CPC, 1997, 16 (1-2), 102-107

COMMENTARY ON "RATIONALITY IN REASONING"
(J. ST. B. T. EVANS and D. E. OVER)

Deductive competence: A desert devoid of content and context

Ralph Hertwig, Andreas Ortmann, and Gerd Gigerenzer

Max Planck Institute for Psychological Research, Munich

Evans and Over (1997) argue that people have some kind of deductive competence, as benchmarked by the rules of first-order logic. We are not totally unsympathetic to such an agenda, if only for challenging the preoccupation with human reasoning errors, which has led researchers on judgment and choice to what Barbara Mellers (1996) has called an "already lopsided view of human competence" (p. 3). Such a lopsided view has also dominated research on deductive reasoning for several decades, and Jonathan Evans' retreat from emphasizing "non-rational aspects of human reasoning" (Evans, 1982, p. 4) is therefore noteworthy. We are, however, skeptical of the value of the proposed distinction between rationality$_1$ and rationality$_2$, or what Evans and Over (1996, p. 357) have elsewhere called *personal* and *impersonal* rationality.

Comparing human judgment and decision making with some rule of logic or probability and calling the difference a reasoning error has not generated precise models of cognitive processes (Gigerenzer, 1991,

---

Correspondence should be sent to Ralph Hertwig, Center for Adaptive Behavior and Cognition, Max Planck Institute for Psychological Research, Leopoldstrasse 24, 80802 Munich, Germany (e-mail: hertwig@mpipf-muenchen.mpg.de).

1996; Kahneman & Tversky, 1996). Sound reasoning draws on content and context, on goals and perspectives, and on payoffs and decision costs, and we therefore need models that specify how the mind and its environment are adapted to each other. We are disappointed that Evans and Over (1997) do not take up the challenge to advance such a research program. Instead they revive the old debate over the comparative explanatory power of mental rules and mental models, which Evans and Over (1997, p. 21) seem to realize is outdated. While they identify themselves as "enthusiastic supporters of [a] wider agenda" (p. 9) for studying reasoning, they declare that it is not their business, and do business as usual, under a new label: rationality$_2$.

Though we think that studying rationality$_2$ is a misguided program for uncovering the laws of human reasoning, the distinction between rationality$_1$ and rationality$_2$ can be criticized on its own terms. Specifically, we argue that the criteria with which Evans and Over (1997) distinguish rationality$_1$ and rationality$_2$ are vague and of unclear utility. Their conceptualization of rationality$_2$ is silent about the existence of multiple and possibly contradictory criteria for sound reasoning, and Evans and Over fail to show how deductive competence examined in laboratory research could help in solving the real-world problems they use as examples. We conclude that the rationality$_1$-rationality$_2$ distinction does not improve our understanding of real-world judgment and decision making, and instead propose to study how the mind and its environment are adapted to each other.

Experience and hypothetical thinking: vague criteria

Evans and Over (1997) provide two criteria for delineating these two rationalities. The first is *experience*: "The major constraints on rationality$_1$ lie in its reliance on learning from past success .... Most decision making is of this kind – described as intuitive – and works quite well provided that we have had adequate and relevant opportunities for learning" (p. 8). In contrast, rationality$_2$ is "reasoning or acting in conformity with a relevant normative system such as formal logic or probability theory" (Evans & Over, 1996, p. 357). The authors argue that rationality$_2$ is required in situations in which we cannot fall back on our experience. In these situations – and here the second criterion, *hypothetical thinking*, comes in – we need to "model hypothetical and future possible states of the world and to calculate consequences" (p. 8). Evans and Over (1997) give three examples of problems that require rational-

ity$_2$: "to avoid a nuclear holocaust or catastrophic and irreversible effects of global warming" (p. 8), and whether or not one should quit smoking (p. 32). Unfortunately, experience does not in fact distinguish rationality$_1$ from rationality$_2$. For example, we certainly have experience with the social and bureaucratic processes that threaten nuclear holocaust and contribute to global warming (e.g., Allison, 1970; Plott et al., 1992). And smokers who wake up coughing every day have first-hand experience indicating that smoking is dangerous to their health. Hypothetical thinking also fails to delineate rationality$_1$ and rationality$_2$. Think, for example, of social contracts such as those between employers and employees, which according to Evans and Over, belong to the realm of rationality$_1$. At every stage of such repeated games, the assessment of expected costs and benefits involves modeling hypothetical and future possible states of the game and the associated payoffs. Decision making about such social contracts involves hypothetical thinking just like the assessment of the dangers of nuclear holocaust and global warming.

To summarize, experience and hypothetical thinking seem to be inadequate criteria for distinguishing decisions that require rationality$_2$ as opposed to rationality$_1$.

Rationality$_2$: multiplicity of norms and neglect of content and context

As we have seen, Evans and Over (1997) do not provide us with usable criteria for mapping decisions into rationality$_2$ and rationality$_1$. But even if we assume that such a delineation exists, we would still stumble on two major problems for their conceptualization of rationality$_2$. The first problem has to do with the multiplicity of norms that can be used as normative standards. Take the Wason selection task as an example. Over the past 30 years, hundreds of experiments using this task have been interpreted as raising doubts about human reasoning capabilities. Recently, Oaksford and Chater (1994, 1996) provided an analysis of the task that vindicates people's card choices as rational because they are consistent with a Bayesian model of optimal data selection, rather than with an "outmoded falsificationist philosophy of science" (Oaksford & Chater, 1994, p. 608). In a comment, Evans and Over (1996, p. 362) referred to Oaksford and Chater's approach as "a rational$_2$ analysis" rather than a psychological account. Thus, the same choices are said to be sound from the perspective of a Bayesian model of optimal data

selection, but irrational from the perspective of material implication; paradoxically, both norms belong to the realm of rationality$_2$. The general problem is that there are many rationalities$_2$, such as the various kinds of logic, Bayesian inference, Neyman-Pearson inference, and Fisher's models of inference, which can lead to competing solutions for the same problem (e.g., Gigerenzer & Murray, 1987; Gigerenzer, 1991).

We believe that rationality$_2$ is by itself of little or no use for solving real-world problems such as global warming, and dealing with such dangers as nuclear holocaust and cigarette smoking. Deductive competence as understood by Evans and Over (1997) is typically assessed using toy problems, that is, logical exercises in which content and context are by definition irrelevant. In these toy problems "arbitrary constraints are imposed by experimental instructions" (p. 6), and participants are required "to ignore prior belief and often to assume the truth of implausible premises" (p. 7). Since real-world situations always have content and context, toy problems are inadequate templates for analysis of the kind of real-world situations that according to Evans and Over require rationality$_2$. As a matter of fact, the real-world problems that rationality$_2$ can solve by itself seem to comprise a nearly empty set. If Evans and Over (1997) disagree, they need to show how one gets from first-order logic to decisions about problems such as global warming without any experience or substantive knowledge. This is not to say that deductive reasoning cannot play a role in the solution of these problems, or even in decisions that Evans and Over (1997) would assign to rationality$_1$. By itself, however, deductive competence does not advance their solution.

To summarize: Rationality$_2$ is not of one kind; it is also not an internally consistent concept. In addition, it has not been shown how deductive competence as examined in toy problems contributes to solving real-world problems.

From deductive competence to bounded rationality

What is the alternative to continuing to study deductive competence in toy problems? We propose that to make progress in understanding real-world reasoning, it is imperative to bring in content and context, that is, to analyze the structure of task environments. Without looking outside of the mind, we cannot assess the adaptive intellectual capabilities of reasoners. This is an old insight that Simon (1990) captured with

his metaphor of rationality as a pair of scissors with two blades – one cognitive and the other ecological.

Those who study first-order logic or variants thereof, such as mental rules and mental models, ignore the ecological and social structure of environments. The literature on cognitive "biases" is full of examples in which evidence of ecological and social rationality is mistaken for systematic error in logical reasoning. Examples are the Linda problem and the Wason selection task, in which researchers who focus exclusively on logical competence fail to recognize people's responses as socially intelligent (Hertwig & Gigerenzer, 1997; Gigerenzer & Hug, 1992). Logical connectives such as 'and' and 'if-then' have multiple meanings in everyday life. These meanings need to be inferred from what the reasoner knows or assumes about the physical and social environment. Studies of deductive competence overlook Simon's ecological blade of reasoning.

By evaluating human competence against first-order logic or variants thereof, research on deductive competence also neglects important features of Simon's cognitive blade: limited time, limited knowledge, limited attention, and other constraints on computational capabilities, all of which play little or no role in simple deductive reasoning tasks. Human cognition, in other words, is a scarce resource, and deliberation about decisions is costly (Wilcox, 1993). Costly deliberations will have to be accommodated by satisficing algorithms (Conlisk, 1996): fast and frugal mechanisms that exploit the structures of environments in order to make accurate inferences under computational constraints (Gigerenzer & Goldstein, 1996). Understanding satisfying algorithms in tandem with the structures of environments means building models of bounded rationality. In Simon's (1991, p. 35) words, "Bounded rationality is what cognitive psychology is all about".

REFERENCES

Allison, G. T. (1970). Conceptual models and the Cuban missile crisis. *American Political Science Review, 63,* 689-718.

Conlisk, J. (1996). Why bounded rationality? *Journal of Economic Literature, 34,* 669-700.

Evans, J. St. B. T. (1982). *The psychology of deductive reasoning.* London: Routledge and Kegan Paul.

Evans, J. St. B. T., & Over, D. E. (1996). Rationality in the selection task: Epistemic utility versus uncertainty reduction. *Psychological Review, 103,* 356-363.

Evans, J. St. B. T., & Over, D. E. (1997). Rationality in reasoning: The problem of deductive competence. *Cahiers de Psychologie Cognitive/ Current Psychology of Cognition, 16,* 3-38.

Gigerenzer, G. (1991). How to make cognitive illusions disappear: Beyond "heuristics and biases". In W. Stroebe & M. Hewstone (Eds.), *European review of social psychology* (Vol. 2, pp. 83-115). Chichester, England: Wiley.

Gigerenzer, G. (1996). On narrow norms and vague heuristics: A reply to Kahneman and Tversky (1996). *Psychological Review, 103,* 592-596.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 103,* 650-669.

Gigerenzer, G., & Hug, K. (1992). Domain-specific reasoning: Social contracts, cheating, and perspective change. *Cognition, 43,* 127-171.

Gigerenzer, G., & Murray, D. J. (1987). *Cognition as intuitive statistics.* Hillsdale, NJ: Erlbaum.

Hertwig, R., & Gigerenzer, G. (1997). The "conjunction fallacy" revisited: How intelligent inferences look like reasoning errors. Manuscript submitted for publication.

Kahneman, D., & Tversky, A. (1996). On the reality of cognitive illusions. *Psychological Review, 103,* 582-591.

Mellers, B. (1996). From the president. *J/DM Newsletter, 15,* 3.

Oaksford, M., & Chater, N. (1994). A rational analysis of the selection task as optimal data selection. *Psychological Review, 101,* 608-631.

Oaksford, M., & Chater, N. (1996). Rational explanation of the selection task. *Psychological Review, 103,* 381-391.

Plott, C. R., et al. (1992). Experimental methods in economics and the economics of global change: A report to the National Science Foundation. NSF working paper.

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

Simon, H. A. (1991). Cognitive architectures and rational analysis: Comment. In K. Van Lehn (Ed.), *Architectures for intelligence: The Twenty-second Carnegie Mellon Symposium on cognition* (pp. 25-39). Hillsdale, NJ: Erlbaum.

Wilcox, N. T. (1993). Lottery choice: Incentives, complexity and decision time. *The Economic Journal, 103,* 1397-1417.