Chapter 7

Fast and Frugal Media Choices

Julian N. Marewski, Mirta Galesic, and Gerd Gigerenzer

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Imagine you are going to the movies on a first date. Your companion asks you to choose the film you will see. How can you infer which ones will be reasonably entertaining? You quickly scan the newspaper and recognize the names of two movies, which you suggest to your date. She has only heard of one and picks that one. Possibly without even realizing it, she relied on a very simple decision strategy: the *recognition heuristic* (Goldstein & Gigerenzer, 1999, 2002). According to this simple rule of thumb, recognized *alternatives* (e.g., movies) are likely to have higher values on a criterion (e.g., being entertaining) than unrecognized ones.[1]

Media choice is based on selecting and executing different decision strategies. What cognitive processes underlie the decision making of media users? Understanding what strategies people use, how they work, and when these strategies lead to good decisions is an important step toward a full comprehension of media choice. The recognition heuristic, for example, is only one of several decision-making strategies that may guide media choice. Together with other strategies, this heuristic is investigated within the *fast and frugal heuristics approach* (e.g., Gigerenzer et al., 1999; Todd & Gigerenzer, 2000). This framework has proven to be fruitful for studying decision making in tasks that parallel those occurring in media choice (e.g., Brandstätter, Gigerenzer, & Hertwig, 2006, for risky choice; Gigerenzer & Goldstein, 1996, for inferential judgments).[2] The purpose of this chapter is to introduce the fast and frugal heuristics research program and to show how this approach can be used to study media choice.

The chapter is arranged as follows. First, we will give a brief introduction to some of this framework's historical predecessors. Second, we will provide an overview of its theoretical agenda. Third, we will describe some of the decision strategies proposed by this program. Fourth, we will compare this framework's theoretical assumptions to those made in current theories of media choice and provide a series of examples of how this framework could be used to gain insight into the way people make media choices.

Visions of Rationality

Which movies to watch, whom to court, which newspapers to read, what to eat—our days are filled with decisions, yet how do we make them? The answer to this question depends on one's view of human rationality because this view determines what kind of models of cognitive processes one believes represent people's decision strategies. There are two major approaches.

Unbounded Rationality

The study of *unbounded rationality* asks the question, if people were omniscient and omnipotent, that is, if they could compute the future from what they know, how would they behave? The maximization of subjective expected utility is one example (e.g., Edwards, 1954). When judging, for instance, which movie you should see to make it most likely that your date will kiss you, such models assume that you will collect and evaluate all information, weight each piece of it according to some criterion, and then combine the pieces to reach the mathematically optimal solution to maximize your chance of attaining the goal. Typically unbounded rationality models assume unlimited time to search for information, unlimited knowledge, and large computational power (i.e., information-processing capacity) to run complex calculations and compute mathematically optimal solutions. These models are common in economics, optimal foraging theory, and computer science.

Bounded Rationality

According to the second approach, unbounded rationality models are unrealistic descriptions of how people make decisions. Our resources—time, knowledge, and computational power—are limited. Herbert Simon (1956, 1990), the father of this *bounded rationality* view (see also Bilandzic, this volume), argued that people rely on simple strategies to deal with situations of sparse resources. One research program that is often associated with Simon's work is the *heuristics-and-biases framework* (e.g., Kahneman, Slovic, & Tversky, 1982; Tversky & Kahneman, 1974), which proposes that humans rely on rules of thumb, or heuristics, as cognitive shortcuts to make decisions.[3] Even though this program thus differs from the unbounded rationality view, it still takes unbounded rationality models—such as maximization of subjective expected utility models—as the normative yardstick against which to evaluate human decision making. According to the heuristics-and-biases tradition, decisions deviating from this normative yardstick can be explicated by assuming that people's heuristics are error prone and subject to systematic cognitive biases. Conversely, people's use of heuristics explains why decisions can be suboptimal, or irrational, when compared to the normative yardstick. In short, in this tradition the term bounded rationality mainly refers to the idea that limitations in our cognitive abilities, in our knowledge, and in other reasoning resources produce errors, biases, and judgmental fallacies (for a discussion of the "irrationality" rhetoric of the heuristics-and-biases tradition, see Lopes, 1991).

However, Simon (e.g., 1990) not only stressed the cognitive limitations of humans and proposed simple strategies we may rely on but also emphasized how the strategies are adapted to our decision-making environment: "Human rational behavior ... is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor" (1990, p. 7). The fast and frugal heuristics research program (e.g., Gigerenzer et al., 1999) has taken up this emphasis. In this framework, the term bounded rationality conveys the idea that by exploiting the structure of information available in the environment, heuristics can lead to good decisions even in the face of limited knowledge, computational power, or time. This approach thus shares with the heuristics-and-biases program the idea that people rely on heuristics to make decisions, but it dispenses with the normative yardsticks that are used in the heuristics-and-biases tradition to invoke cognitive deficits and irrational errors. Instead, the fast and frugal heuristics framework has developed an ecological view of rationality through which it tries to understand *how* and *when* heuristics result in adaptive decisions (for more on the differences between the two approaches, see Gigerenzer, 2008).

Fast and Frugal Heuristics

The fast and frugal heuristics program focuses on three interrelated questions (see Gigerenzer, Hoffrage, & Goldstein, 2008). The first is descriptive and concerns the *adaptive toolbox*: What heuristics do organisms use to make decisions, and when is a particular heuristic used? The second question is prescriptive and deals with *ecological rationality*: to what environmental structures is a given heuristic adapted—that is, in what situations does it perform well? The third question focuses on practical applications: how can the study of people's repertoires of heuristics and their fit to environmental structure aid decision making? In what follows, we will focus on the first two questions and briefly touch on the third.

The Adaptive Toolbox of Ecologically Rational Heuristics

According to the fast and frugal heuristics program, boundedly rational decision makers are equipped with a repertoire of heuristics—an adaptive toolbox of the cognitive system. The toolbox contains heuristics that allow people to make inferences (e.g., about movie quality), to develop preferences (e.g., for brands), to plan interactions with others (e.g., salary negotiations

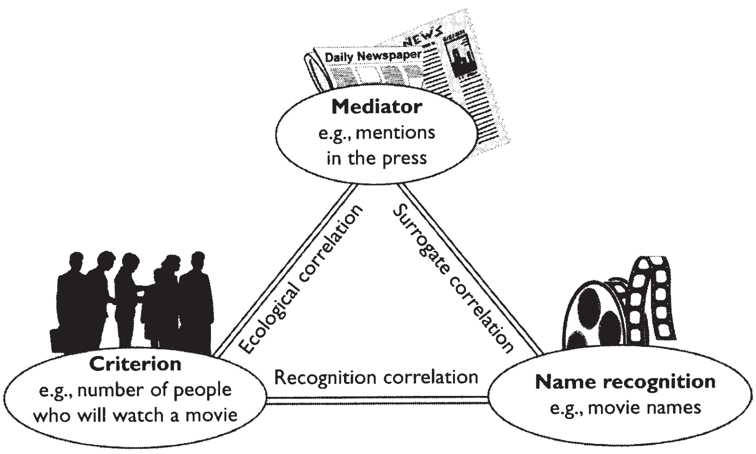

Figure 7.1 How does the recognition heuristic work? An unknown *criterion* (e.g., the number of viewers attracted by a movie) is reflected by a *mediator* (e.g., the press). The mediator makes it more likely for a person to encounter alternatives with larger criterion values than those with smaller ones (e.g., the press mentions more popular movies more frequently). As a result, the person will be more likely to recognize alternatives with larger criterion values than those with smaller ones, and, ultimately, recognition can be relied upon to infer the criterion (e.g., to infer which of two movies will be watched by more people). The relations between the criterion, the mediator, and recognition can be measured in terms of correlations.

with the boss), or to make other judgments and decisions in social and non-social contexts. By building on the way our evolved cognitive capacities work (e.g., the way recognition memory works) and by exploiting regularities in the structure of the human physical and social environment, these heuristics can yield accurate decisions in the face of limited time, knowledge, and computational power.

For instance, Figure 7.1 illustrates the ecological rationality of exploiting a sense of recognition in inferring the number of viewers attracted by a movie, say, the number of people who will watch a movie from the time of its release to the cinemas until three months later. There is an unknown criterion, namely, the number of people who watch a movie, an environmental mediator, say, the news media, and a person who infers the criterion. It is likely that the news media report more on movies that are watched by many people than on movies that attract few viewers, and as a result one is more likely to hear of the former. Correspondingly, recognizing the name of a movie alone can be informative for judging how many viewers a movie attracts, which is the principle by which the recognition heuristic works. More generally, relying on heuristics that exploit a sense of recognition is ecologically rational when there is both a substantial *ecological correlation* between the mediator and the criterion and a substantial *surrogate correlation* between the mediator and recognition. This combination yields a substantial *recognition correlation*; that is, recognized alternatives tend to have higher criterion values than unrecognized ones. If the recognition correlation is zero then it is not ecologically rational to rely on heuristics that exploit a sense of recognition.

In fact, none of the heuristics in the adaptive toolbox are all-purpose tools that can and should be applied invariantly in all kinds of situations. Rather, each heuristic is tuned to specific environmental regularities and designed for specific decision problems. Just as a screwdriver is of little use to hammer a nail into a wall but works well to attach a screw, each heuristic is a specialized tool for specific tasks. For instance, heuristics operating on recognition have little value in situations in which a person is equally likely to hear of alternatives that score high on a criterion of interest and those that score low on it. More generally, the use of a given heuristic from the adaptive toolbox is only ecologically rational when the environmental structure to which it is adapted is encountered. Humans and other organisms choose among the heuristics in their toolbox as a function of the environment.

How to Study Heuristics' Ecological Rationality

The fast and frugal heuristics framework assumes that phylogenetic evolution as well as social and individual learning processes design heuristics such that they are able to solve problems sufficiently well under the constraints of limited knowledge, computational power, and time. It is here that the heuristics' rationality needs to be understood, namely, by how well they solve given problems as they occur in the real world, and not by to what extent judgments deviate from some theoretical yardstick. Criteria for investigating the ecological rationality of heuristics include their *predictive accuracy* (e.g., in making predictions or estimations with respect to phenomena or events in the world), their *frugality* (i.e., the amount of information required in order to derive decisions), and the *speed* with which they allow for making decisions.

To study heuristics and their ecological rationality, one has to specify precise models of the heuristics. Often a high degree of precision can be achieved by describing heuristics as algorithms. Then their ecological rationality, with respect to, say, their predictive accuracy, can be assessed—for instance, by using computer simulations. And then, strong experimental tests of people's reliance on different heuristics can be designed, for instance, by comparing how well different heuristics predict people's behavior. In the fast and frugal heuristics program, heuristics are specified on an algorithmic level as *process models*; that is, they are precise enough to allow for computational modeling of *outcomes* and *processes*. For instance, in a two-alternative choice situation, say, which movie to watch, heuristics should predict both *which* of two alternatives is chosen, and *how* the corresponding decision is derived (i.e., what computational steps are involved in the decision-making process). In an experimental test of people's reliance on a heuristic, an investigator can therefore examine whether both the processes and the outcomes agree with observed behavior.[4]

Even though heuristics differ with respect to the problems they have been designed to solve, they can be understood in terms of common *building blocks* specifying the processes of how information is searched for (*search rules*), when information search is stopped (*stopping rules*), and how a decision is derived based on the information attained (*decision rules*). These building blocks are included in the mind's adaptive toolbox and can be combined into different heuristics.

The study of heuristics also requires precise concepts of environmental structure. For instance, at the time of writing this chapter, the Berlinale 2008, a famous European movie festival, is taking place. When choosing between the movies exhibited at the festival, one might consider attributes of these movies, for instance, whether the director is famous, whether the movie has won a prize, or whether the leading actor is known to be good. All of these attributes may be indicative of movie quality, which is the criterion on which one evaluates the movies. Therefore, one could use these attributes as *cues* (or clues) to infer which movie is likely to have a higher quality. More generally, in the context of inferential judgments, an environment can be described in terms of a set of alternatives from a reference class (e.g., all movies shown at the 2008 Berlinale) where each alternative is characterized by a value on an unknown quantitative criterion (e.g., movie quality) and values on a set of cues (e.g., attributes of movies). Cues are attributes of alternatives that are probabilistically related to the criterion to be inferred.

Table 7.1 illustrates the concept of an environment for a set of fictional movies that vary in the number of viewers they will attract in the next three months. Three attributes of the movies, that is, three cues for inferring the number of people who will watch each movie, are coded as 1 or 0, depending on whether an attribute is present (1) or not (0). Table 7.1 also shows how the accuracy of different heuristics in inferring the number of viewers could be studied. For instance, compare all recognized movies to all unrecognized ones by exhaustively pairing recognized with unrecognized movies: When inferring which of two movies in each pair will be watched by more people, does a heuristic that integrates the information from all three cues yield more correct inferences than the recognition heuristic? The answer is no, as a quick glance at Table 7.1 reveals: the recognition heuristic, which simply predicts more viewers for recognized movies, would yield correct

Table 7.1 Hypothetical Movie Environment

Alternatives	*Criterion*	*Cue 1*	*Cue 2*	*Cue 3*	*Recognition*	*Retrieval fluency*
(8 movies shown at a film festival)	*Number of people who will watch the movie in the next 3 months*	*Director's name famous? (1 = yes; 0 = no)*	*Movie has won a prize? (1 = yes; 0 = no)*	*Leading actor good? (1 = yes; 0 = no)*	*Movie title recognized? (1 = yes; 0 = no)*	*How fluent is movie title's retrieval? (retrieval time in seconds)*
"Rock Me"	14,000,000	1	1	0	1	0.30
"Baby Boy"	12,000,000	1	0	1	1	0.50
"Gangsters"	9,000,000	1	1	0	1	0.60
"Submarine"	7,000,000	0	0	1	1	0.80
"Hot Pot"	500,000	0	0	0	0	Not retrieved
"Red Potato"	400,000	0	0	0	0	Not retrieved
"Marry Me!"	75,000	0	0	0	0	Not retrieved
"Woman"	8,000	0	0	0	0	Not retrieved

Note
All movie names are fictional. Research in the fast and frugal heuristics framework, however, usually focuses on real-world environments, rather than on hypothetical ones.

inferences in *all* comparisons between recognized and unrecognized movies; hence a heuristic operating on cues could only equal but not outperform this heuristic.

Applications: Where are Ecologically Rational Heuristics Studied?

Ecologically rational heuristics are studied in diverse areas, including more applied ones, such as the improvement of coronary care unit allocations (Green & Mehr, 1997), first-line antibiotic prescription in children (Fischer et al., 2002), and risk communication in law and medicine (Gigerenzer, 2002; Gigerenzer & Edwards, 2003; Hoffrage, Lindsey, Hertwig, & Gigerenzer, 2000). At the same time, the fast and frugal heuristics approach is discussed in several branches of science, including philosophy (e.g., Bishop, 2006), the law (e.g., Gigerenzer & Engel, 2006), and biology (e.g., Hutchinson & Gigerenzer, 2005). In particular, in more basic research, this program has proposed a range of heuristics for different tasks—mate search (Todd & Miller, 1999), parental investment (Davis & Todd, 1999), inferential judgments (e.g., Gigerenzer & Goldstein, 1996; Goldstein & Gigerenzer, 2002), estimation (Hertwig, Hoffrage, & Martignon, 1999), categorization (Berretty, Todd, & Martignon, 1999), and choices between risky alternatives (Brandstätter et al., 2006), to name a few. Moreover, it has produced a large amount of research investigating whether and when people rely on given heuristics (Bröder & Schiffer, 2003; Mata, Schooler, & Rieskamp, 2007; Pachur, Bröder, & Marewski, 2008; Pachur & Hertwig, 2006; Pohl, 2006; Rieskamp & Hoffrage, 1999, 2008; Rieskamp & Otto, 2006), under what environmental structures the heuristics perform well (e.g., Gigerenzer & Goldstein, 1996; Hogarth & Karelaia, 2007; Katsikopoulos & Martignon, 2006; Martignon & Hoffrage, 1999), and how accurate they are for predicting events in the real world, such as the outcomes of sports events (e.g., Pachur & Biele, 2007; Scheibehenne & Bröder, 2007; Serwe & Frings, 2006) or political elections (Marewski, Gaissmaier, Schooler, Goldstein, & Gigerenzer, 2008), how much time various mammals sleep (Czerlinski, Gigerenzer, & Goldstein, 1999), or the performance of stocks (Borges, Goldstein, Ortmann, & Gigerenzer, 1999; Ortmann, Gigerenzer, Borges, & Goldstein, 2008).

Next we will illustrate this program by presenting three particularly fast and frugal heuristics in more detail: the recognition heuristic (Goldstein & Gigerenzer, 1999, 2002), the fluency heuristic (Schooler & Hertwig, 2005), and the *take-the-best heuristic* (Gigerenzer & Goldstein, 1996). All three have in common that they base decisions on just one piece of information—as opposed to weighting and adding all possible pieces, as assumed by subjective expected utility models.

Three Heuristics from the Adaptive Toolbox

The Recognition Heuristic

Which newspaper is of better quality, the *Göttinger Tageblatt* or the *Financial Times Deutschland*? Suppose you have heard of the *Financial Times* before reading this chapter, but you have never heard of the *Göttinger Tageblatt*. In this case, you could use the recognition heuristic (Goldstein & Gigerenzer, 1999, 2002) to respond: You would simply decide for the *Financial Times*, which is the alternative you have heard of before, that is, the alternative you recognize.

In its simplest form, this heuristic is designed for inferring which of two alternatives, one recognized and the other not, has a larger value on a quantitative criterion. It simply searches for recognition information and stops information search once an alternative is judged as recognized. When recognition correlates strongly with the criteria on which alternatives are evaluated, the heuristic is defined as follows.

> *Search rule*: In a comparison of two alternatives, determine which alternative is recognized and which is not.
> *Stopping rule*: Stop once both alternatives are classified as recognized or unrecognized.
> *Decision rule*: If one alternative is recognized but not the other, infer the recognized alternative to have a larger value on the criterion.

For instance, when used to infer how many people will watch the movies "Rock Me" and "Hot Pot" in the next three months (Table 7.1), the recognition heuristic would suggest that the movie "Rock Me" will be watched by more viewers than the movie "Hot Pot," because "Rock Me" is recognized while "Hot Pot" is not.

Even more so than in the case of two alternatives, recognition is particularly useful when winnowing down many alternatives. It requires almost no thinking—instead recognition is rapidly available, often before other information about an alternative can be retrieved from memory (Pachur & Hertwig, 2006). For instance, a person will more quickly know that she recognizes a movie's name than she will recall attributes of the movie, say, who the leading actors are. How does recognition help when a media user faces multiple alternatives, say, has to choose between eight movies? Many theories of choice assume a two-stage process: When evaluating multiple alternatives, first a smaller set of relevant alternatives is formed, and then a choice is made after more detailed examination of the alternatives in this *consideration set* (e.g., Alba & Chattopadhyay, 1985; Hauser & Wernerfelt 1990; Howard & Sheth, 1969). When recognition correlates strongly with the criteria on which alternatives are evaluated, the recognition heuristic generates "consideration sets" consisting of recognized alternatives (Marewski et al., 2008):

Search rule: If there are *N* alternatives, determine which *n* alternatives are recognized and which *N–n* alternatives are not recognized.
Stopping rule: Stop once all alternatives are classified as recognized or unrecognized.
Decision rule: Rank all *n* recognized alternatives higher on the criterion than the *N–n* unrecognized ones.

Consideration sets facilitate decisions by reducing the number of alternatives. To illustrate, take the movies shown in Table 7.1. A media user may want to identify the top ones, that is, those that will be watched by the most people, but she does not know the numbers yet and has to make an inference. One way to determine which of the eight movies are at the top is to rank order them. However, if the media user does not generate a smaller consideration set but instead attempts to rank *all* the movies, then she would face a total of 8! (40,320) possible rank orders. In contrast, if the recognition heuristic is used, and, say, four movies are unrecognized and four recognized, then there are only 4! (24) possible rank orders, namely, those of the recognized movies that constitute the consideration set of top ones. In a second stage, the final rank order of these movies can be determined with heuristics that use cues, such as knowledge about the movies' directors. The four unrecognized alternatives can be put aside (or ranked at random) because they are likely to score low on the criterion.

The Ecological Rationality of the Recognition Heuristic

The recognition heuristic is a specialized tool: It is only applicable when at least one alternative is recognized while others are unrecognized. If there is a positive correlation between one's recognition of alternatives and the criterion values of alternatives (e.g., number of viewers of a movie), then its application is ecologically rational, that is, it can yield accurate decisions. Recall, mediators in the environment drive such correlations: The BBC, CNN, *The Times*, and the like make it probable that we will encounter and recognize alternatives with large criterion values (c.f., Figure 7.1). In fact, the recognition heuristic has been shown to yield accurate decisions for inferring soccer teams', tennis players', and hockey teams' success in competitions (e.g., Pachur & Biele, 2007; Serwe & Frings, 2006; Snook & Cullen, 2006), the quality of universities (Hertwig & Todd, 2003), demographic and geographical variables (Goldstein & Gigerenzer, 2002; Pohl, 2006; Reimer & Katsikopoulos, 2004; Schooler & Hertwig, 2005), as well as political parties' and candidates' success in elections (Marewski et al., 2008), among others.

When do People Rely on the Recognition Heuristic?

When the correlation between one's recognition of alternatives and the criterion is substantial, people tend to make inferences in accordance with the recognition heuristic (e.g., Goldstein & Gigerenzer, 2002; Hertwig, Herzog, Schooler, & Reimer, 2008; Pachur et al., 2008; Volz et al., 2006). In contrast, when they are less pronounced, people tend not to do so. For instance, Pohl (2006) asked people to infer which of two cities is situated farther away from the Swiss city of Interlaken, and which of two cities is larger. Most people may have intuitively known that their recognition of city names is not indicative of the cities' spatial distance to Interlaken but is indicative of their size, and indeed, for the very same cities, people tended not to make inferences in accordance with the recognition heuristic when inferring spatial distance but seemed to rely on it when inferring size. There is also evidence for a range of other determinants of people's reliance on the recognition heuristic (e.g., Marewski et al., 2008; Newell & Fernandez, 2006; Pachur et al., 2008; Pachur & Hertwig, 2006).

The Fluency Heuristic

Now consider a different pair of newspapers. Which is of better quality? The *Financial Times Deutschland* or the *New York Times*? Suppose you have heard of both before reading this chapter. Thus, the recognition heuristic is of no use, because it requires that only one alternative is recognized. However, there is another heuristic you could use to make the decision.

Recognizing an alternative typically implies that a representation of this alternative is stored in one's memory. The speed of retrieving this representation from memory largely determines the time it takes to recognize the alternative. According to Schooler and Hertwig's *fluency heuristic*, a person can rely on the time it takes to retrieve alternatives, that is, their *retrieval fluency*, to infer which of two alternatives has a higher value on a given quantitative criterion.[5] When the retrieval time of an alternative correlates with a given quantitative criterion, the fluency heuristic is defined as follows:

> *Search rule:* If two alternatives are recognized, determine their retrieval time.
> *Stopping rule:* Stop once the retrieval time is determined.
> *Decision rule:* If one of the two alternatives is more quickly retrieved, then infer that this alternative has the higher value with respect to the criterion.

For instance, when used to judge how many people will watch the two recognized movies "Rock Me" and "Baby Boy" shown in Table 7.1, the fluency heuristic would suggest that the movie "Rock Me" will be watched more often than the movie "Baby Boy," because it takes more time to retrieve "Baby Boy" than "Rock Me."

The Ecological Rationality of the Fluency Heuristic

Like the recognition heuristic, the fluency heuristic is a specialized tool. First, it can only be relied on when both alternatives are recognized and when one alternative is more quickly retrieved than the other. An alternative's retrieval time largely depends on a person's history of past encounters with the alternative. Roughly speaking, the more often and the more recently an alternative, say, the name of a movie, is encountered, the more quickly it will be retrieved. Second, using the fluency heuristic is only ecologically rational when the frequency of encounters with alternatives, and consequently, their retrieval time, correlates with the alternatives' values on a given criterion (e.g., number of viewers attracted by a movie). Again, environmental mediators can create such correlations by making it more likely we will encounter alternatives that have larger values on the criterion. Thus the names of, say, popular movies tend to be more quickly retrieved than the names of less popular ones, and, ultimately, a person can rely on retrieval time to correctly infer which of two alternatives is larger on the criterion. In short, the ecological rationale of the fluency heuristic resembles very closely that of the recognition heuristic, which is illustrated in Figure 7.1. And just like the recognition heuristic, the fluency heuristic has been shown to yield accurate inferences for a range of criteria, including inferences about record sales of music artists (Hertwig et al., 2008), countries' gross domestic product (Marewski & Schooler, 2008), and the size of cities (Schooler & Hertwig, 2005), among others.

When Do People Rely on the Fluency Heuristic?

Marewski and Schooler (2008) provided evidence to suggest that the fluency heuristic is most likely to be relied on when people lack knowledge about the attributes of the alternatives they make judgments about, say, knowledge about a movie's leading actors. When knowledge about the attributes is available, people tend to rely on that knowledge rather than on the fluency heuristic. Next we will introduce a heuristic that operates on knowledge.

The Take-the-Best Heuristic

While the fluency heuristic and the recognition heuristic rely on retrieval fluency and recognition, other heuristics use knowledge about alternatives' attributes as cues to make judgments. For instance, when judging which of two newspapers is of better quality one could consider whether the newspapers are nationally distributed. Being a national newspaper might be a positive cue to quality; being a local newspaper, in turn, might be a negative cue, indicating poorer quality. Another attribute to consider might be whether the newspapers are published in a capital city. Recall, one can also think of such positive and negative cues as being coded with numbers, such as "1" (positive), and "0" (negative).

A prominent representative of such knowledge-based heuristics is Gigerenzer and Goldstein's (1996) take-the-best heuristic. It considers cues sequentially (i.e., one at a time) in the order of their *validity*. The validity of a cue is the probability that an alternative A (e.g., a newspaper) has a higher value on a criterion (e.g., quality) than another alternative B, given that alternative A has a positive value on that cue and alternative B a nonpositive value. Take-the-best bases an inference on the first cue that discriminates between alternatives, that is, on the first cue for which one alternative has a positive value and the other a negative one. Take-the-best is defined as follows:

> *Search rule*: Look up cues in the order of validity.
> *Stopping rule*: Stop search when the first cue is found that discriminates between alternatives.
> *Decision rule*: Decide for the alternative that this cue favors.

The way take-the-best operates can be illustrated for the set of movies shown in Table 7.1. For inferring how many people will watch a movie, the most valid cue is whether the movie's director is famous. If one movie director is famous but not the other, then this cue discriminates and take-the-best would infer the movie with the famous director will be watched by more people. To illustrate, in a comparison of "Rock Me" and "Submarine," take-the-best would infer "Rock Me" to be more popular because the director of "Rock Me" is famous but the director of "Submarine" is not. If two movies being compared both have famous directors (or if both do not have famous directors), then the second most valid cue would be considered, that is, whether the movies have won a prize. If this piece of information discriminates between the movies, an inference would be made; otherwise the third most valid cue would be considered, until finally, a discriminating cue is found or a random guess must be made. For example, "Rock Me" and "Baby Boy" both have famous movie directors. Therefore, take-the-best would consider whether the movies have won a prize and infer a higher criterion value for "Rock Me" because this movie has won one while "Baby Boy" has not.

The Ecological Rationality of Take-the-Best

Take-the-best tends to ignore available information by looking up cues in the order of their validity and basing an inference on the first discriminating cue. Many unboundedly rational models, in turn, integrate all available information into a judgment, for instance, by weighting and adding it. Now, if a decision maker has unlimited access to information and enough computational power and time to weight and add it, should he ever rely on take-the-best instead of on strategies that integrate all information? Czerlinski et al. (1999) compared the accuracy of several models in predicting a range of diverse phenomena in 20 different real-world environments, ranging from rainfall to house prices. Take-the-best outperformed the competing models in most environments (for similar results, see also Gigerenzer & Goldstein, 1996).[6] That is, even if a decision maker could integrate all information, in these environments he would be better off not doing so but using take-the-best instead! Martignon and Hoffrage (1999) explored conditions under which different strategies work well and found that in certain environments take-the-best can actually never be outperformed by strategies that integrate all information by weighting and adding it. This happens in the environments where each cue is more valid than all less valid cues taken together. Especially in such situations, it is ecologically rational to rely on take-the-best (for more research on the ecological rationality of take-the-best and related strategies, see Baucells, Carrasco, & Hogarth, 2008; Brighton, 2006; Brighton & Gigerenzer, 2008; Gigerenzer & Brighton, 2008; Hogarth, & Karelaia, 2007; Katsikopoulos & Martignon, 2006).

On a side note, a model closely related to take-the-best has been applied to the psychologist's world of media choice, namely, to prioritizing literature searches from the PsycINFO database: Lee, Loughlin, and Lundberg (2002) examined the performance of a take-the-best variant in identifying articles that are relevant to a given topic of interest (e.g., eyewitness testimony). A researcher going by their take-the-best variant would have had to read fewer articles in order to find the relevant ones than a person behaving in accordance with an alternative model. In contrast to the take-the-best variant, the alternative model integrated all available information to rate the articles' relevance.

When do People Rely on Take-the-Best?

Numerous experiments have been conducted that investigate people's use of this simple heuristic (e.g., Bergert & Nosofsky, 2007; Bröder & Gaissmaier, 2007; Bröder & Schiffer, 2003, 2006; Rieskamp & Otto, 2006). In general, people tend to make inferences consistent with take-the-best when using it is ecologically rational. However, there are also a range of other determinants of strategy selection (see Bröder, in press, for an overview). Bröder and Schiffer (2003), for instance, showed that people are more likely to rely on take-the-best when judgments have to be made by retrieving relevant knowledge about alternatives' attributes from memory (as opposed to reading information on a computer screen).

Fast and Frugal Media Choice

Heuristics such as those introduced above can be successful because they exploit both the structure of information in the environment and the evolved capacities of the mind, such as the way memory works. In what follows, we will (i) contrast the fast and frugal heuristics approach with the assumptions theories of media choice make about decision processes and then (ii) provide a few examples of how the fast and frugal heuristics approach could be applied to studying media choice.

Assumptions About Judgmental Processes in Media Choice

The fast and frugal heuristics approach can be compared with theories of media choice on at least two dimensions, reflecting their assumptions about (i) media users' rationality (e.g., bounded or unbounded) and (ii) the role the environment plays in people's media-related behavior. First, theories of media choice differ in their view of people's resources. Some theories silently assume that people have unlimited computational power and unlimited time to process all available information about a certain problem and combine it in complex ways to come to the best solution. Others describe a case in which a solution must be found within the limits imposed by knowledge, time, and computational power.

For instance, the *uses-and-gratifications approach* (Atkin, 1985; Katz, Blumler, & Gurevitch, 1974) proposes that people actively select media content whose anticipated values exceed its anticipated costs. To illustrate, a TV program can be valuable because of the momentary gratification it provides (such as entertainment) or because it satisfies some long-term goal (such as education). It can be costly because it takes time and may cost money to watch (cf., Scherer & Naab, this volume), and because of a range of psychological and social consequences such as feelings of guilt, fear, or embarrassment stemming from exposure to certain content (e.g., pornography, a horror movie, or a mediocre soap opera). As in the broader theories of attitude formation of Fishbein and Ajzen (1975, theory of reasoned action) and Ajzen (1991, theory of planned behavior), whether to watch the program is decided by weighting the subjective evaluation of each possible positive and negative outcome by the expected likelihood that a particular media offering will lead to that outcome, and then summing the weighted evaluations. Numerous studies have used such models to predict people's media choices, though the explanatory power of such models leaves much room for further improvement (cf., LaRose, Mastro, & Eastin, 2001).

Models based on weighting and adding often assume—unrealistically—that people can predict all the consequences of their choices, are able to assign them a joint probability distribution, and can order them using a single utility function (Simon, 1983). But in real life, people rarely have the information, time, or cognitive capacity to think of all possible scenarios for the future, their likelihoods, and their subjective utilities. Moreover, life often involves so many choices and so many possible outcomes that *the* optimal solution to a problem rarely exists. Instead of trying to find the best solution, which may not be attainable, people may *satisfice* (Simon, 1997)—that is, look for solutions that are good enough for their current purposes.

This is recognized in Zillmann and Bryant's (1985) *selective exposure approach*. They proposed that people sample available media choices until they find the first alternative that is pleasing because it reduces negative or enhances positive hedonic experience. They argued that people sometimes do make elaborate evaluations of all alternatives on multiple dimensions, but that "this is the exception, even the rare exception" (p. 163). This approach, although coming from a different tradition, is closer to the fast and frugal heuristics framework—the view that people use rules to stop information search and rely on strategies that perform well even when there is little information available.

The second dimension along which the fast and frugal heuristics approach and theories of media choice differ is the emphasis they put on the interplay between the mind and the environment. While the heuristics approach highlights this interplay, some media choice theories, such as the uses-and-gratifications approach (Blumler & Katz, 1974), deal primarily with the mind and seek *internal* explanations for people's behaviors in their interests and motives. For instance, media choices are explained as serving to satisfy basic needs such as being entertained or achieving personal insight.

Other theories of media choice deal almost exclusively with the environment. For example, studies on *television inheritance effects* investigate what characteristics of TV programs make viewers more likely to watch the subsequent program on the same channel once the first program ends (Webster, 2006; see also Webster, this volume). Similarly, studies measuring *TV exposure* focus on characteristics of TV programs that make them more or less popular (cf., Webster & Wakshlag, 1985) and often treat people as merely passive receivers of media content.

Still other approaches to media choice recognize the importance of both the effects of environmental structure on people's cognitions, moods, and behaviors and the effect of people on their environments. For example, Zillmann and Bryant (1985) proposed that people try to rearrange their environments to increase the gratification they receive from them. This is reflected, for example, in their choice of TV programs—one aspect of their environment that is under their control and that they can use to modify their mood. Another example of how environment shapes people's behavior comes from a study by Dennis and Taylor (2006). They found that people stay longer on those Web pages that take longer to open, meaning that the informational structure of the Web environment affects their behavior. This parallels findings related to the foraging behavior of animals, which spend a longer time exploiting the food patches that are costlier to reach (cf., Pirolli & Card, 1999).

In sum, in line with some of the aforementioned theories, a promising approach to media choice would recognize both that people are boundedly rational and that their choices depend on the structure of the media environment. Next, we will show what corresponding models might look like.

Fast and Frugal Heuristics for Media Choice?

The best way to show that the fast and frugal heuristics program can be applied to media choice is to give concrete examples. In doing so, we will draw on the heuristics introduced above. Although these heuristics were developed primarily for inference tasks, that is, tasks where a person has to make judgments about alternatives' value on an objective criterion (e.g., number of viewers of movies), in principle they can also be applied to more subjective preferential choices—for instance, about what will make us feel good in the future. First, we describe simple strategies that could be used to pick a magazine from a large newsstand. Second, we illustrate how knowledge-based heuristics can be applied to preferential choice of TV shows. Third, we give an example of using the recognition heuristic and take-the-best to infer what is the most up-to-date health-related website. Finally, we discuss the value of using information from our social environments in making media choices. Note that all the examples should be seen as hypotheses intended to inspire research rather than summaries of empirical results.

Buying Magazines

Consider the question of how people choose a magazine at a newsstand. There are hundreds of magazines and it would take ages to read even the headlines on each one. What are possible strategies? Instead of collecting information about all alternatives and weighting and adding them, people could follow the recognition heuristic to winnow down the number of alternatives. That is, they could consider only the magazines with titles they recognize. If a person recognizes two titles, she can use the fluency heuristic to pick the one that is more quickly retrieved than the other. This can be ecologically rational in situations where recognized magazines are likely to be more interesting, appealing, or on some other criterion "good" for a person.

Choosing a TV Program

After a busy week, a person finally collapses in front of his TV and tries to find something to watch. He looks at a program guide and sees that there are five TV shows that will all start in a few minutes, of course on different stations. Being very busy lately, he has not had a chance to watch any of them before. How can he choose the one that he will be most likely to enjoy?

One option, following from the subjective expected utility approach (cf., Edwards, 1954; Savage, 1954), demands significant time and effort. First, a decision maker should collect all the available information about the shows, for instance, what genres they are, who the actors are, what the critics are saying about them, and what his friends think. Then he might weight each attribute by its correlation with his past preferences for shows. For instance, if he usually likes the shows that his friends like, he might want to put higher weight on that cue; and if he cares less about what critics say, he can discount that feature. Finally, he has to combine the scores of each program on each attribute to be able to pick the one that he is most likely to enjoy. Note that there is little evidence that this deliberate form of reasoning makes people happy (Gigerenzer, 2007; Schwartz et al., 2002).

A simpler and more efficient way is to use only a few cues that were in the past the best predictors of whether the person liked a show or not. For example, if our TV viewer almost always liked the shows his friends liked, then he could use that cue first to reduce the number of alternatives. If his friends recommended more than one show, he could use the second most predictive cue, for instance, whether any of the alternatives is in the genre he likes, say, crime investigation. If just one of them is in that genre, he can pick that show and be fairly confident that he will enjoy it (but see also Hsee & Hastie, 2006, for examples of situations in which people cannot predict what will make them happy). This strategy is a variant of the take-the-best heuristic for situations where one has to decide between multiple alternatives. It has also been called *deterministic elimination by aspects* (Hogarth & Karelaia, 2005).[7]

Choosing a Website

Let us now consider a patient who wants to find health-related information on the Web but who cannot name any medical websites off the top of her head. She types "health" into Google and gets 900 million hits. On the first Google page listing the search results, these hits include nine sponsored links, and a list of ten regular links to websites with the highest ranks as calculated by the Google search engine.[8] Let us further assume that, as many users do (cf., Brooks, 2004; Joachims, Granka, Pan, Hembrooke, & Gay, 2005), she decides to consider just these 19 hits on the initial page and to disregard the other 899,999,981. From the 19 hits, how can she choose the one link that leads to the website with the most up-to-date medical information? If people are more likely to recognize names of websites that are updated more frequently (e.g., because people talk about them more often), one hypothesis is that they could use the recognition heuristic to narrow down the initial alternatives. If our patient has not heard of any of the sponsored links nor of, say, four of the regular links, she will be left with only six possible websites to consider. Sorted in the order of their Google rank, they are the Yahoo health site, a major specialized health site, let's call it HW, and the health sections of CNN, *The New York Times*, MSNBC, and the BBC.

She could now use take-the-best to make her final pick. From her previous experience in searching for sites dedicated to specific areas (e.g., cars, sports, or movies), or from talking to her friends, she might have learned that some cues are better than others. For instance, suppose the sites dedicated to a certain topic are usually more up-to-date than more general sites. This one cue will then be enough to make the final decision: Choose HW.

The Role of Social Environments in Media Choice

Social environments are a rich source of information that people can use to solve both social and other problems. The adaptive toolbox includes heuristics that exploit properties of social environments. *Imitate-the-majority* is one example. As the literature on social comparison suggests (cf., Festinger, 1954; Suls, Martin, & Wheeler, 2002), when there are no objective standards by which to evaluate their opinions and choices, people turn to others—especially those similar to them—to make sure they are on the right track. In the world of media there is often no other standard and the popularity of a movie or a TV show may often be the cue people follow to make their media choices: Just choose the movie everybody else chooses! Whatever movie others similar to us like will most likely also be to our own taste. Imitating other people's choices has been shown to be an adaptive strategy, particularly in situations where one has little knowledge, for instance, about alternatives' attributes or other environmental characteristics (for an example from the area of food choice, see Baeyens, Vansteenwegen, De Houwer, & Crombez, 1996).

Imitating others' choices is one strategy, but people can also use their social environments to learn which cues to rely on to evaluate different media alternatives. Garcia-Retamero, Takezawa, and Gigerenzer (2006) have shown that imitation of the cues used by other successful people outperforms individual learning and other more complicated strategies of combining social information. Indeed, most of us have probably copied some of the media cues used by our friends—for instance, we would see a new movie because they praised its director. Conversations with friends about movies and TV shows can be more than a nice pastime—they can be a source of information that helps us make our media choices. This kind of social learning is also important in other areas of life where there are no clear standards for what constitutes the best decision, such as fashion or mate choice. Just like gossip can be a good way of learning about desirable qualities of prospective mates (cf., Miller & Todd, 1998), chatting about movies can help us the next time we take our date to the cinema.

Conclusion

Which of dozens of magazines, hundreds of TV programs, and thousands of websites should win our attention? Life consist of decisions, some of which are media choices. According to the fast-and-frugal heuristics framework, people rely on simple rules of thumb to make them. Most of these rules share at least one feature: They base decisions on little—but relevant—information, say a sense of recognition, while ignoring other data. Thus they differ drastically from unboundedly rational models of decision making, which assume that people integrate all the cues they can get a hold of. Everyone who has ever surfed the Internet or read a newspaper knows why: In the world of mass communication, where decision makers confront an endless stream of texts, pictures, and sounds, the art of making good choices depends on ignoring information rather than integrating all that is available.

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Notes

1 In the memory literature, the term recognition is often used to refer to a person's ability to distinguish between stimuli presented in an experiment (e.g., as in a study list) and those that have not been presented in the experiment. Usually, a person has heard of both examples of stimuli before participating in the experiment (e.g., stimuli could be the names CLINTON and NIXON). Here, we adopt Goldstein and Gigerenzer's (1999, 2002; see also, e.g., Schooler & Hertwig, 2005) usage of the term to refer to a person's ability to discriminate between novel stimuli that have never been heard of before (and are hence unrecognized, e.g., the name XADALL) and those that have been heard of before (and are hence recognized; e.g., NIXON).

2 In this chapter, we use the terms "inferential judgment" and "inference" to refer to judgments about an unknown value an alternative (e.g., a movie) has with respect to a criterion (e.g., being entertaining).

3 Kahneman et al. (1982) credited Simon in the preface to the anthology although their major early papers, which appear in the anthology, do not cite Simon's work on bounded rationality. Thus this connection was possibly by hindsight (Lopes, 1992).

4 Heuristics are models of cognitive processes. This, however, does not mean that they are perfect representation of these processes. A model of mind always remains a *model* of mind. To be considered a good model, a heuristic should meet basic standards for psychological plausibility (e.g., Gigerenzer et al., 2008) and outperform alternative models by certain criteria. For instance, it should predict behavior

better than alternative models (for other model selection criteria, see Jacobs & Grainger, 1994; Marewski & Olsson, 2009; Pitt, Myung, & Zhang, 2002).

5 The term "fluency heuristic" has been used in different ways (e.g., Jacoby & Brooks, 1984; Toth & Daniels, 2002; Whittlesea, 1993). Here we use this term to refer to Schooler and Hertwig's (2005) model. Their use of the term "fluency" not only follows a long research tradition on fluency (e.g., Jacoby & Dallas, 1981), but also builds on the notion of availability (Tversky & Kahneman, 1973), which bases judgments on ease of retrieval (see Schooler & Hertwig for a discussion of the differences between their model and the notion of availability; see also Hertwig, Pachur, & Kurzenhäuser, 2005; Sedlmeier, Hertwig, & Gigerenzer, 1998, for a discussion of differences in various notions of availability).

6 A model's accuracy can be evaluated in terms of its ability to *fit* existing data and, more importantly, in terms of its ability to *predict* new data. In the first case, a model's free parameters are estimated from existing data, and the accuracy of the model in fitting the same data is measured. In the second case, the model's free parameters are estimated from existing data, and its accuracy in predicting new data with fixed parameter values is measured. Note that take-the-best outperformed, on average, competing models in the tougher test, that is, in predicting new data. (For the difference between fitting and predicting, see Pitt et al., 2002; Roberts & Pashler, 2000.)

7 Hogarth and Karelaia (2005) proposed this take-the-best variant, calling it deterministic elimination by aspects. Note that take-the-best differs from elimination by aspects (Tversky, 1972). The latter is a model of preferential choice that has no deterministic rule to order cues (i.e., attributes), and it is not specified how to compute cues' weights. Instead, it has an aspiration level for each cue and cues are quantitative. Take-the-best, in turn, is a model of inference operating on cues with binary values and a deterministic, specified order of cues.

8 Search conducted on May 15, 2007.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211.

Alba, J. W. & Chattopadhyay, A. (1985). Effects of context and part-category cues on recall of competing brands. *Journal of Marketing Research, 22*, 340–349.

Atkin, C. K. (1985). Information utility and selective exposure to entertainment media. In D. Zillmann & B. Jennings (Eds.), *Selective Exposure to Communication* (pp. 63–92). Hillsdale, NJ: Lawrence Erlbaum Associates.

Baeyens, F., Vansteenwegen, D., De Houwer, J., & Crombez, G. (1996). Observational conditioning of food valence in humans. *Appetite, 27*, 235–250.

Baucells, M., Carrasco, J. A., & Hogarth, R. M. (2008). Cumulative dominance and heuristic performance in binary multiattribute choice. *Operations Research, 56*, 1289–1304.

Bergert, F. B. & Nosofsky, R. M. (2007). A response-time approach to comparing generalized rational and take-the-best models of decision making. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 331*, 107–129.

Berretty, P. M., Todd, P. M., & Martignon, L. (1999). Categorization by elimination: Using few cues to choose. In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 235–254). New York: Oxford University Press.

Bishop, M. (2006). Fast and frugal heuristics. *Philosophy Compass, 1*, 201–223.

Blumler, J. G. & Katz, E. (Eds.). (1974). *The Uses Of Mass Communications: Current Perspectives on Gratifications Research.* Beverly Hills, CA: Sage Publications.

Borges, B., Goldstein, D. G., Ortmann, A., & Gigerenzer, G. (1999). Can ignorance beat the stock market? In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 59–72). New York: Oxford University Press.

Brandstätter, E., Gigerenzer, G., & Hertwig, R. (2006). The priority heuristic: Making choices without trade-offs. *Psychological Review, 113,* 409–432.

Brighton, H. (2006). Robust inference with simple cognitive models. In C. Lebiere & B. Wray (Eds.), *Between a Rock and a Hard Place: Cognitive Science Principles Meet AI-hard Problems. Papers from the AAAI Spring Symposium* (AAAI Tech. Rep. No. SS-06-03, pp. 17–22). Menlo Park, CA: AAAI Press.

Brighton, H. & Gigerenzer, G. (2008). Bayesian brains and cognitive mechanisms: Harmony or dissonance? In N. Chater & M. Oaksford (Eds.), *The Probabilistic Mind: Prospects for Bayesian Cognitive Science.* New York: Oxford University Press.

Bröder, A. (in press). The quest for take the best—Insights and outlooks from experimental research. In P. Todd, G. Gigerenzer, & the ABC Research Group, *Ecological Rationality: Intelligence in the World.* New York: Oxford University Press.

Bröder, A. & Gaissmaier, W. (2007). Sequential processing of cues in memory-based multi-attribute decisions. *Psychonomic Bulletin and Review, 14,* 895–900.

Bröder, A. & Schiffer, S. (2003). Take the best versus simultaneous feature matching: Probabilistic inferences from memory and effects of representation format. *Journal of Experimental Psychology: General, 132,* 277–293.

Bröder, A. & Schiffer, S. (2006). Stimulus format and working memory in fast and frugal strategy selection. *Journal of Behavioral Decision Making, 19,* 361–380.

Brooks, N. (2004). *The Atlas Rank Report: How Search Engine Rank Impacts Traffic.* Seattle, WA: Atlas Institute Digital Marketing Insights. Online. Retrieved April 27, 2008 from http://app.atlasonepoint.com/pdf/AtlasRankReport.pdf.

Czerlinski, J., Gigerenzer, G., & Goldstein, D. G. (1999). How good are simple heuristics? In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 97–118). New York: Oxford University Press.

Davis, J. N. & Todd, P. M. (1999). Parental investment by simple decision rules. In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 309–324). New York: Oxford University Press.

Dennis, A. R. & Taylor, N. J. (2006). Information foraging on the web: The effects of "acceptable" Internet delays on multi-page information search behavior. *Decision Support Systems, 42,* 810–824.

Edwards, W. (1954). The theory of decision making. *Psychological Bulletin, 51,* 380–417.

Festinger, L. (1954). A theory of social comparison processes, *Human Relations, 7,* 117–140.

Fischer, J. E., Steiner, F., Zucol, F., Berger, C., Martignon, L., Bossart, W., Altwegg, M., & Nadal, D. (2002). Use of simple heuristics to target macrolide prescription in children with community-acquired pneumonia. *Archives of Pediatrics and Adolescent Medicine, 156,* 1005–1008.

Fishbein, M. & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley.

Garcia-Retamero, R., Takezawa, M., & Gigerenzer, G. (2006). How to learn good cue orders: When social learning benefits simple heuristics. In R. Sun & N. Miyake

(Eds.), *Proceedings of the 28th Annual Conference of the Cognitive Science Society* (pp. 1352–1358). Mahwah, NJ: Lawrence Erlbaum.

Gigerenzer, G. (2002). *Calculated Risks: How to Know When Numbers Deceive You.* New York: Simon & Schuster.

Gigerenzer, G. (2007). *Gut Feelings: The Intelligence of the Unconscious.* New York: Viking.

Gigerenzer, G. (2008). *Rationality for Mortals: How People Cope with Uncertainty.* New York: Oxford University Press.

Gigerenzer, G. & Brighton, H. (2008). Can hunches be rational? *Journal of Law, Economics, and Policy, 4*, 155–175.

Gigerenzer, G. & Edwards, A. (2003). Simple tools for understanding risks: From innumeracy to insight. *British Medical Journal, 327*, 741–744.

Gigerenzer, G. & Engel, C. (Eds.). (2006). *Heuristics and the Law.* Cambridge, MA: MIT Press.

Gigerenzer, G. & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 104*, 650–669.

Gigerenzer, G., Hoffrage, U., & Goldstein, D. G. (2008). Fast and frugal heuristics are plausible models of cognition: Reply to Dougherty, Franco-Watkins, & Thomas (2008). *Psychological Review, 115*, 230–239.

Gigerenzer, G., Todd, P. M., & the ABC Research Group. (1999). *Simple Heuristics That Make Us Smart.* New York: Oxford University Press.

Goldstein, D. G. & Gigerenzer, G. (1999). The recognition heuristic: How ignorance makes us smart. In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 37–48). New York: Oxford University Press.

Goldstein, D. G. & Gigerenzer, G. (2002). Models of ecological rationality: The recognition heuristic. *Psychological Review, 109*, 75–90.

Green, L. & Mehr, D. R. (1997). What alters physicians' decisions to admit to the coronary care unit? *The Journal of Family Practice, 45*, 219–226.

Hauser, J. R. & Wernerfelt, B. (1990). An evaluation cost model of consideration sets. *The Journal of Consumer Research, 16*, 393–408.

Hertwig, R., Herzog, S. M., Schooler, L. J., & Reimer, T. (2008). Fluency heuristic: A model of how the mind exploits a by-product of information retrieval. *Journal of Experimental Psychology: Learning, Memory & Cognition, 34*, 1191–1206.

Hertwig, R., Hoffrage, U., & Martignon, L. (1999). Quick estimation: Letting the environment do the work. In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 209–234). New York: Oxford University Press.

Hertwig, R., Pachur, T., & Kurzenhäuser, S. (2005). Judgments of risk frequencies: Tests of possible cognitive mechanisms. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*, 621–642.

Hertwig, R. & Todd, P. M. (2003). More is not always better: The benefits of cognitive limits. In D. Hardman & L. Macchi (Eds.), *Thinking: Psychological Perspectives on Reasoning, Judgment and Decision Making* (pp. 213–231). Chichester, England: Wiley.

Hoffrage, U., Lindsey, S., Hertwig, R., & Gigerenzer, G. (2000, December 15). Communication of statistical information. *Science, 290*, 2261–2262.

Hogarth, R. M. & Karelaia, N. (2005). Simple models for multiattribute choice with many alternatives: When it does and does not pay to face trade-offs with binary attributes. *Management Science, 51*, 1860–1872.

Hogarth, R. M. & Karelaia, N. (2007). Heuristic and linear models of judgment: Matching rules and environments. *Psychological Review, 114*, 733–758.

Howard, J. A. & Sheth, J. N. (1969). *The Theory of Buyer Behavior*. New York: John Wiley.

Hsee, C. K. & Hastie, R. (2006). Decision and experience: Why don't we choose what makes us happy? *Trends in Cognitive Sciences, 10*, 31–37.

Hutchinson, J. M. C. & Gigerenzer, G. (2005). Simple heuristics and rules of thumb: Where psychologists and behavioural biologists might meet. *Behavioural Processes, 69*, 87–124.

Jacobs, A. M. & Grainger, J. (1994). Models of visual word recognition: Sampling the state of the art. *Journal of Experimental Psychology: Human Perception and Performance, 20*, 1311–1334.

Jacoby, L. L. & Brooks, L. R. (1984). Nonanalytic cognition: Memory, perception and concept learning. In G. H. Bower (Ed.), *Psychology of Learning and Motivation* (Vol. 18, pp. 1–47). New York: Academic Press.

Jacoby, L. L. & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 110*, 306–340.

Joachims, T., Granka, L., Pan, B., Hembrooke, H., & Gay, G. (2005). Accurately interpreting clickthrough data as implicit feedback. In *Proceedings of the Conference on Research and Development in Information Retrieval* (SIGIR), 2005. Online. Retrieved April 27, 2008, from www.cs.cornell.edu/People/tj/publications/joachims_etal_05a.pdf.

Kahneman, D., Slovic, P., & Tversky, A. (Eds.). (1982). *Judgment Under Uncertainty: Heuristics and Biases*. Cambridge, UK: Cambridge University Press.

Katsikopoulos, K. & Martignon, L. (2006). On the accuracy of lexicographic strategies for pair comparison. *Journal of Mathematical Psychology, 50*, 116–122.

Katz, E., Blumler, J. G., & Gurevitch, M. (1974). Utilization of mass communication by the individual. In J. G. Blumler & E. Katz (Eds.), *The Uses of Mass Communications: Current Perspectives on Gratifications Research* (pp. 19–32). Beverly Hills, CA: Sage Publications.

LaRose, R., Mastro, D., & Eastin, M. S. (2001). Understanding Internet usage: A social-cognitive approach to uses and gratifications. *Social Science Computer Review, 19*, 395–413.

Lee, M. D., Loughlin, N., & Lundberg, I. B. (2002). Applying one reason decision-making: The prioritisation of literature searches. *Australian Journal of Psychology, 54*, 137–143.

Lopes, L. L. (1991). The rhetoric of irrationality. *Theory & Psychology, 1*, 65–82.

Lopes, L. L. (1992). Three misleading assumptions in the customary rhetoric of the bias literature. *Theory & Psychology, 2*, 231–236.

Marewski, J. N., Gaissmaier, W., Schooler, L. J., Goldstein, D. G., & Gigerenzer, G. (2008). Models of recognition-based multi-alternative inference.

Marewski, J. N. & Olsson, H. (2009). Beyond the null ritual: Formal modeling of psychological processes. *Journal of Psychology, 217*, 49–60.

Marewski, J. N. & Schooler, L. J. (2008). How memory aids strategy selection. Manuscript submitted for publication.

Martignon, L. & Hoffrage, U. (1999). Why does one-reason decision making work? A case study in ecological rationality. In G. Gigerenzer, P. M. Todd, & the ABC

Research Group, *Simple Heuristics That Make Us Smart* (pp. 119–140). New York: Oxford University Press.

Mata, R., Schooler, L. J., & Rieskamp, J. (2007). The aging decision maker: Cognitive aging and the adaptive selection of decision strategies. *Psychology and Aging, 22*, 796–810.

Miller, G. F. & Todd, P. M. (1998). Mate choice turns cognitive. *Trends in Cognitive Sciences, 2*, 190–198.

Newell, B. R. & Fernandez, D. (2006). On the binary quality of recognition and the inconsequentiality of further knowledge: Two critical test of the recognition heuristic. *Journal of Behavioral Decision Making, 19*, 333–346.

Ortmann, A., Gigerenzer, G., Borges, B., & Goldstein, D. G. (2008). The recognition heuristic: A fast and frugal way to investment choice? In C. R. Plott & V. L Smith (Eds.), *Handbook of Experimental Economics Results*: Vol. 7 (pp. 993–1003). Amsterdam: North-Holland.

Pachur, T. & Biele, G. (2007). Forecasting from ignorance: The use and usefulness of recognition in lay predictions of sports events. *Acta Psychologica, 125*, 99–116.

Pachur, T. & Hertwig, R. (2006). On the psychology of the recognition heuristic: Retrieval primacy as a key determinant of its use. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32*, 983–1002.

Pachur, T., Bröder, A., & Marewski, J. N. (2008). The recognition heuristic in memory-based inference: Is recognition a non-compensatory cue? *Journal of Behavioral Decision Making, 21*, 183–210.

Pirolli, P. L. & Card, S. K. (1999) Information foraging. *Psychological Review, 106*, 643–675.

Pitt, M. A., Myung, I. J., & Zhang, S. (2002). Toward a method for selecting among computational models for cognition. *Psychological Review, 109*, 472–491.

Pohl, R. (2006). Empirical tests or the recognition heuristic. *Journal of Behavioral Decision Making, 19*, 251–271.

Reimer, T. & Katsikopoulos, K. V. (2004). The use of recognition in group decision-making. *Cognitive Science, 28*, 1009–1029.

Rieskamp, J. & Hoffrage, U. (1999). When do people use simple heuristics and how can we tell? In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 141–167). New York: Oxford University Press.

Rieskamp, J. & Hoffrage, U. (2008). Inferences under time pressure: How opportunity costs affect strategy selection. *Acta Psychologica, 127*, 258–276.

Rieskamp, J. & Otto, P. (2006). SSL: A theory of how people learn to select strategies. *Journal of Experimental Psychology: General, 135*, 207–236.

Roberts, S. & Pashler, H. (2000). How persuasive is a good fit? A comment on theory testing. *Psychological Review, 107*, 358–367.

Savage, L. J. (1954). *The Foundations of Statistics*. New York: Wiley.

Scheibehenne, B. & Bröder, A. (2007). Predicting Wimbledon 2005 tennis results by mere player name recognition. *International Journal of Forecasting, 23*, 415–426.

Schooler, L. J. & Hertwig, R. (2005). How forgetting aids heuristic inference. *Psychological Review, 112*, 610–628.

Schwartz, B., Ward, A. H., Monterosso, J., Lyubomirsky, S., White, K., & Lehman, D. (2002). Maximizing versus satisficing: Happiness is a matter of choice. *Journal of Personality and Social Psychology, 83*, 1178–1197.

Sedlmeier, P., Hertwig, R., & Gigerenzer, G. (1998). Are judgments of the positional frequencies of letters systematically biased due to availability? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*, 754–770.

Serwe, S. & Frings, C. (2006). Who will win Wimbledon? The recognition heuristic in predicting sports events. *Journal of Behavioral Decision Making*, *19*, 321–332.

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review*, *63*, 129–138.

Simon, H. A. (1983). *Reason in Human Affairs.* Stanford, CA: Stanford University Press.

Simon, H. A. (1990). Invariants of human behavior. *Annual Review of Psychology*, *41*, 1–19.

Simon, H. A. (1997). *Models of Bounded Rationality, Vol. 3.* Cambridge, MA: MIT Press.

Snook, B. & Cullen, R. M. (2006). Recognizing national hockey league greatness with an ignorance-based heuristic. *Canadian Journal of Experimental Psychology*, *60*, 33–43.

Suls, J., Martin, R., & Wheeler, L. (2002). Social comparison: Why, with whom, and with what effect? *Current Directions in Psychological Science*, *11*, 159–163.

Todd, P. M. & Gigerenzer, G. (2000). Précis of *Simple Heuristics That Make Us Smart. Behavioral and Brain Sciences*, *23*, 727–741.

Todd, P. M. & Miller, G. F. (1999). From pride and prejudice to persuasion: Realistic heuristics for mate search. In G. Gigerenzer, P. M. Todd, & the ABC Research Group, *Simple Heuristics That Make Us Smart* (pp. 287–308). New York: Oxford University Press.

Toth, J. P. & Daniels, K. A. (2002). Effects of prior experience on judgments of normative word frequency: Automatic bias and correction. *Journal of Memory and Language*, *46*, 845–874.

Tversky, A. (1972). Elimination by aspects: A theory of choice. *Psychological Review*, *79*, 281–299.

Tversky, A. & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*, 207–232.

Tversky, A. & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*, 1124–1130.

Volz, K. G., Schooler, L. J., Schubotz, R. I., Raab, M., Gigerenzer, G., & Cramon, D. Y. von. (2006). Why you think Milan is larger than Modena: Neural correlates of the recognition heuristic. *Journal of Cognitive Neuroscience*, *18*, 1924–1936.

Webster, J. G. (2006). Audience flow past and present: Television inheritance effects reconsidered. *Journal of Broadcasting & Electronic Media, 50*, 323–337.

Webster, J. G. & Wakshlag, J. (1985). Measuring exposure to television. In D. Zillmann & B. Jennings (Eds.), *Selective Exposure to Communication* (pp. 35–62). Hillsdale, NJ: Lawrence Erlbaum Associates.

Whittlesea, B. W. A. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19*, 1235–1253.

Zillmann, D. & Bryant, J. (1985). Affect, mood, and emotion as determinants of selective exposure. In D. Zillmann & B. Jennings (Eds.), *Selective Exposure to Communication* (pp. 157–190). Hillsdale, NJ: Lawrence Erlbaum Associates.