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# Diversity in reasoning and rationality: Metacognitive and developmental considerations

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A mental model to capture this reasoning can be expressed as a “rationale” (McCain 1992):

- R:
- (I) I want the highest payoff,
  - (II) Choosing “cooperate” gives both me and my counterpart the highest payoff,
  - (IIa) and my counterpart, knowing that, will choose “cooperate”; so that (IIb) my own maximum payoff comes from a choice of “cooperate.”
  - (III) Choose “cooperate.”

A player with a rich repertoire of game-theoretic mental models will recognize that (IIb) does not apply to game B, the Prisoner’s Dilemma game, and will apply a different rationale to it. However, a player with a less rich set of mental models for game theory may fail to make the distinction between the two games and apply to both the simplified rationale:

- R\*:
- (I) I want the highest payoff,
  - (II) Choosing “cooperate” gives both me and my counterpart the highest payoff, so that is the best choice.
  - (III) Choose “cooperate.”

This oversimple mental model still leads to the best (normatively rational) outcome in the coordination game, but it leads to frequent choices of “cooperate” in the Prisoner’s Dilemma game. If the player is lucky enough to be matched with another player who makes the same mistake, they will both be better off than they would if they were rational, which is the fact that gives the Prisoner’s Dilemma its fascination. As a result, these mistakes may be mistaken for altruistic behavior or for a higher rationality. But the point for our purpose is that they are predictable: we expect a much greater frequency of “mistakes” on the Prisoner’s Dilemma than on the coordination game.

In general, failure to make appropriate distinctions in the mental model will lead to inappropriate contextualization, one of the characteristics of “System 1.” This will be correlated with a smaller and less expert set of mental models for game interactions, which is likely to be correlated with many other things.

In conclusion, it seems correct that examination of individual differences will support a Meliorist as against a Panglossian or Apologist position on rationality. However, these observations are consistent with a pluralist view that sees non-normative responses as arising from idiosyncratic subjective knowledge structures. Such a view should not be lumped with performance errors since it is not at all clear that errors stemming from idiosyncratic knowledge structures will be random. Instead, we should investigate what range of predictable errors might arise from idiosyncratic knowledge structures. In doing so, we may draw on a wide range of evidence, including experimental game theory.

## Diversity in reasoning and rationality: Metacognitive and developmental considerations

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**Abstract:** Tasks in the adult reasoning literature are designed so that heuristic processing leads one astray and adequate rule-based processing requires explicit knowledge about applicable logical and quasi-logical norms. Other research, however, indicates that appropriate rule-based inferences can be automatic. Individual differences in rationality are largely due to differences in developmental progress toward metacognitive understanding of both heuristic and rule-based inferences.

Theorists of human reasoning have typically assumed that there exists a prototypical way people think and that the goal of psychological research on reasoning is to determine what that way is. Although evidence for diversity in reasoning has long been abundant, it has typically been dismissed as artifactual or theoretically uninteresting. In an important and convincing challenge to the standard view, Stanovich & West (S&W) have demonstrated that, on the contrary, diversity in reasoning is genuine, substantial, systematic, and theoretically important. In this commentary, I elaborate on the nature and locus of diversity in reasoning.

Central to S&W’s analysis is a distinction between automatic heuristic processing (characteristic of what they call System 1) and explicit rule-based processing (characteristic of what they call System 2). I believe this dichotomy confounds two orthogonal distinctions. Specifically, the distinction between automatic and explicit processing is conceptually orthogonal to the distinction between heuristic and rule-based processing. Crossing automatic versus explicit with heuristic versus rule-based suggests four possible types of processing: (a) automatic heuristic processing (System 1), (b) automatic rule-based processing (not represented in the Stanovich/West analysis), (c) explicit heuristic processing (also not represented), and (d) explicit rule-based processing (System 2).

Why do S&W collapse the two distinctions into one, and thus end up with two categories rather than four? I think it is because they focus on the literature on adult reasoning. On the tasks presented to subjects in this literature, heuristic processing tends to be automatic, whereas rule-based processing requires explicit awareness and control of one’s inferences.

Research on elementary logical and mathematical inferences, however, shows that people of all ages, including preschool children, routinely make automatic inferences that are fully in accord with rules of deductive logic, probability theory, and so on (Braine & O’Brien 1998; Hawkins et al. 1984; Huber & Huber 1987; Scholnick & Wing 1995). Without a steady stream of unconscious rule-based inferences, in fact, ordinary activities such as reading and conversation would be impossible.

Correspondingly, research and theory on metacognition suggest that explicit reasoning often involves the deliberate application of heuristic principles (for reviews, see Kuhn 2000; Moshman 1998; 1999). In fact, if I may momentarily construe Stanovich & West as research subjects, the arguments they provide in their target article (and similar analyses by authors they cite) constitute clear evidence that human beings are capable of reasoning on the basis of explicit understanding about the advantages and limitations of various heuristic strategies.

Putting all this together suggests that, beginning in the preschool years, all individuals routinely make a variety of automatic inferences, both heuristic and rule-based. Over the course of development, to varying degrees, people increasingly engage in explicit reasoning. That is, they increasingly deploy and coordinate heuristic and rule-based inferences on the basis of increasing metacognitive knowledge about the nature, applicability, and justifiability of various forms of heuristic and rule-based inference (Kuhn 2000; Moshman 1994; 1998; 1999). This picture has several important implications for our understanding of human rationality that are consistent with S&W’s emphasis on diversity but go beyond their focus on individual differences.

First, without denying the importance of differences across individuals, it appears that a great deal of the diversity in human reasoning exists *within* individuals. From early childhood, people routinely process information, automatically and unconsciously, in accord with a variety of norms. Some of these norms are heuristic guidelines and some are strict logical or mathematical rules. Perhaps some people are more disposed toward heuristic processing and some toward rule-based processing but all people at all ages regularly engage in both. With regard to the distinction between heuristic and rule-based processing, the primary locus of diversity is within individuals.

Second, differences *across* individuals appear to be largely developmental. Over the course of childhood, adolescence, and early adulthood, people increasingly – but to differing degrees – recognize that some inferences are better than others and that their conclusions and actions will be more justifiable if they constrain their inferences in accord with appropriate norms. Thus, they construct increasingly explicit knowledge about the nature and applicability of various heuristic and rule-based norms and, on the basis of this knowledge, are increasingly deliberate in their reasoning. Although automatic inferences are ubiquitous across the lifespan, there is a developmental trend toward increasingly explicit reasoning.

Finally, the present developmental picture suggests that rationality is fundamentally a matter of metacognition and only secondarily a matter of conformity to various logical or other norms. Individuals who deliberately choose to apply a particular rule, principle, framework, or metaphor on the basis of an explicit understanding of the advantages and limitations of various normative and strategic options are functioning as rational agents, even if they make mistakes in the course of their deliberations. Their rationality can be evaluated, in fact, precisely because it is possible for them to make mistakes. As metacognitive agents, they can be held responsible for their inferences.

In contrast, a computer that automatically processes information in accord with its program is not a rational agent at all, even if its processing of information is fully in accord with logical or other rules (Moshman 1994). Its rationality cannot be meaningfully evaluated. If it were to generate unjustifiable conclusions, responsibility for the faulty processing would lie with the programmer, not with the computer. The question of rationality arises only with regard to agents who are sufficiently metacognitive to make deliberate inferences and thus to be responsible for their processing of information.

In summary, Stanovich & West have provided a valuable picture of individual differences in rationality. Extending this picture will, I think, require greater attention to diversity *within* individuals, the metacognitive nature of rationality, and the developmental basis for individual differences in metacognition.

## Are there two different types of thinking?

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**Abstract:** Stanovich & West's claim that there are two coherent and conceptually distinct types of thinking, System 1 and System 2, is questioned. Some authors equate System 2 with intelligence whereas others do not; and some authors regard the two types of system as distinct while others regard them as lying on a continuum.

There can be no question that Stanovich & West (S&W) have made an important contribution to research on reasoning by emphasizing the existence of individual differences and the implications they have for theories of reasoning. In this commentary I wish to focus on just one issue: the claim that there is in the literature a wealth of evidence supporting the assertion that there exist two quite distinct types of thinking.

In their Table 3, S&W list a variety of authors who have postulated the existence of two systems. These include the distinctions between heuristic and analytic processing, implicit and explicit learning, and experiential and rational thinking. S&W make the following claim: "Although the details and technical properties of these dual-process theories do not always match exactly, nevertheless there are clear family resemblances." In the ensuing discussion they treat the two types of thinking process, which they label System 1 and System 2, as though they are two quite distinct and conceptually coherent systems. Although they are not the first

authors to make this claim (see, for example, Epstein et al. 1996), and although it is true that there are striking similarities between the distinctions made by different theorists, I wish to claim that there is little or no evidence that they amount to the same thing, and considerable reason for believing that they do not.

In their target article, S&W present no argument or evidence that the same distinction is being made by all these authors. Presumably, they thought that the similarities were so transparent not to require such a defence. It is appropriate, then, to ask what kind of evidence would support their claim. Perhaps the most persuasive line of evidence would be the existence of high correlations between all these different measures. Unfortunately, few such studies seem to have been done. Several studies have looked at correlations between subcomponents of the two, but with inconclusive results. For example, Epstein et al. (1996) found that superstitious and categorical thinking, which might be supposed to be part of System 1, produced no significant correlations, either positive or negative, with Faith in Intuition (System 1) or Need for Cognition (System 2). Stanovich & West (1997) themselves looked at correlations between various measures of thinking which might be related to either System 1 or System 2, but reported only "moderate intercorrelations" (their phrasing). In any case, there are conceptual problems here since it is far from clear just how high a correlation would be needed to provide evidence that two types of thinking are part of the same System.

A more revealing line of evidence derives from systematic correlations between System 1 versus System 2 thinking and other psychometric measures such as general intelligence (*g*). Many of the researchers included in S&W's Table 3 would actually equate System 2 thinking with general intelligence. Evans (2000) states quite explicitly: "Rationality<sub>2</sub> involves individual differences in *g* . . . Hence intelligence – in the sense of *g* – depends upon the effective use of the explicit thinking system."

Others, however, set considerable store by the claim that their version of System 2 thinking is *not* the same as intelligence. Klaczynski and his colleagues have carried out a series of studies investigating relationships between individual differences in rational processing and intelligence, and performance on a variety of reasoning tasks. In the light of their finding that there are few correlations between measures of rational processing and intelligence, Klaczynski et al. (1997) drew the conclusion that "decontextualized reasoning is a function of an array of personal dispositions distinct from intelligence" (p. 481). We have confirmed in our own laboratory (Handley et al., 2000) the claim of Epstein and his colleagues (e.g., Pacini & Epstein 1999) that their measure of rational thought does not correlate with standard intelligence scores. The fact that one supposed type of System 2 thinking is the same as intelligence while another is completely distinct from it surely leads to the conclusion that they are not really part of the same system.

Other aspects of the different types of thinking presented in Table 3 also lead to suspicions that they are really quite different things. Some of the distinctions represent true dichotomies, in the sense that they are mutually exclusive categories. System 1 thinking is unconscious (tacit, implicit) while System 2 thinking is conscious (explicit). This does not seem to permit any half-way house, that is, thinking that is partly conscious. However, other types of System 2 thinking would appear to lie on a continuum with System 1 thinking. There is a continuum between automatic and controlled processing; indeed, one of the most widely used examples is that of driving a car, where a skill which is at first highly controlled gradually becomes more automatic. Similarly, the distinction between fast and slow processing is a difference of degree rather than kind.

A related difference between the various types of thinking lumped together in Table 3 involves the independence of the processes. As we have seen, some of the dimensions are clearly regarded as being related (for example, automatic and controlled processing are usually considered opposite ends of a single dimension). However, Epstein and his colleagues (e.g., Pacini & Ep-

A published commentary on the article:

“Individual differences in reasoning: Implications for the rationality debate?”

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