How smart can simple heuristics be?

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Abstract: This commentary focuses on three issues raised by Gigerenzer, Todd, and the ABC Research Group (1999). First, I stress the need for further experimental evidence to determine which heuristics people use in cognitive judgment tasks. Second, I question the scope of cognitive models based on simple heuristics, arguing that many aspects of cognition are too sophisticated to be modeled in this way. Third, I note the complementary role that rational explanation can play to Gigenerenzer et al.'s "ecological" analysis of why heuristics succeed.

Gigerenzer, Todd, and the ABC Research Group have provided a series of impressive demonstrations of how simple "fast and frugal" cognitive heuristics can attain surprisingly impressive levels of performance, comparable to human performance in a range of tasks. They show, for example, that decision making based on a single piece of evidence, rather than integrating across all available evidence, can lead to close optimal performance in a wide range of estimation tasks (Gigerenzer et al. 1999, Ch. 4, p. 75, Gigerenzer & Goldstein). Gigerenzer et al. interpret these results as having radical implications for cognition in general – in particular, as undercutting the view that cognition must involve well-optimized cognitive machinery which behaves in accordance with classical rational norms of probability theory, logic, and decision theory. This line of thought raises the attractive possibility that the complexity of the mind may have been dramatically overestimated. Perhaps the mind is really just a collection of smart heuristics, rather than a fantastically powerful computing machine. This is an exciting and important thesis. This commentary focuses on three challenges to this approach, which may open up avenues for future research.

1. Empirical evidence. Gigerenzer et al. focus on providing a feasibility proof for the viability of a particular kind of simple reasoning heuristic. This task primarily involves providing computer simulations showing that simple heuristics give good results on specific decision problems, in comparison to conventional methods such as linear regression, and to other heuristic approaches, such as unit-weighted regression. But there is little by way of experimental evidence that people actually do reason in this way, aside from important but preliminary evidence reported in Chapter 7. This is particularly important precisely because the simulations in this book show that a wide range of algorithms give very similar levels of performance. Hence, prima facie, all these algorithms are equally plausible candidates as models of how people might perform on these problems.

In the absence of a broader set of experimental tests there is some reason to doubt that people make decisions by relying on one cue only. As Gigerenzer et al. note, in perception and language processing there is ample evidence that multiple cues are integrated in recognition and classification, in extremely complex ways (e.g., Massaro 1987). Gigerenzer et al. propose that these cases are in sharp contrast to the operation of conscious decision-making processes – determining whether this divide is a real one is an important area for empirical research.

2. Scope. One of the most startling findings in psychology is that, across a very wide range of judgment tasks, including medical diagnosis, expert performance does not exceed, and is frequently poorer than, results obtained by linear regression over sets of features of the cases under consideration (Meehl 1954; Sawyer 1966).

An equally startling finding, this time from artificial intelligence and cognitive science, has been that in everyday reasoning, people vastly outperform any existing computational model (Oaksford & Chater 1998a). Even the inferences involved in understanding a simple story draw on arbitrarily large amounts of world knowledge, and people must integrate and apply that knowledge highly effectively and rapidly. Attempts to model such processes computationally have become mired in the nest of difficulties known as the "frame problem" (Pylyshyn 1987).

So cognition is, in some regards, remarkably weak; and in other regards it is remarkably powerful. In the present context, the crucial point is that the simple heuristics discussed in this book are aimed at modeling areas where cognition is weak – indeed, where cognitive performance is already known to be frequently outperformed by linear regression. But it is by no means clear that the picture of the mind as a set of simple heuristics will generalize to everyday reasoning, where cognitive performance appears to be remarkably strong. Indeed, it may be that it is not that simple heuristics make us smart (as Gigerenzer et al.'s title suggests); rather it may be that we resort to simple heuristics to do the very thing we are *not* smart at.

3.* Why *do heuristics work? Gigerenzer et al. downplay the importance of traditional conceptions of rationality in their discussion of reasoning methods. Indeed, they note that a heuristic such

as Take the Best has not been derived from "rational" principles of probability or statistics. Instead, they focus on an ecological notion of rationality – does the heuristic work in practice on real world data?

The viewpoint may appear to be an alternative to more traditional notions of rationality as used in psychology (Anderson 1990; Chater et al. 1999; Oaksford & Chater 1998b), economics (Kreps 1990) and behavioral ecology (McFarland & Houston 1981), in which behavior is assumed to approximate, to some degree, the dictates of rational theories, such as probability and decision theory. But it may be more appropriate to see the two viewpoints as complementary. Gigerenzer et al. (1999) are concerned to demonstrate rigorously *which* particular heuristics are successful, by computer simulation on realistic data sets. Traditional rational theories aim to explain *why* heuristics work. They characterize the optimization problem that the cognitive process, economic actor or animal faces; using rational theories (probability, decision theory, operations research) to determine the "rational" course of action; and conjecture that the heuristics used in actual performance approximate this rational standard to some degree. From this point of view, rational methods can be viewed as compatible with the "ecological" view of rationality outlined in Gigerenzer et al. (1999). Focusing on simple cognitive heuristics does not make the application of rational standards derived from formal calculi unnecessary. Instead, it gives a defined role for rational explanation – to explain why and under what conditions those heuristics succeed in the environment. This perspective is, indeed, exemplified in Gigerenzer et al.'s formal analysis of the conditions under which the Take the Best heuristic is effective (Ch. 6) and consistent with Gigerenzer et al.'s valuable comparisons between Take the Best and Bayesian algorithms (Ch. 8).

This book shows an important direction for research on human reasoning. It should act as a stimulus for empirical, computational, and theoretical developments in this area.