Foreword: Cooking Eggs on a Toaster[*]

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If you want to understand a device and evaluate its performance, you need to know what it is for. If you think that toasters were designed for cooking eggs, then you will be puzzled by their features and conclude that they are not very effective. With ingenuity, you might be able to cook an egg on a toaster, but it would be tricky and might even be dangerous. There is a strong case for thinking that we have been making a similar mistake about human reasoning.

Traditionally, psychologists thought of reasoning as an abstract, formal process. In the case of deductive reasoning most researchers adopted a model based on classical logic, on which the aim was to construct formally valid, truth-preserving arguments from accepted premises. The model reasoner, we might say, was René Descartes, secluded from the world, effortfully trying to build up a body of secure knowledge from certain foundations by a series of unshakeable deductions. Accordingly, experimental work focused heavily on assessing people's competence with the logical connectives, especially conditionals. In the study of judgment and decision making, similar assumptions were made. A rational agent was thought of as one who applies formal procedures to determine the correct judgment or choice, given his or her beliefs, expectations, and preferences.

If there is one thing that has been learned from experimental work on thinking and reasoning over the last four decades, it is that humans are not very good at this kind of thing. Although we can learn to apply formal rules of inference and choice, it takes discipline and practice, and we have to fight against strong natural tendencies to think in other ways. Our minds, it seems, are wired to be sensitive to content and context and to employ heuristics rather than formal decision procedures.

A moral often drawn from this is that we are naturally irrational. Our attempts to reason correctly are thwarted by innate dispositions to take shortcuts and to be swayed by irrelevant factors. These shortcuts and biases may be necessary, given limitations of time and cognitive resources, but they are suboptimal all the same. This view was often incorporated into the "dual-process" theories of reasoning developed since the 1980s. Such theories distinguish two types of reasoning process: implicit (Type 1) processes, which are fast, effortless, and nonconscious, and explicit (Type 2) processes, which are slow, effortful, and conscious. Typically, biases and fallacies are seen as the product of implicit processing, whereas logical responses are seen as the product of explicit processing. (This is not to say that all explicit thought is rule based; many dual-process theorists argue that explicit thought is also crucially involved in hypothetical thinking.)

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[*] This is the author's preprint of his Macchi, M. Bagassi, and R. Viale (eds), *The Cognitive Unconscious and Human Rationality* (pp. vii-x), MIT Press, 2016. It may differ in minor ways from the print version, which is the definitive one. Version of 24/12/17.

From this logic-based, formalist perspective, then, it looks as if the human reasoning system is not well adapted to its job, succeeding at best only with effort. But maybe that perspective is the wrong one. Perhaps we have been judging human reasoning against an inappropriate standard, like someone who thinks that a toaster is for cooking eggs. Indeed, a new perspective has been emerging, drawing on models of reasoning that assign crucial roles to context, content, and pragmatics in addition to formal features.

A major aspect of this change has been a paradigm shift in the way psychologists think about everyday deductive reasoning, where the classical model has been widely replaced with a probabilistic one on which premises are assigned graded probabilities and the aim of argument is to preserve probability rather than truth. This model represents deductive reasoning as sensitive to the reasoner's degrees of confidence as well as to the logical structure of the premises, and it offers new normative standards based on probabilistic notions of validity and coherence.

This "new paradigm" reflects the type of problems we face in everyday life, which typically involve reasoning from qualified beliefs rather than accepted premises, and experimental evidence suggests that it is a better fit to actual human performance. In addition, it offers a common framework for thinking about deductive reasoning, judgment, decision making, and belief updating, and it allows for the development of decision-theoretic approaches to reasoning, in which considerations of utility and obligation play important roles—as they do in real-life problem solving. Unlike Descartes, everyday reasoners are not seeking timeless certainties but timely solutions to particular problems, and their reasoning activities are shaped by practical goals as well as epistemic ones.

Another important development has been Mercier and Sperber's proposal that human reasoning is not designed for solitary enquiry but for public argumentation—the production and evaluation of arguments intended to persuade others.[1] In this view the model reasoner is not the philosopher by his stove but the lawyer in court. Again, this changes how we think about some supposed biases, in particular confirmation bias (the tendency to look only for evidence that confirms one's views). This is a weakness in solitary enquiry but a useful trait in public argumentation and one that is self-correcting in group enquiry. (There is an interesting link here with the work of Giuseppe Mosconi, to whom this volume is dedicated. Mosconi held that there is a language-involving form of thought, *thinking-speaking*, which is employed in both public argumentation and private reasoning and which is shaped by communicative and rhetorical principles as well as logical ones.)

There are complementary trends in judgment and decision making, where researchers in the traditions of bounded and ecological rationality argue that the heuristics we intuitively rely on are not suboptimal compromises but often the best solutions to particular context-specific problems. Again, it is argued, the traditional view mistook specific intelligent responses for general fallacies.

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[1] Mercier, H. & Sperber, D. (2011). Why do humans reason? Arguments for an argumentative theory. *Behavioral and Brain Sciences*, *34,* 57–111.

Thus, from this new perspective, many factors that were formerly seen as biases or shortcuts appear as legitimate influences and rational procedures. Of course, it does not follow that humans are optimally rational (not all toasters are good ones), or even that it is helpful to set abstract standards of rationality. But the change of perspective yields a new understanding of the strengths and weaknesses of human reasoning, and it is changing the questions psychologists ask and the interpretations they offer.

The new perspective also has important implications for dual-process theory. The developments mentioned do not undermine the dual-process approach: there remains a strong case for thinking that there are two types of mechanism underpinning human reasoning competence. But these developments do undermine the simple equation of implicit processing with bias and explicit processing with normative correctness. And in doing so, they invite us to rethink the function and powers of the implicit mind. There has been a tendency to think that implicit processing is simply a quick-and-dirty substitute for explicit thought, and that if explicit thought is engaged, then it is desirable that it should override implicit responses. From the new perspective, however, many implicit responses appear as intelligent solutions to context-specific problems and may be more successful than those generated by the application of formal rules.

At the same time, researchers are increasingly coming to appreciate the powers of the implicit mind and the crucial role that implicit processes play in enabling and supporting explicit thought—in initiating it, supplying content to it, monitoring it, and shaping the way it is conducted. Indeed, the implicit mind is increasingly looking like the engine room of cognition, and the explicit mind as a fragile superstructure. This approach is also shedding light on creative processes, such as insight problem solving and artistic activity. Rather than arising from some mysterious faculty of intuition, these can be understood as the result of complex implicit processing of various kinds, including, for example, a systematic search for relevance.

This is not to deny the value of explicitly applying logical rules and decision procedures. In modern life there are many situations where we need to do just that. But it is important to recognize that the apparatus we use to do it did not develop for that purpose. The better we understand the functions of the human reasoning system and its powers and limitations, the better placed we shall be to tweak it to do the more artificial jobs we sometimes require of it. If you must cook an egg on a toaster, then it helps to understand exactly how a toaster works.

The essays in this volume are written by researchers centrally involved in the trends mentioned above—the new paradigm, bounded rationality, dual-process theory, and the study of implicit cognition. They vividly illustrate the advantages of the new perspective, the insights it offers, and the new questions it poses. This is an exciting time in the psychology of thinking and reasoning, and this volume offers a stimulating encounter with the latest work in the field.[2]

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