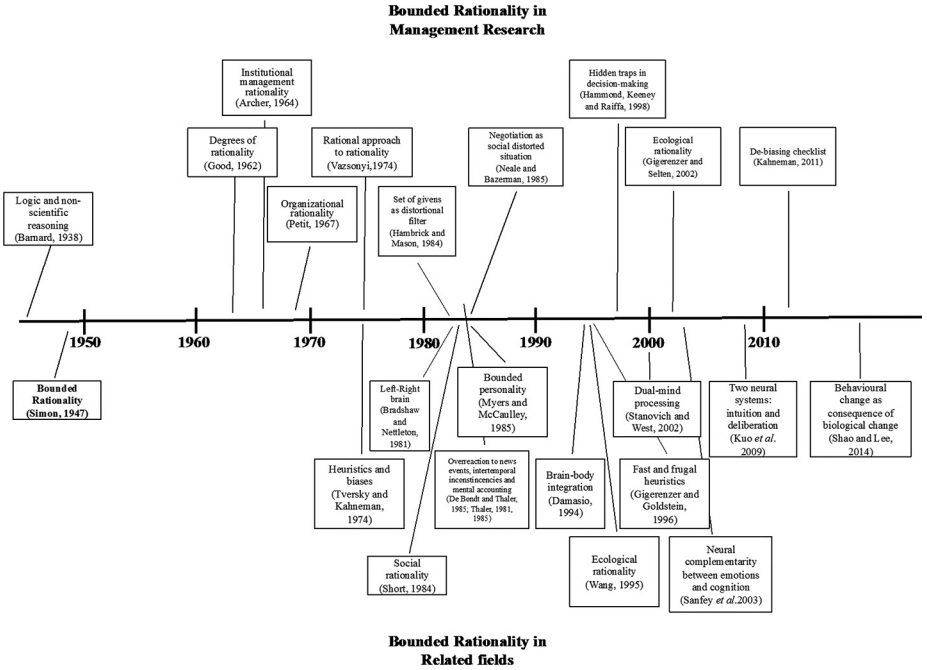


Figure 1.
Key advancements on bounded rationality: a historical timeline

1960s-1970s: understanding the psychological determinants of bounded rationality

Prior to Simon, philosophers typically believed in the power of odds to explain what rationality is (Kyburg, 1961; Skyrms, 1975). Indeed, according to Kyburg (1961, p. 200), chance tells us "what we ought to believe will happen; what is rational to expect". People, in practice, assign degrees of belief, which are the degrees of confidence in the truth of a proposition, to different statements, in the form of probabilities. However, this conceptualization was subsequently questioned with the spread of Simon's bounded rationality; Kyburg (1978) himself later wondered if when we ask a person to report the odds representing his degrees of belief, we have any certainty if these degrees adhere to his calculus of probabilities or not. In practice, if we ask an Italian CEO of a small biotech firm to identify the probability of his company to increase by 20 per cent its market share in the next five years, we do not know if his declared 60 per cent chance in reaching the goal is based on rigid calculus or on random estimation.

In light of Simon's critique, psychologists became more concerned with incorrect human interpretations of chances. The main study in this direction was Kahneman and Tversky's (1979)prospect theory, which explained how the bounded rationality basically works in human beings. Indeed, their prospect theory proved that the assessment of an alternative's outcome comes from individual personal judgment based on the mental shortcuts, namely, heuristics, that govern our rationality (Tversky and Kahneman, 1973, 1974). These heuristics are simple and automatic "rules of thumb" that let humans make a fast decision in an uncertain situation; for example, according to the availability heuristic (Tversky and Kahneman, 1973), a person tends to overestimate the probability to win at bingo if a recent event comes to mind easily in which that person (or others) called out "bingo". Due to this

bias, individuals will decide to play bingo, overestimating their probability to win. In sum, the algorithmic decision maker, who acts according to the expected utility, is replaced by the *homo heuristicus*, who makes faster decisions thanks to his mental shortcuts. This new representation of human reasoning let humans originally appear as irrational for philosophers and logicians who, subsequently, had to reconsider their conceptualization of human rationality.

The reconsideration of the rules that govern human rationality encouraged the study of the real behaviour of people when making decisions, stimulating reflections on how to overcome bounded rationality. Taylor (1975) proposed going beyond human cognitive limits through selecting the "right" decision-maker with good psychological prerequisites, and/or through the engineering of the problem space in which the decision-maker is embedded. For example, a neurotic decision-maker should not be considered for a job position in which he/she has to deal with highly stressful situations. In practice, Taylor's (1975) solution, to go beyond human and situational limits, was focused on the shift from the comparison of alternatives to the investigation of human limits themselves – such as the cognitive functions of decision-makers.

From Taylor's insight, a new approach investigating human cognitive bounds themselves was theorized: the behavioural decision theory. This approach, though originating in the 1960s (Edwards, 1961), was largely developed by Tversky and Kahneman (1973, 1974). Behavioural decision theory scholars proposed – supported by previous studies on the sociological approach in organizations (March, 1978) – an hypothesis that threatened against normative approaches: decision-makers act according to unstable and ambiguous preferences (Slovic *et al.*, 1977). This conceptualization was based on the idea that people have multiple selves with conflicting assumptions. This causes them to act inconsistently with regards to their previous choices (Gazzaniga and LeDoux, 1978; Einhorn and Hogarth, 1981). For example, people who want to save their money for Christmas shopping, deposit it in Christmas clubs (the name of special savings programmes offered by some banks in the USA) that do not allow them to withdraw money before Christmas time. Banks offer this solution to protect people against themselves, thus to prevent depositors withdrawing money before Christmas because of the unpleasant consequences of running out of it during Christmas time. So, because the behavioural decision theory approach clearly explains that humans act in a contradictory way, its application is detrimental in fields that need to understand the probable effect of an action on human behaviour, such as the effect of a legal reform (Hillman, 2000).

1960s-1970s: reformulating rationality in management theory

Under the influence of the bounded rationality concept, and the advancements made in the psychological field, during the 1970s, a re-examination occurred on how humans behave within organizations. Notably, Good (1962) elaborated a theory of rationality, suggesting that the impossibility of complete human rationality in organizations comes from unconscious psychological events and external forces that determine human decisions and their consistency. As Good stated "A conscious man can be only *more or less* consistent; in other words, there are degrees of consistency or of rationality" (Good, 1962; p. 385). In particular, the theory of rationality suggests that when a fast decision is needed, such as responding to a competitor statement, managers should be highly consistent with their previous choices; however, when managers have much more time to think about a decision, they should attach expected utilities to preferences. In this latter case, managers are usually inconsistent with their previous actions because of the better fit of a more considered choice.

This revisited conceptualization of rationality in organizations, being less rigid than that of traditional economists, stimulated other, new theories. The main contribution in this direction was the *Behavioral Theory of the Firm* by Cyert and March (1963), which stated that decisions in organizations are always made in the presence of scarce information, and negotiated within coalitions composed of managers and other stakeholders with different preferences and interests. As a consequence, these coalitions, operating in an uncertain environment, choose satisficing alternatives to solve conflicts and to pursue organizational goals.

The uncertainty that pushes managers to the formation of a coalition was further explored by Petit (1967) in his *Behavioral Theory of Management*, which took into account the problem of rationality in the overall organization. In particular, the firm is seen as being formed by three levels of management – technical, organizational and institutional – which have different degrees of uncertainty according to their proximity to the technical operations. For example, the technical manager, who has a low degree of uncertainty due to the tasks he/she carries out, operates from an engineering viewpoint and applies computational decision-making strategies based on operations research – he/she in a nutshell, a "technical rationality". According to this theory, rationality depends on the specific role of the manager and its related level of uncertainty. Other scholars, such as Vazsonyi (1974), attempted to deepen the drivers of individual uncertainty in organizations, looking at the emotional nature of humans and proposing a rational approach to rationality. According to this approach, the inconsistent behaviour of people is driven by their uncertainty. This can be resolved only by recognizing their own irrationality, which should then be peeled off from rationality. Decision-makers know that their limits are driven by their feelings and try to force themselves to lay them aside and head towards a more "aseptic" behaviour.

Despite this increasing trend in redefining managers' rationality according to the bounded rationality assumptions, some management scholars elaborated new approaches still anchored to *homo economicus* principles. For example, Archer (1964) introduced the management decision theory (MDT). According to this theory, managers should attach payoffs to alternatives relying on their existing information, and in doing so, they should also consider the internal and external trends that can occur in the near future. For example, a high-level manager who has to make a decision on a new investment, should consider all the possible assets to which financial resources can be assigned; then, by hypothesizing the most probable macroeconomic and microeconomic situations in the next five years, the manager should attach payoffs to the different assets and make the investment by choosing the solution with the best payoff. Managers are, therefore, still considered as perfectly rational and able to assign the exact payoff to each alternative.

Thanks to the focus on the uncertainty of the organizational decision-maker, as well as on feelings as biasing agents, the conceptualization of rationality in management is positioned close to the behavioural theories of psychologists. However, none of the theories produced during the 1960s-1970s are defined a congruent set of concepts, assumptions and causal predictions (Argote and Greve, 2007).

1980s-1990s: the branching-out of bounded rationality studies

In 1980, Simon (1980, p. 73) pointed out three substantive areas that could contribute to further development of his concept of bounded rationality:

(1) evolutionary theory, with particular reference to sociobiology;

(2) *the theory of human rational choice*, with reference to new behavioural streams; and

(3) the cognitive science discipline, with reference to the study of the mind's mechanisms.

This is the thread of the following analysis. The first of these domains, *sociobiology*, or *behavioural ecology*, has been defined as "the extension of population biology and evolutionary theory to social organization" (Wilson, 1978; pp. xx). This discipline is based on two assumptions:

(1) some behaviours (social and individual) are partly inherited; and

(2) these behaviours are shaped by natural selection mechanisms.

According to this theory, social behaviour (e.g. mating patterns and territorial fights) – that continuously evolves over time – is the result of the pressure brought about by natural selection, which pushes individuals to adapt their behaviour in useful ways to interact with others. For example, a man may inherit a sense of altruism from his parents, but he will probably become more selfish if his main social environment is entirely formed of narcissists. Such understanding led to so-called social rationality (Short, 1984), a concept that focuses on the rules that people follow in making decisions when possible gains are constrained by relationships with others who have their own preferences.

The rise in the sociobiological theory stimulated the growth of other disciplines based on the same assumptions in psychology and economics, such as *evolutionary psychology*. According to evolutionary psychologists, "the mind is a set of information-processing machines that were designed by natural selection to solve adaptive problems faced by our hunter-gatherer ancestors" (Cosmides and Tooby, 1997, p. 1). When people respond to the uncertainty of the environment, such as when managers experience a profound governance crisis of their own firm, they activate their sense of survival as well as an evolutionary process of learning and selection of behaviours, such as trying to undertake a management buyout (Tversky and Kahneman, 1986; Slovic, 1987). Modern economists were also attracted by the adoption of sociobiological approaches, as they sought to match neoclassical theories with the bounded rationality concept. A major example in this regards is the evolutionary game theory. Traditional game theory assumes that humans perfectly forecast the consequences of their decisions (Von Neumann and Morgenstern, 1944), whereas in the evolutionary game theory, players cannot foresee the consequences of their decisions and are affected by bounded rationality (Aumann, 1997). Moreover, the evolutionary version of the game theory assumes that players act according to a strategy that takes into account the strategy of competitors (Smith, 1982). The well-known example of Smith (1982) on the "Hawk and Dove" fight for survival is clarifying. These two species of bird compete with different strategies within the same population. The hawk to survive at the expense of the dove, implements a fighting strategy based on aggressiveness that later culminates in a "win or die" duel. The reaction of the dove is, initially, to counterpose the aggressiveness strategy, but it will run for safety if there is an escalation of hostility. If there is no hostility escalation, the dove will share resources for the survival of both species. As a consequence, the resulting population is the product of continuous contests and of reciprocal adaptation. This mechanism is at the core of the new concept of ecological rationality (Wang, 1995), which describes the human behaviour as the result of the interaction of human cognitive mechanisms, governed by heuristic principles, and the structure of the particular environment in which people are embedded.

The second direction proposed by Simon (1980) is, *de facto*, one favouring new rational choice models that must take into account the real behaviour of humans. Since the works of eminent psychologists, such as Tversky and Kahneman, (1973, 1974); Slovic *et al.* (1977, 1984), new branches in behavioural studies were born and grew. Two of these descended streams are well known and are considered to be from the direct cross-fertilization of behavioural decision theory, namely, behavioural economics and behavioural finance.

Initially, behavioural economics sought to link economics and psychology to allow better predictions and more effective policies (Camerer, 1999; Camerer *et al.*, 2004). Previously, despite Vilfredo Pareto, in the nineteenth century, having included assumptions on how people feel about choices, it was not until the first work of Allais (1953) – who demonstrated the fallacy of the expected utility principle in some choices – that economists looked to psychology for increased predictive reliability. Under the influence of Simon's concepts, behavioural economists began to set up laboratory experiments in which they tried to understand the inconsistency of humans in making economic decisions. For example, Guth *et al.* (1982) proved the deviation from classical economic behaviour in multistage bargaining processes. In this experiment, one player (the allocator) had a sum of money that he had to be allocate between himself and another anonymous player (the recipient), who could choose between an "accept" or "reject" (i.e. the money is not allocated to anyone) strategy. Results demonstrated the inconsistency of game theory, which theoretically predicts a favourable division of money for the allocator.

In the same vein, the behavioural finance stream was originally set to investigate the "influence of psychology on the behaviour of financial practitioners and the subsequent effect on markets" (Sewell, 2007, p. 1). The main assumption of behavioural finance is that investors act in an irrational way because of their financial decisions and their cognitive and emotional biases (Thaler, 1985, 1993). One of the first works in this stream was by De Bondt and Thaler (1985), who identified the existence of the overreaction of people to news events. The two authors tested the reactions of investors, to bad and good news with regards to two initial portfolios of shares, one classified as "winning" and the other as "losing". In both the portfolios, the investors overreacted by pushing stocks' prices down more than they deserved. The exaggerated reaction was based on the excessive weight assigned to more recent information; investors were basically biased by the easy availability of financial news.

During the 1980s-1990s, cognitive and brain scientists also became more interested in human rationality, reinvigorating the study of reasoning fallacies and investigating new possible sources at the basis of those fallacies, such as personality traits, emotions and brain composition (also called brain lateralization) of individuals. A number of developments occurred. First, studies in the self increased during the 1980s-1990s, as cognitive scholars sought the drivers of the consistency, over time and situations, of individual actions (Simon, 1990). Accordingly, researchers studied the recurring characteristics of personality (i.e. traits). Psychometric tests to investigate these traits, and their influence on human information processing – such as the Myers–Briggs Type Indicator (MBTI) test (Myers and McCaulley, 1985) and the Big Five Questionnaire (McCrae and Costa, 1987) – were developed. These tests sought to identify the key dimensions in which people differ, whether in terms of the emotional, experiential and motivational styles of human behaviour. For example, Costa and McCrae (1990), investigated correlations between the most studied five personality traits (openness to experience, conscientiousness, extraversion, agreeableness and neuroticism) and a vast amount of personality disorders, finding that schizoids were highly introverted, while histrionic people were highly extroverted. This was one of the first proofs that the behaviour of humans is closely connected to personality traits. However, some scholars (Boyle, 2008), identifying the context and the emotions as further factors that influence human rationality, questioned if it is only personality traits can integrally derive human behaviours.

A second development involved the well-known neuroscientist Antonio Damasio. During the 1990s, Damasio started studying the profoundly biasing role of emotions in human cognition. Damasio's works were originally stimulated by the parallel works of philosophers (Finkelstein, 1999) and psychologists (Salas *et al.*, 1996), who were concerned with the effect

of mental states (e.g. stress, depression, etc.) on human rationality. Indeed, some philosophers originally hypothesized that human cognition is the product of human mental states (Armstrong, 1999). These theories pushed neuroscientists to deepen the role of emotions in rationality. For example, Isen *et al.* (1988) demonstrated how a positive mood drives towards a superficial process of the information collected, while a negative mood pushes towards more precise information processing. In practice, therefore, people's actions were demonstrated as also closely depending on their emotions. According to Damasio (1994), p. 12), the evolution of reasoning strategies, such as heuristics, had developed thanks to the "mechanisms of biological regulation, of which emotion and feeling are notable expressions". Due to the interconnections between the biology of the organism and the human mind, the brain and the body were hypothesized as closely integrated (Churchman, 1968). However, this exploration of the body–brain relationship underwent later criticisms. According to Mosca (2000), neurobiological studies did not take into proper consideration the role of cognition in building the emotional state, because neuroscience lacked in its differentiation between the perception mechanism – how humans perceive objects through senses – and the sensation mechanism – how humans interpret objects.

A third development involved neuroscientists, who despite the highlighted criticisms, continued deepening the understanding of the physiological study of human rationality. In particular, Springer and Deutsch (1985) considered the human brain as being divided into two cerebral hemispheres, left and right. This division is also called brain lateralization and is based on the assumption that the left brain side is responsible for logical and inductive thinking, while the right side is devoted to intuitive and creative thinking (Bradshaw and Nettleton, 1981). In practice, the brain division affects the rationality of the individual thanks to these two different activities. However, despite the increase of supportive results on brain lateralization during the 1980s, some scholars were unconvinced about these findings. In this regard, Hines (1987) underlined the following methodological flaws: the electroencephalography measure that is used to assign the hemispheric dominance and the lack of control of the tasks' variables that are proposed to respondents in those studies.

1980-1990: bounded rationality in management theories – new models and new applications

Since the behavioural theory of the firm in the 1960s, scholars placed increasing emphasis on the role of coalitions and group rationality, generating new approaches to the study on how organizations make decisions. One of the well-known theories in this direction was the *upper echelons theory* of Hambrick and Mason (1984). This theory aimed at demonstrating that organizational outcomes, firm's strategic choices and related performance levels could be predicted by looking at the background (i.e. socio-demographic) characteristics, cognitive base and personal values of top managers. Through this, the bounded rationality of managers is regarded as the product of these three predictors, because they work as "a screen between the situation and the eventual perception of it" (Hambrick and Mason, 1984; p. 195). In practice, what the top manager perceives is different from the real situation because he has an innate, biased perception. In consequence, the top manager makes a strategic decision that is boundedly rational in its roots. For example, Bantel and Jackson (1989) conducted an empirical analysis of the top management teams of 199 banks to test the hypothesis – if the level of attention to innovation changes according to top managers' characteristics. The two scholars found that teams, in which top managers were well-educated and diverse in terms of work experience, paid greater attention to innovation than top management teams in which executives had low education and were similar in their working background. In this case, the

level of education and the heterogeneity in job experience had a distortional, but positive, influence on their firm's level of innovation.

Following a general trend in cognitive and behavioural studies, some scholars of upper echelons theory added psychological factors to the original approach. These additions let upper echelons theory increasingly absorb the developments of cognitive studies, even if the introduced psychological variables were not psychometrically experimented. For instance, Hayward and Hambrick (1997), tried to prove that CEOs with high levels of hubris were positively associated with acquisition overpayments in mergers and acquisitions operations. However, hubris was operationalized by looking at the media praise of CEOs and their annual compensation, not by using psychologically validated tools. Nevertheless, the major merit of the upper echelons theory is in having absorbed Cyert and March's (1963) idea of managers acting through dominant coalitions. Indeed, Hambrick and Mason (1984) conceptualized the interrelationships among top managers as mechanisms that allow managers to overcome their individual cognitive limitations, bringing them to a satisficing choice.

Emphasis on choices in organizations led to a new behavioural approach to collective rationality: negotiation theory. In this new approach, parties with different preferences are forced to reach a negotiated agreement to satisfy their interests, but most of the time they leave value on the table that does not form a profit for anyone (Lax and Sebenius, 1986). Contrary to game theory, negotiation theory considers humans as boundedly rational (Sebenius, 1992); in fact, negotiators bargain in pursuit of a satisficing alternative but continuously suffer cognitive limitations (Caputo, 2013). Negotiation theory researchers have been increasingly concerned with how the bargaining values of negotiators are affected by their cognitive abilities, offering a practical field for the application of heuristic principles. For example, Neale and Bazerman (1985) found that parties framing the negotiation in a positive way, thus favourably interpreting the risk within the bargaining task, had a less-competitive behaviour in transactions than negotiators who negatively framed the negotiation task. The negotiator's cognitive ability is, therefore, directly responsible for the value obtained from the negotiation.

Studies in the management field between the 1980s and 1990s also involved an increased examination of how managers treat information and how their judgment is cognitively formed, building on the behavioural discoveries during the 1970s. For example, Russo and Schoemaker (1989) undertook an investigation into executive choice, identifying the ten common cognitive barriers that managers encounter when making decisions (e.g. frame blindness, lack of frame control, overconfidence, etc.). These barriers, further expanded by Hammond *et al.* (1998), are the unconscious brain processes that can cause individuals to deviate negatively from rationality. The effect of these traps on managers can be more critical than for other individuals because of the consequences for the society. In fact, according to Hammond *et al.* (1998), the higher the importance of the decision, the higher the risk of falling into a cognitive trap. For example, a CFO who has to make a decision about a merger, may prefer to avoid that decision because of a willingness to maintain a less risky financial position in the market (status quo trap), offering to his stakeholders the information that supports his point of view (*confirming evidence* trap). In this case, different cognitive traps occur together and could carry to the strategic dormancy of the firm. Advances in cognitive studies in management stimulated others (Taggart and Valenzi, 1990) to investigate the roots of cognitive error. In particular, researchers paid attention to the personality traits of decision-makers, implementing the most cited psychometric tools developed in psychology. The MBTI tool, in particular, has been used for the study of managers' personality and their cognitive styles (Gardner and Martinko, 1996), offering

some important results for the research on bounded rationality. For example, Nutt (1990) found that sensor–feelers – people whose information gathering approach is based on the five senses and whose evaluating information approach is driven by personal warmth – were the most risk tolerant in choice situations.

2000s – onwards: the brain-mind revolution

At the beginning of the new millennium, previous findings on the right-left brain theories of the 1980s were deepened by cognitive scholars with the aim of mapping human rationality and finding its levers. In particular, Stanovich and West (2002) and Kahneman (2003) defined human cognitive functioning as occurring in two different systems of our mind. Notably, these scholars discovered that mental operations that are spontaneous, fast and automatic are associated with "System 1" of our mind, while the mental operations of "System 2" are "more likely to be consciously monitored and deliberately controlled" (Kahneman, 2003, p. 698). The outputs of the two systems are also different: System 1 generates impressions of a perceived and considered object's characteristics, while System 2 elaborates complex judgments.

This investigation on the twofold functioning of the human mind offered an explanation as to why human biases happen (Kahneman, 2011). For example, when a novice is driving a car, he/she is very focused on operating the vehicle to ensure good driving; this activity requires mental effort and System 2 is continuously in action. In contrast, the expert driver is more confident about driving and activates only the automatic processes of System 1. The expert driver executes this and other tasks at the same time (such as calling a friend), and the switch from System 1 to System 2 is activated only when stimulated by external forces, such as extreme weather conditions. In this case, those considering themselves to be expert drivers can push themselves into an overconfidence cognitive trap, creating risky situations. The dual-system theory has been questioned by several scholars (Kruglanski and Gigerenzer, 2011) – who have challenged the different and not conclusive definitions of Systems 1 and 2 – and the methodology at the core of the experiments behind the theory. The seminal works on Systems 1 and 2 offered an explanation as to what is at the heart of the irrational behaviour.

During the 2000s, pure neuroscientists incorporated these discoveries into their studies, trying to bridge the gap between the reasoning mechanisms of the mind and the biological mechanisms of the brain. For example, Kuo *et al.* (2009) faced the first important question of this cross-fertilization: is the distinction between intuition and deliberative reasoning related to a parallel biological brain division? They found that the mind divergence between left and right reasoning is essentially based on the activation of different brain areas. When the individual is stimulated to deliberative reasoning (typical of System 2), some brain areas (middle frontal gyrus, inferior parietal lobule, and precuneus) are more active; in contrast, intuition-based tasks executed by System 1 activate other brain areas (insula and anterior cingulate cortex). These discoveries offered answers to old issues on human rationality, stimulating the birth of cross-fertilized studies, such as neuroeconomics, to explain erratic human decisions. In particular, neuroeconomists are concerned with understanding the neural roots of erratic economic behaviour by using neuroscientific methodologies and techniques, such as magnetic resonance. Drawing on this framework, Tom *et al.* (2007) studied the relationships among potential losses and regions of brain activity. In particular, their findings questioned the established hypothesis that potential losses are connected with an increase in activity regions of the brain responsible of negative feelings (Luce, 1998). Indeed, they found that when a person is experiencing losses, there is a decrease in the activity in brain regions (ventral striatum, medial prefrontal cortex and posterior cingulate

cortex) connected to positive emotions and reward, and not an increase of activity in neural activity linked with negative emotions. However, the first applications of neuroscience in the social science sub-fields raised some ethical, social and legal concerns, such as the safety of the participant during the experiments (Fuchs, 2006).

2000s – onwards: present and future of managerial studies on bounded rationality

The theorization of heuristics and cognitive traps from the 1970s to the 1990s started cross-fertilizing during the 2000s. In particular, studies in this era were mainly concerned with the reduction of cognitive errors of managers and the first theorization of the behavioural approach for organizations. A specific management tool to reduce cognitive biases was first proposed by Kahneman *et al.* (2011). Starting from the assumption that the mind works according to Systems 1 and 2 (Kahneman, 2003), a checklist of 12 questions, each one linked to a precise cognitive distortion, was developed. Thanks to this tool, a third person may recognize – through his own System 2 – the unconscious distortions of participants' System 1 that have affected the decision-making process. The rationale behind this tool and other developed instruments to reduce biases (Klein, 2007), lies in the adoption of a "vigilant mindset" (Zhang *et al.*, 2015), considered as a main step towards bias-free organizations (Gardiner, 2016). Although the adoption of a behavioural approach to organizations and strategy was previously claimed by Ansoff (1987), but, onlyPowell *et al.* (2011) offered it as a first formal conceptualization of a behavioural strategy paradigm and of its field. Specifically, in the Powell *et al.* (2011, p. 1371) field-positioning paper, this new stream was seminally identified as merging the "cognitive and social psychology with strategic management theory and practice". From that, the use of the behavioural approach to look at four main challenges in the study of rationality in organizations was proposed:

(1) understanding the scaling from individual cognition to collective behaviour;

(2) identifying the psychological pillars of strategic theory;

(3) understanding complex judgment in organizations; and

(4) ameliorating the psychological architecture of the firm.

After this first conceptual contribution, Gavetti (2012, p. 268) focused his attention on drawing a behavioural theory of strategy aimed at "identify[ing] the behavioral drivers of superior performance" for organizations. In particular, Gavetti classified the factors that systematically bound the human rationality while competing in organizations, namely, rationality bounds (Simon's, 1947) human limits); plasticity bounds (inertia in moving towards the goal); and shaping-ability bounds (limits in legitimating, in front of the stakeholders, the pursuit of specific opportunities that drive superior performance). Following this path, Greve (2013) proposed four behavioural strategies with the intention of enhancing the understanding of how some organizations are more rational and astute in catching opportunities than others.

The four behavioural strategies of Greve (2013) (momentum, feedback, inference and anticipation) were, moreover, offered as means for the investigation of the decision-making processes, to improve organizational rationality and to understand the processes' evolutionary path. However, in contrast to Gavetti (2012), who perceived individual limitations as a more fertile field for explaining the superior performance of some organizations, Greve (2013) identified the whole organizational rationality as the unit of analysis for explaining firms' supremacy. The contrast between the two schools of thought is evident. While Gavetti (2012) approaches the behavioural question on strategy by looking

at single, individual behaviours, Greve (2013) observes the entire organizational strategic behaviour. Despite this huge commitment of management scholars in building a behavioural approach to strategy, Powell *et al.* (2011) highlighted that this field still needs to find its unity; in particular, the challenge for this approach is to bring together the different paradigms that over time have operated independently.

If on the one hand, behavioural strategists are claiming for a greater involvement of psychology in the managerial field, then on the other hand, other management scholars are currently trying to attract neuroscientists to the research on how to increase rationality in organizations. Despite the ethical issues in the adoption of neuroscientific methodologies in social science (Fuchs, 2006), management scholars have synthesized a new interdisciplinary field of investigation adopting neuroscientific techniques and frameworks: neurostrategy. This is an approach that tries to clarify grey areas in the study of human rationality in organizations connecting unobserved mental constructs with the activation of particular areas of the brain (Gazzaniga, 2006). Although there is this increasing interest in the cross-fertilization of management and neuroscientific studies, Powell *et al.* (2011) highlighted that neurostrategic studies mainly suffer from the "so what" problem. Among management scholars the contribution is questioned. For practitioners, there is a desire to know what part of the brain is activated during a strategic choice. For example, Waldman *et al.* (2011) began a research programme on neuroscience and inspirational leadership, which highlighted differences in neural connectivity. Results of the study show that managers with high activity in the right frontal cortex were also reputed to be excellent in visionary communication and charismatic leadership. Good leaders are such because of their innate "good neural activity"; however, the contribution for management scholars and practitioners remains blurred. As a consequence of these criticisms, Powell *et al.* (2011) responded by declaring that neurostrategy will be an advantageous approach if it acts as a bridge for behavioural strategy studies, with which neurostrategy is expected to converge in the near future. Neuroscientific techniques, therefore, should be used to "neurally validate" the constructs and theories on human rationality in organizations.

Discussion and implications for future research

This study sought to delineate how the bounded rationality concept has evolved in an interdisciplinary manner over the past seven decades; and offer historically informed recommendations to bounded rationality researchers in management that may illuminate the way forward. This section aims to tackle this second point.

First, although the bounded rationality principles and assumptions are well-known in management and related domains, this concept is now often being confused with irrationality. Despite Simon (1997) himself refusing to speak about bounded rationality as irrationality, since Barnard's (1938) masterpiece, several other studies on irrational forces (such as intuition, emotions and mental states; Isen *et al.*, 1988; Damasio, 1994) have enlarged the spectrum of human limitations. Being boundedly rational or being irrational still remain two different concepts, because making either a boundedly rational decision or an irrational choice is driven by different limitations, although they may lead to the same results. Even if some scholars regard irrationality as an abnormal behaviour of mentally ill people (Selten, 1999), others assert that "severe irrationality is sometimes caused by normal human motivation rather than by mental or physical dysfunction" (Sakakibara, 2016, p. 147); this latter conceptualization of irrationality has increasingly pervaded recent management literature, becoming the main interpretation (Ariely, 2008; Guo, 2009). This study suggests that future research on human rationality in management should instead investigate the impact of irrational forces by trying to find their inter-connections with the bounded rational

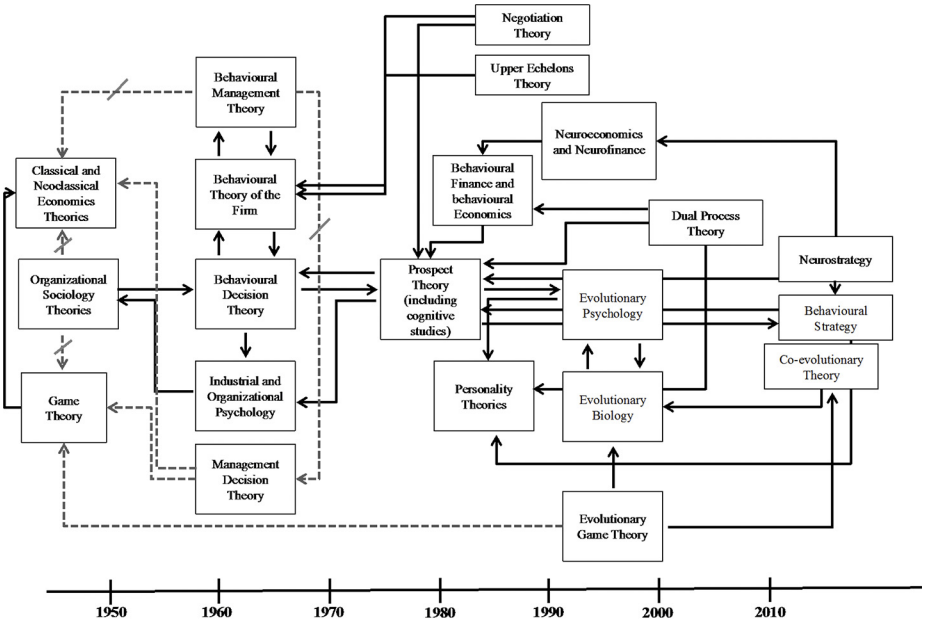
ones, so as to amplify the strength of both the concepts. For example, it would be interesting to understand the effects of positive and negative feelings of individuals on their computational skills in a social situation, such as a bargaining process.

Second, despite the new frontier of neuroscience broadening the biological understanding of the hidden rationality mechanisms, it suffers some weaknesses that curtail its application in management research. Among these weaknesses are the lack of consideration of brain neuroplasticity; and the unreliability of empirical data/methods. Recently, Pascual-Leone *et al.* (2011) discovered the phenomenon of neuroplasticity of the brain, which is the neural adaptation of the brain to social environmental changes across the lifespan. This proves that the brain mechanisms studied in the adolescent phase of an individual give different responses if investigated in the maturity period, because of the intervening social experiences that influenced neural connectivity. These changes affect the validity of neuroscientific research. Apart from the problematic interpretation of neural results, neural data themselves have over time received different criticisms. Brain studies, despite the increasing number of publications (Gazzaniga, 2006), are not able to give solid insights into the connections of a single brain area with a unique mind activity (Powell, 2011). Indeed, different mind activities can occur in the same brain region, affecting the reliability of neural data (Poldrack, 2006). For example, the overconfidence mechanism, motivation and reward perception are all mechanisms that activate the striatum of the brain. Moreover, an interdisciplinary study by Eklund *et al.* (2016), which involved experts in statistics and medical informatics, demonstrated that the most used neuroscientific statistical techniques – applied in more than 25,000 publications – are without doubt profoundly biased because of the lack of initial solid tests on the adopted neuroscientific software. This important finding clearly compromised, and continues to compromise, the reliability of neuroscientific studies and related data.

In sum, the cross-fertilization from neuroscience to management is far from being the panacea that can heal (fill) all the rationality illnesses (gaps). Only after having solved these methodological problems, also thanks to the contemporaneous adoption of the behavioural strategy lens, can neuroscientific applications be considered as useful for research in the management area.

Third, scholars over time have studied bounded rationality in depth from different standpoints. The trajectories taken from these different views – charted in Figure 2 – ask for a reconnection in favour of a comprehensive study of the new forthcoming challenges on human rationality and to overcome the different pitfalls that have emerged in each theory.

Within the proposed outline, the bounded rationality concept proposed by Simon (1947) – comprising the organizational sociology theories – has conditioned the assumptions of all the other subsequent approaches, as exposed in this historical analysis. The second landmark happened during the 1970s, when Kahneman and Tversky (1979) introduced their prospect theory, which was directly descended from the original bounded rationality ancestor, to empirically demonstrate the erratic deviation of humans from rational behaviour. Prospect theory influenced all the other consecutive studies in management and related fields with its insights on human cognitive shortcuts used to deal with decisions under risk. During and after the introduction of the bounded rationality concept and prospect theory, different approaches have been developed and applied to understand individual rationality (e.g. classical and neoclassical economic theories) or collective rationality (e.g. behavioural theory of the firm). The current problem for researchers is to reconnect the theories that over time were concerned with these two different levels of rationality. The goal is to face the challenges on human rationality wisely delineated by behavioural strategists (Powell *et al.*, 2011). In this regard, sociobiological and behavioural theories – that already demonstrated



Notes: Strong ties between two theories/streams: →; weak ties between two theories/streams: --->. Strong ties are used when a theory directly descends from another one and accepts all its assumptions and results; two strong ties are used when the influence is reciprocal. Weak ties are used when a theory either partially accepts (--->) or totally rejects (--/->) the starting assumptions of another one as the basis for new advancements. Within the Organizational Sociology Theories are included the bounded rationality of Simon (1947) and the organizational advancements by Barnard (1938). Theories are chronologically ordered according to their contribution to bounded rationality

Figure 2.
Perspectives on bounded rationality: a timeline of the historical evolution

their power in delineating how individuals act in their social and competitive environment (Smith, 1982; Cosmides and Tooby, 1997) – are the most promising to fill this gap because of their evolutionary and behavioural assumptions (Akinci and Sadler-Smith, 2012; Shao and Lee, 2014). However, even if biology and sociobiology were constantly used during the whole historical timeline to explain economics phenomena, from Simon (1956) to game theorists (Smith, 1982) and neuroeconomists (Bossaerts and Murawski, 2015), there are very few works that apply these approaches in the management field to explain firms' and groups' behaviours (Abatecola, 2014; Breslin, 2014; Cafferata, 2014).

A boost will hopefully come from the adoption of a deepened behavioural approach to organisational rationality (Gardiner, 2016) – i.e. behavioural strategy – which has as its basis in both evolutionary and behavioural assumptions and can, therefore, work as a solid initial framework for facing old and new open issues in organizational rationality (Powell *et al.*, 2011; Gavetti, 2012; Greve, 2013). For example, light should be shed on why, within some firms or industries, altruistic individuals are selected out, while in others they adapt to the environment; this investigation is even more interesting if performed in cross-cultural settings.

To conclude, the innate blurry disciplinarity of human rationality variables, and the already discovered congenital interrelations of the different scientific fields, have augmented the complexity of the investigation into human rationality in organizations. The most important challenge, that has to inspire current and future management scholars, still remains the one indicated by Simon (1983): producing a comprehensive theory of human rationality that can compete with the classical one. However, at this stage of the literature, reaching a general theory of rationality that is able to determine all the unique implications of individual and collective behaviours, is at least utopian; in fact, the totality of variables and their interrelated mechanisms that govern our reasoning are still unknown. The next level, therefore, is to design transdisciplinary studies that will provide a broader lens than those of the recent past, facing the human rationality problem from a holistic perspective (Gintis, 2006). The proposed approach is best executed by merging the boundaries of a multitude of different fields in natural and social science to create new synthesized disciplines. Even if it may be argued that neuroeconomics, neurostrategy and behavioural strategy are already existing examples of transdisciplinary studies, current frameworks should be enlarged so as to unify natural and social science disciplines. Merging behavioural and neuroscientific approaches, in a new synthesized and more systemic discipline, can help scholars to look at the individual, collective and environmental variables all together. Only by the consolidation of natural and social science sub-fields can a general theory of rationality be reached.

Note

1. To whom Simon (1957, p. 47) "owe[s] a special debt: first, for his own book, *The Functions of the Executive*, which has been a major influence upon my thinking about administration".

References

Abatecola, G. (2014), "Untangling self-reinforcing processes in managerial decision making: *co-evolving* heuristics?", *Management Decision*, Vol. 52 No. 5, pp. 934-949.

Abatecola, G., Cafferata, R. and Poggesi, S. (2012), "Arthur Stinchcombe's 'liability of newness': contribution and impact of the construct", *Journal of Management History*, Vol. 18 No. 4, pp. 402-418.

Akinci, C. and Sadler-Smith, E. (2012), "Intuition in management research: a historical review", *International Journal of Management Reviews*, Vol. 14 No. 1, pp. 104-122.

Allais, M. (1953), "Le comportement de l'homme rationnel devant le risque, critique des postulats et axiomes de l'ecole americaine", *Econometrica*, Vol. 21 No. 4, pp. 503-546.

Ansoff, H.I. (1987), "The emerging paradigm of strategic behavior", *Strategic Management Journal*, Vol. 8 No. 6, pp. 501-515.

Archer, S.H. (1964), "The structure of management decision theory", *Academy of Management Journal*, Vol. 7 No. 4, pp. 269-287.

Argote, L. and Greve, H.R. (2007), "Behavioral theory of the firm – 40 years and counting: introduction and impact", *Organization Science*, Vol. 18 No. 3, pp. 337-349.

Ariely, D. (2008), *Predictably Irrational*, Harper Collins, New York, NY.

Armstrong, D.M. (1999), *The Mind-Body Problem: An Opinionated Introduction*, Westview Press, Boulder, CO.

Aumann, R.J. (1997), "Rationality and bounded rationality", *Games and Economic Behavior*, Vol. 21 Nos 1/2, pp. 2-14.

Bantel, K.A. and Jackson, S. (1989), "Top management and innovations in banking: does the composition of the top team make a difference?", *Strategic Management Journal*, Vol. 10 No. S1, pp. 107-124.

Barnard, C.I. (1938), *The Functions of the Executive*, Harvard University Press, Cambridge, MA.

Becker, G.M. (1962), "Irrational behavior and economic theory", *The Journal of Political Economy*, Vol. 70 No. 1, pp. 1-13.

Bossaerts, P. and Murawski, C. (2015), "From behavioral economics to neuroeconomics to decision neuroscience: the ascent of biology on human decision making", *Current Opinion in Behavioral Sciences*, Vol. 5, pp. 37-42.

Boyle, G.J. (2008), "Critique of the five-factor model of personality", Humanities & Social Sciences Papers, Paper 297, available at: http://epublications.bond.edu.au/hss_pubs/297

Bradshaw, J. and Nettleton, N. (1981), "The nature of hemispheric specialization in man", *Behavioral and Brain Sciences*, Vol. 4 No. 1, pp. 51-91.

Breslin, D. (2014), "The routinization of group behavior and the evolution of ideas", *14th European Academy of Management (EURAM) Conference, Valencia*.

Cafferata, R. (2014), "Management in adattamento", *Tra Razionalità Economia, Evoluzione e Imperfezione dei Sistemi*, Mulino, Bologna, IL.

Callebaut, W. (2007), "Herbert Simon's silent revolution", *Biological Theory*, Vol. 2 No. 1, pp. 76-86.

Camerer, C.F. (1999), "Behavioral economics: reunifying psychology and economics", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 96 No. 19, pp. 10575-10577.

Camerer, C.F., Loewenstein, G. and Rabin, M. (2004), *Advances in Behavioral Economics*, Princeton University Press, NJ.

Caputo, A. (2013), "A literature review of cognitive biases in negotiation processes", *International Journal of Conflict Management*, Vol. 24 No. 4., pp. 347-398.

Churchman, C.W. (1968), *Challenge to Reason*, McGraw Hill, New York, NY.

Cosmides, L. and Tooby, J. (1997), *Evolutionary Psychology: A Primer*, Center for Evolutionary Psychology, available at: www.psych.ucsb.edu/research/cep/primer.html (accessed 3 October 2016).

Costa, P.T. Jr. and McCrae, R.R. (1990), "Personality disorders and the five-factor model of personality", *Journal of Personality Disorders*, Vol. 4 No. 4, pp. 362-371.

Cyert, R.M. and March, J.G. (1963), *A Behavioral Theory of the Firm*, Prentice-Hall, Englewood Cliffs, NJ.

Dahlgaard-Park, S.M. and Dahlgaard, J.J. (2007), "Excellence – 25 years evolution", *Journal of Management History*, Vol. 13 No. 4, pp. 371-393.

Damasio, A.R. (1994), *Descartes' Error: Emotion, Reason, and the Human Brain*, G.P. Putnam, New York, NY.

De Bondt, W.F.M. and Thaler, R. (1985), "Does the stock market overreact?", *The Journal of Finance*, Vol. 40 No. 3, pp. 793-805.

Edwards, W. (1961), "Behavioral decision theory", *Annual Review of Psychology*, Vol. 12, pp. 473-498.

Einhorn, H.J. and Hogarth, R. (1981), "Behavioral decision theory: processes of judgment and choice", *Annual Review of Psychology*, Vol. 32, pp. 53-88.

Eklund, A., Nichols, T.E. and Knutsson, H. (2016), "Cluster failure: why fMRI inferences for spatial extent have inflated false-positive rates", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 113 No. 28, pp. 7900-7905.

Finkelstein, D.H. (1999), "On the distinction between conscious and unconscious states of mind", *American Philosophical Quarterly*, Vol. 36 No. 2, pp. 79-100.

Fuchs, T. (2006), "Ethical issues in neuroscience", *Current Opinion in Psychiatry*, Vol. 19 No. 6, pp. 600-607.

Gardiner, M. (2016), "Designing a bias-free organization", *Harvard Business Review*, Vol. 94 Nos 7/8, pp. 62-67.

Gardner, W.L. and Martinko, M.J. (1996), "Using the Myers–Briggs type indicator to study managers: a literature review and research agenda", *Journal of Management*, Vol. 22 No. 1, pp. 45-83.

Gavetti, G. (2012), "Toward a behavioral theory of strategy", *Organization Science*, Vol. 23 No. 1, pp. 267-285.

Gazzaniga, M.S. (2006), "The brain as boondoggle", *Harvard Business Review*, Vol. 84, p. 66.

Gazzaniga, M.S. and LeDoux, J.E. (1978), *The Integrated Mind*, Plenum Press, New York, NY.

Gigerenzer, G. and Gaissmaier, W. (2011), "Heuristic decision making", *Annual Review of Psychology*, Vol. 62, pp. 451-482.

Gintis, H. (2006), "The foundations of behavior: the beliefs, preferences, and constraints mode", *Biological Theory*, Vol. 1 No. 2, pp. 123-127.

Good, I.J. (1962), "How rational should a manager be?", *Management Science*, Vol. 8 No. 4, pp. 383-393.

Greve, H.R. (2013), "Microfoundations of management: behavioral strategies and levels of rationality in organizational action", *Academy of Management Perspectives*, Vol. 27 No. 2, pp. 103-119.

Guo, Y. (2009), "Study on irrational strategic management", *International Journal of Marketing Studies*, Vol. 1 No. 2, pp. 92-95.

Guth, W., Schmittberger, R. and Schwarz, B. (1982), "An experimental analysis of ultimatum bargaining", *Journal of Economic Behavior and Organization*, Vol. 3 No. 4, pp. 367-388.

Hambrick, D.C. and Mason, P.A. (1984), "Upper echelons: the organization as a reflection of its top managers", *Academy of Management Review*, Vol. 9 No. 2, pp. 193-206.

Hammond, S.H., Keeney, R.L. and Raiffa, H. (1998), "The hidden traps in decision making", *Harvard Business Review*, Vol. 76 No. 5, pp. 47-58.

Hayward, M. and Hambrick, D. (1997), "Explaining the premiums paid for large acquisitions: evidence of CEO hubris", *Administrative Science Quarterly*, Vol. 42 No. 1, pp. 103-127.

Hillman, R.A. (2000), *Limits of Behavioral Decision Theory in Legal Analysis: the Case of Liquidated Damages*, Cornell Law Faculty Publications, Paper 548, available at: http://scholarship.law.cornell.edu/facpub/548 (accessed 25 October 2016).

Hines, T. (1987), "Left brain/right brain mythology and implications for management and training", *Academy of Management Review*, Vol. 12 No. 4, pp. 600-606.

Isen, A.M., Nygren, T.E. and Ashby, F.G. (1988), "Influence of positive affect on the subjective utility of gains and losses: it is just not worth the risk", *Journal of Personality and Social Psychology*, Vol. 55 No. 5, pp. 710-717.

Kahneman, D. (2003), "A perspective on judgment and choice: mapping bounded rationality", *American Psychologist*, Vol. 58 No. 9, pp. 697-720.

Kahneman, D. (2011), *Thinking, Fast and Slow*, Farrar, Straus and Giroux, New York, NY.

Kahneman, D. and Tversky, A. (1979), "Prospect theory: an analysis of decision under risk", *Econometrica*, Vol. 47 No. 2, pp. 263-291.

Kahneman, D., Lovallo, D. and Sibony, O. (2011), "The big idea. Before you make that big decision", *Harvard Business Review*, Vol. 89 No. 6, pp. 50-60.

Kalantari, B. (2010), "Herbert A. Simon on making decisions: enduring insights and bounded rationality", *Journal of Management History*, Vol. 16 No. 4, pp. 509-520.

Kerr, G. (2007), "The development history and philosophical sources of Herbert Simon's Administrative Behavior", *Journal of Management History*, Vol. 13 No. 3, pp. 255-268.

Kerr, G. (2011), "What Simon said: the impact of the major management works of Herbert Simon", *Journal of Management History*, Vol. 17 No. 4, pp. 399-419.

Klein, G. (2007), "Performing a project premortem", *Harvard Business Review*, Vol. 85 No. 9, pp. 18-19.

Kruglanski, A.W. and Gigerenzer, G. (2011), "Intuitive and deliberative judgements are based on common principles", *Psychological Review*, Vol. 118, pp. 97-109.

Kuo, W.-J., Sjöström, T., Chen, Y.-P., Wang, Y.-H. and Huang, C.-Y. (2009), "Intuition and deliberation: two systems for strategizing in the brain", *Science*, Vol. 324 No. 5926, pp. 519-522.

Kyburg, H.E. (1961), *Probability and the Logic of Rational Belief*, Wesleyan University Press, Middletown, CT.

Kyburg, H.E. (1978), "Subjective probability: criticisms, reflections, and problems", *Journal of Philosophical Logic*, Vol. 7, pp. 157-180.

Lax, D.A. and Sebenius, J.K. (1986), *The Manager as Negotiator: Bargaining for Cooperation and Competitive Gain*, Macmillan, New York, NY.

Luce, M.F. (1998), "Choosing to avoid: coping with negatively emotion-laden consumer decisions", *Journal of Consumer Research*, Vol. 24 No. 4, pp. 409-433.

McCrae, R.R. and Costa, P.T., Jr. (1987), "Validation of the five-factor model of personality across instruments and observers", *Journal of Personality and Social Psychology*, Vol. 52 No. 1, pp. 81-90.

March, J.G. (1978), "Bounded rationality, ambiguity, and the engineering of choice", *The Bell Journal of Economics*, Vol. 9 No. 2, pp. 587-608.

March, J.G. and Simon, H.A. (1958), *Organizations*, John Wiley and Sons, New York, NY.

Mosca, A. (2000), "A review essay on Antonio Damasio's: the feeling of what happens: body and emotion in the making of consciousness", *Psyche: An Interdisciplinary Journal of Research on Consciousness*, Vol. 6 No. 10.

Murphy, P.J., Liao, J. and Welsch, H.P. (2006), "A conceptual history of entrepreneurial thought", *Journal of Management History*, Vol. 12 No. 1, pp. 12-35.

Myers, I.B. and McCaulley, M.H. (1985), *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator*, Consulting Psychologists Press, Palo Alto, CA.

Neale, M.A. and Bazerman, M. (1985), "The effects of framing and negotiator overconfidence on bargaining behaviors and outcomes", *Academy of Management Journal*, Vol. 28 No. 1, pp. 34-47.

Nutt, P. (1990), "Strategic decisions made by top executives and middle managers with data and process dominant styles", *Journal of Management Studies*, Vol. 27 No. 2, pp. 173-194.

Pascual-Leone, A., Freitas, C., Oberman, L., Horvath, J.C., Halko, M., Eldaief, M., Bashir, S., Vernet, M., Shafi, M., Westover, B., Vahabzadeh-Hagh, A.M. and Rotenberg, A. (2011), "Characterizing brain cortical plasticity and network dynamics across the age-span in health and disease with TMS-EEG and TMS-fMRI", *Brain Topography*, Vol. 24 Nos 3/4, pp. 302-315.

Petit, T.A. (1967), "A behavioral theory of management", *Academy of Management Journal*, Vol. 10 No. 4, pp. 341-350.

Poldrack, R.A. (2006), "Can cognitive processes be inferred from neuroimaging data?", *Trends in Cognitive Sciences*, Vol. 10 No. 2, pp. 59-63.

Powell, T.C. (2011), "Neurostrategy", *Strategic Management Journal*, Vol. 32 No. 13, pp. 1484-1499.

Powell, T.C., Lovallo, D. and Fox, C.R. (2011), "Behavioral strategy", *Strategic Management Journal*, Vol. 32 No. 13, pp. 1369-1386.

Russo, E. and Schoemaker, P.J.-H. (1989), *Decision Traps: The Ten Barriers to Brilliant Decision Making and How to Overcome Them*, Simon & Schuster, New York, NY.

Sakakibara, E. (2016), "Irrationality and pathology of beliefs", *Neuroethics*, Vol. 9 No. 2, pp. 147-157.

Salas, E., Driskell, E. and Hughes, S. (1996), "The study of stress and human performance", in Driskell, J.E. and Salas, E. (Eds), *Stress and Human Performance*, Lawrence Erlbaum Associates, NJ, pp. 1-45.

Sebenius, J.K. (1992), "Negotiation analysis: a characterization and review", *Management Science*, Vol. 38 No. 1, pp. 18-38.

Selten, R. (1999), "What is bounded rationality?", SFB Discussion Paper B-454, Dahlem Conference.

Sewell, M. (2007), *Behavioral Finance*, University of Cambridge, Cambridge, MA, available at: www.behaviouralfinance.net/behavioural-finance.pdf

Shao, R. and Lee, T.M. (2014), "Aging and risk taking: toward an integration of cognitive, emotional, and neurobiological perspectives", *Neuroscience and Neuroeconomics*, Vol. 3, pp. 47-62.

Short, F.J. Jr. (1984), "The social fabric at risk: toward the social transformation of risk analysis", *American Sociological Review*, Vol. 49, pp. 711-725.

Simon, H.A. (1947), *Administrative Behavior*, 1st ed., Free Press, New York, NY.

Simon, H.A. (1955), "A behavioral model of rational choice", *The Quarterly Journal of Economics*, Vol. 69 No. 1, pp. 99-118.

Simon, H.A. (1956), "Rational choice and the structure of the environment", *Psychological Review*, Vol. 63 No. 2, pp. 129-138.

Simon, H.A. (1957), *Administrative Behavior*, 2nd ed., Free Press, New York, NY.

Simon, H.A. (1978a), "Prize lecture: rational decision-making in business organizations", *Nobel Media AB 2014*, available at: www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1978/simon-lecture.html (accessed 2 Jun 2016).

Simon, H.A. (1978b), "On how to decide what to do", *Bell Journal of Economics*, Vol. 9 No. 2, pp. 494-507.

Simon, H.A. (1980), "The behavioral and social science", *Science*, Vol. 209 No. 4452, pp. 72-78.

Simon, H.A. (1983), "On the behavioral and rational foundations of economic dynamics", *Journal of Economic Behavior and Organization*, Vol. 5 No. 1, pp. 35-55.

Simon, H.A. (1987), "Making management decisions: the role of intuition and emotion", *Academy of Management Executive*, Vol. 1 No. 1, pp. 57-64.

Simon, H.A. (1990), "Invariants of human behavior", *Annual Review of Psychology*, Vol. 41, pp. 1-20.

Simon, H.A. (1997), *Administrative Behavior*, 4th ed., Free Press, New York, NY.

Simon, H.A. (2005), "Darwinism, altruism and economics", in Dopfer, G. (Ed.), *The Evolutionary Foundations of Economics*, Cambridge University Press, Cambridge, MA, pp. 89-104.

Skyrms, B. (1975), *Choice and Chance: An Introduction to Inductive Logic*, Dickenson Publication.

Slovic, P. (1987), "Perception of risk", *Science*, Vol. 236 No. 4799, pp. 280-285.

Slovic, P. Fischhoff, B. and Lichtenstein, S. (1984), "Behavioral decision theory perspectives on risk and safety", *Acta Psychologica*, Vol. 56, pp. 183-203.

Slovic, P., Fischhoff, B. and Lichtenstein, S. (1977), "Behavioral decision theory", *Annual Review of Psychology*, Vol. 28, pp. 1-39.

Smith, M.J. (1982), *Evolution and the Theory of Games*, Cambridge University Press, Cambridge, MA.

Springer, S. and Deutsch, G. (1985), *Left Brain, Right Brain*, 2nd ed., Freeman, San Francisco, CA.

Stanovich, K.E. and West, R.F. (2002), "Individual differences in reasoning: implications for the rationality debate", *Behavioural and Brain Sciences*, Vol. 23 No. 5, pp. 645-726.

Taggart, W. and Valenzi, E. (1990), "Assessing rational and intuitive styles: a human information processing metaphor", *Journal of Management Studies*, Vol. 27 No. 2, pp. 149-172.

Taylor, R.N. (1975), "Psychological determinants of bounded rationality: implications for decision making strategies", *Decision Sciences*, Vol. 6, pp. 429-429.

Thaler, R. (1985), "Mental accounting and consumer choice", *Marketing Science*, Vol. 4 No. 3, pp. 199-214.

Thaler, R. (1993), *Advances in Behavioral Finance*, Sage Publications, New York, NY.

Tom, S.M., Fox, C.R., Trepel, C. and Poldrack, R.A. (2007), "The neural basis of loss aversion in decision-making under risk", *Science*, Vol. 315 No. 5811, pp. 515-518.

Tversky, A. and Kahneman, D. (1973), "Availability: a heuristic for judging frequency and probability", *Cognitive Psychology*, Vol. 5 No. 2, pp. 207-232.

Tversky, A. and Kahneman, D. (1974), "Judgment under uncertainty: heuristics and biases", *Science*, Vol. 185 No. 4157, pp. 1124-1131.

Tversky, A. and Kahneman, D. (1986), "Rational choice and the framing of decisions", *The Journal of Business*, Vol. 59 No. 4, pp. S251-S278.

Vazsonyi, A. (1974), "Pragmatics: rational approach to irrationality", *Interfaces*, Vol. 4 No. 3, pp. 40-45.

Von Neumann, J. and Morgenstern, O. (1944), *Theory of Games and Economic Behavior*, Princeton University Press, Princeton, NJ.

Waldman, D.A., Balthazard, P.A. and Peterson, S. (2011), "The neuroscience of leadership: can we revolutionize the way that leaders are identified and developed?", *Academy of Management Perspectives*, Vol. 25 No. 1, pp. 60-74.

Walras, L. (1883), *Théorie Mathématique de la Richesse Sociale*, Duncker & Humblot, Lausanne.

Wang, X.T. (1995), "Evolutionary hypothesis of risk-sensitive choice: age differences and perspective change", *Ethology and Sociobiology*, Vol. 17 No. 1, pp. 1-15.

Wilson, E.O. (1978), *On Human Nature*, Harvard University Press, Cambridge, MA.

Zhang, T., Fletcher, P.O., Gino, F. and Bazerman, M.H. (2015), "Reducing bounded ethicality: how to help individuals notice and avoid unethical behavior", *Organizational Dynamics*, Vol. 44 No. 4, pp. 310-317.

Further reading

Gigerenzer, G. and Goldstein, D. (1996), "Reasoning the fast and frugal way: models of bounded rationality", *Psychological Review*, Vol. 103 No. 4, pp. 650-669.

Gigerenzer, G. and Selten, R. (2002), *Bounded Rationality: The Adaptive Toolbox*, MIT Press, Cambridge, MA.

Sanfey, A.G., Rilling, J.K., Aronson, J.A., Nystrom, L.E. and Cohen, J.D. (2003), "The neural basis of economic decision-making in the ultimatum game", *Science*, Vol. 300 No. 5626, pp. 1755-1758.

Thaler, R. (1981), "Some empirical evidence on dynamic inconsistency", *Economic Letters*, Vol. 8 No. 3, pp. 201-207.

Wei, L.-Q. and Ling, Y. (2015), "CEO characteristics and corporate entrepreneurship in transition economies: evidence from China", *Journal of Business Research*, Vol. 68 No. 6, pp. 1157-1165.

Corresponding author

Matteo Cristofaro can be contacted at: matteo.cristofaro@uniroma2.it