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Cognitive Heuristics and Biases and Their Impact on Negotiations

Verfasserin

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Dedicated to my parents

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"All perceiving is also thinking, all reasoning is also intuition, all observation is also invention."

(Rudolf Arnheim)

1. Introduction

Decision-making is a vital part of our lives. What are the right decisions for attaining my goals? How can I draw the correct conclusion in a world full of uncertainty, with incomplete information and limited cognitive skills?

For decades, human beings were regarded as complete rational decision makers, prescribed to behave to the norms and axioms as postulated by mathematics and economics. However, for making decisions in consistence with these models humans lack the knowledge and information as well as the required computational capacities – as coined by Herbert Simon, their rationality is bounded. Instead, judgmental evaluations and choices are made by the use of cognitive heuristics, colloquially called 'mental short-cuts'.

The purpose of this thesis is to examine how these cognitive heuristics – divided into judgmental and choice heuristics – influence the individual's decision process, as well as to study their impact on the interpersonal negotiation situation.

Chapter 2 illuminates the nature of human decision behavior: According to the dual-process theories of reasoning, cognition can be split into the outcome-oriented associative System 1 (intuition) and the process-oriented deliberate System 2 (reflection). Both systems work in an interactive way, where System 2 is ascribed the monitoring role. The opening chapter touches upon the selective perception and processing of information, defines choice and problem solving and explains how judgments are embedded within the task environment and a person's schema. It furthermore gives an overview of decision analysis – the prescriptive approach to rational decision making.

Chapter 3 continues with the notion of rational decision making, presenting two different models of rationality: On the one hand, the classical homo œconomicus view that submits decision makers to the norms of expected utility theory and probability theory, and on the other hand Herbert Simon's concept of bounded rationality that emphasizes the necessity of a successful fit between the environment and human's limited cognitive abilities.

Chapter 4 immerses into the matter by giving an introductory example of a cognitive heuristic, showing that mental activity consists of 'simplifying' the judgmental situation: In a world full of

ambiguity, human beings have to make intelligent inferences from the environmental structures given ('intelligent context-sensitive reasoning').

Chapter 5 studies the program of research on judgment under uncertainty as introduced by Tversky and Kahneman in the 1970ies, which became known as the 'Heuristics and Biases Program'. This approach covers judgmental heuristics; Tversky and Kahneman regard processes of intuitive judgment not as simplifications of the rational models, but as different in kind. The main heuristics of their program comprise representativeness, availability, and anchoring and adjustment, later being enlarged by the affect heuristic. The chapter closes with the main critique on the program, in the first instance by Gerd Gigerenzer, director of the Center for Adaptive Behavior and Cognition (ABC) at the Max Planck Institute for Human Development in Berlin.

Whereas the previous chapter deals with judgmental heuristics (based on impressions that arise automatically), Chapter 6 deals with choice heuristics – conscious strategies, intentionally designed to simplify choice and to save mental effort. The 'fast and frugal' heuristics of the ABC research group present choice or system 2 heuristics for the most part as they are intentionally chosen in order to reduce computational burden. They are contained in an adaptive toolbox, which the human mind draws on for making decisions under uncertainty; fast and frugal heuristics can be split into the following classes: ignorance-based decision making, one-reason decision making and elimination heuristics. The focus of the program lies on one-reason decision making (in particular on the Take the Best heuristic), which bases decision on a single cue. The chapter also illuminates critical factors that are likely to foster the use of simple heuristics as well as the influence of emotions and social context, and concludes with critique on ABC's Heuristics.

Chapter 7 and Chapter 8 turn from the intrapersonal decision situation to the interpersonal negotiation situation. The main characteristics of negotiations and the concept of negotiation analysis are defined; an overview of judgmental heuristics in negotiations and their impact on the perception of negotiations is given: Judgmental heuristics in negotiations include, inter alia, framing, the mythical fixed-pie and the irrational escalation of commitment.

The last chapter concludes with a critical review of ABC's heuristics, compared to the Heuristics and Biases Program and their suitability for negotiations.

2. The Nature of Human Decision Behavior

2.1 The Architecture of Cognition

Cognitive processes can be divided into two main families, being labeled System 1 (**Intuition**) and System 2 (**Reasoning**)[1]. Reasoning is at work when we, for example, fill out an income statement; intuition takes place when we feel repulsed by the image of a gigantic flea, depicting a flea market's advertisement (Rozin/Nemeroff 2002, in: Kahneman 2003: 1450). Reasoning is deliberately controlled and effortful, goes on in a sequential manner and is slower than System 1, intuition, which is characterized by rapidity, automatic processes, effortlessness and emotions. The characteristics of intuition are governed by habit[2] and are therefore difficult to control or modify, whereas the characteristics of reasoning are relatively flexible and submitted to rules. Whether a task is processed more by System 1 or by System 2, is to a certain extent a question of effort needed, since overall capacity for mental effort is limited (Kahneman 2003: 1450ff).

Intuitive operations produce impressions of perception and thought, which arise voluntary and need not be expressed in words. Judgments, on the other side, are characterized by their intended and explicit nature; consequently, System 2 is involved in all judgments, no matter if they are generated by impressions or by deliberate reasoning. However, whether people's judgments and actions and ensuing errors are corrected depends on the monitoring function of System 2 (Kahneman 2003: 1452; 1467).

According to Kahneman (2003:1469), the central characteristic of agents is not that they reason weakly but that their actions are often intuitive (therefore, the term 'reasoning error' in this context is misleading).

The main characteristics of the 2-systems-approach can be summarized in the following table:

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[1] These labels were proposed by Stanovich and West (2000): Individual Differences in Reasoning. Implications for the Rationality Debate?, Behavioral and Brain Sciences, Vol. 23, pp. 645-726. They also list terms for the systems as used by a variety of researchers, and the properties of **dual-process** theories of reasoning (p. 659).

[2] In decision making *habits* – old behaviors that are used in new but similar situations – are called *policies* (see Beach/Connolly 2005[2]:32).

System 1 (Intuitive)	System 2 (Reflective)
Process Characteristics	
Automatic	Controlled
Effortless	Effortful
Associative	Deductive
Rapid, parallel	Slow, serial
Process opaque	Self-aware
Skilled Action	Rule application
Content on Which Processes Act	
Affective	Neutral
Causal propensities	Statistics
Concrete, specific	Abstract
Prototypes	Set

Fig 1: Two Cognitive Systems (see Kahneman/Frederick 2002).

2.2   Problem Solving, Choice and Judgment

Eysenck (2004[2]: 315f) suggests that the key aspects to **problem solving** are the following: goal orientation, the use of cognitive processes (System 2) rather than automatic processes (System 1), with the instant solution being not at hand due to the lack of relevant information. He furthermore makes a distinction between *well-defined* and *ill-defined problems*: Well-defined problems show clearly specified situations, a range of possible moves and a goal or solution. The main focus of laboratory studies or psychological experiments lies on well-defined problems as it is easier that way to detect the blunders in the human problem solver's strategies. In our everyday lives, however, we are confronted with ill-defined problems most of the time.

Choice can in most cases be regarded as the end product of a process of conflict resolution. People make choices in order to satisfy needs which become expressed as goals. One definition of goals could be Simon's (1955) aspiration level: The decision maker fixes a level which he finds acceptable. If this level is reached, search will stop. Examples of potentially conflicting *processing* goals (i.e. meta-goals within the decision process) could be the maximization of accuracy and the

easiness of justification of the decision to others, and the minimization of cognitive effort and negative decision-related affect (Payne/Bettman 2001: 125).

Engagement in action is necessary to achieve a certain goal. – Before doing so, one first has to engage in mental effort of analyzing the problem which leads to conflict; cognitive commitment clarifies goals and preferences. If the individual chooses to reject the potential conflict he can pursue the no-choice option to preserve the status quo. Keeping the status quo has the advantages of bearing less uncertainty and less responsibility than with conscious choice (Corbin 1980)[3]. Habitual choice, on the other hand, occurs when the problem solver wants to avoid conscious thought in choice as he is relying on habits required through past experiences. However, even if habitual choices were successful in the past, their success depends on a stable environment (Hogarth 1989[2]: 66ff; Einhorn, Hillel J. / Hogarth, Robin M. 1981: 74).

Based on the fact that the human mind is capacity limited, **perception** of information is not comprehensive but *selective*: The senses take in information from the environment, the mind performs computations on that information, which finally leads to goal-directed actions. What has to be taken in consideration is that the mind actively seeks information for integration within existing norms and thought patterns – anticipations of what people expect to see play an important part in what they actually see and remember (Hogarth 1989[2]: 135; Newell/Bröder 2008: 196).

In order to think one has to **process** information: Information processing in human problem solving is assumed to be serial; people possess limited short-term memory capacities (i.e. it is only possible to operate on a small number of items of information at a given time), but the ability to retrieve important information from long-term memory. For changing the current state, they apply mental operators to bridge the difference between the goal state and its subgoal. Due to the complexity of most problems this is achieved by the use of *heuristics* or mental shortcuts (Newell/Simon 1972, in: Eysenck 2004[2]: 322f, op. cit.).

The *conceptual model of judgment* as presented by Hogarth (1989[2]: 206ff) sees **judgment** taking place within a system of three elements: the person, the task environment within which the judgments are made and the actions that result from judgment:

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[3] See Corbin, R. M. (1980): Decisions that might not get made, in: T. S. Wallsten (ed.): Cognitive Processes in Choice and Decision Behavior, Erlbaum, Hillsdale/NJ.
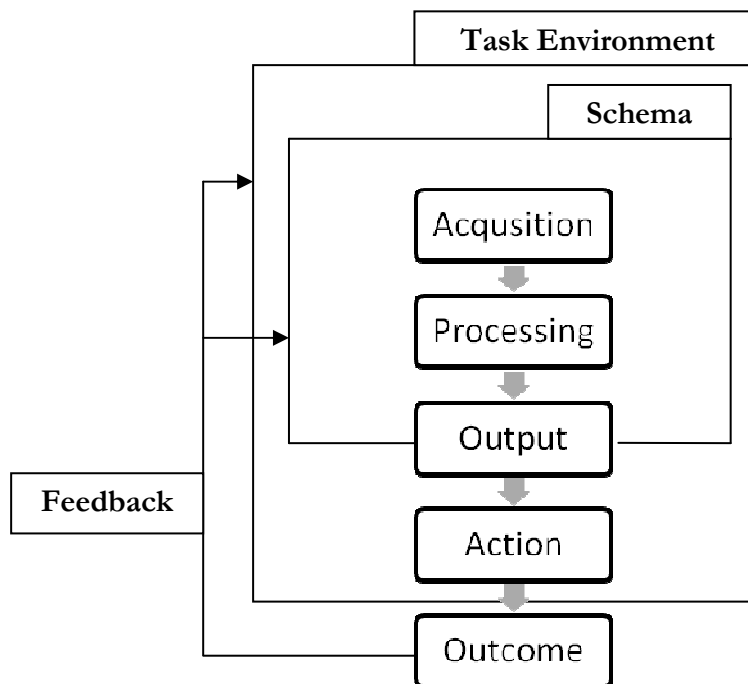
Fig 2: A Conceptual Model of Judgment (see Hogarth 1989[2]).

Judgments take place within the task environment; the person's schema (or frame) – his beliefs about the task environment and his representation of it – is embedded within the task environment. The operations that lead to judgment can be split up into *acquisition* of information (from the individual's memory and the environment), *processing* of information and *output*. Normally, the output is impossible to differentiate from *action* for a third party. Action leads to an *outcome* which will entail a feedback loop into the person's schema.

Judgments can be understood within a framework where the individual, actions and the environment reciprocally affect each other: The individual makes a judgment which consequently leads to action, action affects the environment and the environment affects the individual who forms new judgments (Hogarth 1989[2]: 126).

2.3   An Outlook on Decision Analysis

Decision problems can be structured methodically by the means of decision analysis; its purpose is to help the decision maker improve the quality of his decisions (Hogarth 1989[2]:177; Clemen 1991: 9).

According to Clemen (1991: 2f), there are four basic sources of difficulty in a decision problem: its complexity, the intrinsic uncertainty in the given situation, the necessity of the individual make

trade-offs (cost/benefits, i.a.) with regard to several objectives, and the outlook that different perspectives lead to different conclusions.

All decisions depend on the answer to two questions:

- What are the consequences if alternative actions are taken?
- How can the uncertainties in the environment of relevance to the decision be assessed?

The questions above refer to the *evaluative* and *predictive* dimensions of judgment. Personal judgments about uncertainty (with a subjective probability representing an individual's *degree of belief*) and values are crucial inputs for decision analysis. The steps that are involved in decision analysis are in effect an elaboration of these two fundamental questions (Hogarth 1989[2]: 177f, Clemen 1991: 5; 209).

Key questions at the different stages of the decision approach (see figure 3) are the following (Hogarth 1989[2]:178ff):

1. Structuring the problem: Who is the decision maker? What are the alternatives and how should they be evaluated? Where do the uncertainties lie?
2. Assessing consequences: How adequate are the measurements on which the alternatives should be evaluated and how should they be weighted?
3. Assessing uncertainties: What information is of relevance to the uncertainties?
4. Evaluating alternatives: What decision rule should be used?
5. Sensitivity analysis: What degree of variation of the assessed consequences and uncertainties would change the optimal decision?
6. Information gathering: What are the costs and benefits of obtaining more information?
7. Choice: Which alternative maximizes *expected utility*? (I.e. the assessed consequences – utilities – are weighted by the assessed uncertainties – probabilities – and one chooses the alternatives for which the weighted sum is largest.)

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          ┌─────────────────┐
          │ 1. Structuring the │
          │     Problem        │
          └─────────────────┘
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┌─────────────────┐  ┌─────────────────┐
│ 2. Assessing    │  │ 3. Assessing    │◄──┐
│  Consequences   │  │  Uncertainties  │   │
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            │              │                │
            └──────┐  ┌────┘                │
                   ▼  ▼                      │
            ┌─────────────────┐             │
            │ 4. Evaluating   │             │
            │  Alternatives   │             │
            └─────────────────┘             │
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            │ 5. Sensitivity  │─►│ 6. Information  │
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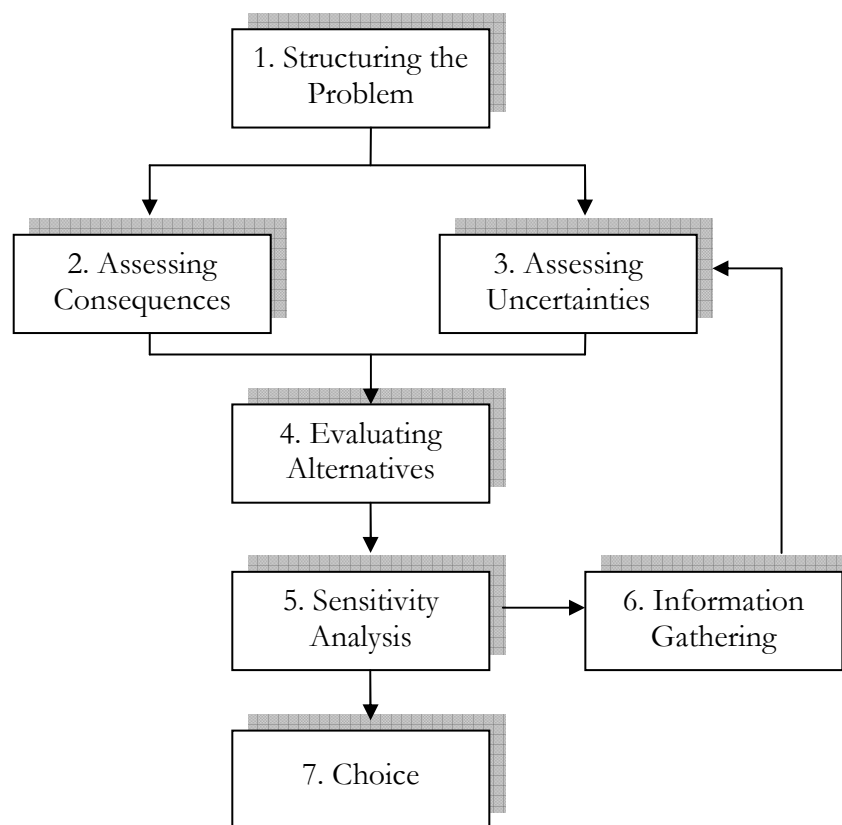
Fig 3: A Simplified Flowchart of the Decision Analysis Process (see Hogarth 1989[2]).

Decision Analysis can, per definition, be regarded as a set of **normative** (or prescriptive) decision-theoretic models conjoint with the techniques for applying them. **Descriptive** models, on the contrary, try to predict what people *actually* do. Psychological models are for the most part descriptive; the umbrella term **behavioral decision theory** comprehends the set of descriptive decision-theoretic models (Von Winterfeldt/Edwards 1986: 16).

The idea of rationality is clearly a prescriptive one – it considers some actions to be appropriate and some that are not (Von Winterfeldt/Edwards 1986: 2).

But what defines human beings' choice behavior to be rational?

3. Models of Rationality

3.1   Homo œconomicus

According to a possibly apocryphal story, an eminent philosopher of science once encountered a noted decision theorist in a hallway at their university. The decision theorist was pacing up and down, muttering "What shall I do? What shall I do?"
"What's the matter, Howard?" asked the philosopher.
Replied the decision theorist: "It's horrible, Ernest - I've got an offer from Harvard and I don't know whether to accept it. "
"Why Howard, "reacted the philosopher, "you're one of the world's great experts on decision making. Why don't you just work out the decision tree, calculate the probabilities and expected outcomes, and determine which choice maximizes your expected utility?"
With annoyance, the other replied: "Come on, Ernest. This is serious."

(Thagard/Millgram 1997)

Traditionally, the study of judgment and decision making has been approached by comparing a judgment or decision to a standard. An evaluation is made whether some judgment or decision is 'good' or 'bad' seen in relation to a standard or norm. Normative models offer these standards, because they are based on rules or axioms, such as *expected utility theory* (derived from economics) and *probability theory* (derived from mathematics). The *homo œconomicus* metaphor states that the complete rational decision maker behaves according to the norm (Newell/Bröder 2008: 195).

Prescriptive theory assumes that a decision maker strives to do what is best for him, which is usually interpreted as deciding on the option that offers the most attractive payoff. Decision makers, however, do not always know about the payoffs (i.e. consequences/results) or how valuable they will be; most decisions' features are, indeed, uncertainty and risk. – Therefore, decisions can be seen as *gambles*: Each option is a potential bet, characterized by its potential gains or losses and beyond the decision maker's control (Beach/Connolly 2005[2]: 49f).

In the 18th century, Daniel Bernoulli prescribed a rational method of gambling: For each bet the payoff for winning should be multiplied with the probability of winning and the payoff for losing should be multiplied with the probability of losing. These two products should be added; a gambler should select the sum with the largest *expected value* (Beach/Connolly 2005[2]: 50f). Together with Gabriel Cramer, Bernoulli sought to solve the *St. Petersburg Paradox*: Why would people only pay a small amount of money if some game renders infinite mathematical expectation? Bernoulli's proposition was that people maximize **expected utility** rather than expected monetary value. Therefore, the dollar amounts should be replaced by their subjective worth (or utility). Bernoulli's proposition of the utility function U(x) was logarithmic, showing

diminishing increases in utility for equal increases in wealth. John von Neumann and Oskar Morgenstern (1944) turned Bernoulli's descriptive model into a prescriptive one – denoted[4] as

$$\sum_{i=1}^{n} p_i u(x_i)$$

The model rests upon five basic assumptions or axioms – completeness, transitivity, continuity, monotonicity and substitution[5] - that define consistent behavior with which the decision maker is supposed to express preferences among risky prospects (Schoemaker 1982: 530f; Clemen 1991: 405).

In the Von Neumann-Morgenstern utility function probability is considered to be **objectively** given, following the view of LaPlace (1812) who defined probability "as the number of elementary outcomes favorable to some event divided by the total number of possible elementary outcomes" (in: Schoemaker 1982: 536, op. cit.). Jacques Bernoulli (1713)[6], on the other hand, had earlier defined probability as a "degree of confidence" which may vary from decision maker to decision maker for a given choice situation. He considered the art of guessing to consist of accurate assessments of unknown probabilities, e.g. by observing objective frequencies. This view bears certain restrictions: Probability cannot be seen as exactly numerical; furthermore it is often unclear which sample space should be used. The **subjective** school of probability as developed by Savage (1954)[7] et al. saw probabilities as "degree of beliefs": For a given set of hypotheses, basically any subjective probability can be assigned, under the conditions $\sum p_i = 1$ and $0 \leq p \leq 1$. Normative expected utility theory seeks to improve decisions; it is supposed to overcome the shortcomings of unaided, intuitive decision making. Its drawbacks, however, are that people neither structure decision problems as holistically as expected utility theory prescribes nor do they process information, particularly probabilities, in accordance with the model's rules. Intuitive decision making (System 1) may be so basic that it is incompatible with normative models (Schoemaker 1982: 536ff; 552; 554).

It also gives raise to the question how flawed human reasoning is: Evans and Over (1997: 403, in: Eysenck 2004[2]: 376, op. cit.) make the distinction between two types of rationality – Rationality[1] and Rationality[2]. People have personal rationality or Rationality[1] when "they are generally

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[4] Notation: p_i=probability, u=utility of outcome x_i, i=consequence of a given alternative.
[5] For a thorough presentation of the axioms see: Von Neumann, John / Morgenstern, Oskar (1947[2]): Theory of Games and Economic Behavior, Princeton University Press, NJ.
[6] See Bernoulli, Jacques (1713): Ars Conjectandi.
[7] See Savage, Leonard J. (1954): The Foundations of Statistics, Wiley, NY.

successful in achieving their basic goals, to do with keeping themselves alive, finding their way in the world, and communicating with each other." For Evans and Over, personal rationality depends on our implicit cognitive system, operating at an unconscious level (System 1). Impersonal rationality or Rationality$_2$, on the other hand, is shown when "they [people] act with good reasons sanctioned by a normative theory such as formal logic or probability theory." Thus, impersonal rationality depends on our explicit cognitive system, operating at a conscious level (System 2). Research tends to set its studies on how Rationality$_2$ is susceptible to cognitive errors, even when Rationality$_1$ (intuition) is not. This leads to the conclusion that rational models may be seen as "theories, and not standards, of behavior" (McKenzie 2003).

3.2   The Concept of Bounded Rationality

In 1955, Herbert Simon stated that

"Traditional economic theory postulates an 'economic man', who, in the course of being 'economic' is also 'rational.'[…] He is assumed also to have a well-organized and stable system of preferences, and a skill in computation that enables him to calculate, for the alternative courses of action that are available to him, which of these will permit him to reach the highest attainable point on his preference scale." (p. 99)

Simon, Nobel Laureate in economics, revolutionized the study of choice by contrasting observations of how people actually make choices and decisions with the rational (normative) models as postulated by economists. – For making decisions in consistence with these models humans lack the knowledge and information as well as the required computational skills. He declared that human decision making may not be rational from an economic point of view; however, it is still 'reasonable' (Hogarth 1989[2]: 63).

The constraints of limited computational capacity and predictive ability have to be taken as givens; people construct 'small worlds' that present limited representations of a decision problem, and find techniques to solve the problem *approximately* (Beach/Connolly 2005[2]: 10; Simon 1955: 101; Simon 1990: 6).

Simon coined the term 'bounded rationality', explaining human behavior to be shaped by a **pair of scissors** "whose two blades are the structure of the task environments and the computational capabilities of the actor" (Simon 1990: 7). In order to describe, predict and explain the behavior of a system of bounded rationality, it is crucial to build a theory of the system's processes and to describe the environment to which it is adapting (Simon 1990: 6f). It is necessary to look at both blades to make the scissors cut successfully; human behavior cannot be understood by studying

cognition or the environment alone. Minds with limited time, knowledge and other resources can be doing well in decision making by capitalizing on the structures in their environments. In addition to that, bounded rationality dispenses with *optimization* (synonymous with maximizing expected utility) as required by normative decision theory (Gigerenzer/Selten 2001: 4; Klein 2001: 105). Instead of searching for the optimal solution, the decision making '**satisfices**' – search is stopped when a solution meets expectations. Choosing the first satisfactory solution mean to pick an alternative that is regarded as 'good enough', i.e. when the decision maker's aspiration level is met or exceeded. The concept of satisficing therefore takes into respect human's computational as well as informational constraints (Simon 1990: 9f).

4. Cognitive Heuristics: An Approach

4.1 An Introductory Example[8]

Imagine the task of catching a baseball: As the ballplayer is determined to catch it, he has to be at the spot where the ball will land in time. But how does he proceed to reach the right spot? One possible solution would be to find the ball's initial distance and speed, and its projection angle. Other factors such as wind speed, air resistance or spin of the ball would have to be taken into consideration as well. All the computations about the ball's trajectory would have to be made within seconds – the time the ball flies. Clearly, the ball would have landed long before all the necessary calculations would have been finished.

But how do players indeed know where to run? – They make use of the *gaze heuristic* (fig. 4). According to this heuristic, the player fixates the ball and starts running, adjusting running speed so that the angle of gaze remains constant. All the information that is of relevance is the angle of gaze; there is no need of taking *all* causally information into account, as **omniscience** would imply. The player is not able to compute where the ball will land – by proceeding heuristically and just using one variable (the angle of gaze), however, he will be carried to the point where the ball will hit the ground. Or, to put it into biologist Richard Dawkins' (1989: 96; in: Gigerenzer 2005: 211, op. cit.) words: "At some subconscious level[9] something functionally equivalent to the mathematical calculation is going on."
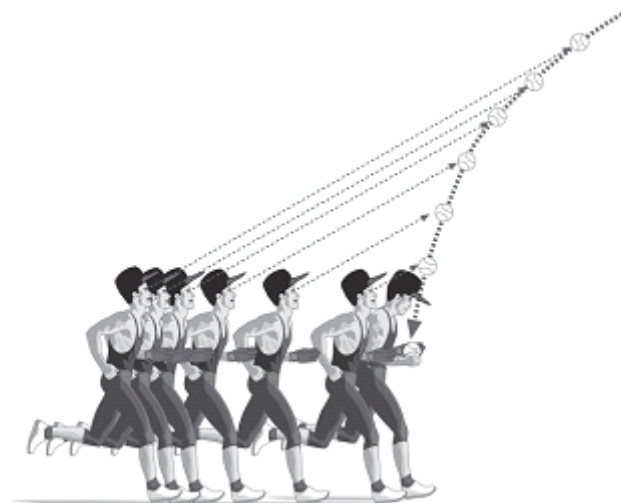
Fig 4: The Gaze Heuristic (see Gigerenzer 2001a)

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[8] Gigerenzer 2004: 63; Marsh/Todd/Gigerenzer 2004: 273; Gigerenzer 2005: 211.

[9] 'Subconscious' would refer to the use of *judgmental heuristics*.

This example wants to show that mental activity consists of 'simplifying' the judgmental situation. – Humans possess cognitive skills such that e.g. the computational ability to calculate the route of a ball is not required. A similar illustration – a billiard ball's trajectory – can already be found in Friedman/Savage 1948[10] (Hogarth 1989[2]: 230f).

4.2 Context-sensitive Reasoning

It is an undeniable fact that we commit mistakes. This, of course, raises the question whether errors are caused by the limitations of our cognitive system or whether they are a vital part of our intelligent system. According to Gigerenzer (2004: 195), errors tend to be labeled as 'good' or 'bad': A 'good' error's feature is that someone is (in the long run) better off committing the error than not committing it, for reaching a goal more quickly or for reaching it at all. **Trial-and-error learning** presents one basis of good errors; not trying out things and sporadically committing errors would lead the intelligence of the system ad absurdum.

The second view of errors is at the opposite end: To err means *not* to think, or, at least, not hard enough; an intelligent system should better do without mistakes. The study of cognitive errors has been dominated by logical principles: Errors were seen as nuisances, as a gap between people's behavior and an established rule of arithmetic, logic or statistics. The same way perceptual illusions (like seeing things that diverge from the appropriate physical measurements) should help to unravel the laws of perception, errors of judgment should help to discover the laws of higher cognition (Tversky/Kahneman 1983: 313, in: Gigerenzer: 2005, op. cit.). In this sense, the laws of logic and probability are regarded as the norm for good reasoning (Gigerenzer 2005: 197ff).

Human intelligence, however, cannot be restricted to these norms: In a world full of ambiguity, we have to make **intelligent inferences** from the environmental structures given, making an "uncertain yet informed bet based on cues", resulting in "intelligent context-sensitive reasoning". (Gigerenzer 2005: 204). Context can be considered to refer to both the formal structure as well as the content of a given task. It not only comprises task variables, but also what the decision maker brings to the task, like past experience gained through learning, limitations on memory or attention and similar traits. Cognitive processes must not be seen as givens: they develop and change over time due to maturation, experience and education. Prescriptive models, on the

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[10] See Friedman, M./Savage, L.J. (1948): The Utility Analysis of Choice involving Risk, Journal of Political Economy, Vol. 56, pp. 279-304.

contrary, make simplifying assumptions of the environment and achieve their generality and power by treating problems out of context, setting their focus on structure (Einhorn/Hogarth 1981: 56, 61; Von Winterfeldt/Ward 1986: 550).

Intuitive predictions, as System 1 proposes, are for the most part founded on the decision maker's causal understanding of the environment. – As the environment structures are too complex and uncertain in comparison to one's cognitive abilities, people are prone to discover **causal patterns**. The problem hereby is that it is difficult to distinguish between pattern and noise: Sometimes *probable cause* is inferred where none exists. The nature of causal reasoning, as opposed to statistical reasoning which is fully based on the logical structure of information, responds both to content and structure (Hogarth 1989[2]: 40).

As humans can infer causality from the environment, they possess the ability to adapt their behavior, i.e. they can learn from the cause-effect between actions and outcome. This not only presents an ability crucial for survival, but it also facilitates causal inference and induction and leads to the development of categorization. Apart from being able to organize our knowledge, people also possess the skill to think about their own thinking (metacognition) which can be directly linked to one's decision to e.g. alter behavior in different situations. Another aspect of **contingent learning** is that it can lead to a change in tastes and preferences – as opposed to fixed preferences in normative models. Furthermore, a lot of judgmental and decision research focused on studies where all the necessary information for reaching a judgment or decision was provided in descriptions of the respective problem (also see Eysencks 2004[2] definition of *well-definded problems* in section 2.2), thus making learning irrelevant (Einhorn/Hogarth 1981: 78; Newell/Bröder 2008: 196, 198).

4.3   Heuristics and History

The term 'heuristic' is of Greek origin, translated as 'serving to find out or discover'. From the 19th century up until the 1970ies, 'heuristics' referred to **useful cognitive processes** that could not be dealt with by logic and probability theory. In 1905, Albert Einstein used the term 'heuristic' in his Nobel Prize-winning paper "On a heuristic point of view concerning the generation and transformation of light" to show that he considered the view he presented as incomplete, even false, but nonetheless useful. From Einstein's perspective, a heuristic can be seen as an approach to a problem that is necessarily incomplete given the knowledge at hand, and

therefore unavoidably false, but nevertheless helpful for leading thinking in the right directions (Gigerenzer/Todd/The ABC Research Group 1999: 25f).

Some decades later, Gestalt psychologists[11] carried the idea a bit further and spoke of 'heuristic reasoning'. They conceptualized thinking as interaction between mental processes and external problem structure. Herbert Simon and Allen Newell subsequently modeled heuristics for search with more precise computational models. Information processing theory in cognitive psychology elaborated the meaning of a heuristic as a **useful shortcut**, an approximation, or a rule of thumb for guiding search (Gigerenzer/Todd/The ABC Research Group 1999: 26).

In the 1960ies, Ward Edwards made a fundamental methodological contribution by introducing Bayesian analysis to psychology, setting up a normative standard with which everyday judgments could be compared. However, not only from Edwards' own research, it became evident that intuitive judgments of probability did not correspond to the 'golden' normative benchmark. Consequently, a lot of research was carried out to discover the causes of suboptimal performance and strategies for improvement (Gilovich/Griffin 2002: 2).

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[11] Gestalt psychology is, per definition, "a school of thought that looks at the human mind and behavior as a whole" (http://psychology.about.com/od/schoolsofthought/f/gestalt_faq.htm, retrieved on 08/2010). According to this approach, the cognitive system shows the tendency to automatically minimize inconsistencies between given pieces of information so as to form consistent mental representations, i.e. "Gestalten" (Glöckner/Betsch 2008).

"The only real valuable thing is intuition."

(Albert Einstein)

5. The Heuristics and Biases Program

In the 1970ies, Amos Tversky and Daniel Kahneman introduced a program of research on judgment under uncertainty, which became known as the '**heuristics and biases approach'**. They suggested that intuitive predictions and judgments rest on a "limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations" (Tversky/Kahneman 1974: 1124). The main goal of the research was to gain insight into the cognitive processes that lead to both valid and invalid judgments: Each heuristic was associated with a set of *biases* – departures from the normative classical model of rational choice (Gilovich/Griffin 2002: 1ff; Kahneman/Tversky 1996: 582).

In contrast to the 'cognitive miser' view (Fiske/Taylor 1991) that sees heuristics as simplifications of a task produced by idle and negligent minds[12], Tversky and Kahneman regard processes of intuitive judgment not as simplifications of rational models, but as *different in kind*. The main general-purpose heuristics of their program underlying intuitive judgments under uncertainty are **representativeness**, **availability**, and **anchoring and adjustment**, later having been enlarged by the **affect heuristic**.

There are three aspects crucial to the program:

- Heuristics are per se intelligent assessment procedures that are – in spite of their deviations from normative reasoning processes – by no means 'irrational'.
- Although heuristics lead to "quick and dirty" solutions, they make use of highly sophisticated underlying processes in the human's mind.
- Heuristics are not exceptional responses in order to reduce mental effort due to information overload or high complexity, but can be seen as normal intuitive answers to even the simplest questions about probability, frequency and prediction (Gilovich/Griffin 2002: 3f).

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[12] See Fiske, Susan T./Taylor, Shelley E. (1991²): Social Cognition, McGraw-Hill, NY.

5.1   Representativeness

As uncertainty is an unavoidable part of our lives, choices must be based on our beliefs about the likelihood of uncertain events. Intuitive judgment thus is often the only practical method for assessing uncertainty. 'Correct' probabilities of events cannot be easily defined, as everyone has a different knowledge or holds different beliefs and therefore assesses different probabilities to the same event; however: subjective probabilities *can* fulfill the requirements of probability theory (Tversky/Kahneman 2002: 19).

People do not follow the principles of probability theory in judging the likelihood of an uncertain event. This is also due to the fact that the laws of chance are neither intuitively evident, nor easy to apply. Deviations of subjective probability from objective probability are the resulting phenomenon (Kahneman/Tversky 1982: 32).

If a decision maker follows the representativeness heuristic he assesses the probability of an uncertain event or a sample by the degree to which it is: (a) similar in crucial properties to its parent population, and (b) reflects the outstanding features of the process by which it is generated. In many situations, an event X will be judged more probable than an event Y, given that X appears more representative; people tend to consistently judge the more representative event to be more likely, whether this is the case or not (Kahneman/Tversky 1982: 33).

Presented as such, representativeness is "an assessment of the **degree of correspondence** between a sample and a population, an instance and a category, an act and an actor or, more generally, between an outcome and a model." (Tversky/Kahneman 2002: 22). When the model and the outcomes can be described in the same terms, representativeness is reduced to similarity: A sample, for example, appears representative if its outstanding characteristics match the corresponding parameters of the population; a person may seem representative of a particular social group if he resembles the stereotypical member of that group. – *Stereotyping* is a typical feature of representativeness as information is usually stored and processed in relation to mental models, such as prototypes and schemata. Representativeness furthermore may covary with frequency as frequent events tend to be more representative than unusual events (e.g., a representative winter day is cold and snowy) (Tversky/Kahneman 2002: 23).

5.1.1.   The Conjunction Fallacy

A judgment is given the label 'fallacy' if most of the people who commit it, are willing to accept – after thorough explanation – that they made a nontrivial, conceptual error and that they should have known better due to knowledge already available (like, for example, knowledge of statistical rules) (Tversky/Kahneman 2002: 34).

The conjunction fallacy shows the contrast between the extensional logic that underlies most formal conceptions of probability and the natural assessments that are intrinsic to many judgments and beliefs:

The most fundamental principle of probability is the **extension rule**: If A includes B, then the probability of B cannot exceed the probability of A, or: $P(A) \geq P(B)$, expressed in the conjunction rule as: $P(A\&B) \leq P(A)$, where A&B constitute a subset of A. – A conjunction cannot be more probable than one of its constituents (Kahneman/Tversky 1996: 585); intuitive judgments, however, are in general not extensional. Violations of extensional logic of probability theory while applying the representativeness heuristic can be shown in the **Linda** example:

Linda is 31 years old, single, outspoken and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

- Linda is a teacher in elementary school.
- Linda works in a bookstore and takes Yoga classes.
- Linda is active in the feminist movement. *(F)*
- Linda is a psychiatric social worker.
- Linda is member of the League of Women Voters.
- Linda is a bank teller. *(T)*
- Linda is an insurance salesperson.
- Linda is a bank teller and active in the feminist movement. *(T&F)*

The description of Linda is supposed to be representative of an active feminist (F) and unrepresentative of a bank teller (T). In their set of studies (from 1974 ongoing) Tversky and Kahneman expected the ratings of representativeness to be higher for the classes of conjunction attributes (T&F) than for the less representative constituent of each conjunction. The respondents, undergraduates at the University of British Columbia, confirmed their expectations by displaying a ranking order of F>T&F>T, thus violating the conjunction rule (Tversky/Kahneman 2002: 23f; 43).

Other studies were conducted, trying to induce the respondents to apply the conjunction rule by simplifying the personality sketch of Linda to the following description:

a. Linda is a bank teller. (T)
b. Linda is a bank teller and is active in the feminist movement. (T&F)
Which alternative is more probable?

Still, undergraduates ranked option b more probable. Tversky and Kahneman, though, came to the conclusion that profound statistical knowledge can lead respondents to conform to the rule, after having conducted the Linda study with graduate students of social sciences at the University of California and at Stanford University (but nonetheless: knowledge does not alter intuitions about representativeness) (Tversky/Kahneman 2002: 26ff; 44).

Furthermore, they found out that when they omitted the sketch of Linda's personality and solely described her as '31-year-old woman', almost all respondents followed the conjunction rule, thus ranking the conjunction (bank teller and active feminist) as less probable than its constituents. This can be shown in their *M* ➔ *A paradigm*:

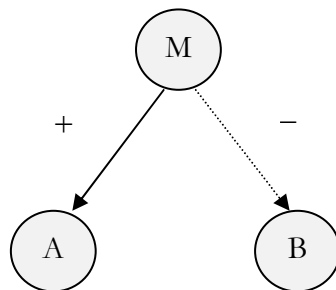*Fig 5: The M➔A Paradigm (see Tversky/Kahneman 2002).*

The conjunction error in the Linda problem can be attributed to the relation M (Linda's personality) and event A (highly representative: active feminist, therefore a strong positive association), not to the relation between A and B (unrepresentative: bank teller) (Tversky/Kahneman 2002: 35).

5.1.2   Base-rate Neglect

Insensitivity to prior probability of outcomes is another bias of the representativeness heuristic: Tversky and Kahneman (1974: 1124) stated that prior probabilities will be neglected if people evaluate probability by representativeness.

The neglect of base-rate (or: a priori) data can be shown in the following problem (Tversky/Kahneman 1980):

A cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city. You are given the following data:

(a) 85% of the cabs in the city are Green and 15% are Blue.

(b) A witness identified the cab as Blue. The court tested the reliability of the witness under the same circumstances that existed on the night of the accident and concluded that the witness correctly identified each one of the two colors 80% of the time and failed 20% of the time.

Question: What is the probability that the cab involved in the accident was Blue rather than Green?

Rev. Thomas Bayes focused on situations in which there are two possible beliefs or hypotheses and demonstrated how new information or data can change the probabilities of the two hypotheses. According to **Bayes' theorem**, probabilities are combined in order to work out the impact of new evidence on a pre-existing probability (Eysenck 2004[2]: 338).

To come to the right conclusion, B and G denote the hypotheses that the cab involved in the accident was Blue or Green, and W denotes the witness's report (cab = Blue). Applying Bayes' theorem, with prior chances of 15/85 and a likelihood ratio of 80/20,

$$P(B/W) / P(G/W) = P(W/B)P(B) / P(W/G)P(G)$$
$$= (0.8)(0.15) / (0.2)(0.85) = 12/17$$

therefore: $P(B/W) = 12/(12+17) = 0.41 = 41\%$

However, most of the respondents in the cab study focused on the evidence of the eye-witness, thus claiming that there was an 80% probability that the cab was Blue. The discrepancy shows

that the participants tended to ignore the base-rate information, which was only 15% of the cabs being Blue (Tversky/Kahneman 1982: 156f).

A different pattern of judgments could be observed when the incidental base rate of cabs was replaced by a causal base rate, i.e. of accidents. Consequently, formulation (a) was replaced with

(a') Although the two companies are roughly equal in size, 85% of cab accidents in the city involve Green cabs and 15% involve Blue cabs.

The rewording presented a causal relationship between the accident record of the cab company and the likelihood of it being responsible for a given accident. Base-rate information was now partially taken into account, though answers were to a great extent inconsistent (Tversky/Kahneman 1982: 157; Eysenck 2004[2]: 340).

5.1.3 Attribute Substitution

Kahneman and Frederick (2002: 53) suggested a formulation in which complex tasks are reduced to simpler operations by an operation labeled attribute substitution: "Judgment is mediated by a heuristic when an individual assesses a specified *target attribute* of a judgment object by substituting another property of that object – the *heuristic attribute* – which comes more readily to mind."

The role of attribute substitution can be shown in the study by Fritz Strack et al. (1988)[13] in which college students answered two questions successively: "How happy are you with your life in general?" and "How many dates did you have last month?" The correlation between these two questions was little when presented in the order above, but rose to 0.66 when the questions were asked vice versa. It could be deduced that the dating question evoked an affectively charged evaluation of one's romantic life, which becomes the heuristic attribute when the happiness question is asked subsequently: The love status stands *pars pro toto* for the general well-being. (Kahneman/Frederick 2002: 53; Kahneman 2003: 1461).

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[13] See Strack, F./Martin, L. L./Schwarz, N. (1988): Priming and Communication. The Social Determinants of Information Use in Judgments of Life-satisfaction, European Journal of Social Psychology, Vol. 18, pp. 429-442.

Attribute substitution takes place when the target attribute cannot be recalled immediately (e.g., happiness in general), but the search for it brings to mind the value of other attributes (e.g. love life) that possess an **associative relationship** with the target attribute. In the example above the effect of momentary ease of access results in the 'romantic satisfaction heuristic' (Kahneman/Frederick 2002: 54f).

In the *Linda* study, the respondents substitute a judgment of representativeness (similarity) for the desired judgment of probability: The personality sketch resembles a feminist bank teller more than it resembles a stereotype bank teller – the study endorses the hypotheses of attribute substitution and shows a foreseeable error in judgment (Kahneman/Frederick 2002: 62; Kahneman 2003: 1461).

5.2   Availability

According to Tversky and Kahneman (1974: 1127), "people assess the frequency of a class or the probability of an event by the ease with which instances or occurrences can be brought to mind." – As instances of larger classes are normally recalled better and quicker than instances of less frequent classes, this presents a helpful cue for judging frequency and probability.

The judgmental heuristic in application is called *availability*; relying on this heuristic may lead to biases due to the **retrievability of instances**: a class whose instances are brought to mind more easily will appear more numerous than a class of equal frequency but whose instances are not that easily brought to mind (e.g., deaths due to car crashes will be found more often in the newspaper than deaths due to stomach cancer). Other factors, such as salience (an outstanding feature) may have an effect on the retrievability of instances (e.g., seeing some event has a different impact than reading about it); also recent occurrences are probably more available than earlier occurrences (Tversky/Kahneman 1974: 1127).

Tversky and Kahneman (1982: 166f) conducted a study on the judgment of frequency of letters in the English language: Is it more probable that a word, sampled at random from an English text, starts with *K* or that *K* is its third letter? People assess the ease with which words come to their mind that start with K; therefore the letter *K* is judged to be more frequent at the first place, even though a typical text contains twice as many words in which *K* actually is in the third position.

5.3   Anchoring and Adjustment

Tversky and Kahneman (1974: 1128) defined anchoring as a process in which "people make estimates by starting from an **initial value that is adjusted** to yield the final answer [and]…adjustments are typically insufficient."

Like the other heuristics, anchoring may present a useful way of making judgments. An example: Trying to set a value on an antique chair, you recall having seen a similar chair at another antique dealer in a little better condition. – The price of the other chair may serve as a reservation price (i.e. the sum one would be willing to pay at most). (Chapman/Gretchen 2002: 120).

The term 'anchoring' first refers to the *anchoring procedure,* in which an outstanding but uninformative number is presented to the respondents. *Experimental result* is the influence of this uninformative number on judgments. Third, anchoring and adjustment is used to refer to the *psychological process* by which the uninformative number has its effect (Chapman/Gretchen 2002: 121).

Most anchoring studies apply a two-step procedure as introduced by Tversky and Kahneman (1974): An opening comparison task is followed by a numeric estimation of the target. For example: participants were asked to estimate the percentage of African countries in the United Nations; a number was determined by spinning a wheel of fortune. Then, participants were asked to indicate whether the percentage was higher or lower than the value and subsequently to make an estimation by moving upward or downward from that value: Indeed, the random number served as an anchor; the participants did not move too far away from the quantity given (Tversky/Kahneman 1974: 1128).

The three stages at which an anchoring mechanism could occur is shown in the following figure:
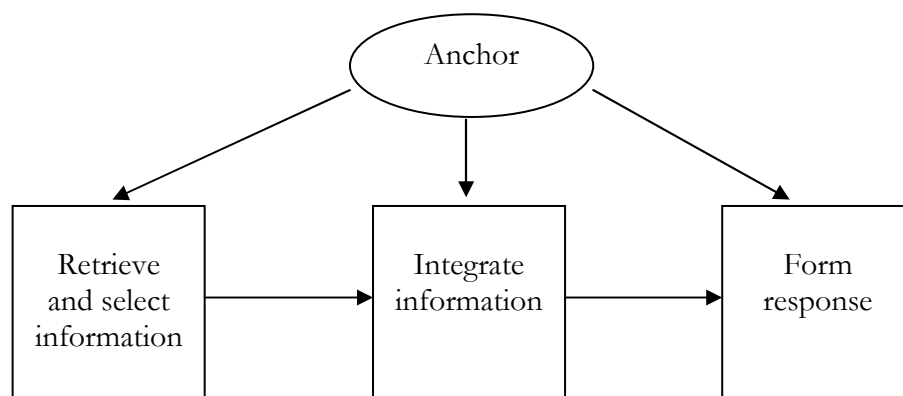
Fig 6: Stages of the Anchoring Mechanism (see Chapman/Johnson 2002).

At the first stage, information regarding the target is retrieved through search of memory or the environment; information similar to an available anchor might be positioned first. – People tend to evaluate hypotheses by attempting to confirm them, thus search may yield evidence that is disproportionately consistent with a present anchor. The information then is integrated to lead to an overall target judgment – at this stage, greater weight might be given to information compatible with the anchor. Finally, the anchor might have an influence on how the judgment is presented on the external scale (Chapman/Gretchen 2002: 126; Epley/Gilovich 2002: 140).

Explanations for insufficient adjustment might be lack of effort (e.g., anchoring on one piece of information and underweighting ensuing knowledge) or lack of cognitive resources that lead to answers not too far away from the anchor. Neither pointing out to the participants to give attention to their own anchoring nor the presence of incentives resulted in a reduction in the occurrence of anchors (Chapman/Gretchen 2002: 125). Cognitive processes also differ when an anchor is provided by an experimenter or by another external source; self-generated anchors activate a different set of mental operations (Epley/Gilovich 2002: 147f).

5.4.   The Affect Heuristic

In their later work, Tversky and Kahneman came to the conclusion that the anchoring heuristic should be replaced as a major general-purpose heuristic by the *affect heuristic*: There is undeniable evidence that every stimulus evokes an **affective evaluation**; this evaluation normally occurs unconsciously (Kahneman/Frederick 2002: 56).

Affect as used here refers to the specific quality of 'goodness' or 'badness' experienced as a feeling. Affective responses occur fast and automatically and are very often the first reactions to a stimulus and therefore guiding information processing and judgment. According to Zajonc (1980), every perception has an affective component: "We sometimes delude ourselves that we proceed in a rational manner and weight all the pros and cons of the various alternatives. But this is probably seldom the actual case. […] We buy the cars we 'like', choose the jobs and houses we find 'attractive', and then justify these choices by various reasons." (Zajonc 1980: 155, in: Slovic et al. 2002: 398, op. cit.). The emotional basis is one of the characteristics of System 1 (intuition): Despite the necessity of thorough analysis of decision-making problems, reliance on affect presents the quicker and more efficient way to navigate with limited mental resources in a complex and uncertain, sometimes even dangerous world (Slovic et al 2002: 397f).

Damasio (1994) argued that thought is made up to a large part by images that include sounds, smells, real or imagined perceptual impressions, ideas and words. Due to lifelong learning these images receive a 'marker' of positive and negative feelings linked to somatic states of a person. **Somatic markers** are supposed to increase the efficiency and accuracy of a decision process; their absence is supposed to worsen decision performance, which has been observed in people with certain types of brain damage (Damasio 1994: 174, in: Slovic 2002: 399, op. cit.).

Another proposition is that the affect heuristic has its origin in risk perception: Alhakami and Slovic (1994)[14] discovered that the inverse relationship between perceived risk and perceived benefit showed a linkage to the strength of positive or negative affect related to an activity; i.e. people also make their judgments on the basis of their feelings about it, thus judging risks as low if they like a certain activity (high benefits) and vice versa (Slovic et al. 2002: 410f).

Reliance on affect may also deceive us – deliberate manipulation of affect in order to influence judgments and decisions can be found in the advertising industry to a large extent: Manipulation of affect is more subtle than persuasive argumentation and taking place without our consciousness. Cigarette advertising, for example, is designed to increase positive affect (cowboys, nature,…) associated with smoking, which at the same time is likely to decrease perceptions of risk (Slovic et al. 2002: 416ff).

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[14] See Alhakami, A. S./Slovic, P. (1994): A Psychological Study of the Inverse Relationship Between Perceived Risk and Perceived Benefit, Risk Analysis, Vol. 14, pp. 1085-1096.

5.5   Critique on the 'Heuristics and Biases' Program

The main critique on the program was that it presents human beings as erroneous and biased creatures (*"We cannot be that dumb"*) that make use of heuristics due to their cognitive limitations (heuristics = second-best solutions) or to save mental effort (cognitive miser view) (Gilovich/Griffin 2002: 8).

Gigerenzer (2000), a vigorous critic of the program, put it that way:

> *"In artificial intelligence research one hopes that heuristics can make computers smart; in the 'heuristics and biases' program one hopes that heuristics can tell why humans are not smart. […] Rather than explaining a deviation between human judgment and allegedly 'correct' probabilistic reasoning, future research has to get rid of simplistic norms that evaluate human judgment instead of explaining it."* (p. 260)

I want to present two different approaches to conjunctive thinking and base-rate neglect as proposed by Gigerenzer et al.:

5.5.1   The Conjunction Fallacy Revisited

Hertwig and Gigerenzer (1999:275ff) reproach Tversky and Kahneman with using the conjunction rule in a "content-blind way": The Linda example is reduced to the terms 'probability' and 'and', supposed to be interpreted as mathematical probability. Humans, however, possess the ability to make **semantic and pragmatic inferences**. By making an inference about the instruction, the term 'probability' is interpreted as nonmathematical, but as "something which, judged by present evidence, is likely to happen" or as a "credible story". Also the personality sketch of Linda is taken into account; the assumption is made that a simple mathematical interpretation of the problem would render the description of Linda irrelevant (Sloman 2002: 386). This was later acted on by Tversky and Kahneman (2002) in their M ➔ A paradigm as explained in Section 5.1.1.

In summary, Gigerenzer and Hertwig (1999: 278) suggest that, if semantic inference by social rationality is applied, then T&F is not a violation of the conjunction rule as probability in the mathematical sense is not being assessed.

5.5.2 Bayesian Reasoning Revisited

Gigerenzer and Hoffrage (1995: 684ff) propose that Bayesian algorithms are computationally simpler if they are presented in **frequency formats** rather than probability formats, i.e. there are fewer operations needed and operations can be performed on natural numbers (absolute frequencies) rather than percentages. Frequency formats are supposed to correspond to the sequential way in which information is acquired in natural sampling. This can be depicted in a natural sampling tree: Coming back to the *cab example* as presented in section 5.1.2, probabilities can be shown in frequencies, with the lower branches presenting 80% and 20% of the respective base rates (85 Green, 15 Blue). For solving the equation, base rates need not be attended to, as we just need the numbers of the witness's account:

$$P(B/W) = 12/(12+17) = 41\%$$
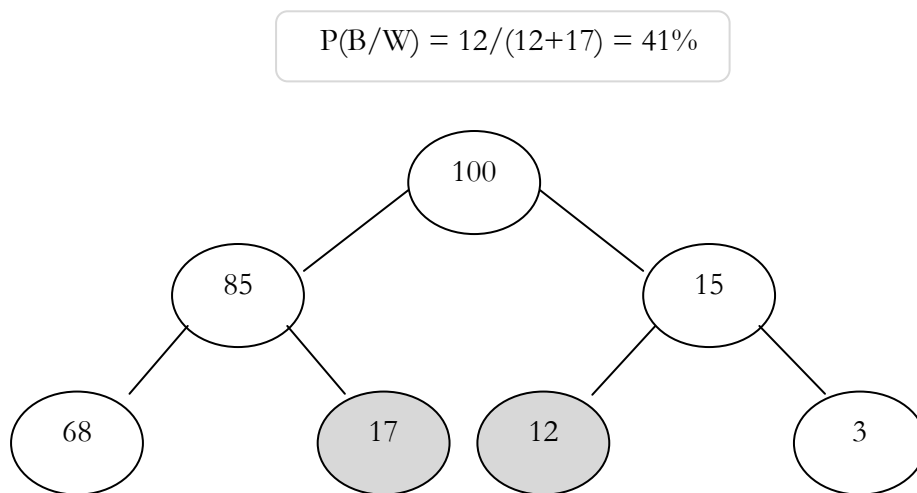
Fig 7: Cab Example: Natural Sampling of Frequencies.

Despite studies that even fourth graders can compute the Bayesian way if they are presented numbers in natural frequencies (Zhu/Gigerenzer 2006), this approach contains certain shortcomings: Gigerenzer and Hoffrage (1995) put emphasis on the fact that their results hold for an elementary form of Bayesian inference with binary hypotheses and data. Therefore it is unlikely that frequency formats would extract Bayesian algorithms, when the human inference has to handle several cues or data that are not independent.

5.6   The Difference between Judgmental and Choice Heuristics

Judgmental heuristics in Tversky and Kahneman's sense are largely based on impressions that arise **automatically** and independently of any explicit judgmental goal. They are natural assessments that are carried out as a part of the perception of events and the understanding of messages. In the case of Linda, people notice the dissimilarity of a stereotype bank teller and the description of a political activist spontaneously. This intuitive judgment may be used to come to the conclusion that Linda is unlikely to be a bank teller by attribute substitution (Tverksy/Kahneman 2002: 20; Frederick 2002: 549).

An important feature of judgmental heuristics is that people do not view this process as a heuristic, as they do not make deliberate use of it to save mental effort. The use of similarity to judge probability is labeled a heuristic only in comparison with a normative standard of judgment (Frederick 2002: 549).

Choice heuristics, on the other hand, represent conscious strategies, intentionally designed to simplify choice. In case of a decision maker being shown a matrix of numbers summarizing the attributes of his choice problem, no intuitive computation generates an image of which option is best. Thus, the decision maker has to **deliberately** decide how to proceed and which strategy to apply. – Many decision theorists conducted studies with Herbert Simon's view of humans' computational and memory limitations at the back of their minds. How do people make reasonable decisions when they are confronted with an information overload or complex situations? Researchers usually use stimuli that are abstract and do not bring to mind any intuitive impression. As a consequence, some type of analytical solution will be chosen (Frederick 2002: 548f).

In general, traditional judgmental heuristics can be seen as originating from System 1 (resulting from cognitive processes that are fast and not completely controllable), while traditional choice heuristics can be seen as originating from System 2 (resulting from slower and more intentional cognitive processes) (Frederick 2002: 549).

Whereas chapter 5 dealt with *judgmental heuristics*, chapter 6 will focus on *choice heuristics*.

"Make everything as simple as possible, but not simpler."

(Albert Einstein**)**

6. ABC's Heuristics: The Adaptive Toolbox

The 'fast and frugal' heuristics of the **Center for Adaptive Behavior and Cognition** (abbr. **ABC**, director: Gerd Gigerenzer) at the Max Planck Institute for Human Development in Berlin present System 2 heuristics for the most part as they are intentionally chosen in order to reduce computational burden. ABC is an interdisciplinary research group that was founded in 1995; its premise is the following:

> *"The Center for Adaptive Behavior and Cognition* **investigates reasoning and decision making under uncertainty** *at the levels of both individuals and social groups. The research group consists of psychologists, mathematicians, computer scientists, evolutionary biologists, economists, and researchers from other fields. With different methodological abilities, such as experimental methods, computer simulation, and mathematical analysis, they cooperate in solving the same problems.*
>
> *The ABC program combines a strong theoretical focus with practical applications, that is, the research group both develops specific models and explores their applications. Applications range from helping physicians and patients understand the statistical evidence arising from medical research, helping courts, administrators, and legislators understand the importance of heuristic thinking in the law, and improving teaching practices in statistical education by introducing transparent representation formats.* **The theoretical focus is on rationality** *and can be divided into three aspects:* **bounded, ecological, and social rationality."** [15]

6.1.   Visions of Rationality

According to the ABC research group (Gigerenzer/Todd 1999: 5f), human beings as well as animals have to make **inductive inferences** about the world they live in with limited time, knowledge and computational capacities. Many normative models of rational inference, however, see the mind as omniscient, i.e. in possession of *demonic* powers of reason, unlimited knowledge and an eternal span of time for making decisions. In their research work, ABC replaces the picture of the all-knowing mind with a bounded mind that has an adaptive toolbox full of fast and frugal (or 'simple') heuristics at its disposal. These heuristics are *fast* because information search is less cognitively demanding, and they are *frugal* because they use only a small amount of the information at hand. ABC's heuristics indeed make inferences with limited time and

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[15] http://www.mpib-berlin.mpg.de/en/forschung/abc/index.htm (retrieved on 07/2010).

knowledge without having to compute probabilities or utilities; they belong to the class of bounded rationality, which can be depicted in the following graph:
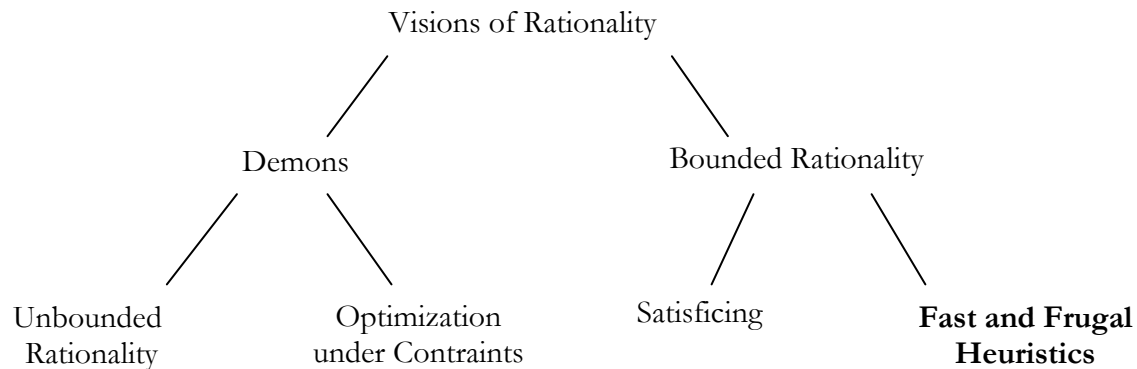

Fig 8: Visions of Rationality (see Gigerenzer/Todd 1999).

Demons (with reference to the French mathematician and astronomer Pierre Simon de Laplace who pondered about an omniscient genius) can be split into two categories:

Unbounded rationality is traditionally realized in maximization of expected utility and Bayesian models, assuming that people possess unrealistic cognitive abilities and an unlimited amount of time. **Optimization under constraints**, on the other hand, no longer assumes the omniscience of unbounded rationality; like the other concepts it focuses on limited information search which requires a stopping rule that tells when to stop looking for new information. Under this vision of rationality, search stops when the costs of finding new information are outweighing marginal benefits. The problems are obvious: first, estimates of costs (including opportunity costs) and benefits demand profound knowledge; the second problem is that of infinite regression (cost-benefit computations); third, demands of knowledge and computation knowhow can be so high that an ordinary person is supposed to act like an econometrician (Sargent 1993)[16] (Gigerenzer/Todd 1999: 8ff; Gigerenzer/Selten 2001: 5; Gigerenzer 2006: 22).

Bounded rationality follows the tradition of Herbert Simon (1955, 1956, and 1990; also see section 3.2) who wanted to construct a more realistic theory of human economic decision making: In Simon's view, the limitations of the human mind and the structure of the environment in which the mind operates represent two interlocking components (pair of scissors

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[16] See Sargent, T.J. (1993): Bounded Rationality in Macroeconomics, Oxford Univ. Press, NY.

example). Environmental structure should explain when and why simple heuristics succeed: the structure of the heuristic is supposed to be adapted to the environment in which it performs. The ABC research group uses the term *ecological rationality* to prescribe how a heuristic should be adapted to the structure of the environment – a heuristic is ecologically rational if it performs well in a real-world environment. Models of bounded rationality do not only describe the *outcome* of a decision process, but the *process* itself, namely how the decision is reached (Gigerenzer/Todd 1999: 12f; Gigerenzer/Selten 2001: 4; Selten 2001: 16; Gigerenzer 2006: 23).

One category of bounded rationality is **satisficing**[17]: Evolutionary pressures do not make people optimize *globally* (i.e. choose the best possible alternative), but instead make them optimize *locally*. An adjustable aspiration level is set to reduce the costs of information processing. As soon as an alternative is reached that exceeds the aspiration level (by comparing alternatives sequentially), search stops. Setting an appropriate aspiration level, however, can still require a large amount of cognitive capacities (Simon 1956; Hogarth 1989[2]: 65; Gigerenzer/Todd 1999: 13f; Gilovich/Griffin 2002: 9).

The second category of bounded rationality is presented by **fast and frugal heuristics**, contained in an adaptive toolbox, which the human mind draws on for making decisions under uncertainty. ABC considers them to be "bounded rationality in its purest form" (Todd/Gigerenzer 2000: 740).

6.2   Characteristics of Fast and Frugal Heuristics

A heuristic in ABC's sense has the qualities of exploiting evolved capacities (like tracking objects as done with the gaze heuristic, see section 4.1) as well as exploiting the structures of the environment. The latter means that the rationality of heuristics is **eco**logical, rather than logical, i.e. heuristics cannot be categorized as rational or irrational per se, but – as they are context-bound – must be seen *in relation* to the environment in which they are applied. Thus, the potential of heuristics lies in their performance in a suitable environment: like the blades of scissors, the structure of the environment and the cognitive heuristics are required to match. As **domain-specificity** is a main feature of ABC's heuristics, their success or failure depends on the respective environment (Todd 2001: 52; Gigerenzer 2004: 63f; Raab/Gigerenzer 2005: 193).

The following arguments (Raab/Gigerenzer 2005: 196) endorse *domain-specific intelligence*:

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[17] The word, a blend of *sufficing* and *satisfying*, is of Northumbrian origin, a region in England on the Scottish border, where it meant 'to satisfy'(Gigerenzer/Todd 1999: 13).

- Stating the US-psychologist Jerome Bruner (1973), much of intelligence involves going "beyond the information given", i.e. humans have to make sensible inferences on the basis of little or incomplete information.
- An omniscient mechanism not only is infeasible but would lead to computational explosion. – The more general, the slower a system.
- Human intelligence comprises the interaction between cognitive as well as social and emotional abilities.

Fast and frugal heuristics make a trade-off on the dimension *generality* versus *specificity*: ABC's domain-specific heuristics can be as accurate as complex computational models by only using some of the available information (one or a few cues or features) while at the same time neglecting more variable uninformative cues. *Overfitting*, on the other hand, describes the failure of generalization – the assumption that every detail and every free parameter has to be taken into account for making precise inferences (Gigerenzer/Todd/The ABC Research Group 1999: 18f).

Many theories of rationality assume that all the information and evidence available should be used for the final judgment and decision. Heuristics in that sense are seen as a trade-off between accuracy and effort (the amount of information that is integrated and used for cognitive computation). This trade-off, however, does not hold for all situations. Indeed, **less-is-more effects** describe a point where obtaining more information and doing more calculations could decrease accuracy. It is important to note that less-is-more does not *always* refer to better performance by using less information; it rather explains that there exists a point where additional pieces of information would become disadvantageous, even if there were no calculation costs and information was free. ABC's heuristics make use of less information by ignoring cues and dependencies between cues (Gigerenzer/Brighton 2009: 110f).

Furthermore, simple heuristics' performance is not measured according to the *coherence criterion of rationality* (that demands internal logical consistency, intensive information search and integration of information), but by the success of their adaptive inferences (how well they work in the external world). The latter approach can be subsumed as **correspondence criterion of rationality**. The US-psychologist Egon Brunswik (1957) once compared the mind and the environment to husband and wife who have to arrange with one another by mutual adaptation[18]. As they have become estranged, ABC's goal is to get the couple on a corresponding level again, even if they will not act coherently (Gigerenzer/Todd/The ABC Research Group 1999: 18ff).

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[18] See Brunswik, E. (1957): Scope and Aspects of the Cognitive Problem, in: H. Gruber et al. (eds.): Contemporary Approaches to Cognition, Harvard University Press, Cambridge (MA), pp. 5-31.

Another important aspect of simple heuristics is that of **social rationality** (a special form of ecological rationality). Social rationality refers to the ability of humans to interact with others in an intelligent way. The two main characteristics of social environments are the following: First, by the speed with which they can change and second, by the need to take not only one's own, but the behavior and decisions of others as well into consideration; this also requires coordination. *Social goals* are crucial for building and nourishing social structure and cooperation. These goals are expected to comprise transparency (which decisions are understandable and predicable by the group?), fairness (which decisions do not violate the expectations between people of equal social standing?) and accountability (which decisions can be justified?) (Gigerenzer/Todd/The ABC Research Group 1999: 25; Gigerenzer 2001: 48).

6.3   Classes of Heuristics

The adaptive toolbox provides heuristics that are composed of cognitive and emotional building blocks. These building blocks can be part of more than one heuristic as they are more general than the heuristics themselves. The three functions of the building blocks are the following:

- **Guiding search**: Alternatives (the choice set) and cues (for evaluation of alternatives) have to be found through active search. Simon's concept of satisficing involves searching for alternatives, whereas fast and frugal heuristics search for cues.

  Heuristic principles for guiding search may tell that the search for cues can be random or in order of some criterion related to the cue's validity or based on which cues worked well for similar decisions previously made.

  Generally speaking, emotions can set limits to the search for choice sets and cues more successfully and for a longer span of time than cognitive tools.

- **Stopping search**: Search for alternatives and information must be stopped at some point. However, simple stopping rules do not deal with cost-benefit calculations as in optimization under constraints; indeed, one of the simple stopping rules would stop search as soon as the first cue in favor of one alternative is found.

  Also in here, emotions can be successful tools for stopping search. Whereas cognitive stopping rules could be instable with regard to the aspiration level – e.g., leaving one's partner every time someone more attractive comes along –, emotions can stop the search

for a partner for a longer time and enable commitment. The same holds for rearing one's child: parental love dispenses with cost-benefit calculations when it comes to bearing all the sleepless nights with the crying infant.

▪ **Decision making**: A decision rule tells how to proceed after the search has been stopped. For example, decisions can be made by a simple elimination process, where successive cues eliminate alternative after alternative until one final choice is left.

ABC's working hypothesis is that people make use of a range of heuristics contingent on the environment in which they are applied. The evolved mind will be ascribed the function of an adaptive toolbox that contains specific heuristics tailored to handle different types of decision problems (Gigerenzer/Todd/The ABC Research Group 1999: 16f; Gigerenzer 2001: 43ff; Marsh/Todd/Gigerenzer 2004: 275; Raab/Gigerenzer 2005: 194f).

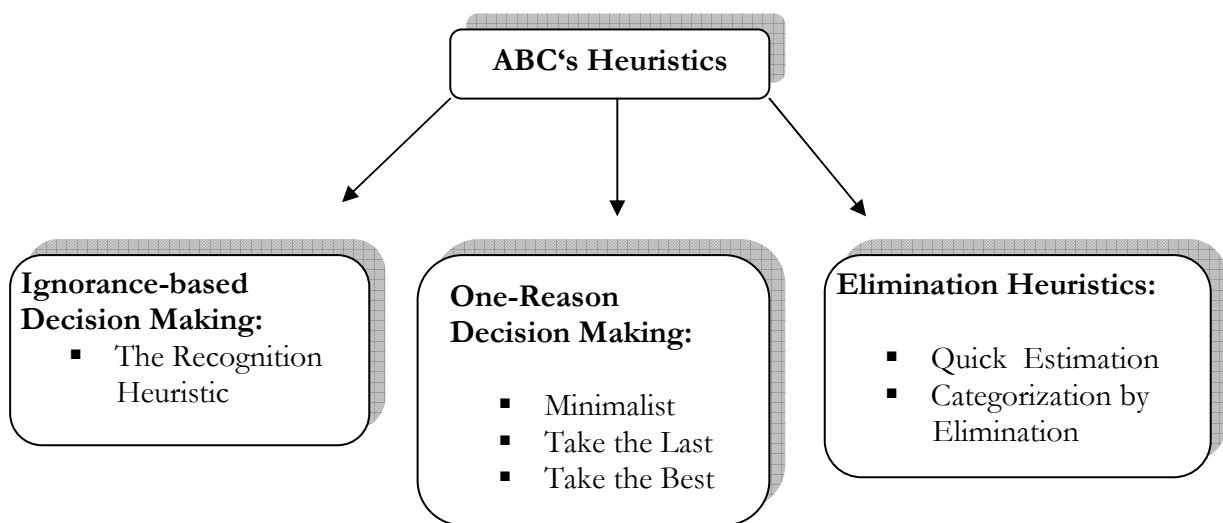Fast and frugal heuristics can be divided into three classes:

Fig 9: Overview of ABC's Heuristics.

6.3.1   Ignorance-Based Decision Making: The Recognition Heuristic

An illustration (Marsh/Todd/Gigerenzer 2004: 276): *Imagine you are on a journey through an exotic country and invited for ham and eggs. You have to choose between eggs with either green or yellow yolks. Which eggs would you like to eat?*

Sometimes the situation arises where the only information at hand is whether or not an option has ever been encountered before. One of ABC's simplest heuristics is the *recognition heuristic*[19]*:* It makes use of the less-is-more effect by requiring a certain lack of knowledge for making efficient inferences about unknown aspects of the world. The recognition heuristic is based on the binary distinction between the previously experienced and the unfamiliar; it is defined as follows:

Which of two options has a higher value on some criterion? If one of two objects is recognized and the other is not, then infer that the recognized object has the higher value.

The search rule limits search to recognition memory. As soon as recognition has been assessed for both objects, search stops. Decision is based on only one piece of information: recognition. In case of the eggs-choice problem, the decision maker would certainly choose the yellow-yoked eggs as they are recognized. Hence, the recognition heuristic is a heuristic *spontaneously* activated by System 1 (recognition processes) and *consciously* adopted by System 2.
Fast and frugal heuristics in ABC's sense can therefore be seen as heuristics for "higher order cognitive processes that call upon lower order processes of cue perception and memory" (Gigerenzer/Todd 1999: 30; Goldstein/Gigerenzer 1999: 38; 41; 57; Kahneman/Frederick 2002: 59).

The ABC Research Group analyzed the use of the recognition heuristic by means of computer simulation, mathematical analysis and experimentation: In one experiment, they used a geographical topic about which their participants (students at the University of Chicago and the University of Munich) had only partial knowledge. The task was a two-alternative choice on the criterion: Which city has a *larger* population? When posing the question if San Diego or San Antonio had a larger population, 100% of the German students chose correctly (i.e. San Diego), in comparison to only 62% of the US-students: German students were able to make use of the recognition heuristic as all of them had heard of San Diego, but many among them did not recognize San Antonio. They were thus *ignorant enough* to make the correct inference (Goldstein/Gigerenzer 1999: 41; 43).

The question arises, how the correlation between recognition and the *criterion* (e.g., larger) is estimated. Though the criterion is inaccessible (i.e. there is no direct information) in cases of

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[19] NB: *Recognition* must not be confused with *availability* of the 'Heuristis and Biases Program': Whereas availability is about (the order or speed of) *recall* of an object, recognition is about *ignorance* (Goldstein/Gigerenzer 1999: 57).

inference, there exist *mediators* in the environment that mirror the criterion and are available for the senses.

The interaction between **criterion**, **mediator** and **recognition** can be depicted in the following graph:
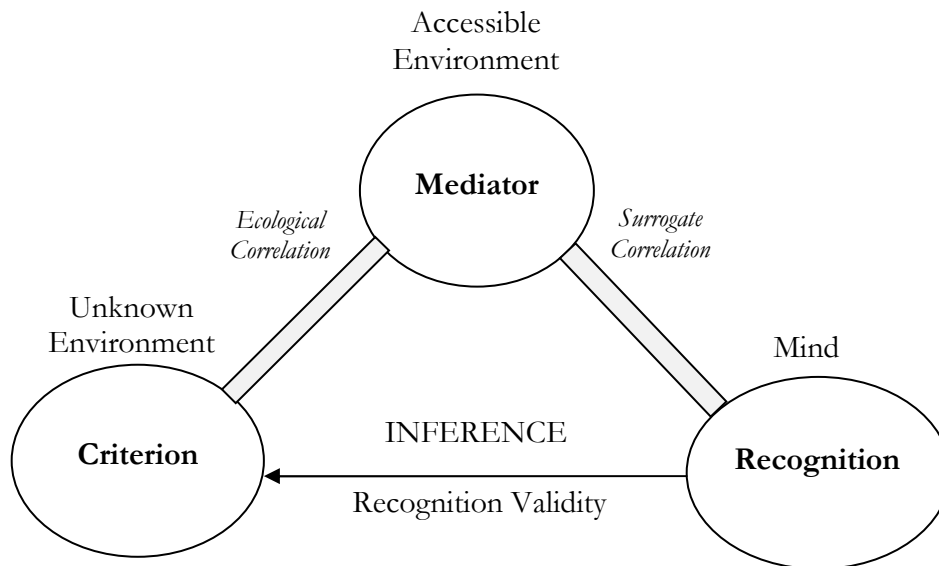
Accessible
Environment

Mediator

Ecological   *Surrogate*
Correlation   *Correlation*

Unknown
Environment   Mind

Criterion   INFERENCE   **Recognition**

Recognition Validity

Fig 10: The Ecological Rationality of the Recognition Heuristic (see Goldstein/Gigerenzer 1999).

A newspaper could function as a mediator (as it is accessible); the more often a city is mentioned in it, the more likely it is that a person will recognize the name. Due to the mediator, an inference about the size of the city can be made. The *ecological correlation* describes the relation between the criterion (city size) and the mediator (how often the name of the city occurs). The mediator acts as a surrogate for the inaccessible criterion; the *surrogate correlation* links the accessible environment and the contents of recognition memory (the number of times the city is mentioned correlating against recognition of these names). *Recognition validity* comprises the relationship between recognition and the criterion: the proportion of times a recognized object has a higher criterion value than an unrecognized object. Therefore, recognition validity α can be calculated with the following formula:

$$\alpha = R/(R+W)$$

R stands for the number of right inferences computed across all pairs where one object is recognized and the other is not, and *W* represents the number of wrong inferences ceteris paribus (Goldstein/Gigerenzer 1999: 41ff).

The recognition heuristic has also been tested in the **stock market**: Do more-often-recognized companies have better performing stocks? The ABC Research Group constructed investment portfolios of highly recognized companies, based on the information of several German and US participants: American participants were, inter alia, asked to select their top 10 most-recognized German companies, and German participants to choose the top 10 most-recognized American firms. The experiment was conducted during 1996-1997, and finally showed that the recognition heuristic was more successful than fund managers' sophisticated strategies as well as randomly chosen portfolios. ABC, however, does not know yet if the results also hold in a decreasing bear market, as their recognition-based portfolios were obtained in a strong bull market (Borges et al. 1999: 71; Todd 2001: 57).

6.3.2   One-Reason Decision Making

If several pieces of information are available and recognition cannot be applied, one-reason decision making relies on a *single* cue that favors one over the other option: Again, two objects will be compared on some criterion; there are several cues that can be used for assessing each object on the criterion.

- First, a cue dimension is selected and the corresponding cue values of each option are appointed.
- Second, the two alternatives are compared with regard to their binary cue values (1 = positive value, indicating a higher criterion value; 0 = negative value, indicating a lower criterion value).
- Third, if the cue discriminates between alternatives (**stopping rule**), search stops and the option with the cue value representing a greater value on the decision criterion will be chosen (**decision rule**).
- Forth, in case of no cue discrimination, there will be a backward loop to the first step. If no cue satisfies the stopping rule, a random guess is made. (Gigerenzer/Goldstein 1999a: 79; Todd 2001: 58; Marsh/Todd/Gigerenzer 2004: 277).

The four steps of one-reason decision making can be shown in a flowchart:
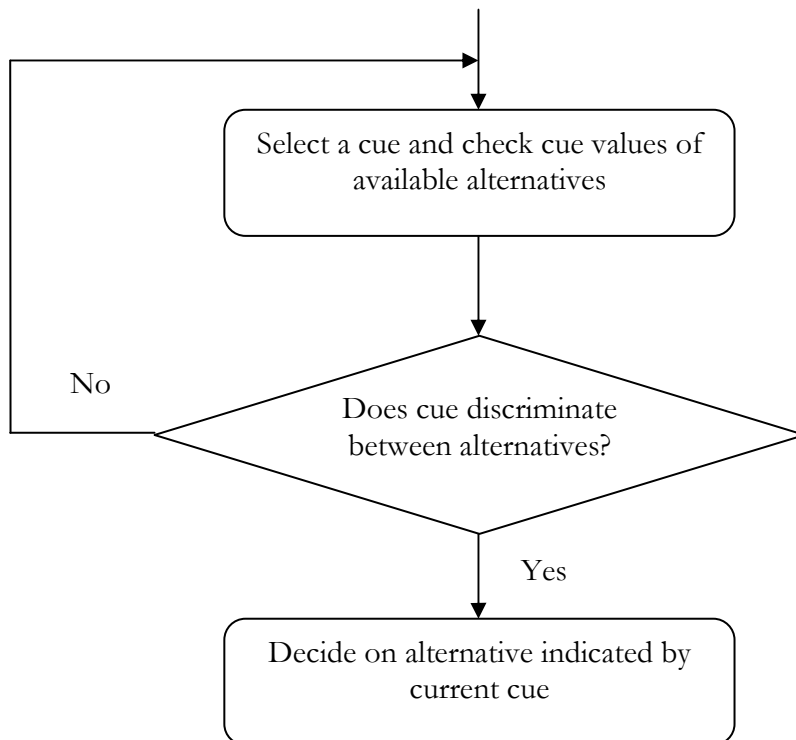
Fig 11: A Flowchart of One-Reason Decision Making (see Todd 2001).

One-reason decision making heuristics are *fast* as they do not search through all available alternatives and cues, respectively as do not integrate the information, and they are *frugal* because they base their decision on a single cue.

ABC distinguishes between three types of one-reason decision making heuristics that only differ in one building block: the **search rule**.

6.3.2.1   The Minimalist

An illustration (Marsh/Todd/Gigerenzer 2004: 279): *You want to go on vacation – either to the Bahamas or to Jamaica. Your most important criterion is active outdoor leisure time. As both places are recognized, you select any cue at random that may refer to the criterion. For instance, does the hotel have a pool? Jamaica: yes (cue value = 1), Bahamas: no (cue value = 0). Thus, you infer that the hotel in Jamaica has the higher value on the criterion (outdoor leisure activities).*

The minimal intuition needed for applying the minimalist heuristic is inferring correctly where the randomly chosen cue points. E.g., does the hotel pool indicate greater outdoor activities (Gigerenzer/Goldstein 1999:79f)?

6.3.2.2   Take the Last

An illustration (Marsh/Todd/Gigerenzer 2004: 279): *You are again choosing between the Bahamas and Jamaica (both are recognized). Your memory tells you that last year the decisive cue was whether or not the hotel had easy access to boat rental. Again, this cue will be used for inference. As only the hotel in the Bahamas fulfills this condition, you choose going to the Bahamas.*

Thus, Take the Last applies the cue that stopped search last time in a similar-looking decision situation. When encountering the first problem, a cue will be randomly chosen like in the Minimalist; from the second problem onward, the cue that stopped search last time will be chosen. If this cue does not discriminate, the cue that stopped search the time before the last one will be taken, and so on. Contrary to the Minimalist, Take the Last relies on a memory record for which cues discriminated in the past (Gigerenzer/Goldstein 1999:80).

6.3.2.3   Take the Best

An illustration (Marsh/Todd/Gigerenzer 2004: 278): *Now the choice for your holiday destination is between Bali and Tahiti (both are recognized, depicted as ++ in fig. 12). Again, the most important vacation criterion is active outdoor leisure time. The cue that could be best for discriminating between alternatives is sunshine: Both destinations have great weather forecasts. So, you turn to the second-most important cue: Is there a beach near the hotel? As both hotels are on beachfronts, this cue is also tied (i.e. they have the same value on the cue with the highest validity). The third-most important cue is chosen: Is boat rental available? You find out that boats are easily accessible in Tahiti, but not in Bali. Thus, the last cue will be the discriminating cue (the last step in fig. 12: +-): You decide to go on holiday in Tahiti.*

According to Take the Best, there will be a subjective (not 'optimal') ranking of cues. This heuristic of one-reason decision making tries the cue with the highest *validity* (the conditional probability that the cue will identify the right alternative). Potential dependencies between cues will not be considered and thus conflicts are avoided.

Therefore, Take the Best as well as the Minimalist and Take the Last belong to the group of **noncompensatory** heuristics, i.e. successive cues cannot compensate for or counteract the decision made by an earlier cue. They work best in environments with a similar structure: where each cue is more important than any combination of less valid cues. If this is the case, then there is a *fit*; its degree determines the ecological rationality of the heuristic (Gigerenzer/Goldstein 1999: 80f; Martignon/Hoffrage 1999: 123ff).

Start

--   +-

Recognition

++

No

Guess   Other cues   Choose the
known?   alternative to
which the cue
points

Yes

Choose the Best
Cue

No   Yes

+- or
+?
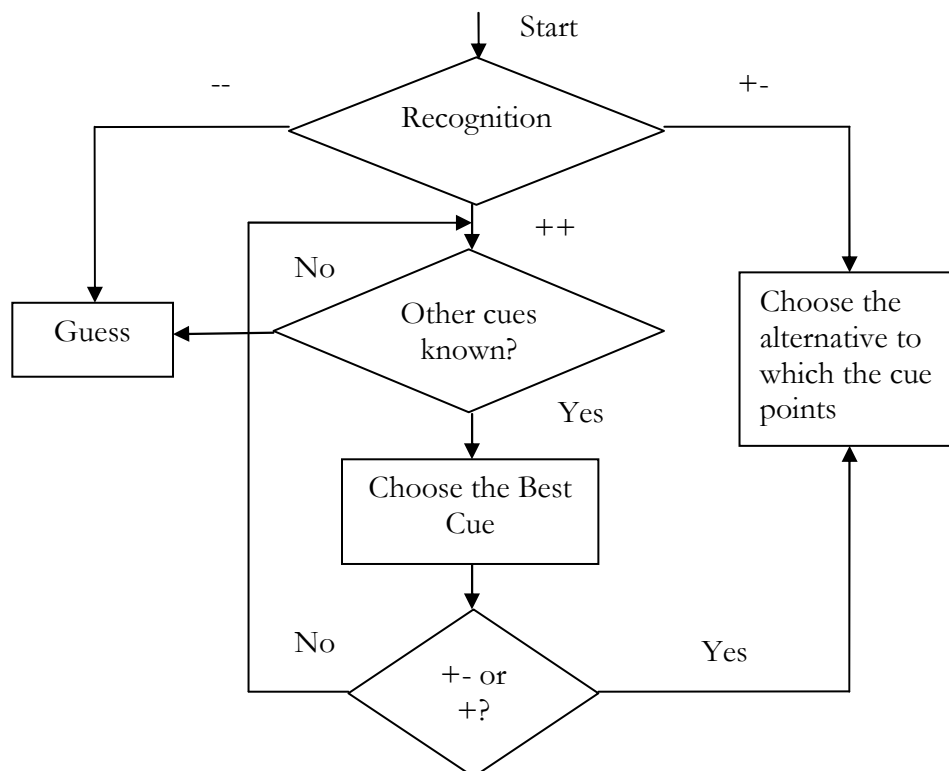
Fig 12: Flowchart of the Take the Best Algorithm (see Gigerenzer/Goldstein 1996).

The ABC Research Group conducted several experiments that tested the Minimalist and the Take the Best's accurateness against 'traditional' mechanisms that use all available information and combine it. *Multiple regression*, for example, considers dependencies between cues; *Dawes's rule* adds up the number of positive cue values and subtracts the number of negative cue values. It was shown that "simplicity is a virtue, rather than a curse" (Todd 2001: 53), as these two fast and frugal heuristics always came close, and also exceeded, the performance of the traditional algorithms (Gigerenzer/Goldstein 1999: 83f).

6.3.3   Elimination Heuristics

Often, there are situations with more available options than values in each available cue dimension. Thus, a single cue will not be enough to discriminate between all the alternatives. To single out an option from among several alternatives will be done by **elimination**. There are two ABC's heuristics that proceed this way: *QickEst*, which is used to estimate the criterion value of a particular object, and *Categorization by Elimination*, which uses one cue after the other to narrow down the set of remaining possible alternatives until only one is left (Todd 2001: 61; Marsh/Todd/Gigerenzer 2004: 281).

6.3.3.1   Quick Estimation

An illustration (Marsh/Todd/Gigerenzer 2004: 282): *You are a marketing manager and need to estimate a competitor's advertising budget, which is presumably to be tied to advertising channels. You ask yourself: Which channel might he use that separates it from most others? Many companies make use of local newspapers, only few advertise in regional papers. – Your competitor puts advertisements in larger papers. You search for the next cue: Does he use the national radio? The answer again is yes, so you turn to television. Your competitor does not make use of this channel, so the search is stopped. The estimation is made on the basis of the expected budget size of a company that advertises in larger newspapers and on radio, but not on TV.*

QuickEst works best in environments that have **J-shaped distributions** (i.e. they look like the letter 'J' rotated clockwise by 90 degrees). Therefore, it contradicts the assumption of educational researchers that knowledge, learning and performance usually conform to a bell-shaped distribution across individuals (where moderate values are the most frequent). For instance, when asked to name all the characters in Shakespeare's *Comedy of Errors*, results would probably be that many people get a low score (recalling only a few names), and only few will achieve a high score (recalling many names). City population size also presents a J-distribution: there are few large cities and a large number of smaller ones (Hertwig/Hoffrage/Martignon 1999: 219f).
QuickEst proceeds the following way: First, a cue has to be identified that is expected to separate the most common objects from all of the others. Second, you have to look at the next cue that is expected to separate the remaining common objects from the rest of the J-shaped distribution. Carry on that way until a cue is found that no longer places the object with the most common objects. Then, a value is attributed to the object based on the attributes of the discriminating cue (Marsh/Todd/Gigerenzer 2004: 282).

6.3.3.2   Categorization by Elimination

An illustration (see Marsh/Todd/Gigerenzer 2004: 282f): *You need to describe a beverage bottle. There are the following basic categories (color of drink/bottle shape) at your disposal: beer (amber brown/beer bottle), red wine (red/wine bottle), white wine (white/wine bottle), rose (pink/wine bottle), sauterne (yellow/wine bottle) and champagne (white/champagne bottle). It is evident, thus, that 'color' has the higher validity since it will identify the type of beverage in four cases (only white wine and champagne have the same color), while 'bottle shape' will do so in only two cases (beer, champagne). Therefore, you look at the cue 'color' first. Since you need 'white', you can eliminate all alternatives except champagne and white wine. The last two candidates can be distinguished by the discriminating criterion 'bottle shape'.*

Categorization by Elimination is similar to Tversky's *Elimination by Aspects* model of choice. In Tversky's (1972) model[20], the cues (or aspects) are selected in a *probabilistic* order based on their utility for making a decision. Remaining possibilities that do not correspond to the current aspect are eliminated from the choice set. The two models have in common that they make use only of the necessary aspects and do not integrate cues (this would be a feature of *compensatory* heuristics, where a good value on one attribute can compensate for a poor value on another). What separates them is that Categorization by Elimination is a *deterministic* model of categorization. Furthermore, in Elimination by Aspects cues are selected probabilistically according to their weight (or validity), so that the order in which aspects are considered is not essentially the same for each object. In Categorization by Elimination, cues are ordered by their success measure before the categorization process starts, i.e. the same cue order is used to assess each object (Berretty/Todd/Martignon 1999: 242; 249; Payne/Bettman 2001: 126).

The processing steps of Categorization by Elimination are shown in fig. 13:

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[20] See Tversky, Amos (1972): Elimination by Aspects. A Theory of Choice, Psychological Review, Vol.79, pp. 281-299.
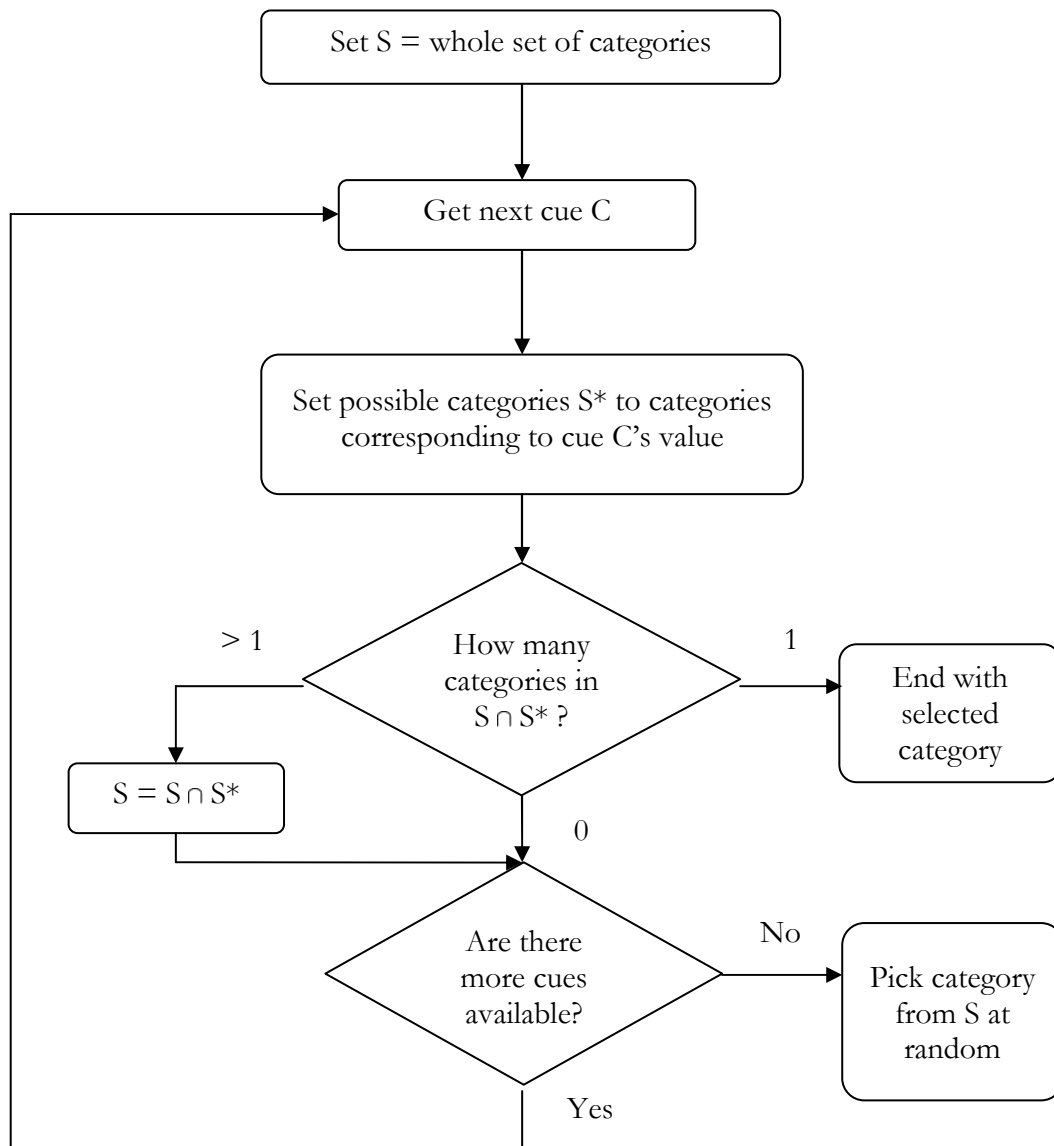
Fig 13: Flowchart of the Categorization by Elimination Algorithm (see Berretty/Todd/Martignon 1999).

The process starts with a stimulus that shall be categorized; there is an initial set of possible categories S. The cue dimension C with the highest probability of success is chosen. Then, the object's value on C is mapped to the corresponding set S* of the possible categories for that cue value. If S* contains only one category, the categorization process ends. Otherwise (if there is more than one possible category in S*), all those categories that are not in both the new and the old set of possibilities are eliminated. If no more cues are available, a category from S shall be picked at random (Berretty/Todd/Martignon 1999: 248).

6.4   When do People Use (Simple) Heuristics?

A decision maker is supposed to choose the appropriate heuristic adaptively from his toolbox for a given situation. But how does he decide how to decide? One view of strategy selection is a '**top-down**' approach, where the decision maker evaluates the available tools in his toolbox by doing a cost-benefit analysis of the heuristic's potential performance. A main concern about this view is that of infinite regress. Another view involves a more '**bottom-up**' process of decision making: Instead of a conscious decision on the possibly appropriate strategy, the selection of the heuristic reflects a learned response about what worked well in similar situations. However, this approach encounters the problem of how to decide in *new* situations. It is also probable that people select their strategies in a more top-down approach when faced with complex problems, but only moderate time pressure (Goldstein et al. 2001: 183f).

Rieskamp and Otto (2006: 207ff) argue that people select the appropriate heuristic for an inferential choice situation on the basis of *learning*. They conducted experiments, in which feedback about the accuracy of the selected strategy was given to the participants. According to their **Strategy Selection Learning Model** (SSL), cognitive strategies will be reinforced through feedback. People are expected to select a strategy adaptively, depending on how well the strategy performed last time. However, Rieskamp and Otto (2006) admit that people might simply learn through stimulus-response relations as well.

Time pressure, as stated above, is a critical factor that is likely to foster the use of simple heuristics. Consistent with Payne et al. (1993, in: Todd 2001: 64, op. cit.), the ABC research group assumes that limited time is an important determinant of decision making: If speed is weighted more highly than accuracy, information is shifted from extensive, alternative-based compensatory strategies to more selective, cue-based non-compensatory strategies. Compensatory algorithms search for all cues one alternative at a time, whereas non-compensatory algorithms search for information about one cue at a time across all available alternatives.

It can furthermore be assumed that under great time pressure people either apply the same decision strategy more quickly (by speeding up information gathering) or shift their decision strategy to a simple, cue-oriented non-compensatory heuristic (Rieskamp/Hoffrage 1999: 164).

6.5   The Influence of Emotions and Social Context

ABC's heuristics are for the most part based on *cognitive processes*. However, emotional and social factors are unquestionably crucial co-players in the decision process. The ABC Research Group (Mellers et al. 2001: 267ff) distinguishes between three types of emotions that can influence choice:

- Background emotions
- Task-related emotions
- Anticipated emotions

Background emotions refer to moods and emotions that are not related to the decision task, but still affect perception and memory. They also influence the strategies and heuristics that are used to process information: A happy decision maker focuses on different stimuli than an anxious decision maker (e.g., he may not want to change the status quo as he is satisfied with his current achievements). The latter one may be involved in more intensive search for alternatives; negative emotions can lead to more in-depth thinking and greater processing of cues (Luce et al. 1997)[21], hence possibly leading to the use of compensatory heuristics like the *weighted additive strategy*.

Task-related emotions arise in the course of making a decision. They can promote the use of simpler choice heuristics to avoid emotionally difficult conflicts and trade-offs between alternatives. As the complexity of choice rises, people also exhibit a tendency to select their affectively preferred alternative more often (Hsee 1995)[22]. Furthermore, as time pressure plays an important part in decision making, maladaptive coping strategies with stress and ambiguous situations may lead to shunning behavior, increased wariness and panic (Janis/Mann 1977)[23].

Anticipated emotions refer to the imagination of potential outcomes and how the decision maker feels about them. This may involve cognitive processing or more intuitive processing, which is in line with Damasio's (1994) *somatic marker* hypothesis (see section 5.4). Intense

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[21] See Luce, Mary Frances et al (1997): Choice Processing in Emotionally Difficult Decisions, Journal of Experimental Psychology: Learning Memory Cognition, Vol. 23, pp. 384-405.
[22] See Hsee, Christopher K. (1995): Elastic Justification. How tempting but Task-Irrelevant Factors influence Decisions, Organizational Behavior and Human Decision Processes, Vol. 62, pp. 330-337.
[23] See Janis, Irving L. / Mann, Leon (1977): Decision Making. A Psychological Analysis of Conflict, Choice, and Commitment. Free Press, NY.

emotions are likely to activate more intuitive processing, while milder emotions probably involve both cognitive and emotional processing (Le Doux 1996)[24].

Not only emotions, but also **social context** has a great influence on fast and frugal heuristics. One essential characteristic is represented by *accountability*, i.e. the demands to justify one's decision to others. Tetlock (1983, in: Rieskamp/Hoffrage 1999: 165, op. cit.) assumes that people who are held liable for their decisions use strategies that require more cognitive effort (hence, compensatory ones), while expecting to achieve more accuracy by doing so.

Furthermore, **social learning** is incorporated in fast and frugal *social* heuristics: they include imitation behavior strategies such as 'do-what-the-majority-do' or Tit-for-Tat, which recalls the opponent's last move, cooperation or defection (Rieskamp/Hoffrage 1999: 165; Mellers et al. 2001: 272).

6.6   Critique on ABC's Heuristics

Oppenheimer (2003: B1-B9) conducted a study showing that people do not always conform to the **recognition heuristic** as predicted by the ABC research group: Participants were likely to judge a recognized city *smaller* than an unfamiliar one, if they had knowledge that the city in question *was* small. This clearly contrasts with the recognition heuristic's postulation. Rather than inferring that recognized cities are *larger* than unrecognized ones, people with high probability took more information into consideration than one single cue, thus plunging into more in-depth reasoning. It could be argued that they were using some other heuristic from the adaptive toolbox; this interpretation, however, poses the problem that recognition is always used first in ABC's one-reason decision making heuristics.

Another criticism on the recognition heuristic refers to Borges et al.'s (1999) **stock market experiment**: German and American laypeople (pedestrians in downtown Chicago or Munich) as well as experts (finance or economics graduates from the University of Chicago or Munich) were asked to indicate which companies they recognized from those listed on the New York Stock Exchange and several German stock exchanges. The experiment included 798 companies, therein 500 American companies of Standard & Poor's 500 index and 298 German companies with the Dax 30. Two investment portfolios for each of the four groups (German laypeople and experts,

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[24] See Le Doux, Joseph E. (1996): The Emotional Brain, Simon and Schuster, NY.

American laypeople and experts) were constructed: The 'domestic recognition' portfolios (4) contained highly recognized companies within the group's home country; the 'international recognition' portfolios (4) consisted of the ten companies that each group recognized most often from the other country. The performance of the portfolios was measured from Dec. 13, 1996, for the next six months following. Stocks of unrecognized companies (recognition rate below 10%), market indices (at that time Dow 30 and Dax 30), mutual funds, chance portfolios and individuals' investment choices served as benchmarks. Results, in short, were that the eight recognition portfolios performed better than their benchmarks in almost all tests. This, however, does not justify exultation. Although Borges et al. (1999) admit that their portfolios have been tested in a bull market where big companies in general perform well, the power of ignorance will not always lead to money-making investment decisions.

When we have a closer look at the period Dec. 13, 1996, to June 13, 1997 (were the recognition portfolios were tested), we see that the 100 leading US stocks (S&P 100) performed better than the small caps of the S&P 600 stocks (fig. 14)[25]. The same was the case with the German stocks: Dax 30, containing the 30 biggest German companies on the stock exchange, did better than SDax[26], which consists of 50 small-cap companies (fig. 15). Thus, in this period there happened "big-firm effects" (Borges et al. 1999: 71). Had the recognition portfolios been tested in another period, there would have been totally different results, to the disadvantage of the recognition heuristic: The US stock market showed so-called *small-firm effects*[27], for example, in the years 2004-2007 (fig. 16), outperforming large-cap companies (and in case of the recognition heuristic: highly recognized ones) by far, as did the German stock market in the years 1990-1991 (fig. 17)[28].

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[25] Also see: http://www.standardandpoors.com/indices/main/en/us/ (retrieved on 08/2010).
[26] Also see: http://www.finanzen.net/index/SDAX/Werte (retrieved on 08/2010).
[27] Also see: http://www.investopedia.com/terms/s/smallfirmeffect.asp (retrieved on 08/2010).
[28] Source of indices: Thomson Reuters Datastream; fig. 14-17: own elaboration.
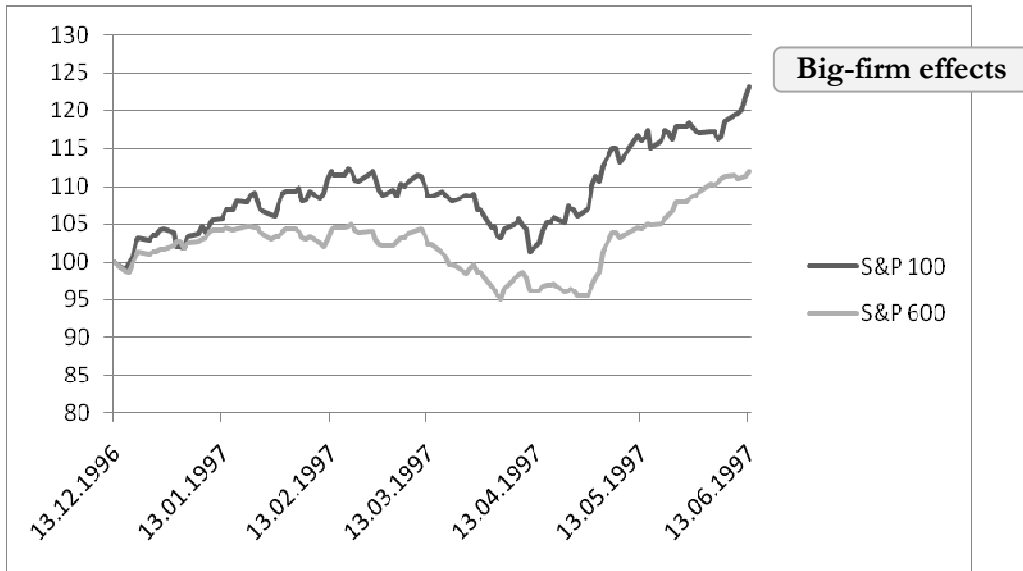
Fig 14: US Stock Market Dec. 1996 - June 1997.
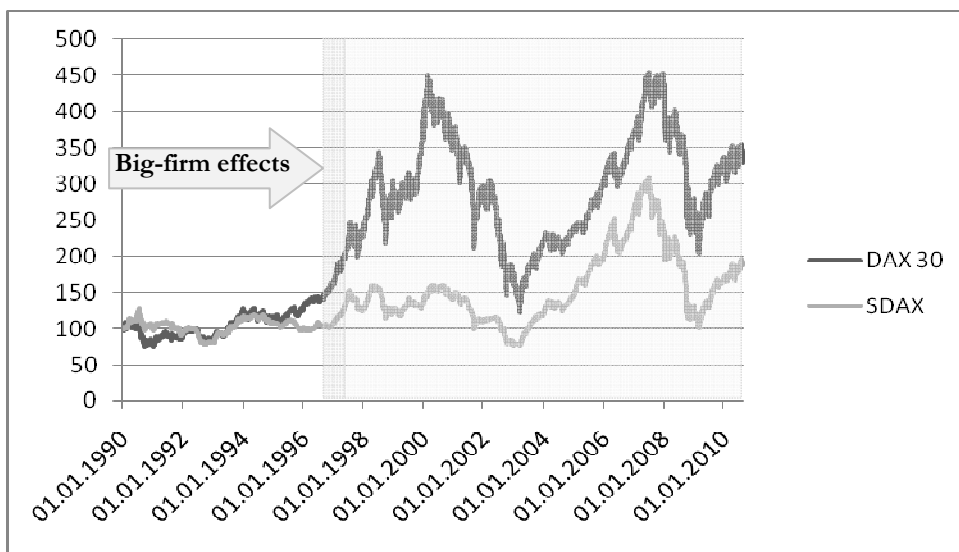

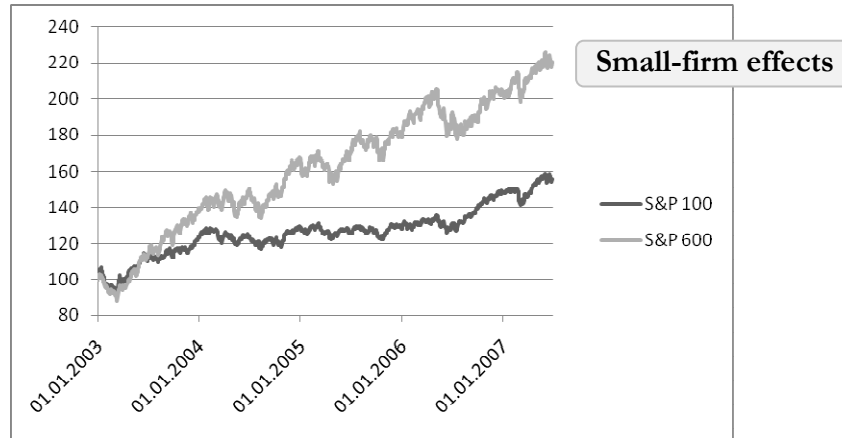*Fig 15: German Stock Market 1990-2010.*

Fig 16: US Stock Market 2003-2007.
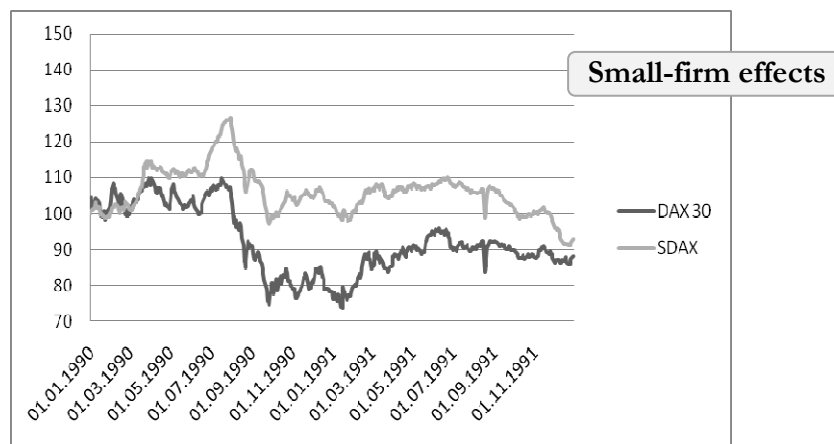
Fig 17: German Stock Market 1990-1991.

Newell and Shanks (2003: 53ff) used a process-oriented approach to test if people actually select the **Take-the-Best** heuristic in environments in which it is predicted to work: In artificial stock-market experiments, participants were confronted with two-alternative choices between the shares of two fictional companies. The shares were described by four binary cues with varying validities. Participants were thus expected to buy cues in order of their validities; *costs of information* were set high to discourage buying of unneeded information. However, Newell and Shanks (2003) discovered that Take-the-Best's stopping rule was violated a significant number of times: participants continued the search (=bought more information) even if they already had a cue that discriminated between two alternatives. This behavior was described as 'weight of evidence' strategy: People are not always content to base their decision on one discriminatory cue, but rather search for additional information to become more confident in their choice.

In a similar experiment setting, Newell et al. (2003: 84ff) wanted to assess if people make use of a non-compensatory heuristic like Take-the-Best if the *complexity* of the share task was raised (by increasing the number of binary cues from four to six). Also in here, ABC's assumptions were violated: despite the complex environment, a high number of participants were not making use of the fast and frugal heuristic.

For Newell et al. (2003: 84) and Newell (2005: 13), Gigerenzer's notion of the nature of the environment determining which heuristic will be used is a problematic one: if one cannot predict which heuristic will be used in which environment, however restricted it may be, a particular heuristic will be assessed *afterwards*, therefore rendering the fast and frugal approach irrefutable. Although the adaptive toolbox "may prove to be a fruitful impulse for behavior decision research", there is a strong need for (further and more specific) empirical validation (Bröder 2003: 622).

6.7   Challenges Ahead: What remains to be answered

The ABC research group admits that so far most of their attention has been paid to their heuristics' performance in comparison to normative models of rationality. Still, there are many challenges and open questions that have to be focused on (see Gigerenzer/Todd/The ABC Research Group 1999: 362ff):

- Could simple heuristics be used for tasks that do not demand quick problem solving such as planning? Or will more time for pondering automatically lead to the selection of compensatory heuristics?
- Where can further proof for the decision-making functions of emotional and social processes be found and how can they be integrated as building blocks?
- What performance criteria should be used to measure the utility of fast and frugal heuristics?
- How does the mind know which heuristic to select for a particular decision problem?

Another question to be attended to would be how people actually learn about cue validities. As Gigerenzer and Goldstein (1999: 92) speculate, this may be "genetically coded through evolution", furthermore be learned through cultural transmission, or direct observation. Thus, there is much need for empirical research on this issue.

7. Negotiations

So far the focus was mainly on the individual's decision making behavior when there is no need to take someone else's perspective into consideration. A negotiation situation, on the other hand, presents a very complex social happening that not only demands to deal with one's own judgmental evaluations and choices but also to come to terms with the complexities of interactive behavior. This chapter wants to give an overview of judgmental heuristics in negotiations and their impact on the perception of negotiations.

7.1   Characteristics of Negotiations

Negotiation can be defined as a "formal, civilized [decision-making] process that occurs when parties are trying to find a mutually acceptable solution to a complex conflict" (Lewicki et al. 1994[2]: 1), and as a "form of interpersonal communication, which itself is a subset of the broader category of human perception and communication" (Lewicki/Saunders/Minton 2003[4]: 147).
Its main characteristics (Lewicki et al. 1994[2]: 4, 24f) are the following:

- Negotiation involves two or more parties – individuals, groups, organizations. It can therefore be seen as an **interpersonal** or **intergroup process**.
- There exists a conflict of interest between the parties.
- Interests do not have to be necessarily at opposite ends.
- Parties normally negotiate voluntarily, as they hope to solve their conflict that way more successfully.
- Negotiation takes place when there is no established set of procedures for resolving the conflict, or when the parties want to find an own solution to settle their dispute.
- Modifications of opening statements as well as give-and-takes are expected to occur during the negotiation process.
- Negotiation is furthermore characterized by **interdependent relationships** (i.e. both parties need each other to achieve their goals), which is the basis for **social interaction**. Deutsch (1962, 1973, in: Lewicki 1994[2]: 25, op. cit.) makes the distinction between *contrient interdependence* (zero-sum or distributive negotiations, "I win, you lose") and *promotive interdependence* (nonzero-sum or integrative negotiations, "Let's expand the pie").

Interdependent relationships are of dynamic nature: people adjust their behavior based on how they expect the other party to behave, and how the other party actually behaves. The negotiator can take an approach from his own perspective and only focus on the components that affect his own goals; for mutual problem-solving and gains, however, the other party's perspective has to be taken into consideration as well (Lewicki et al. 1994[2]: 25, 31).

One popular approach to managing conflict is the **Dual Concerns Model** as proposed by Pruitt and Rubin (1986, in: Lewicki 1994[2]: 10, op. cit.): The two-dimensional framework postulates that negotiators either show more *concern for their own outcomes* (x-axis, assertiveness dimension) or more *concern for the other's outcomes* (y-axis, cooperativeness dimension). Depending on their respective concern, negotiators can pursue five major (pure-form) negotiation strategies:

high	**Concern about other's outcomes**	*Accommodating*		*Collaborating*
			Compromising	
low		*Avoiding*		*Competing*
		Concern about own outcomes		
		low		high

Fig 18: The Dual Concerns Model (adopted from Pruitt and Rubin 1986, see Lewicki 1994[2]).

Competing (also called *contending* or *dominating*) negotiators pursue their own goals strongly and show little concern for the other party's desired outcomes. This strategy creates win-lose situations and is usually applied if quick-decision making is necessary and a good long-term relationship with the other party does not have to be considered.

Accommodating (also called *yielding* or *obliging*) negotiators create win-lose situations as well, but to their own disadvantage: They go along with the other party's wishes as the relationship is

considered more important than the substantive outcome. This strategy can be pursued if the negotiation relationship will extend over the current negotiation. Thus, in the long term, it can be regarded as more advisable to accept a suboptimal result as reciprocity ('tit-for-tat') is expected in future negotiations.

Avoiding (also called *inaction*) (non-)negotiators neither show much concern for their own nor for the other one's outcomes; they prefer to stay passive or withdraw from the negotiation table. This strategy is used, for example, if the party considers the issue too unimportant for negotiation. Another reason might refer to the availability of BATNAs (*Best Alternative To a Negotiated Agreement*, also see section 7.2): a strong BATNA possibly enables the negotiator to reach his desired outcomes without negotiating at all; a weak BATNA, on the other hand, may pressurize him to accept the negotiation outcome in any case.

Collaborating (also called *problem solving* or *integrating*) as a negotiation strategy will be used if both the outcome and the relationship are important. This leads to a win-win situation for both parties. However, the difficulty in this approach lies in perceiving a situation as having integrative potential as well as the necessity to invest time and energy in creating solutions.

Compromising is not considered a possible strategy by Pruitt and Rubin (1986), though other scholars (e.g., Thomas and Kilmann 1974[29]) using versions of this model do believe so. Compromising presents a moderate effort to pursue one's own outcomes as well as a moderate effort to let the other party attain some of his outcomes by making concessions.

It is, indeed, important to bear in mind that these five strategies present *pure* forms; however, as most conflicts are neither purely competitive nor cooperative, approaches to negotiation will consist of mixed strategies (Lewicki 1994[2]: 8ff, 115ff).

To understand the nature of interdependence between negotiation parties is vital to optimally manage negotiations: Negotiators make judgments about the nature of interdependence in the negotiation situation; the way interdependent situations are perceived has a crucial impact on how negotiations will be approached (Lewicki 1994[2]: 33f).

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[29] See Thomas, Kenneth W./Kilmann, Ralf H. (1974): Thomas-Kilmann Conflict Mode Survey, Xicom, Tuxedo/NY.

7.2   An Outlook on Negotiation Analysis

In the late 1970s, the cognitive revolution had a great influence on research in negotiation, moving it in the direction of behavioral decision research in the following decades. Prescriptive advice beforehand set its focus mainly on **game theory**, the mathematical analysis of what "ultrasmart, impeccably rational, superpeople *should* do in competitive, interactive situations" (Raiffa 1982: 21). Game theory assumes both parties to behave rationally; Raiffa's (1982) **'asymmetrically prescriptive/descriptive'** approach, however, acknowledges the importance of developing realistic predictions of the opposite negotiator's (probabilistic) behavior rather than assuming him to pursue purely game-theoretic rational strategies. Raiffa's type of analysis is therefore prescriptive for the party receiving advice and descriptive from the point of view of the other party, assuming it to act in an intelligent and goal-seeking way (Raiffa 1982: 21f; Neale/Bazerman 1991: 17; Sebenius 1992: 20; Bazerman et al. 2000: 282).

The basic features of negotiation analysis are the following:

- The **BATNA** (Best Alternative To a Negotiated Agreement, Fisher/Ury 1981[30]) is the alternative in case of negotiation impasse, thus providing a lower bound for the minimum requirements of a negotiated agreement. Any joint agreement of higher subjective worth will be preferred to the BATNA. The reservation point indicates where the negotiator is indifferent between impasse and agreement. Before entering negotiation, one's own as well as the opponent's BATNA should always be assessed, respectively estimated.

- The **interests** of the parties – their real concerns – have to be separated from the parties' positions (what they require of the other side).

- All negotiations involve **distributive** as well as **integrative** aspects; rarely will an integrative strategy eliminate the distributive dimension of negotiation. *Distributive negotiation* is about how to divide a fixed amount of resources – one party's achievement is at the direct expense of the other party. Walton and McKersie's (1965)[31] 'bargaining zone concept' organizes the distributive aspects of negotiation by combining the reservation points of each party. If there is a gap between the two negotiators' reservation points, a negative contract zone will be created; if the two resistance points overlap, a positive one.

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[30] See Fisher, Roger/Ury, William (1981): Getting to Yes, Houghton Mifflin, Boston.
[31] See Walton, Richard E./McKersie, Robert B. (1965): A Behavioral Theory of Labor Negotiation, McGraw-Hill, NY.

Negotiation analysis focuses on actions that can change perceptions of the zone of possible agreements, in order to foster more successful distributive outcomes.

Integrative negotiation involves the creative search for additional sources to enlarge the pie and thus to conclude negotiations 'Pareto-optimal', i.e. where deviations from the agreement would make the parties worse off (Neale/Bazerman 1991: 21ff; 32; Sebenius 1992: 21f).

Behavioral decision research in the 1980s and 1990s focused on what Raiffa's (1982) work left unanswered: how the negotiator's behavior is prone to judgmental errors or biases, thus deviating from rationality as postulated by prescriptive theory.

8. Judgmental Heuristics in Negotiations

Based on Tversky and Kahneman's thorough research on judgment and cognitive processing (from the 1970s ongoing, also see **chapter 5**), Bazerman and Neale (1982, 1991, 1992) present a number of judgmental heuristics negotiators rely on to cope with the complex and uncertain environment inherent to decision situations but that nonetheless can hamper their performance.

8.1   Framing

In general, framing means to embed observed events – as they do not happen in isolation – in a context, so as to give them meaning. Or, more down-to-earth, framing is a guide to the "decision maker's interpretation of what is going on" (Beach/Connolly 2005[2]: 16; 23).

Bazerman and Neale (1982: 54f) have adopted the famous case of Kahneman and Tversky's (1979)[32] **prospect theory** to show the impact of framing on the negotiation process and outcome: There is the imminent threat that a large car manufacturer has to close his three plants and dismiss 6000 employees. Two emergency plans exist: plan A will save one of three plants and 2000 jobs, plan B has a 1/3 probability of saving three plants and all 6000 jobs, but a 2/3 probability of saving no plants and no jobs.

Reformulated, plan A (or C) will result in the loss of two of three plants and 4000 jobs, plan B (or D) has a 2/3 probability of resulting in the loss of all three plants and 6000 jobs, but has a 1/3 probability of losing no plants and no jobs.

As can be seen clearly, plan A and C as well as plan B and D are objectively the same, just presented in different ways. One would expect the 'rational' individual to select the combinations A-C or B-D. However, people tend to choose the certain outcome A and at the same time the risky outcome D. How come?

According to Prospect Theory, individuals are **risk-averse** when confronted with **potential gains** and **risk-seeking** when confronted with **potential losses** ("losses loom larger"). For negotiations, this means that the way the negotiation issue is frame has an impact on the parties' perception of risk and respective behavior: Risk-averse negotiators may be prone to accept any feasible offer due to their fear of loss; risk-seeking negotiators, on the other hand, are likely to protract the negotiation, waiting for possible future concessions. Furthermore, there tend to be

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[32] See Kahneman, Daniel/Tversky, Amos (1979): An Analysis of Decision under Risk, Econometrica, Vol. 47, No. 2, pp. 263-292.

fewer concessions in negotiations that are negatively framed, as well as fewer agreements and a perception of the outcome as less fair than with positive frames (perceived gains). Although reality checks and detailed information might present remedies for framing effects, frames are often tied to deeply rooted beliefs and values beyond one's awareness (Neale/Bazerman 1991: 44; Bazerman/Neale 1992: 39; Lewicki/Saunders/Minton 2003[4]: 155f).

8.2   Anchoring and Adjustment

People estimate values for uncertain objects or events by starting from an **initial anchor** that serves as a benchmark; subsequent adjustments – seen as gains or losses – are measured against the initial value that is based on the information at hand, may it be incomplete or faulty.

Initial offers, for example, can be chosen as an anchor: Final agreements are under the influence of the initial offer more strongly than under concessions made by the other party. This can also lead to impasse as the perception of the (positive) zone of possible agreements might be distorted. Furthermore, especial attention has to be given to the starting point or initial offer: if an unacceptable anchor is provided, the other negotiating party should not yield by adjusting, thus rendering the anchor valid, but re-anchor the whole process anew.

Also**, intended goals** or **targets** can serve as anchors; they can either impede or enhance performance: If the negotiator does not adjust expectations sufficiently, he might miss out on a possible agreement between his desired outcome and his reservation point by only focusing on the target that will not be attained (Neale/Bazerman 1991: 48ff; Bazerman/Neale 1992: 28f; Lewicki/Saunders/Minton 2003[4]: 155).

8.3   Availability

According to Tversky and Kahneman (1974), an event whose instances are retrieved more easily will appear more frequent than an event of equal occurrence whose instances are recalled less easily. Thus, a negotiator's subjective probability of an event is likely to be greater if memory associations with that event are predominantly vivid.

The availability heuristic can lead to three application biases: First, the **ease of retrievability** might occur when some information is presented particularly colorful or in emotionally vivid ways, thus being retrieved more easily from memory. This leaves room for potential manipulation of the negotiation outcome through the control of information by the mode and amount of

presentation. Also, biases in frequency judgment can be attributed to the affective component with which remembered images have become tagged (Slovic et al. 2002: 414). Second, the accessibility of information also affects negotiation through the use of **established search patterns**. Biases can be due to the overreliance on the way in which events or facts are stored in memory. For example, if a group of sales, production, accounting and human resources executives were asked to identify the most important challenge facing their company, each of them would approach the problem in terms of his own functional area of know-how. Third, individuals are prone to detect causal patterns and associative bonds, therefore misjudging the probability of two events occurring together. This is due to **illusory correlations** (Hogarth 1989[2]: 40; Neale/Bazerman 1991: 50ff; Bazerman/Neale 1992: 44f).

8.4   The Mythical Fixed-Pie

Many negotiators wrongly assume that their own interests are diametrically opposed to the other party's interests – one person's gains are at the expense of the other one, which is a characteristic of the 'fixed-pie' distribution. This can also be attributed to the **incompatibility bias**[33]: the assumption that the parties do not have common interests ("What is good for them must be bad for us"). Most conflicts, however, are not of purely distributive nature but involve mixed-motive elements. Also, there is often more than one issue at stake, and each party places different values on them (Neale/Bazerman 1991: 64; Bazerman/Neale 1992: 16).

Fixed-pie perceptions can partly be explained by our **upbringing in a performance and achievement-oriented society** that views most situations as competitive ones. This leads to a win-lose orientation about obtaining the largest share of the perceived fixed pie. Integrative agreements, on the other hand, are about adding resources to the available limited resources so that both parties can realize their objectives; integrative bargaining also involves **logrolling**, i.e. the trade-off of issues upon each party places different priorities (Neale/Bazerman 1991: 61f; Lewicki et al. 1994[2]: 91)

The fixation on a competitive approach is the most crucial barrier to creative problem-solving that integrative negotiations require for. In their 'Nine Dots Problem', Bazerman and Neale (1992: 18f) show that people often fail to solve problems due to their self-imposed assumptions about the respective problem. When asked to connect all nine dots with four straight lines,

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[33] See Thompson, Leigh (1990): Information Exchange in Negotiation, Journal of Experimental Social Psychology, Vol. 27, pp. 161-179.

people often do not push the boundaries of the square – a behavior that can be attributed to the desire to fit a problem into well-established expectations. To connect the dots, not a mythical fixed pie must be assumed (by making inappropriate assumptions about the opponent), but one's eyes should be kept peeled for trade-offs.
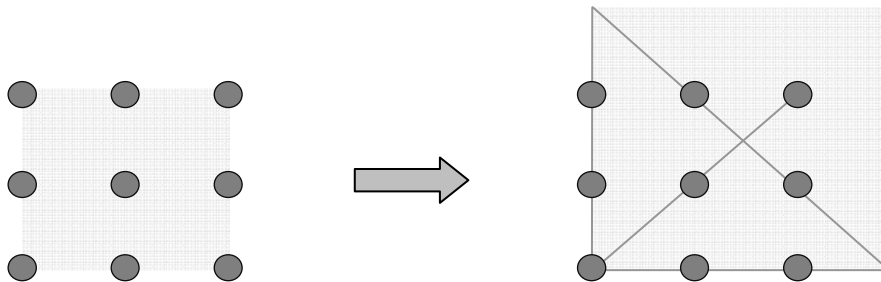

Fig 19: The 'Nine Dots Problem': Creative Problem-Solving (see Bazerman/Neale 1992).

Opportunities for joint gain can also be shown in the example of Follett (1940)[34]: Two sisters are haggling about how to divide an orange; of course, both demand the whole fruit. By exchanging information about what each of them needs, they could find out that one of them wants the peel for making a cake, and the other one the pulp for making orange juice.

It is important, however, to bear in mind that a conflict-laden and competitive **past relationship** increases the likelihood of a defensive and win-lose approach to the current negotiation, thus to a failure of seeing feasible integrative potential (Lewicki et al. 1994[2]: 106).

In his experiments, De Dreu (2003) also came to the conclusion that (felt!) **time pressure** prevents the revision of fixed-pie perceptions, hence leading to lower mutual outcomes. De Dreu concludes that this could be due to the *closing of the mind* (see Kruglanski/Webster 1996), i.e. the freezing upon the status quo of perception and available knowledge. The closing of the mind supposedly reduces the motivation to encode new information about the other party's preferences, so as to not disconfirm the prior judgment.

8.5   The Irrational Escalation of Commitment

Sometimes negotiators maintain commitment (and allocation of resources) to a failing course of action. Unbowed commitment should justify previous actions, even if the choice of doing so is

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[34] See Follett, Mary Parker (1940): Constructive Conflict, in: Metcalf & Urwick (eds.): Dynamic Administration. The Collected Papers of Mary Parker Follett, Harper, NY, pp. 36-47.

no longer valid ("throwing good money after bad"). This behavior can be attributed to the concept of **sunk costs**: time and money already invested are taken into account when deciding for a future course of action, though resources invested cannot be recovered and thus should not be integrated into the decision process (Neale/Bazerman 1991: 66; Bazerman/Neale 1992: 10).

Escalation of commitment is partly due to individual perception and judgment: First, an initial course of action will be pursued. Then, people are prone to get stuck in the **confirmation trap** – information that supports or confirms the earlier decision will be more salient than data that contradicts it. Thus, confirming information to the action taken is sought intuitively, while disconfirming evidence will be ignored either deliberately or unconsciously. Festinger (1957)[35] argues that this is endorsed by the need for *cognitive balance*, which requires that an individual cannot maintain inconsistencies in actual behavior and beliefs at the same time (Neale/Bazerman 1991: 69; Bazerman/Neale 1992: 13).

Finally, the desire to be consistent in a chosen course of action is often strengthened by the desire to **save face** and to maintain the impression of having hold of the reins. Unilaterally giving up in a conflict seems like admitting defeat; escalation of commitment, on the other hand, leaves the future uncertain. This could be regarded as more desirable than accepting the certain loss of retreating (also see section 7.3.1 on framing effects: "losses loom larger"). If both negotiating parties hold this view, escalation of conflict is preprogrammed: Commitment to their respective positions will be enforced and the willingness to change to a different course of action (e.g., to a compromise) is diminished. Furthermore, announcement to the general public of one's commitment increases the probability to escalate non-rationally (Bazerman/Neale 1982: 61; Neale/Bazerman 1991: 69f; Lewicki/Saunders/Minton 2003[4]: 153).

The **dollar auction paradigm** as introduced by Shubik (1971)[36] is a well-known example for **competitive irrationality**: It occurs that many situations look like opportunities first, but then turn out to be traps because the probable behavior of the other party has not been taken into account. In Shubik's experiment, participants are asked to bid for a one-dollar bill; the auction will be finished until no further bidding occurs. The highest bidder will get the dollar bill and pay the amount he bid; the second highest bidder has to pay his bid as well, but will not receive anything in return. The potential gain and the possibility of winning the auction are reason enough to enter the game. However, when coming near the one-dollar boundary, the highest and the second highest bidder are trapped: one bidder may have the feeling that one more bid will

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[35] See Festinger, Leon (1957): A Theory of Cognitive Dissonance, Row, Peterson, Evanston (Ill.).
[36] See Shubik, Martin (1971): The Dollar Auction Game. A Paradox in Non-Cooperative Behavior and Escalation, Journal of Conflict Resolution, Vol. 15, pp. 109-111.

get the other one to exit the auction; the same reason applies to the other bidder. Yet, without knowing the bidding pattern of the opposite party, entering the game and making the initial bid cannot be classified as irrational behavior per se; a smart decision maker, however, takes the other decision maker's probable behavior into consideration as well to finally not get caught in the trap (Neale/Bazerman 1991: 66f; Bazerman/Neale 1992: 11f; 15).

9. Discussion: A Critical Review of ABC's Heuristics in Comparison to the Heuristics and Biases Program and Their Suitability for Negotiations

Coming to the right conclusion with only little information (=frugal), while at the same time using few mental resources (=fast) – indeed, ABC's heuristics seem like an intriguing approach of how to interpret the world. But, as the saying goes, all that glitters is not gold, or: an appealing wrapping will not belie certain discrepancies and limitations, as I want to discuss as follows.

The ABC research group (in particular Gerd Gigerenzer: e.g., see Gigerenzer 1996a) has been persistently criticizing Tversky and Kahneman's work on human judgmental evaluations (from the 1970s ongoing) as a **glass half-empty approach**. This view has not been changed despite the fact that Tversky and Kahneman revised their earlier work, shifting it from a Bayesian reasoning and probability theory centered analysis to a more psychologically plausible approach – as can be seen in the Linda example that was formerly interpreted as violating extensional logic, but later regarded as context-sensitive understanding of causal conjunctions (see Tversky/Kahneman 2002).

Much of the Heuristics and Biases Program is based on the assumption that human cognition has **dual aspects**, an outcome-oriented associative system that produces intuitive answers, and a process-oriented system that comprises abstract and deliberate thinking. The mode of operation is supposedly interactive; both systems respond to the respective problem, though their answers might not come to the same conclusion. System 2 is ascribed the monitoring, controlling and overriding role of System 1's original proposal; judgmental biases in Tversky and Kahneman's sense can thus be contributed to the intuitive judgments of System 1 and give raise to the question why the judgmental error was not corrected by System 2 (see Kahneman/Frederick 2002 and Sloman 2002).

Gigerenzer, on the other hand, condemns the dual-reasoning approach; for him, dividing reasoning into "good" and "bad" cognition endorses the homo œconomicus view of the rational decision maker that is supposed to behave to a norm's prescription: "[…] The unquestioned assumption behind these theories is that the more laborious, computationally expensive, and nonheuristic the strategy, the better the judgments to which it gives rise. […] Consequently, it comes as a surprise to the dichotomy makers when people perform better by violating one of these ideological dictums, for instance when people make judgments by relying on their intuition

than when they reason (sic!) […]" (Gigerenzer/Todd 1999: 20f). This is a surprising statement insofar as ABC's heuristics themselves are based on "*higher* order cognitive processes that call upon *lower* order processes of cue perception and memory [such as voice and face recognition]" (Gigerenzer/Todd 1999: 30). In other words, simple heuristics are based on dual-process models of cognition as well; only has System 1 been assigned the inferior part in the simple heuristics' algorithmic procedure. Interestingly, Gigerenzer's popular book 'Gut Feelings – The Intelligence of the Unconscious' (2007, Penguin Books) is about decision making by relying on intuition – an intrinsic feature of the associative "bad" cognition –, as is his favorite example for showing the fast and frugal heuristics' approach: a baseball player, catching the ball by making use of the gaze heuristic. As the player certainly does not consciously choose to think with his gut, the focus will solely be on the outcome: the ball is caught. The discrepancy is obvious – if only the result can be seen, judgmental heuristics come into play; for better retracing the process, the conscious use of choice heuristics is more optimal.

Apart from the confusing state of ABC's heuristics being choice heuristics that mostly rely on the subconscious (as do Tversky and Kahneman's judgmental heuristics), Gigerenzer likes to present his approach to human's bounded rationality as innovative and a **glass half-full** one. Not only does he base simple heuristics on the abundantly available findings of Tversky and Kahneman (while nonetheless at the same time claiming to be more pro-human than the latter ones) –, two of his most used examples to show how we can do without the economic concept of reasoning are, in fact, someone else's slightly altered illustrations: As already mentioned in section 4.1, the baseball player example has originally been made up by Friedman and Savage (1948), showing how a billiard player uses the angle of gaze for shooting in the right direction; Gigerenzer's second-favorite example is the following, clearly based upon the (uncited) illustration of Thagard and Millgram (1997) (see section 3.1):

> "*A decision theorist from Columbia University was struggling whether to accept an offer from a rival university or to stay. His colleague took him aside and said, "Just maximize your expected utility – you always write about doing this." Exasperated, the decision theorist responded, "Come on, this is serious." (Gigerenzer 2004: 62)*

According to the ABC research group, fast and frugal heuristics operate on **inference from memory** or **inference from the environment** (Gigerenzer/Todd 1999), as opposed to *inference from givens*. The latter one refers to experimental situations, in which all the information needed is directly given to the participants and no cognitive costs occur (hence, strategies for dealing with

the mind's boundedness cannot be tested). The research group, though, does not act in unison when it comes to the inference approach: For Gigerenzer (1996a: 651), a person making use of Take-the-Best performs an inference based on knowledge retrieved from memory only, whereas Todd (2001: 54) states that cognitive energy is consumed when cues have to be found in the environment. This leads to the following conclusion: if the cues are part of the background knowledge of a person, integration of information might not be as restricted as postulated by the ABC research group and costs of retrieving information might not be high at all. Indeed, when it comes to common-sense knowledge parallel architecture of cognition can enable the integration of a vast amount of information (see Chater et al. 2003).

A blend of inference from givens as well as inference from memory can be found in the experiments by Bröder and Schiffer (2003, for a revision see Newell 2005): Participants were expected to solve a murder; first, they loaded cues (or attributes) of the suspects into their memories. Then, cue validities were built by the number of witnesses agreeing on certain attributes. In the final phase, the potential murderer had to be found in a two-choice inference by retrieving the information about the suspects only from memory.

The **representation format** of information was indeed playing a crucial role; Take-the-Best was selected more often as an inference strategy when presented in word lists rather than as images. This indicates that simple heuristics are based on System 2 (choice heuristics), with the only exception being the recognition heuristic – it relies on the associative system first and is adopted by the deliberate system in the next step. The proposition can be made that the list of attributes (words, evoking the deliberate system) is supposedly translated into 'images', thus stirring the associative system that actives associate information – a mental representation will be formed thereupon that combines given and memory-stored information (see Glöckner/Betsch 2008 for the **neural network/connectionist view** on cognitive processing, resp. Newell/Bröder 2008: 198 for a discussion).

Transferring these thoughts to the artificial crime decision-problem leaves room for the following hypothesis: Cue values were established by the number of witnesses consenting on certain attributes (e.g., does the breed of the accompanying dog have a higher value than the type of clothing of the suspect?); even though participants inferred by retrieving the established ranking of cues from their memories, the associative system *cannot* be deactivated. Therefore, the rise of a heuristic like representativeness will be inevitable. Stereotyping, a typical feature of this judgmental heuristic, tells the participant that a Doberman could be more likely the accompanying dog of a criminal than a dachshund. If the respective participant already made

close and bad contact with such a breed (and this particular memory got a negative somatic tagging), probability will be high that he classifies the Doberman as a potential murderer's dogs, *no matter* if the cue value on the respective dog was low. Problems occur, if there is a negative attribute correlation; according to Bettman et al. (1993), this should lead to more extensive processing strategies. For example: A dachshund and a heavily tattooed, chunky man do not fit into the schema of the *typical* criminal. As ambiguity and uncertainty normally do not arise in intuitive judgments, System 2 – that enables us to think contrary thoughts about the same thing (see Kahneman 2003: 1454) – will probably take the leading role and start comparing and weighing different attributes (a feature of compensatory strategies, which should not come up if a simple heuristic is chosen).

Furthermore, negative background moods – though literature proposes they may lead to a more careful processing of cues (see section 6.5) – , may also cause the need to seize on early or first information instantly and suppress information that is conflicting with one's existing knowledge structures and schemata (see Kruglanski/Webster 1996 on the motivated closing of the mind).

ABC's heuristics are for the most part based on **one-reason decision making**. Simple heuristics like Take-the-Best work most efficiently in environments with an **outstanding cue** that speeds up the decision process; an often used example of the ABC research group for demonstrating the power of one-reason decision making is the following one, designed by Breiman et al. (1993): "A man is rushed to the hospital in the throes of a heart attack. The doctor needs to decide quickly whether the victim should be treated as a low-risk or a high-risk patient. […]…She or he must decide under time pressure using only the available cues, each of which is, at best, merely an uncertain predictor of the patient's risk level […]". (Breiman et al. 1993, in: Gigerenzer/Todd 1999: 3, op. cit.).

Breiman et al. (1993) designed a simple decision tree (fig. 20) to classify heart attack patients according to risk using only three available predictors:
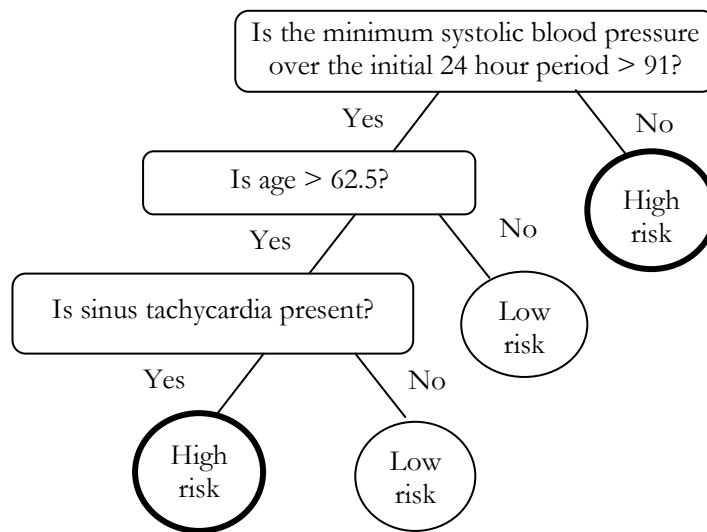
Fig 20: Simple Decision Tree for Classifying Incoming Heart Attack Patients (see Gigerenzer/Todd 1999).

The emergency doctor's two-choice yes/no approach of decision reaching is a prime example for simple heuristics' fast and frugal strategy; indeed, ABC's heuristics are pervaded by the **Darwinian view** of *do lunch or be lunch*. To explain in greater detail: As already stated in Todd (2001: 53f), the key factors influencing cognitive evolution came from the external environment. Time and resources are limited, so there is great pressure on the organism to a) react quickly in dangerous predator-prey situations and b) predict fast which food is edible to have a higher rate of energy intake than the competitors, which also means being able to focus on reproduction sooner etc.

Take-the-Best's strategy of taking the best cue can be traced back to the Darwinian concept of competition and survival: Undeniably, the two-choice algorithm is *do lunch or be lunch* oriented. – It does not come as a surprise then that there are many comparisons to the animal kingdom in ABC's research work, e.g. see Blythe/Todd/Miller 1999: A zebra has to predict quickly what a moving lion probably means for him:

- better turn tail (he is heading straight for you, looking very hungry) or
- continue grazing (the lion is just chasing the lioness, eager to mate and thus not interested in food at the moment).

If ABC's heuristics are regarded from the Darwinian angle (which the research group stresses, e.g. see Gigerenzer 2001a), quick decision making means survival (being not eaten) and competitive advantage (having enough to eat, respectively females to mate). Thus, simple heuristics are based on instinct and intuition; intuition in that sense can be understood as

knowledge that has become integrated in the associative network (Sloman 2002). Speaking of humans again, the reference can also be made to Evans and Over's (1997) *personal rationality* – how to keep oneself alive – which is relying on the unconscious System 1. Transferred to mankind's world where we are chased only metaphorically by lions, judgmental heuristics tell us what to do in most situations; System 2 will check in case of validity concerns or if a comparison to a norm has to be made. From this perspective, one of ABC's questions concerning future research on simple heuristics can now be answered (see section 6.7): *Could simple heuristics be used for tasks that do not demand quick problem solving such as planning?* As a decision maker certainly does not plan his immediate survival but a good living instead (and this requires more in-depth thinking), simple heuristics are supposedly *not* applicable for the planning process.

As the last point I critically want to examine the **suitability of ABC's heuristics for negotiations**:

In chapter 7, judgmental heuristics and their impact on the negotiation situation have been illuminated. Clearly, the question arises if fast and frugal heuristics could also be of use when the individual decision maker's behavior is shifted from an intrapersonal to the interpersonal negotiation situation.

Social context is a crucial part of negotiations; social happenings supposedly stir more emotions than intrapersonal decision-making. As negotiations are about solving a conflict (see the definition by Lewicki et al. 1994[2]), it can be hypothesized that positive emotions are at a lower level. Recalling section 6.5 (The Influence of Emotions and Social Context), conflict means stress which in turn triggers negative emotions, thus leading to an affective judgment that is charged more strongly; the evaluation of the situation is done by the associative system. This can result, inter alia, in

- avoidance behavior (*feign death*)
- panic (*flight*), possibly leading to some headless decision or
- aggressive behavior (*fight*).

The terms in brackets are supposed to refer to the Darwinian concept of *do lunch or be lunch* as described above. Bridging these thoughts with the Dual Concerns Model by Pruitt and Rubin (1986), *fight* presents the competing strategy where the concern about the own outcome is high, as opposed to the little concern shown for the other one's outcome. If fast and frugal heuristics are thus seen from the Darwinian angle – just recall that one of the reasons for exposing

competitive behavior is that *quick* decision making is required –, ABC's one-reason decision-making heuristics will yield distributive negotiation behavior; the famous "I win, you lose" situation consequently occurs (hereby not coming as a surprise: if the lion catches the zebra, he wins and the zebra loses, unfortunately being trapped in a zero-sum game).

But could *mutual problem-solving* be possible if fast and frugal heuristics are applied? – The research on social context's influence on simple heuristics regrettably is advanced in the animal kingdom only (done by observations, see Gigerenzer/Todd/The ABC Research Group 1999); there is hardly any empirical validation for human social processes. – Nonetheless, they are claimed to be important for the building blocks of simple heuristics. (Ironically, *integration*, as required by the problem-solving approach, is not a term favored by the ABC research group, either.)

In my understanding, social context (especially in face-to-face negotiations) will always raise the associative system first, though the deliberate system may override the initial judgmental – particularly, if there is much at stake (*Did I really consider and integrate every detail?* – compensatory strategies) or in case of accountability. Albeit System 2 can 'correct' System 1 (that eagerly strives for schemata, availability, anchors and projection – cases of perceptual distortion), the associative evaluation cannot be suppressed, subsequently leading to possible thoughts like: *My choice does not feel right, even though it should be regarded as reasonable.* Seen as such, the use of electronic tools in negotiations may probably reduce the raise of judgmental heuristics, as evident social context is reduced, and hence activate the deliberate system more strongly – which favors the use of choice heuristics as ABC's fast and frugal ones.

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11. Appendix

Abstract (English)

Decision-making is an integral part of our lives. For decades, human beings were regarded as complete rational decision makers, prescribed to behave to the norms and axioms of mathematics and economics. However, for making decisions in consistence with these models humans do possess neither the knowledge and time nor the required computational capacities; as coined by Herbert Simon, their rationality is bounded. Instead, judgmental evaluations and choices are made by the use of cognitive heuristics, colloquially called 'mental short-cuts'. According to the state-of-the-art literature, cognitive heuristics can be divided into judgmental and choice heuristics. Judgmental heuristics are covered in the Heuristics and Biases Program as introduced by Tversky and Kahneman; the 'fast and frugal' approach of the ABC research group of the Max Planck Institute for Human Development deals with choice heuristics for the most part – conscious and adaptive strategies, intentionally designed to simplify choice. The purpose of this thesis is to examine how these heuristics influence the individual's decision process, as well as to study their impact on the interpersonal negotiation situation.

Abstract (German)

Entscheidungen zu treffen ist ein zentraler Bestandteil unseres Lebens. Während für lange Zeit die präskriptive Entscheidungstheorie das Bild des Nutzen maximierenden und rational agierenden homo œconomicus geprägt hat, zeichnete Herbert Simon ein differenziertes Bild: Menschen handeln aufgrund begrenzter kognitiver Fähigkeiten und Zeit sowie begrenztem Wissen eingeschränkt rational. Die Urteils- und Entscheidungsfindung unter Unsicherheit wird stattdessen durch die Anwendung kognitiver Heuristiken ('Daumenregeln') getroffen; diese können nach dem aktuellen Stand der Literatur unterteilt werden in Urteils- und Wahlheuristiken. Das 'heuristics and biases' Programm von Tversky und Kahneman beschäftigt sich mit intuitiven Denkprozessen (Urteilsheuristiken); die ABC Forschungsgruppe des Max-Planck-Instituts für Bildungsforschung untersucht vor allem den Einsatz bewusst gewählter, adaptiver Wahlheuristiken. Die Zielsetzung der vorliegenden Arbeit ist es, den Einfluss dieser kognitiven Heuristiken auf den Entscheidungsprozess des Einzelnen zu beleuchten, sowie den Bogen zu spannen zu deren Bedeutung für die interpersonelle Konfliktsituation in Verhandlungen.

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Seminararbeiten	- International Energy Management: 'Productivity Improvements in Public Organizations' - International HRM: 'Whistleblower Legislation in Europe' - Internationale Unternehmensführung: 'Internationalisierungstheorien in der Literatur' - International Negotiations: 'Perception, Cognition and Framing in Negotiations. Traps and Challenges for Negotiators'
Diplomarbeit	'Cognitive Heuristics and Biases and Their Impact on Negotiations'
08/2009	Helsinki Summer School: 'Developing Intercultural Competence' Kurs im Rahmen des Master's Degree Program in Intercultural Encounters der Universität Helsinki
10/2007 – heute	Bakkalaureat Fennistik Institut für Europäische und Vergleichende Sprach- und Literaturwissenschaft der Uni Wien, Abteilung Finno-Ugristik
10/2001 – 06/2003	Studium der Übersetzungswissenschaften Zentrum für Translationswissenschaft der Uni Wien Gymnasiumstraße 50, 1190 Wien
1993 – 2001	Bundesgymnasium Parhamerplatz 18, 1170 Wien Reifeprüfung: abgelegt am 16.06.2001 mit gutem Erfolg