SCIENCE BRIEFS

The Rational Mind: Thin Colonies of Reason Amid a Savage World

by Edward A. Wasserman

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The rational mind: What is it?

"People are smart." That's how a corporate commercial tries to flatter those who would take advantage of its services. There's certainly no disputing humans' ability to profit by experience and to engage in adaptive behavior. There's also no disputing that we are also prone to repeat our errors and to engage in maladaptive behavior. So, how smart are we really? Are we truly endowed with a rational mind, what René Descartes called the "universal instrument?"

To many theorists, the rational mind is a thing or process that: (a) guides sensible or logical action, (b) avoids emotion or bias in judgment, (c) maximizes some good or function, and (d) produces universally optimal results (see Kahneman, 2003 for further elaboration).

A survey of discussions about the rational mind suggests that this idea can be approached from many different angles. My own approach is comparative. It asks: Is the rational mind peculiarly human (see Hurley & Nudds, 2006 for more on rationality in animals)?

A seed for a comparative approach can be gleaned from the words of Wilford O. Cross. In his 1964 Prologue to Ethics, Cross wrote that, "The rational mind of man is a shallow thing, a shore upon a continent of the irrational, wherein thin colonies of reason have settled amid a savage world."

If signs of the rational mind are so unlikely to be seen in a notoriously savage world, then we must ask, "Why?" One answer is that humans and animals have adapted to highly complex and constantly changing environments by deploying behavioral and cognitive processes of a decidedly mechanical sort. These mechanical processes of adaptation are usually, but not always effective; critically, they need not be rational.

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The notion that mechanical processes might join with rational processes in producing adaptive action is far from new. Indeed, it was advanced by the Greek philosophers Plato, Aristotle, and Galen, and it was advocated by the French philosopher René Descartes.

Plato hypothesized an appetitive soul (emotion or desire), a spirited soul (will or volition), and a rational soul (mind or intellect). The rational soul was believed to be exclusively human; Plato likened it to a "charioteer" who adeptly controls his appetitive and spirited "steeds." Aristotle hypothesized a nutritive soul (characteristic of plants, animals, and humans), a sensitive soul (characteristic of animals and humans), and a rational soul (characteristic of humans alone and residing in the heart). Galen hypothesized a vegetative soul (in the liver), an animal soul (in the heart), and a rational soul (in the brain).

Descartes famously distinguished the involuntary, unconscious, and unlearned reflexes of the body from the rational soul of the mind. Both humans and animals display mindless, reflexive action; but only humans exhibit mindful, rational behavior which is voluntary, conscious, and learned in the lifetime of an individual. Descartes believed that human mind and body converge in the pineal gland.

Integrating these related notions, we see that the idea of the rational mind has been prominent in Western thought for nearly 2,500 years. Both humans and animals are impelled by biological forces to survive and procreate. Many behaviors of humans and animals promote these aims. But only humans are rational: we alone are capable of using our minds to make prudent decisions that maximize the ends of proper living.

In empirically evaluating the claim that the rational mind is uniquely human, I will focus on two out of many possible illustrative realms primarily because of my familiarity with them: concept learning and causal judgment. I will also explore whether we need the notion of the rational mind to explain either kind of cognition—in animals or humans. And, I will end by commenting on the prospects of a scientific account of behavior, whether or not we deem the behavior in question to be rational.

Concepts

Concepts epitomize rationality; they are highly efficient cognitive devices or shortcuts that reduce the taxing demands that a complex and changing world places on an organism's limited information processing and storage systems. As well, concepts are universal and effectively control behaviors to new stimuli in new settings. And concepts may be uniquely human—at least, so contended the English philosopher John Locke. "The having of general Ideas, is that which puts a perfect distinction betwixt Man and Brutes…. For brutes have not the faculty of abstracting, or making general Ideas" (1690, pp. 159-160).

Of many different kinds of concepts, one will concern us here: natural kind concepts (often and perhaps more aptly called "basic-level" concepts, because human made things are similarly classified). Basic-level concepts (e.g., tree and axe) are not simply conventional and contrived for mere convenience, but real. To use Plato's words, they "cut nature at its joints."

My specific questions concerning concept learning are these: Do animals too learn basic-level concepts? Must reason be invoked to explain this brand of conceptualization?

Basic-level concepts are easy to learn, even by young children (Wasserman & Rovee-Collier, 2001). They take very little time for both adults and children to report. And, they are based on physical similarity—at least, so claimed American philosopher and mathematician W. V. Quine.

According to Quine, both humans and animals possess an innate standard of similarity; that standard is absolutely animal in its lack of intellectual status. Critically, Quine believed that similarity is the bedrock of basic-level categories.

Of course, humans readily learn and use basic-level concepts. But, what about nonhuman animals? To answer this question, researchers in my laboratory (Bhatt, Wasserman, Reynolds, & Knauss, 1988) endeavored to teach pigeons a four-alternative forced-choice "naming" task, where pecks replaced words as arbitrary report responses. After having been shown a color photograph of a cat, a car, a chair, or a flower, hungry pigeons had to correctly peck one of four different report keys; food was given after correct reports, whereas no food and one or more correction trials were given after incorrect reports.

The pigeons did, in fact, promptly learn to correctly report these four basic-level concepts by pecking four different report keys in the presence of the different classes of photos, with ten or more different photos in each of the classes. Furthermore, the pigeons reliably generalized this discrimination to new photos of objects from the four classes, showing that these categories were effectively open-ended.

What evidence supports the idea that this conceptual discrimination learning is actually based on an "innate standard" of similarity? First, pigeons learn the just-described discrimination that "cuts nature at its joints" far faster than they learn an otherwise similar discrimination involving the same stimuli that does not (Wasserman, Kiedinger, & Bhatt, 1988). An example of the latter kind of discrimination is one in which equal numbers of photos from each of the four classes are arbitrarily placed into four "pseudocategories;" such pseudocategories lack any "perceptual glue" to bind together members of the different groupings. Second, confusion errors in an altogether different kind of discrimination task (Astley & Wasserman, 1992) unequivocally demonstrate that pigeons do indeed see discriminably different members of a basic-level human language category, like flowers, to be more similar to one another than to members of other categories, like people, cars, or chairs.

It is therefore wholly unnecessary to appeal to reason in order to explain basic-level concept learning. Rather, perceptually homogeneous stimuli are simply associated with arbitrary responses: words for people and pecks for pigeons. Those discriminative responses transfer to new stimuli within the same perceptual classes—a textbook case of what behavior theorists have for a century called primary stimulus generalization.

Causation

Causation exemplifies rationality. Ascertaining true natural causes can help guide sensible or logical action without the intrusion of emotion or bias as well as help maximize important goods or functions in any and all circumstances. Causal judgment is fundamental to natural science. Identifying and verifying causal relations between natural phenomena would appear to demand sophisticated logical or statistical thinking. Such highly advanced thinking should surely be uniquely human. Right? "Wrong," answered the Scottish philosopher David Hume.

According to Hume, utterly mechanical associative processes lead to the impression of causation, which lies not in the environment, but in the mind of the beholder. Furthermore, Hume believed that the same associative processes operate in humans and animals. Why? Because survival in an inherently dangerous world cannot possibly depend on the slowness, deliberateness, and elaborateness of formal logic and deductive reason. The phrase "lost in thought" does indeed have two dramatically different meanings!

My specific questions concerning causal judgment are these: Are there clear empirical parallels between associative learning in animals and causal judgment in people? Must reason be invoked to explain human causal judgment? Can a different sort of theoretical account embrace both associative learning in animals and causal judgment in people?

Hume offered several seminal insights into the psychology of causal judgment. First, causal beliefs arise from the association of ideas. Because that association emerges from the frequent conjunction of events, causal beliefs must ascend to their peak by degrees. So, like associative learning curves, causal judgments should emerge gradually. Second, causal beliefs cannot produce assurance in any single event as the cause unless it proves to be superior to rival causes. So, as in the case of the familiar phenomenon of associative cue competition, the "discounting" of inferior candidates should occur in causal judgment.

What does the empirical evidence indicate? Causal judgments do indeed rise in strength as a function of pairings of cause with effect (Wasserman, Kao, Van Hamme, Katagiri, & Young, 1996), in clear accord with the acquisition functions typically obtained in Pavlovian appetitive and aversive conditioning. Furthermore, the mere pairing of cause with effect may not be adequate to forge a firm causal association. The putative cause may have to be the best among several rival causes. Similar processes participate in associative conditioning.

One of the most celebrated cases of discounting is the so-called cue validity effect first reported by Wagner, Logan, Haberlandt, and Price (1968). Key to the cue validity effect is that Target Cue X is equally often paired with the outcome in all experimental conditions. Rival Cues A and B are differentially paired with the outcome in different experimental conditions, in each of which only two stimulus compounds are arranged: AX and BX. The critical result is that animals' conditioned responses as well as humans' causal judgments display robust discounting: Target Cue X loses associative or causal strength the more valid Rival Cues A and B become. Indeed, the empirical functions in both behavioral realms are strikingly similar (Wasserman, 1990).

Thus, causation and association may be strongly related empirically. Both exhibit acquisition. Both exhibit cue competition. And, both are explainable by associative learning theories, such as the Rescorla-Wagner (1972) model, which mathematically embodies Hume's laws of causal perception. Reason is not necessary to explain either.

Would Hume be pleased with this state of affairs? Definitely. He, himself, proposed that, "... any theory, by which we explain the operations of the understanding, or the origin and connection of the passions in man, will acquire additional authority, if we find, that the same theory is requisite to explain the same phenomena in all other animals (1777/1951, p. 104)."

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What then should we make of Cross's provocative opening quotation? Are we humans hopelessly limited by the bestial cognitive mechanisms with which we are endowed in our quest to understand and adapt to a world which is fraught with change and complexity? What sense, if any, can be made of rationality in humans or animals if even conceptualization and causation are rooted in primordial behavioral processes?

Let's further explore these challenging questions.

I hope that my earlier discussions of conceptualization and causation have persuasively documented that individually acquired adaptive behavior is not uniquely human. These and many other findings from the study of animal behavior and cognition further suggest that the mechanisms of learning and adaptation are very old and widespread among today's animal species. In point of fact, the field of comparative cognition has for over a century studied the nature and limits of intelligence in humans and animals; this field continues to treasure up new discoveries which prompt us to confer greater respect to the cognitive abilities of our animal kin (Wasserman & Zentall, 2006).

One especially interesting area of comparative cognition where new insights are emerging concerns tool construction and use. Research with crows (Weir, Chappell, & Kacelnik, 2002) and chimpanzees (Whiten, Goodall, McGrew, Nishida, Reynolds, Sugiyama, Tutin, Wrangham, & Boesch, 1999) strongly suggests that humans can no longer lay claim to being the only tool-wielding organisms.

Arguably fundamental to tool use is the recognition that one's desired ends are unattainable without additional assistance. A mealworm may be wedged into a space that is too narrow to grasp; a nut may be too firm to crack. What to do?

The obvious answer is to fashion a tool. But, which one? And, how should it be constructed and deployed?

Thus, with thwarted goals, the process of invention begins. But, is this process purely logical, devoid of bias, and maximally functional from the outset? Surely not.

Most human tools and contrivances—like forks, mousetraps, and watches—rarely emerge as full-blown successes; instead, they go through prolonged periods of development which are rife with failures and setbacks (Petroski, 1992). The production of even the most marvelous of human inventions seems to be subject to the same trials and errors that led Edward Thorndike to reject rationality as an explanation for the effects of reward and punishment on human and animal behavior. His powerful Law of Effect was positively mindless.

Like animals, we humans do gradually learn from our past successes and failures—both as individuals and as cultures. Such individual acquisitions allow us to tie our shoes, to ride a bicycle, and to peel a banana. Cultural acquisitions enable adaptive actions to be taken by all of us who are fortunate enough to live in those cultures and to profit from our predecessors' labors; we cannot help but be impressed by the ways in which air conditioning, automobiles, and personal computers have improved our lives beyond those of our grandparents.

Science itself represents another key cultural acquisition. Science has produced innovative ways of asking and answering questions of nature that have proven to be of unparalleled incisiveness and effectiveness; it has also led to the very technologies that are responsible for the manufacturing of air conditioning, automobiles, personal computers, and countless other devices that are now common in industrialized nations.

One especially interesting illustration of the power of science is the development and deployment of instruments and methodologies which can disclose other animals' perception of energies to which we ourselves are oblivious (Hughes, 1999). We are now quite familiar with the fact that bats, whales, and dolphins can sense sounds of extreme frequencies—well beyond the range of human hearing. But how did we discover such ultrasonic perception?

First, we had to build instruments that both generated and detected ultrasonic frequencies. Second, we had to develop suitable behavioral testing methods that allowed animals to sense those ultrasounds and to report their sensations to us.

Our remarkable success at each of these steps attests to the power and flexibility of human cognition. But, the truth behind each of these steps is a far cry from an optimal designer prescribing a detailed plan of action based solely on achieving the task at hand.

Perhaps uniquely, we humans appreciate our own perceptual and cognitive limits. Faced with those limits, we have learned—both as individuals and as cultures—to rise above them. Our range vision is limited; so, we have developed increasingly powerful microscopes and telescopes to expand our range of sight. We are regrettably biased by possibly unreliable and unrepresentative trends in data collection and interpretation; so, we have developed sophisticated statistical tools to guard against such biases of judgment.

Equipped with these and other tools, natural science has continued its inexorable advance to explain and control the inorganic and organic worlds. But, the most elusive of all of these quests is an understanding of human nature itself. Can we ever comprehend ourselves? The intriguing answer is "yes," but only if we continue along the same path that science has followed in its pursuit of other natural mysteries. ■

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