2 Broad Theoretical Background

This section deals with some foundational psychological notions which provide valuable insights into the cognitive foundations of human judgment as a prelude to the inquiry into the central features and determinants of auditor judgment. It should be noted that the considerations within this section are of general nature and are not intended to be all-encompassing.[24] Rather, they aim to provide a broad theoretical basis for the study of information order effects and professional skepticism in the context of auditors' belief revisions.

2.1 Need for Adoption of a Psychological Lens in Behavioral Research

2.1.1 Normative Economic Theory and Its Behavioral Limitations

Economics, the queen of social sciences, is built upon the fundamental notion of rationality, which serves as the central behavioral assumption in explaining economic phenomena.[25] According to expected utility theory[26], which is the core formal account of rationality, human behavior can be viewed as a choice from a set of alternatives, each of which is characterized by a designated value as well as a probability of occurrence. The economic agent effortlessly and thoroughly processes the vast amounts of information[27], assesses all available options in terms of their likelihood and expected value, and eventually chooses the alternative that promises the maximal expected utility, i.e., goal achievement.[28] As new information arrives, the rational economic man is assumed to revise his previously held probabilistic positions in strict accordance with logical rules. The core normative principle typically applied for updating probabilities in light of new evidence is Bayes' theorem, which represents a rigorous combi-

[24] As claimed by *Kaufman* (1999): 363, the relevant literature in economics and psychology is immense. Hence, it is barely possible to provide an overview that does more than merely scratch the surface. The same applies to the voluminous auditing literature on judgment and decision making.

[25] See, e.g., *Hogarth/Reder* (1986): 2. Overall, the rationality concept has been viewed as one of the most important achievements of the social sciences ever. See *Simon* (1980): 75. For an excellent and very insightful review of the varieties of economic rationality from *Adam Smith* (1723-1790) to the present, refer to *Zouboulakis* (2014): 5-139.

[26] The origins of expected utility can be traced back to 1738 and the famous St. Petersburg essay of *Daniel Bernoulli* (1700-1782). However, the real prominence of the notion of expected utility came only two centuries later with the publication of the seminal work of *von Neumann/Morgenstern* (1944). See *Abdellaoui* (2004): 15f; *Kahneman* (2003a): 164. For a discussion of the central aspects of expected utility theory, including its violations, the most prominent of which are known as the *Allais* (1953) paradox and the *Ellsberg* (1961) paradox, refer to *Abdellaoui* (2004): 15-30.

[27] Information can be broadly defined as "*zweckorientiertes Wissen*" (*Wittmann* (1959): 14), i.e., a source of knowledge for purposeful judgment and decision making. Information is an immaterial good with unique characteristics, including relevance, validity, reliability, trustworthiness, availability, source, topicality, and acquisition costs. See *Ballwieser/Berger* (1985): 1; *Gemünden* (1993): 847.

[28] See *Baron* (2007): 24; *Sontheimer* (2006): 238. Essentially, goals can be viewed as criteria by which states of affairs are evaluated. See *Baron* (2007): 23.

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nation of contingent probabilities.[29] Stated formally, the theorem runs along the following lines:[30]

$$(1) \qquad p(H|D) = \frac{p(D|H)\cdot p(H)}{p(D|H)\cdot p(H)+p(D|\bar{H})\cdot p(\bar{H})}$$

where

$p(H)$ = *a priori* probability of event H;

$p(\bar{H})$ = *a priori* probability of the complement of event H;

$p(D|H)$ = probability of D given H;

$p(D|\bar{H})$ = probability of D given the complement of H; and

$p(H|D)$ = probability of H given D (*a posteriori* probability of H).

Overall, the rationality concept and its major formal and logical pillars (e.g., the expected utility paradigm and Bayes' theorem) provide a reasonable and stringent account of human behavior in that they reflect its purposefulness and goal-orientation.[31] However, the unlimited rationality assumed in economic theory does not reflect the manner in which individuals actually process information, update beliefs, form judgments, and arrive at decisions. As prominently argued by *Herbert Simon*, as a consequence of the limited availability of information as well as the restrictions of cognitive resources and computational abilities, human behavior in the real world is "*intendedly* rational, but only *boundedly* so."[32]

The concept of bounded rationality coined by *Simon* highlights the discrepancy between the limitless human rationality that is at the heart of normative economic theory and the reality of human behavior.[33] The bounded rationality paradigm is built upon the notion that the capacity of human cognition (involving both knowledge and computational ability) is not sufficient to achieve the optimal outcomes posited in economic theory, especially under conditions of high

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29 See *Birnberg* (1964): 108f.; *Karni* (2013): 5; *Tisdell* (1975): 266. As will be shown in Section 3.1, Bayes' theorem represents the relevant normative benchmark for the process of belief revision in light of newly incoming evidence. Therefore, it is considered in more detail in the present section. Note in passing that the theorem is named after Reverend *Thomas Bayes* (1702-1761) whose outrageous propositions and groundbreaking ideas summarized in a work labeled "An Essay towards solving a Problem in the Doctrine of Chances" were discovered post mortem by his friend *Richard Price* (1723-1791) and published in 1763.

30 See, e.g., *Baron* (2007): 32. For an extensive review of the Bayesian theory and a number of interdisciplinary practical application of the Bayes' rule, consult *Damien et al.* (2013).

31 See *Simon* (1980): 75.

32 *Simon* (2013): 88, italics in original. Similar arguments and quotes can also be found in his earlier publications (see, e.g., *Simon* (1955): 101; *Simon* (1957a): xxiv). It is instructive to note that the subsequent consideration of the boundaries of human cognition does not aim to discard the fundamental normative models. Rather, the main goal is to stress the importance of relaxing the utopic behavioral assumptions regarding global rationality, thereby extending the descriptive and empirical validity of mainstream economics. See *Fromlet* (2001): 64.

33 See *Simon* (1992): 3. For a concise consideration of the fundamental notion of bounded rationality, see *Simon* (1997): 291-294. For critical remarks on this concept, see *Marris* (1992): 194-221.

complexity.[34] Accordingly, in the real world, optimization is replaced by satisficing, i.e., a search for a good and feasible solution rather than an optimal one.[35]

Importantly, the notion of bounded rationality does not imply that humans are consciously and intentionally irrational, but merely that they possess limited cognitive capacities.[36] To cope with cognitive resource constraints, people usually take mental shortcuts, i.e., they adopt heuristics[37] which simplify complex problems and provide rapid solutions at low cognitive cost.[38] The use of simplifying heuristics procedures typically results in intuitively reasonable and acceptable solutions. However, in some cases, heuristics can also lead to systematic errors in judgment and decision making, the so-called "biases".[39] In essence, biases represent deviations from the normative standards of rationality.[40]

Overall, by assuming unlimited rationality, economic theory places severe demands on the economic agent, while considering his/her internal structures and mental properties as a black box.[41] As aptly put by *Simon*, to explain real-world human behavior performed under conditions of considerable complexity and dynamics of the environment, normative economic theory has to describe the economic agent "*as something more than a featureless, adaptive organism; it must incorporate at least some description of the processes and mechanisms through which the adaptation takes place*."[42] In contrast to normative economic theory that *prescribes* how individuals *ought* to behave under the orthodox assumption of perfect rationality, psychology *describes* how people *actually* behave in the real world.[43] The following section outlines the fundamental importance of the discipline of cognitive psychology for the understanding and exploration of human judgment and behavior.

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34 See *Simon* (1957b): 198. In a similar vein, *Gigerenzer* (2007): 62f. argues that even for well-structured problems such as chess, the optimal solution and methods for achieving it are unknown. This uncertainty applies all the more to less well-defined problems such as what stocks to invest in or whom to marry.

35 See *Simon* (1955): 108; *Simon* (1959): 262-264, 277; *Simon* (1997): 295-298.

36 See *Simon* (1992): 3.

37 For a broader discussion of the term "heuristic", refer to *Keren/Teigen* (2007): 92f. For a general psychological and accounting-related discussion of some central heuristics, including representativeness, availability as well as anchoring and adjustment, see *Belkaoui* (1989): 203-231.

38 See *Fiske/Taylor* (2008): 12f., 197.

39 See *Tversky/Kahneman* (1974): 1124.

40 See *Kahneman* (2003b): 1449.

41 See *Kaufman* (1999): 363f.; *Simon* (1955): 103.

42 *Simon* (1959): 256. Henceforth, for the sake of readability, direct quotes are highlighted by italics. The instances where italics were used in the original quotation are marked accordingly.

43 See *March/Simon* (1958): 138; *McKenna* (2000): 219; *Over* (2007): 3. It might be remarked that economists have put considerable effort in defending the rationality paradigm and categorically distancing economic theory from psychology. For a review of this issue, see *Bruni/Sugden* (2007): 146-171. Generally, economists criticize psychological research for its manner of generating lists of cognitive fallacies, while being unable to provide a coherent alternative to normative models of rational human behavior and thought. Indeed, cognitive psychological theories cannot achieve the coherence, elegance, and the formal precision of normative models of rational judgment and choice. However, these qualities of the normative models are at the expense of behavioral reality and descriptive validity. In contrast, psychology offers integrative models with considerable descriptive power that can be applied to a wide range of behavioral phenomena in different domains. See *Kahneman* (2003b): 1449.

2.1.2 Cognitive Psychology and its Contribution to Explaining Human Behavior

The term "psychology" stems from the Greed words "*psyche*" which means "mind", "soul", "spirit", and "*logos*" which means "knowledge", "study". Semantically, then, psychology is the study of the human mind.[44] Psychology can generally be divided into the subfields of applied and theoretical psychology. While the former focuses on the practical use of psychology by individuals and society, and includes the subfields of clinical, counselling, environmental, and educational psychology, the latter deals with the basic principles and mechanisms of how the mind controls human behavior[45]. Theoretical psychology encompasses a wide array of subfields, including perception, learning and memory, thinking, psycholinguistics as well as cognitive, physiological, comparative, developmental, social, and personality psychology.[46]

The focus within this work is on cognitive psychology. The term "cognition" comes from the Latin verb "*cognoscere*" which means "to become acquainted", "to get to know".[47] Hence, cognition refers to all the processes by which humans come to know the surrounding world.[48] It encompasses virtually all human intellectual activities and mental processes, including sensation, perception, attention, learning, memory, problem solving, thinking, imagining, and language, among others.[49] Consequently, as argued by *Neisser* (1967), "*cognition is involved in everything a human being might possibly do*" and essentially, "*every psychological phenomena* [sic!] *is a cognitive phenomena* [sic!]."[50]

Even though cognition is now widely recognized as a central and integral part of psychology, the cognitive approach has not always been that prominent and non-contentious.[51] Specifically, for nearly five decades (from ca. 1913 to ca. 1960) psychology was dominated by the behavioristic stream. The latter considered the behavior (i.e., the physical movements) of organisms as the only real and scientifically justified subject of psychological study; Mental processes, in contrast, were viewed as illusory, and the study of the human mind was considered unworthy.[52] During the 1960s, however, cognition re-emerged as a scientifically legitimate focus for psychological theory. This development is commonly referred to as the "cognitive revolution" in psychology and was reinforced by important developments in the fields of artificial intelligence, computer science, and human problem solving.[53]

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44 See *Gross* (2009): 127.

45 Due to the inseparable relationship between mind and behavior, psychology has been typically referred to as the science of human mind and behavior. See, e.g., the correspondingly titled works by *Blair-Broeker/Ernst* (2007), *Gross* (2012) and *Passer/Smith* (2010).

46 See *Wickelgren* (1979): 3. For a concise historical overview of psychology as a science, see *Wärneryd* (1999): 7-10.

47 See *Anshakov/Gergely* (2010): 1.

48 See *Gross* (2009): 128; *Neisser* (1967): 4; *Neisser* (1976): 1.

49 See *Edelmann/Wittmann* (2012): 109; *Gross* (2009): 128; *Solso/MacLin/MacLin* (2008): 10.

50 *Neisser* (1967): 4.

51 See *Fiske/Taylor* (2008): 21.

52 See *Baars* (1986): 4f., 9; *Miller* (2003): 141.

53 See *Fiske/Taylor* (2008): 9; *Miller* (2003): 142. For a thorough discussion of the cognitive revolution in psychology, refer to *Baars* (1986).

In the last few decades, the cognitive approach has revolutionized and considerably advanced the field of psychology and is nowadays an indispensable and essential part of theoretical psychology. As will be demonstrated throughout the present work, the influence of the cognitive approach reaches far beyond the field of psychology and has marked a number of other scientific disciplines, among which is also the field of auditing.

In conclusion, it should be noted that both economics and cognitive psychology provide valuable insights into and explanations for auditing phenomena, so that the adoption of an interdisciplinary approach in auditing research appears inevitable for advancing the state of knowledge and cognizance in this field. As argued by *Libby* (1991), it is important to bear in mind that the majority of auditing phenomena explored by academic research are essentially economic phenomena. Consequently, neglecting the economic foundation of individual, group, and institutional behavior will yield a fairly fragmentary picture. Not less important is to recognize, however, that auditing involves human decision-makers.[54] Consequently, it is crucial to consider individual factors in the study of judgment and decision making in auditing parallel to the economic motives driving auditors' behavior. With other words, through the combination of the normative rigor of economic theory and the descriptive validity of psychological models and concepts, a more complete picture of auditing phenomena and auditors' behavior can be achieved.

Building on the insight of the essential importance of cognitive aspects for the study of human behavior, subsequently, the basic structure of the human cognition is outlined.[55]

2.2 The Architecture of Cognition

The most essential feature of the human mental system is its modularity.[56] There is a wide spectrum of notions of modularity.[57] In the present work, modularity is understood in the sense that the human mind is constructed of distinct modules or subsystems, each of which fulfils a specific function within the operation of the whole system.[58] Overall, the mind has been conceptualized as consisting of multiple parts, including cognition and emotion, reason and intuition, consciousness and unconsciousness, automaticity and control, ego and id, just to

54 See *Libby* (1991): 19f.

55 Note that the following discussion involves more general features of the cognitive structure, particularly the two prevalent types of cognitive processing. For an extensive neurological review of cognition, consult *Koziol/Budding* (2009).

56 See *Fodor* (1983); *Garfield* (1991): 1; *Gazzaniga* (1985): 74, 77-80; *Gilbert* (1991): 109; *Smith* (2003): 108.

57 For a discussion of the range of notions on modularity, see *Carruthers* (2003): 67-71; *Carruthers* (2006): 1-3.

58 See *Carruthers* (2006): 2. It might be remarked that this view is in line with the massive modularity hypothesis advocated by *Carruthers* (2003): 68; *Pinker* (1994): 420; *Pinker* (1997): 27-31; *Sperber* (1996): 123-129 and *Tooby/Cosmides* (1992): 94, 113, among others. According to this hypothesis, the entire cognitive apparatus can be viewed as modular. That is, both lower-level and higher-level mental processes possess a modular structure. See *Visala* (2011): 35. This notion contradicts the modularity view set forth by *Fodor* (1983) according to which only the peripheral sensory and perceptual systems of the human mind are modular, while the higher-order cognitive systems are conceived as central and holistic. See *Fodor* (1983): 47-119.

name a few. Consequently, a deeper understanding of mental phenomena is only possible by considering the structure and interaction of the multiple parts of the mind rather than by an isolated analysis of the individual components.[59]

The present work builds on recent developments[60] in psychology which have proposed the so-called "dual-system" or "dual-process" view on human cognition.[61] This view highlights the distinction between two general constituent blocs of the cognitive system (categories of cognitive processing): intuition and reasoning. In general terms, intuition involves automatic, effortless, quick, and reflexive processing. Intuitive impulses and associations normally come to mind without conscious search or computation. In contrast, reasoning involves deliberate, effortful, slow, and analytic processing.[62]

The characteristics of the two grand categories of cognitive operations are schematically summarized in Figure 1. Following *Stanovich* (1999) and *Kahneman and Frederick* (2005), the generic labels "System 1" and "System 2" are employed to reflect intuitive and deliberate reasoning, respectively, and the term "system" is used to refer to a bunch of cognitive processes (subsystems) that can be categorized by their speed, their deliberateness and the contents on which they operate.[63] As the classification criteria depicted in Figure 1 are all continua, the placement of strict border lines between the systems is not possible.[64]

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59 See *Gilbert* (1999): 4.

60 Note that the idea of fragmenting the human mind and cognition into active (deliberate) and passive (automatic) domains is not a new one. It can be traced back to the influential work of the famous French philosopher and mathematician *René Descartes* (1596-1650). See *Gilbert* (1991): 108. In the last decade, this notion was revived in psychological research and is now a fairly prominent and topical branch of the contemporary psychological literature. Overall, a variety of differently nuanced dual process theories have been established in psychology in the last years. Although different in focus and detail, these theories share the idea of separating quick and associative cognitive operations from slow and controlled ones. See *Evans* (2008): 270; *Kahneman/Frederick* (2005): 267.

61 For an excellent overview of dual-process theories of higher-order cognition, i.e., thinking, reasoning, judgment and decision making, see *Evans* (2008): 256-271. The consideration of lower-order cognition, i.e., perception, attention, development of motor skills, etc., is beyond the scope of Evan's review as well as the present work. For a critical consideration of dual-system theories, refer to *Keren/Schul* (2009).

62 See *Kahneman* (2003b): 1450; *Kahneman/Frederick* (2002): 51.

63 See *Kahneman/Frederick* (2005): 267; *Stanovich* (1999): 126. Note that the numeration of the two systems follows their evolutionary development. See *Weldon/Corbin/Reyna* (2013): 52. Recently, dual-process theorists increasingly highlight the need to replace the somewhat ambiguous "System 1"-"System 2"- terminology with a new one which should be plural or more neutrally formulated to make clear that there is not a single automatic and a single controlled system, but rather a set of subsystems and processes in the brain. For such claims and a number of relevant references along these lines, see *Stanovich* (2011): 18f. For a list of alternative labels used throughout the relevant dual-process theory literature to refer to System 1 and System 2 processing, including "on-line thinking" versus "off-line thinking"; "heuristic processing" versus "analytic processing"; "associative system" versus "rule-based system"; "reflexive processing" versus "reflective processing"; "stimulus bound processing" versus "higher order processing", see *Evans* (2008): 257; *Stanovich* (2004): 35.

64 See *Kahneman/Frederick* (2005): 288.

	PERCEPTION	INTUITION System 1	REASONING System 2
PROCESS	Fast Parallel Automatic Effortless Associative Slow-learning Emotional		Slow Serial Controlled Effortful Rule-governed Flexible Neutral

Figure 1: Cognitive Systems (Source: *Kahneman* (2003b): 1451)

As illustrated in Figure 1, System 1 involves fast, spontaneous, effortless, associative, and emotionally charged processing. The operations of this system are often habit-based and thus difficult to control or adjust. In fact, automaticity has been considered as the distinctive characteristic of System 1 processing. Automaticity implies the mandatory activation of System 1 operations in light of pertinent triggering stimuli.[65] System 1 is typically associated with heuristic processing and the generation of impressions and perceptions, which are not necessarily conscious and (verbally) explicit.[66] Overall, System 1 processing is viewed as cognitively simplistic, computationally inexpensive, and largely independent of general (analytical) intelligence[67] or working (i.e., short-term) memory[68] capacity. From an evolutionary perspective, System 1 is considered to be the older and more primitive processing apparatus and to possess considerable similarity with animal cognition.[69]

System 2, or the system of reasoning, on the other hand, involves slow, serial, analytic, effortful, and controlled (i.e., non-automatic) processing. The operations of System 2 are more flexible than those of System 1 and are also potentially governed by the rules of logic.[70] Overall, System 2 processing is considered cognitively demanding, related to general intelligence, and

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65 See *Stanovich* (2011): 19. For instance, individuals cannot help themselves but understand simple words and phrases in their native language, nor can they refrain from knowing that 2+2=4. For such claims and a list of further examples for System 1 processing, see *Kahneman* (2011): 21f.

66 See *Kahneman* (2003b): 1451f.; *Stanovich* (1999): 126; *Stanovich/West* (2000): 659.

67 As identified by *Stanovich* (1999): 126f., in contrast to System 2, which is considered to relate to *analytic* intelligence, i.e., the kind of intelligence measured via psychometric test like IQ or SAT, System 1 rather relates to *interactional* intelligence, i.e., intelligence in terms of utilizing a set of computational heuristic strategies, tactics, and meta-rules. See also *Prevignano/Thibault* (2003): 158. For a discussion of the concept of intelligence and a critical note on the use of IQ tests to measure intelligence, see *Sternberg* (1988). For a brilliant discussion of the common misconception of intelligence as a proxy for rationality, see *Stanovich* (2009). In this context, he uses the term “disrationalia” to refer to the phenomenon of irrationality despite adequate intelligence. See *Stanovich* (2009): 7.

68 As indicated by *Schneider/Shiffrin* (1977): 2f., automatic processing generally utilizes the nearly limitless long-term memory store, while controlled processing claims the limited short-term memory store. For a detailed discussion of human memory, refer to *Baddeley* (1997) and *Loftus/Loftus* (1976). The distinction between short- and long-term memory is also touched upon in Section 2.4.2.3.1.

69 See *Evans* (2008): 257; *Evans* (2013a): 116f.; *Stanovich* (2009): 78. Importantly, this finding does not necessarily imply that System 1 is less capable than (or inferior to) System 2. See *Kahneman/Frederick* (2002): 51.

70 See *Kahneman/Frederick* (2002): 51; *Stanovich* (1999): 126f.; *Stanovich* (2011): 20. For a list of instances of typical System 2 operations, see *Kahneman* (2011): 22.

restricted by working memory capacity. Evolutionarily, System 2 is the more recent cognitive system and is conceived to be either a uniquely human property or at least particularly developed in the humankind.[71]

As to the role of consciousness, it is generally assumed that System 2 processing is typically conscious and requires a great deal of attention[72], while System 1 processing can be either conscious or unconscious.[73] With regard to the error proneness of the two systems, it is important to note that even though System 1 typically makes use of heuristic strategies, cognitive biases are equally attributed to the intuitive operations of System 1 as well as the analytic processing of System 2. With other words, the greater deliberation and cognitive effort germane to System 2 processing does not necessarily guarantee bias-free responses.[74] This is also evident in light of the interplay between the two cognitive systems. Specifically, as a particular stimulus or problem is encountered, System 1 typically generates intuitive responses – impressions, associations, stereotypes, and tendencies – which are transmitted and suggested to System 2. The latter has a monitoring and corrective function, and it can endorse, amend, or abolish the input from System 1.[75] However, as empirical research has shown, this function does not always detect and correct potential flaws in the input from System 1. In fact, System 2 processing is typically found to endorse the intuitive stimuli generated by System 1.[76] As argued by *Stanovich* (2009), in order to override responses generated by System 1, System 2 must be capable of suppressing the System 1 stimulus *and* generating a superior (i.e., bias-free) response for replacing the potentially flawed input.[77] Consequently, the judgments that people make and the pertinent mistakes that they commit largely depend on the input from System 1 as well as on the functionality and effectiveness of the corrective mechanisms of System 2.[78] A second important insight emerging from the consideration of the interplay between the dual cognitive systems is that the majority of higher-order cognitive tasks (e.g., problem-solving, judgment, decision making) normally involve a combination of automatic and controlled processing.[79]

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71 See *Evans* (2008): 257; *Evans* (2013a): 116f.

72 For a general discussion of attention, including the origins of the concept, different forms of attention (selective vs. intensive), attention bottlenecks, and pertinent capacity models, refer to *Kahneman* (1973): 1-12.

73 See *Chen/Chaiken* (1999): 86. *Moskowitz/Skurnik/Galinsky* (1999): 33 argue, however, that even intent, will, and control can operate beyond conscious awareness. Hence, System 2 processing may also be sometimes unconscious.

74 See, e.g., *Evans* (2008): 267; *Evans* (2013a): 126f.; *Evans* (2013b): 113; *Moskowitz/Skurnik/Galinsky* (1999): 13; *Van Boven et al.* (2013): 395f.

75 See *Kahneman/Frederick* (2002): 51. For a brief consideration of the interaction between System 1 and System 2, see *Kahneman* (2011): 24f.

76 See *Kahneman/Frederick* (2002): 58f.

77 See *Stanovich* (2009): 23. *Schneider/Shiffrin* (1977): 2 argue that automatically generated responses are relatively difficult to ignore, suppress, or modify.

78 See *Kahneman* (2003b): 1467. Impending factors for the quality of both automatic and controlled processing include, among others, time pressure, stress, and distraction, i.e., the parallel computation of different cognitive tasks. See *Finucane et al.* (2000): 5, 8; *Gilbert* (1991): 110; *Kahneman/Frederick* (2002): 57f.

79 See *Bargh* (1989): 4-7.

Finally, it is important to note that System 1 and System 2 have been theorized to operate concurrently.[80] As argued by *Wilson* (2002), the unique architecture of the human mind allows for a plethora of cognitive tasks to be accomplished simultaneously by performing subconscious processing of a substantial part of the informational stimuli, while consciously working on other issues.[81] Research on the two systems of human cognition indicates that System 1 processing is prevalent in the real world. This observation can largely be attributed to the cognitive economy and efficiency associated with System 1 processing.[82]

Overall, the system of human cognition can be viewed as a remarkable computational device that is fairly efficient and adaptive to changes in its environment. However, this impressive system differs significantly from the standard of rationality assumed in economic theory.[83] Drawing on the dual-system terminology, the rational economic agent can be described as possessing a single cognitive system (rather than a modular one) that has the analytical and computational ability of a flawless System 2 and the high speed and low effort of System 1.[84] In reality, the human mental system has limited perceptual[85], processing, and computational capabilities and operates under conditions of uncertainty and sparse cognitive resources which have to be distributed across a number of competing tasks and problems.[86] In consequence, distortions in both intuitive and analytic cognitive processing are bound to arise.[87]

The preceding considerations and arguments highlight the critical importance of taking into account the structure and limitations of human cognition in order to attain a better understanding of human behavior and thought. The general psychological foundations of the present work are rounded off with a glance at the information processing approach. This approach has proved particularly influential and prominent in cognitive psychology and has found a broad application in auditing research in the last few decades.[88]

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80 See *Chen/Chaiken* (1999): 76; *Evans* (2013a): 121; *Kahneman/Frederick* (2002): 51; *Stanovich* (2009): 22. In this context, *Moskowitz/Skurnik/Galinsky* (1999): 33 emphasize that automatic and analytic processes are conceptualized as “dual” rather than “dueling”.

81 See *Wilson* (2002): 5, 8-10.

82 See *Chen/Chaiken* (1999): 74; *Moskowitz/Skurnik/Galinsky* (1999): 28; *Stanovich* (2009): 22; *Wilson* (2002): 4f. It has long been recognized that in order to cope with limited cognitive resources and the overwhelming complexity of the decision environment, individuals typically follow “the principle of least effort”. That is, people process information, reason, and act in pursuit of their goals with the least amount of cognitive effort and work possible. See *Allport* (1954): 173f.; *Moskowitz/Skurnik/Galinsky* (1999): 28. Individual behavior is further guided by a desire to achieve a reasonable balance between cognitive effort exerted and the satisfaction of the pertinent motivational constraints. See *Chen/Chaiken* (1999): 74.

83 See *Kahneman* (2003b): 1454.

84 See *Kahneman* (2003b): 1469.

85 The notion of perceptual limitations is vividly illustrated by *Simon* (1959): 273. He argues that every single second, the surrounding environment produces millions of bits of new information, while the human perceptual system hardly manages to capture a thousand bits per second.

86 See *Gilbert* (1991): 109; *Kahneman/Frederick* (2005): 268.

87 See *Simon* (1959): 272.

88 See *Galotti et al.* (2009): 23; *Morrow/Fiore* (2013): 204.

2.3 Information Processing Approach

Broadly speaking, information processing relates to the cognitive operations through which information is attained, attended to, interpreted, evaluated, aggregated, and used to draw inferences, judge, and act. In this sense, information processing can be characterized as "*not just a passive response to stimuli but also an active process of constructing reality*."[89]

The psychological information processing approach utilizes a computer metaphor to the study of human cognition. Specifically, it draws a parallel between the operations of human cognition and the serial manner in which computers process information. Essential to the information processing approach is the notion that human cognition can be conceived as information passing through a complex computational system, i.e., the human brain.[90]

In their simplest form, information processing models consist of an *input* (sensory[91] information), a *process* (perception, System 1 and System 2 processing), and an *output* (judgment or decision).[92] This basic structure is illustrated in Figure 2.

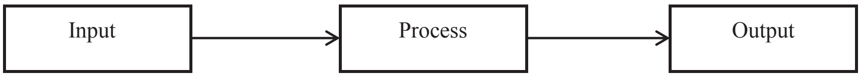

Figure 2: Simple Information Processing Model

At each stage, there are several factors which may impact information processing.[93] Specifically, *input*-related factors concern task and information set characteristics which influence the way in which individuals absorb, weight, and integrate information. Instances for such factors include, among others, task complexity, presentation sequence, presentation format, aggregation level of data, type of task, and response mode.[94] Some of these factors are discussed within Section 2.4.2.1. Of particular relevance to the present work are the task characteristics of complexity, presentation sequence, and response mode which are discussed in detail in Section 3.2.1.1 and Section 3.2.1.2.

Process-related factors, on the other hand, encompass both characteristics of the information processing style (e.g., heuristic (System 1) versus analytic (System 2)) as well as features of the information processor (e.g., ability, personality, cognitive structure, experience, involvement, demographics).[95] Generally, the use of a particular processing mode (analytic versus heuristic) has been theorized to result from an analysis – sometimes explicit and sometime

[89] *Vertzberger* (1990): 9.

[90] See *Fiske/Taylor* (2008): 8; *Galotti et al.* (2009): 23; *Sternberg* (2009): 329. For a concise overview of the brain processes and systems involved in information processing, refer to *Eysenck/Keane* (2010): 473-477.

[91] Generally, there are five grand modalities of the sensory apparatus: vision (sight), audition (hearing), olfaction (smell), somesthesis (touch) and gustation (taste). See *Cardello* (1996): 5; *Noyes/Garland/Bruneau* (2004): 38. For a detailed discussion of these modalities, see *May* (2009): 11-77.

[92] See *Eysenck/Keane* (2010): 2; *Libby/Lewis* (1977): 246; *Noyes/Garland/Bruneau* (2004): 36f.

[93] See *Libby/Lewis* (1977): 247.

[94] See *Libby/Lewis* (1977): 246f.

[95] See *Libby/Lewis* (1977): 246f.

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