searchers who challenge the conventional wisdom are less intelligent than researchers who accept the standard answers to reasoning tasks. However, it is extremely unlikely that the most vocal critics of the conventional wisdom – Allais (1953), Ellsberg (1961), Gigerenzer (1991b; 1996a) and Lopes (1981b; 1996) are less intelligent than other researchers in the field.

S&W's claim is also weakened by the fact that SAT score only predicts performance on "controversial" problems. For example, on the controversial "destination" version of the four card problem, the effect of cognitive ability is "diluted" (sect. 6). There are two problems with this explanation. First, if both modes cue the same response on the uncontroversial problems, you would expect more consensus on these problems than on the controversial ones. However, there is less consensus on the uncontroversal problems than on the controversial ones. Second, S&W claim that the source of variability on controversial problems is intelligence and the source of variability on uncontroversial problems is some other unspecified factor. However, they do not give a reason why there are two sources of individual differences on these problems. Thus, their account is incomplete and not parsimonious.

S&W describe the two camps in the rationality debate as "Panglossian" versus "Meliorist." This frame distorts the "non-Meliorist" perspective. Specifically, they assume that the main reason researchers "reject the norm" is because many subjects do. However, several researchers have rejected the conventional norms for intellectual reasons. For example, Allais (1953) and Lopes (1981b; 1996) have argued that it is perfectly rational to violate the independence axiom of utility theory. Similarly, Kahneman and Tversky (1984) and Frisch and Jones (1993) have argued that violations of description invariance (framing effects) can be sensible.

The target article suggests an alternative way to frame the rationality debate. In Table 3, S&W describe a distinction between an intuitive mode of reasoning and an analytic one. The debate among JDM researchers boils down to the question of how these two modes are related. The "Meliorist" view assumes that the analytic mode is superior to the intuitive one. The "non-Meliorist" view does not assume that either mode is superior to the other.

A better term for the "non-Meliorist" view is the "complementary view." I suggest this term because of a striking similarity between S&W's System 1/System 2 distinction and the Chinese distinction between yin and yang. Capra (1982) describes yin thinking as intuitive, synthetic, and feminine and yang thinking as rational, analytic, and masculine. This is essentially the same as the System 1/System 2 distinction. In S&W's view, yang is superior to yin. But in Chinese thought, the two modes are complementary. As Capra (1982) says, "What is good is not yin or yang but the dynamic balance between the two; what is bad or harmful is imbalance" (p. 36). A growing number of JDM researchers including Epstein (1994), Hammond (1996), and Klein (1998) have endorsed views similar to the complementary view.

In the "Meliorist" versus "Panglossian" frame, only the Meliorists offer advice for improving the quality of thinking. The Panglossians think things are fine the way they are. In the Meliorist (or classical) versus complementary frame, both sides acknowledge it is possible to improve the quality of thinking but they offer different advice about how to achieve this goal. Advocates of the classical view believe that to improve the quality of thinking, a person should increase the extent to which he relies on the analytic mode. Advocates of the complementary view believe that improving the quality of thinking involves achieving an integration between intuitive and analytic processing. In fact, on the complementary view, becoming more analytic can be detrimental if a person was already out of balance in that direction to begin with.

S&W endorse the classical view, while I favor the complementary view (although I realize it is not really in the spirit of complementarity to pit the two views against each other). In closing, I would like to comment on a novel justification provided by S&W for the superiority of System 2 (yang) over System 1 (yin). In section 6.3, they say that "'Life,' in fact, is becoming more like the tests!" (p. 35). The idea is that in our increasingly technological society, the analytic mode is more adaptive than the intuitive mode. However, while it is true that the human made world is increasingly dominated by the abstract, analytic mode (e.g., computer technology), the natural world is *not* becoming more like the tests. To the extent that S&W really believe that "life" is equivalent to "the human made world," they have provided an excellent example of the dangers of excessive reliance on yang thinking.

Gone with the wind: Individual differences in heuristics and biases undermine the implication of systematic irrationality

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Abstract: The target article's finding of stable and general individual differences in solving of problems in heuristics-and-biases experiments is fundamentally subversive to the Meliorist research program's attention-getting claim that human thought is "systematically irrational." Since some people get these problems right, studies of heuristics and biases may reduce to repeated demonstrations that difficult questions are hard to solve.

The target article's analyses of individual differences in susceptibility to cognitive errors pose two serious difficulties for the "Meliorist" program of research on human judgment, even though Stanovich & West (S&W) seem at pains to deny them. The first difficulty is relatively minor; it applies only to some Meliorist studies (though more than one might have expected). The second undermines the foundation of the whole program or, if not its foundation, then its most attention-getting aspect.

First, the minor difficulty. Individual difference data show that people who give the "wrong" answers to Meliorist problems are not always less smart or less successful than those who get them right, and therefore may not be manifesting flawed reasoning. In my own research, subjects who committed a well-studied attributional error appeared *socially advantaged* in nonlaboratory contexts, suggesting that the error manifested a social competence rather than a deficiency (Block & Funder 1986). Findings like these are reminiscent of a midterm exam where a professor discovers that a question either has a flat response curve (reflecting that better students, on the other questions, were no more likely to get this one right), or an inverted one (indicating that better students were more likely to get this item wrong). In the first circumstance, the probable implication is that the professor has written a poor item that fails to discriminate the better and worse students. In the second circumstance, the implication is that the wrong answer was keyed as correct. So it is when one finds, in a Meliorist study, that smarter subjects either do not provide the normative answer or even provide a different answer: the question should be tossed out or re-keyed.

This keying problem indeed seems to afflict a few of the more prominent errors discovered by Meliorist research, such as the putative underutilization of noncausal base rates. But for purposes of further discussion, we can simply set such phenomena aside. With a few notable exceptions, Meliorist studies are probably keyed correctly, the smarter and more competent people are more likely to get the advertised correct answer. However, this finding raises a second problem that is even more ominous for the Meliorist position.

According to the target article (sect. 1, para. 2), the key claim of Meliorist research is that "human cognition [is] characterized by systematic irrationalities."[1] This attention-getting claim is precisely what led Meliorism to become rich and famous. Its very power and appeal stems from the idea that human thought is *sys-*

tematically irrational; a fundamental shortcoming of the architecture of the human cognitive system causes its inferential processes inevitably to go awry. If this idea is true, the implications are profound.

But the finding of broad and stable individual differences in the susceptibility to bias is powerfully subversive to this idea. It implies that the (correctly keyed) errors assessed by Meliorist research reveal not systematic irrationality, but variations in the ability to answer difficult questions. Some questions are so difficult that only very smart people get them right. The Wason task, for example, is hard to figure out (depending, actually, on how it is worded). A few manage to solve it; most do not. And when you give people on the street certain problems in syllogistic reasoning, statistical inference, or covariation detection, most will probably get them wrong but again, a few smart ones will surprise you.

The presence of people – even a few people – who consistently do not miss Meliorist problems implies that what errors demonstrate is not some fundamental limitation on human rationality, but something akin to what the Educational Testing Service (ETS) demonstrates every time it writes a difficult SAT item. As far as I know, nobody has ever claimed that the existence of SAT items that most test-takers get wrong means that human cognition is systematically irrational. Yet this is precisely the kind of implication drawn by Meliorism every time it interprets the invention of a difficult problem as revealing a fundamental limitation on human thought. The target article thus – intentionally or not – exposes the untenability of Meliorism's most dramatic and attention-getting claim. I believe this is the reason why Melioristically inclined reviewers of earlier drafts were so upset with it, despite the authors' yeoman attempts (increased in this final version) to deny any such subversive intent.

Near the end of the target article, S&W note that "significant covariance among the scores from the variety of tasks in the heuristics and biases literature [remains] after they [have] been residualized on measures of cognitive ability" (sect. 7, para. 3). In other words, Meliorist problem-solving is determined by more than just IQ. If this observation is intended to rescue the implication of systematic irrationality, it falls far short, for three reasons. First, the target article's Table 1 demonstrates the impressive amount of variance that individual differences in Meliorist reasoning tasks do share with (of all things) SAT scores – so much so that many Meliorist reasoning tasks would make pretty decent SAT items and perhaps should be brought to the attention of ETS! Second, "residualizing" measures of cognitive ability is limited in its effect to the reliability (always less than perfect) of the measures used and, moreover, removes the influence only of the specific (and sometimes narrow) cognitive skills that they happen to tap. Intelligence, as has been widely publicized recently, is much more than what is measured by typical tests of cognitive ability.

Third, and most important, the existence of significant, stable, and general individual differences in problem-solving on Meliorist tasks – regardless of what turns out to correlate with those differences – implies that the vast literature on heuristics and biases may embody little more than a collection of brain teasers that most people get wrong but that a few people – without tutoring and despite everything – manage to get right. The Meliorist research program might still be worth pursuing, to the extent that it can show how improvement at the kind of problem-solving it assesses has benefits for reasoning or daily living. And a close analysis of the kinds of errors people tend to make, when they make them, might be helpful in the design of decision-making aids. But these relatively mundane possibilities are not what made the heuristics and biases approach so famous in the first place. The attention-grabbing notion that the human mind is afflicted by "systematic irrationality" was fun while it lasted, but is gone with the wind.

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NOTE

1. In a phrase that I believe is intended to mean more or less the same thing, the target article states near its end (sect. 7, para. 3) that human reasoning reflects "a systematically suboptimal intentional-level psychology."

Patterns of individual differences and rational choice

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Abstract: I discuss an aspect of individual differences which has not been considered adequately in the target article, despite its potential role in the rationality debate. Besides having different intellectual abilities, different individuals may produce different *erroneous* responses to the same problem. In deductive reasoning, different response patterns contradict deterministic views of deductive inferences. In decision-making, variations in nonoptimal choice may explain successful collective actions.

I am sympathetic to Stanovich & West's (S&W's) proposal that individual differences may serve as a tool for analysing the gap between normative models and actual performance. S&W have provided convincing evidence that not all errors in thinking problems are owing to what Panglossian authors may label as "adventitious causes." There is, however, an aspect of individual differences that S&W have not considered adequately, despite its potential role in the rationality debate.

In the thinking and reasoning literature, individual differences appear to coincide with differences in general intellectual abilities. S&W have extensively investigated this aspect of individual differences. Showing that more intelligent individuals perform better than less intelligent ones in some reasoning problems is clearly relevant for evaluating the rationality of human thinking. Individuals, however, vary: not only in their general cognitive abilities. As S&W note in their concluding remarks, individuals also differ in their thinking styles (e.g., they may have different dispositions toward confirmation, premature closure, etc.). Following mental model theory, S&W hypothesise that these factors may determine the extent to which reasoners search for potential counterexamples, that is for contradictory models of the premises. Indeed, some empirical results corroborate the non-deterministic stance of model theory (i.e., the assumption that a given set of inputs may elicit different representations and different responses by different individuals). Reasoners appear to produce different answers (all equally *incorrect*) to the same reasoning problem. For example, some probabilistic reasoning problems elicit different inferences which may be owing to different representations of the same premises (e.g., Girotto & Gonzalez 2000; see also Stanovich & West 1998c). These and other results obtained with deductive (e.g., Bucciarelli & Johnson-Laird 1999) and meta-deductive (e.g., Johnson-Laird & Byrne 1990; 1993) reasoning tasks contravene the deterministic assumption according to which individuals use just one general strategy to solve various reasoning problems (see Rips 1989).

Variations in the patterns of nonnormative responses are relevant for a further reason. According to rational choice theory, individuals tend to maximise their expected utility. Actual decision patterns, however, may depart from economic rationality. For example, many individuals solve conflicts in decision making by acting cooperatively, in the service of collective interests, rather than competitively, in the service of individual interests. Thus, the extensive literature on one-shot conflicts with the structure of a Prisoner's Dilemma (PD) game show that between one-third and one-half of the participants cooperate (see Sally 1995). How can cooperation in one-shot PD games be explained? We may argue that cooperation is due to some "adventitious causes," that is, in-