The Evolutionary Principles Underlying Natural Cognitive Competences

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Modern research into human reasoning and decision-making has produced a formidable paradox. The consensus among many modern reasoning and decision-researchers is that the faculty of human reasoning is governed by crude and error-prone heuristics, bears little or no resemblance to the logician or theorist's ideal, and systemacially departs from normative models of ideal statistical and deductive inference.

Yet despite this apparent human ineptitude on laboratory-administered artificial problems, natural reasoning systems--human and nonhuman minds alike--negotiate the complex natural tasks of their evolutionary world with a level of operational success far surpassing that of the most sophisticated existing artificial intelligence systems. On virtually every natural inferential problem that has been carefully investigated--from grammar induction, semantic induction, and speech perception to vision, object recognition, and color constancy--organisms perform better than the systems that cognitive scientists have been able to construct, even though these scientists have had full access to modern logics, statistical decision theories, and other formal methods of inference.

The paradox can be resolved by considering the evolutionary principles that underlie what we call ecologically rational domain-specific inferential principles. Ecologically rational computational devices can generate effective decisions and reconstruct reliable knowledge that would have been unobtainable by any methods that did not incorporate specializations designed to exploit the evolutionarily stable structure of the world, divided into functionally distinct domains.