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Cognitive Sophistication Does Not Attenuate the Bias Blind Spot

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The so-called bias blind spot arises when people report that thinking biases are more prevalent in others than in themselves. Bias turns out to be relatively easy to recognize in the behaviors of others, but often difficult to detect in one's own judgments. Most previous research on the bias blind spot has focused on bias in the social domain. In 2 studies, we found replicable bias blind spots with respect to many of the classic cognitive biases studied in the heuristics and biases literature (e.g., Tversky & Kahneman, 1974). Further, we found that none of these bias blind spots were attenuated by measures of cognitive sophistication such as cognitive ability or thinking dispositions related to bias. If anything, a larger bias blind spot was associated with higher cognitive ability. Additional analyses indicated that being free of the bias blind spot does not help a person avoid the actual classic cognitive biases. We discuss these findings in terms of a generic dual-process theory of cognition.

Keywords: thinking biases, heuristics and biases, bias blind spot, cognitive ability

The psychometric tradition in psychology has long focused its attention on individual differences in aspects of reasoning. This attention to individual differences has not been paralleled in the study of decision making and probabilistic reasoning. For many years, the heuristics and biases tradition in cognitive psychology (Tversky & Kahneman, 1974) was focused on the nature of cognitive biases and how they were affected by experimental factors (Tversky & Kahneman, 1983). The heuristics and biases tradition was not grounded in a concern for individual differences. In recent years this focus has shifted. Researchers have attempted to understand why some individuals show persistent biases on certain tasks and why others do not.

There is substantial evidence indicating that errors on decision-making and probabilistic reasoning tasks are not just performance errors—that is, that the variability in performance is systematic and not random error (Stanovich & West, 1998, 1999, 2000; West, Toplak, & Stanovich, 2008). This systematic variance has been associated with certain individual difference variables. For example, thinking dispositions such as need for cognition and actively open-minded thinking have been associated with belief bias and the magnitude of framing effects (Smith & Levin, 1996; West et al., 2008). Individuals higher in need for cognition and actively open-minded thinking displayed less belief bias and less susceptibility to framing effects. Intelligence has been related to probabilistic reasoning performance (Bruine de Bruin, Parker, & Fischhoff, 2007; Chiesi, Primi, & Morsanyi, 2011; Del Missier, Mäntyla, & Bruine de Bruin, 2010, 2011; Toplak, West, & Stanovich, 2011; West & Stanovich, 2003). However, intelligence does not always correlate with information-processing biases. Myside bias and anchoring effects have been shown to be fairly independent of intelligence in university samples (Stanovich & West, 2007, 2008a, 2008b). Stanovich and West (2008b) have developed a preliminary taxonomy of tasks and biases that do and do not correlate with intelligence—largely based on the extent to which overcoming the bias depends on inhibition and executive control.

One of the more potent predictors of performance on heuristics and biases tasks is the extremely short (three items) Cognitive Reflection Test (CRT) introduced into the journal literature by Frederick (2005). The task is designed to measure the tendency to override a prepotent response alternative that is incorrect and to engage in further reflection that leads to the correct response. When they answer the three seemingly simple problems, many people show a characteristic that is common to many reasoning errors. They behave like cognitive misers (Dawes, 1976; Taylor, 1981; Tversky & Kahneman, 1974). That is, they give the first response that comes to mind. The three problems on the CRT (see Method section) seem at first glance to be similar to the well-known insight problems in the problem-solving literature, but they in fact display a critical difference. Classic insight problems (see Gilhooly & Fioratou, 2009; Gilhooly & Murphy, 2005) do not usually trigger an attractive alternative response. Instead the participant sits lost in thought trying to reframe the problem correctly, as in, for example, the classic nine dot problem. The three problems on the CRT are of interest to researchers working in the heuristics and biases tradition because a strong alternative response is initially primed and then must be overridden (Kahneman, 2011). Kahneman (2011; Kahneman & Frederick, 2002) made it clear that this aspect of the psychology of heuristics and biases tasks fits in nicely with currently popular dual-process frameworks (Evans, 2008, 2010; Evans & Frankish, 2009; Lieberman, 2007, 2009; Stanovich, 1999, 2009, 2011).

Frederick (2005) observed that with as few as three items, his CRT could predict performance on measures of temporal discount-

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ing, the tendency to choose high expected-value gambles, and framing effects. Likewise, Cokely and Kelley (2009) found a correlation of .27 between performance on the CRT and the proportion of choices consistent with expected value (but see Campitelli & Labollita, 2010). Finally, Oechssler, Roider, and Schmitz (2009) found the CRT to be related to the number of expected-value choices and the tendency to commit the conjunction fallacy, and Koehler and James (2010) found significant correlations between the CRT and the use of maximizing strategies on probabilistic prediction tasks.

The predictive properties of intelligence, the CRT, and other indices of individual differences were more fully explored by Toplak et al. (2011), who used a much wider range of the heuristics and biases than had been employed in previous research. Specifically, 15 classic heuristics and biases tasks were chosen that reflected important aspects of rational thought. The heuristics and biases battery contained base-rate problems, sample size problems, regression-to-the-mean tests, gambler's fallacy and conjunction problems, Bayesian reasoning problems, and the assessment of outcome bias and sunk cost tendencies. Toplak et al. found that the CRT was a more potent predictor of performance on the heuristics and biases battery than measures of cognitive ability, thinking dispositions, and executive functioning. Although the CRT has a substantial correlation with intelligence, a series of regression analyses indicated that the CRT was a unique predictor—accounting for additional variance after the other measures of individual differences had been statistically controlled.

There is an important metabias that remains unexamined in all of the previous work on individual differences, however. It is the so-called bias blind spot—explored in an important article by Pronin, Lin, and Ross (2002). They found that people thought that various cognitive and motivational biases were much more prevalent in others than in themselves. Bias turns out to be relatively easy to recognize in the decisions of others, but often difficult to detect in one's own judgments. Pronin (2007) discussed two explanations for the bias blind spot—naive realism and overreliance on introspective evidence of one's own biases—in addition to the possibility that it is a self-enhancing bias.

Naive realism involves the belief that one perceives and responds to the world objectively. A result of this belief is that responses by others that differ from one's own tend to be attributed to the other's biases. Overreliance on introspective evidence fosters the bias blind spot because of people's false belief that biasing processes can be detected by introspection. When introspective effort fails to detect biasing processes, one may erroneously conclude that they are free of these processes. At the same time, they may presume that biasing processes are still common in others. The possibility that a self-enhancing bias contributes to the bias blind spot is supported by an increasing body of evidence that people are motivated to view themselves in a positive light (Kruger & Gilovich, 2004; Williams & Gilovich, 2008).

Much previous research has documented the bias blind spot in the social domain (Ehrlinger, Gilovich, & Ross, 2005; Frantz, 2006; Pronin, 2007; Pronin, Gilovich, & Ross, 2004; Pronin & Kugler, 2007). For example, people have been found to judge themselves, compared to others, to be less susceptible to making self-serving attributions for success versus failure, less susceptible to making the fundamental attribution error in "blaming the victim," and less susceptible to letting judgments about the "greater good" be influenced by personal self-interest (Pronin et al., 2002).

Although the social domain is well researched, less is known about the bias blind spot in the cognitive domain (Pronin, 2007; see Wilson, Houston, Etling, & Brekke, 1996). In the current study, we examined whether there is a bias blind spot present with respect to many of the classic cognitive biases studied in the heuristics and biases literature (Kahneman & Tversky, 1973; Nisbett & Ross, 1980; Tversky & Kahneman, 1974, 1983). We examined whether there were systematic individual differences in the bias blind spot and whether a variety of individual difference variables—intelligence, CRT, and thinking dispositions—were related to the degree that individuals were characterized by the bias blind spot.

It might seem that the bias blind spot would be related to a person's level of cognitive sophistication. In experiments assessing the bias blind spot, the participants have to assess the degree of bias in themselves and then simulate its degree in other individuals. Thus, the assessment of the bias seems to involve a kind of metacognitive judgment that might well be related to cognitive sophistication assessed by measures of cognitive ability or measures of thinking dispositions. On the other hand, to the extent that two of the explanations for the bias blind spot that Pronin (2007) has discussed—naive realism and overreliance on introspection—are true, we might expect correlations with cognitive sophistication to be attenuated. This is because the defaults to naive realism and introspection might be so evolutionarily and computationally basic (Nichols & Stich, 2003; Sperber, 1994; Stanovich, 2003, 2004; Sterelny, 2003) that we would expect them to have low variance (Buss, 1999; Reber, 1992a, 1992b; Tooby & Cosmides, 1992) and thus to not be highly correlated with more recently acquired (from an evolutionary point of view) cognitive capabilities (Evans, 2010; Lieberman, 2009; Toates, 2005, 2006).

The prediction that individual difference correlations with evolutionary basic processes such as naive realism and introspection are attenuated would be consistent with currently popular dual-process models of cognition (Evans, 2008, 2010; Evans & Stanovich, in press; Kahneman, 2011; Stanovich, 1999, 2011). Evidence from cognitive neuroscience and cognitive psychology is converging on the conclusion that the functioning of the brain can be characterized by two types of cognition having somewhat different functions and different strengths and weaknesses. Type 1 (sometimes referred to as System 1) processing is fast and automatic heuristic processing that is not computationally demanding. Type 2 (System 2) is slow, analytic, and computationally expensive.

The defining feature of Type 1 processes is their autonomy—their execution is mandatory when the triggering stimuli are encountered. Type 1 processing would include behavioral regulation by the emotions, the encapsulated modules for solving specific adaptive problems that have been posited by evolutionary psychologists, processes of implicit learning, and the automatic firing of overlearned associations. Type 1 processing, because of its computational ease, is a common processing default.

Type 2 processing contrasts with Type 1 processing on each of the critical properties that define the latter. Type 2 processing is relatively slow and computationally expensive. One of the most critical functions of Type 2 processing is to occasionally override Type 1 processing. This is because all the different kinds of Type 1 processing (processes of emotional regulation, Darwinian mod-

ules, associative and implicit learning processes) can produce responses that are irrational in a particular context if not overridden. People will sometimes engage in attribute substitution (see Kahneman & Frederick, 2002)—the substitution of an easy-to-evaluate characteristic for a harder one even if the easier one is less accurate. For example, people will substitute the less effortful attributes of vividness or salience for the more effortful retrieval of relevant facts. But when we are evaluating important risks—such as the risk of certain activities and environments for our children—we do not want to substitute vividness for careful thought about the situation. In such situations, we want to employ Type 2 override processing to block the attribute substitution.

In order to override and improve upon Type 1 processing, Type 2 processing must display a host of capabilities in the domains of inhibition, decoupling, and cognitive simulation. Because Type 2 processing involves working memory and processes of inhibition and cognitive simulation, heuristics and biases tasks that implicate Type 2 processing tend to be correlated with intelligence (Stanovich & West, 1998; West et al., 2008). However, when a heuristics and biases task is translated into an "evolutionarily friendly" format, correlations with intelligence attenuate because Type 1 processes tend to trigger the correct response and do not need to be overridden (Stanovich, 1999). Thus, if it is assumed that naive realism and introspection are evolutionarily basic Type 1 processes not prone to be overridden, then the bias blind spot might not correlate with intelligence or thinking dispositions (both of which are individual difference properties of Type 2 reflective mind; see Evans & Stanovich, in press).

Study 1

In study to be described, we assessed whether participants displayed a bias blind spot with respect to any of the following classic cognitive biases: outcome bias, base-rate neglect, framing bias, conjunction fallacy, anchoring bias, and myside bias. Participants were also assessed on the classic cognitive biases themselves. This made it possible to examine whether those who claimed to be more bias-free than their peers actually were more unbiased in their own actual performance.

Method

Participants. The participants were 482 undergraduate students (122 men, 360 women) from a medium-sized, eastern university recruited through an introductory psychology subject pool. The sample comprised 277 freshmen, 154 sophomores, 32 juniors, 17 seniors, and one postbaccalaureate student; one participant did not indicate a year in school. The average age was 18.7 years ($SD = 0.98$). The sample comprised 416 Caucasian participants, 23 Asian American participants, 17 African American participants, and 23 participants who indicated "other," and three who left the item blank.

Bias blind spot questionnaire. Participants read short descriptions of seven specific cognitive biases: outcome bias, base-rate neglect, framing bias, conjunction fallacy, anchoring bias, and myside bias, and a brief statement about the danger of cell phone use while driving. All the biases we described to the participants have an experimental analogue (described in a later section) except for the cell phone hazard. For this latter bias, we had no experimental method to show that people who drive while talking on a cell phone are at increased likelihood for an accident, but the literature strongly indicates that this is the case (Levy, Pashler, & Boer, 2006; McEvoy et al., 2005; Strayer & Drews, 2007; Strayer & Johnston, 2001).

As an example item, base-rate neglect was presented as follows (see Appendix for all bias blind spot descriptions):

> Base-Rate Neglect: Psychologists have shown that people tend to ignore overall probabilities when judging how likely something is and instead focus too much on the specific situation. For example, when judging the likelihood of a shark attack, people tend to focus on a news report of a single attack, rather than on the fact that although several million of people swim in ocean water, only a few people are killed by sharks every year. When people focus on the specific example and ignore the overall probability, this is termed base-rate neglect.
>
> a. To what extent do you believe that you are likely to commit base-rate neglect?
>
> b. To what extent do you believe that the average JMU student is likely to commit base-rate neglect?

Responses to the likelihood questions were given on a 6-point Likert-type scale anchored at 1 (*not at all likely*) and 6 (*very highly likely*). The order of the likelihood questions was counterbalanced. Half the participants saw the likelihood questions as shown (participants rated themselves first); the other half saw the likelihood questions in the reverse order (participants rated themselves second). The order of self–other ratings had no significant influence on the ratings and will not be discussed further; a composite of the seven bias blind spot items resulted in $t(480) = 0.179$, *ns*, for the order comparison.

CRT. Taken from Frederick (2005, p. 27), the CRT is composed of three questions, as follows:

> (1) A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? ___ cents
>
> (2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? ___ minutes
>
> (3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ___ days

What characterizes these problems is that although a quick, intuitive answer springs to mind, this quick answer is incorrect. The key to deriving the correct solution is to suppress and/or evaluate the first solution that springs to mind (Frederick, 2005). The solution to the bat and ball problem is 5 cents, to the widget problem is 5 min, and to the lily pad problem is 47 days. A composite measure of performance formed by summing these three items was used as the dependent measure. Mean performance was 0.79 items correct ($SD = 0.92$); 50.0% ($n = 241$) participants did not solve any of the problems, and 5.6% ($n = 27$) solved all three items.

Participants were also administered seven additional potential CRT items supplied to our laboratory by Shane Frederick. These seven items displayed a correlation of .83 with the original three CRT items and showed nearly identical relationships with the other variables in the study. Because the three-item CRT is the one used almost exclusively in the published literature, it will be the version employed in the analyses reported below.

Cognitive ability measure: SAT scores. Students were asked to indicate their verbal, mathematical, and total SAT scores

on a demographics form. The mean reported verbal SAT score of the students was 568 (SD = 81), the mean reported mathematical SAT score was 577 (SD = 69), and mean total SAT score was 1145 (SD = 136). The institution-wide averages for this university were 565, 575, and 1140, respectively, in 2006. Several studies have indicated that the correlation between self-reported SATs and verified SAT scores is in the range of .80–.90 (Cassady, 2001; Kuncel, Credé, & Thomas, 2005; Noftle & Robins, 2007), as is the correlation between other self-reported test scores and verified scores (Amsel et al., 2008; Higgins, Peterson, Pihl, & Lee, 2007). An indication of the validity of the self-reported scores is that they correlated with a third variable to the same extent as verified scores. Stanovich and West (1998) found that the correlation between a vocabulary test and self-reported SAT total scores (.49) was quite similar to the .51 correlation between the vocabulary test and verified total SAT scores in a previous investigation using the same vocabulary measure (West & Stanovich, 1991). These indications of validity are perhaps consistent with the fact that participation in these experiments represents a low-stakes, anonymous situation in which participants have little reason to misrepresent their SAT scores (in contrast to a more high-stakes situation where a job or some other benefit may be on the line). The total SAT score is used as an index of cognitive ability in the analyses reported here because it loads highly on psychometric *g* (Frey & Detterman, 2004; Unsworth & Engle, 2007).

Thinking Dispositions. The Thinking Dispositions Questionnaire consisted of a number of intermixed items. Participants responded to each item using a 6-point scale anchored at 1 (*strongly disagree*) and 6 (*strongly agree*).

Actively Open-Minded Thinking (AOT) Scale. The AOT Scale (Stanovich & West, 1997, 2007) was composed for 41 items drawn from a variety of sources that tapped flexible thinking, openness, dogmatism, categorical thinking, and counterfactual thinking. All items were scored in the direction that higher scores represented a greater tendency toward open-minded thinking. Examples of items are "People should always take into consideration evidence that goes against their beliefs" and "Certain beliefs are just too important to abandon no matter how good a case can be made against them" (reverse scored). The score on the scale was obtained by summing the responses to the 41 items (M = 170.3, SD = 18.4). The reliability (Cronbach's alpha) of the AOT Scale was .83.

Need for Cognition. The 18-item Need for Cognition Scale (Cacioppo, Petty, Feinstein, & Jarvis, 1996) was used in this study. The score on the scale was obtained by summing the responses to the 18 items (M = 66.8, SD = 11.4). The reliability (Cronbach's alpha) of the scale was .85.

Heuristics and biases tasks. The participants were randomly assigned to Condition A (236 participants) and Condition B (246 participants). The resulting two groups had very similar SAT total scores (1141 versus 1150), $t(480) = -0.74$, *ns*.

Outcome bias. Our measure of outcome bias was adapted from Baron and Hershey (1988). Participants in Condition A read a positive outcome for a decision regarding surgery:

> A 55-year-old man had a heart condition. He had to stop working because of chest pain. He enjoyed his work and did not want to stop. His pain also interfered with other things, such as travel and recreation. A successful heart bypass operation would relieve his pain and increase his life expectancy by five years. However, 8% of the people who have this operation die from the operation itself. His physician decided to go ahead with the operation. The operation succeeded. Evaluate the physician's decision to go ahead with the operation. (1) incorrect, a very bad decision; (2) incorrect, all things considered; (3) incorrect, but not unreasonable; (4) the decision and its opposite are equally good; (5) correct, but the opposite would be reasonable, too; (6) correct, all things considered; (7) clearly correct, an excellent decision.

Participants in Condition B read the negative outcome. This form of the problem was designed to be objectively better than the first (2% chance of death versus 8%, 10-year life increase versus 5-year life increase, etc.); however, the outcome was negative (death of the patient). Outcome bias is demonstrated if participants rate the decision for the successful operation (Condition A) as significantly better than that for the failed operation (Condition B).

Base-rate problem. Kahneman and Tversky's (1973) much-studied lawyer–engineer problem was employed as a probe of the degree of base-rate usage. Two versions were used, identical except that lawyer and engineer base rates were switched as a between-subjects variable (30 engineers and 70 lawyers in Condition A and 70 engineers and 30 lawyers in Condition B). Condition A was presented as follows:

> A panel of psychologists has interviewed and administered personality tests to 30 engineers and 70 lawyers, all successful in their respective fields. On the basis of this information, thumbnail descriptions of the 30 engineers and 70 lawyers have been written. One of the descriptions is below. After reading the description, please indicate, on a scale from 0 to 100, what you think the probability is that the person described is an engineer. Here is the description:
>
> Jack is a 45-year-old man. He is married and has four children. He is generally conservative, careful, and ambitious. He shows no interest in political and social issues, and spends most of his free time on his many hobbies, which include home carpentry, sailing, and mathematical puzzles. The probability that Jack is one of the 30 engineers in the sample of 100 is ___ percent.

Disease framing problem. The disease framing problem is based on Tversky and Kahneman's (1981) famous Disease Problem. The positive (gain) and negative (loss) framing of the problem was a between-subjects manipulation (Condition A was the gain frame, and Condition B was the loss frame). Both groups of participants read the same introduction to this problem:

> Imagine that the U.S. is preparing for the outbreak of an unusual disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

Participants receiving the gain framing (Condition A) then selected between the following alternatives:

> If Program A is adopted, 200 people will be saved.
>
> If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.
>
> Which of the two programs would you favor?

Participants then chose a response on a 6-point scale: *I strongly favor Program A* (scored as 1), *I favor Program A* (scored as 2), *I slightly favor Program A* (scored as 3), *I slightly favor Program B* (scored as 4), *I favor Program B* (scored as 5), *I strongly favor*

Program B (scored as 6). Higher scored represented more risk seeking.

Participants receiving the loss framing (Condition B) responded on an analogous scale, but selected between the following alternatives:

> If Program A is adopted, 400 people will die.
>
> If Program B is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die.

Conjunction problem. The conjunction problem was based on Tversky and Kahneman's (1983) much-studied Linda problem. Participants read the following: "Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations."

Participants then used a 6-point scale—that is, *extremely improbable* (1), *very improbable* (2), *somewhat probable* (3), *moderately probable* (4), *very probable* (5), *extremely probable* (6)—to indicate the relative probability of three statements that described Linda. The first two statements were identical for the two groups of participants: "It is ___ that Linda is a teacher in an elementary school" and "It is ___ that Linda works in a bookstore and takes Yoga classes." Each group then read one of two statements that differed in whether they did or did not contain a conjunction of two descriptions. Participants getting Condition A read "It is ___ that Linda is a bank teller." Participants getting Condition B read "It is ___ that Linda is a bank teller and is active in the feminist movement."

Anchoring problems. The two anchoring problems we used here were adapted from Tversky and Kahneman (1974) and Epley and Gilovich (2004). For each problem, participants answered a single question containing a large or small number (anchor) and then gave an estimate of the actual value. The Condition A version was as follows, with the Condition B anchor in brackets:

> 1. Do you think there are more or fewer than 65 [12] African countries in the United Nations? (a. more; b. fewer); How many African countries do you think are in the United Nations?
>
> 2. Is the tallest redwood tree in the world more than 85 [1,000] feet tall? (a. taller; b. shorter); How tall do you think the tallest redwood tree in the world is?

Myside bias. We used the Ford Explorer problem from Stanovich and West (2008b) to assess myside bias. In this problem, we described to the participants a vehicle that was found by the U.S. Department of Transportation to be 8 times more likely than a typical family vehicle to kill someone in a car crash. Condition A describes the possibility of a dangerous German car being sold and driven in the United States; Condition B describes the possibility of the Ford Explorer, a dangerous American car, being sold and driven in Germany. The Condition A version was given as follows:

> According to comprehensive study by the U.S. Department of Transportation, a particular German car is 8 times more likely than a typical family car to kill occupants of another car in a crash. The U.S. Department of Transportation is considering recommending a ban on the sale of this German car.

After reading the above statement, participants responded to two questions about the acceptability of the described vehicle, each on a 6-point Likert-type scale anchored at 1 (*definitely yes*) and 6 (*definitely no*): "Do you think that the United States should ban the sale of this car? Do you think that this car should be allowed on U.S. streets, just like other cars?"

The same statistics are provided for each car. The only differences are the type of car and where the ban is being considered. Myside bias is seen when the participants indicate significantly stronger agreement to ban the German car (sale and use) in the United States than to ban the Ford Explorer in Germany.

Results and Discussion

Table 1 displays the bias blind spot main effects. For each of the seven potential biases, participants rated other students as more likely to commit the bias than themselves. Each bias blind spot effect was significant at the .001 level, and the effect sizes were all moderate—ranging from .341 to .603 (mean effect size = .446). The bias blind spot for outcome bias was the largest in size, but in fact the size of effects did not differ that much from item to item. Participants thought some biases were more likely for everyone (themselves and others) than other biases. Cell phone hazard was thought to be prevalent, but people thought that the conjunction effect was not a prevalent bias. One more variable that we constructed was a composite bias blind spot score that summed the blind spot scores across the seven items ($M = 3.48$, $SD = 4.4$). Higher scores on this variable represent larger bias blind spots—that is, a greater tendency to see others as more susceptible to a bias than the self.

Our results here add to the previous work on the bias blind spot, which has tended to focus more on social biases than cognitive ones. The next several analyses address the question of what predicts variance in these bias blind spot tendencies in the cognitive domain.

Table 2 presents the correlations among all the variables in the study. Focusing first on the seven bias blind spot effects, we see that there was a tendency for the bias blind spots to be associated. Twenty of the 21 possible correlations were significant at least at the .05 level, and all 20 were in the positive direction. The median correlation between bias blind spots was .212—not negligible considering that each bias is measured by a difference score between just two items.

The eighth variable in the correlation matrix is the composite score reflecting the sum of all seven bias blind spots. Column eight

Table 1
The Bias Blind Spot Main Effect: Mean Judgments About the Extent to Which Others and Self Display Various Cognitive Biases

	Other		Self			
Bias	*M*	*SD*	*M*	*SD*	$t(481)$	*d*
Outcome bias	4.45	0.95	3.83	1.10	11.97***	0.603
Base-rate neglect	4.27	1.10	3.74	1.28	9.93***	0.444
Framing bias	4.68	1.06	4.11	1.22	11.03***	0.499
Conjunction effect	3.84	1.04	3.45	1.10	8.83***	0.364
Anchoring bias	4.14	1.09	3.74	1.25	8.31***	0.341
Myside bias	4.72	1.01	4.24	1.20	9.25***	0.432
Cell phone bias	4.99	0.99	4.49	1.28	9.93***	0.437

*** $p < .001$.

Table 2
Intercorrelations Among the Key Variables

Variable	BBS							BBS composite and cognitive sophistication measures				
	1	2	3	4	5	6	7	8	9	10	11	12
1. BBS: Outcome bias	—											
2. BBS: Base rate neglect	.195	—										
3. BBS: Framing	.229	.328	—									
4. BBS: Conjunction	.171	.280	.212	—								
5. BBS: Anchoring	.099	.360	.257	.231	—							
6. BBS: Myside bias	.355	.244	.285	.321	.117	—						
7. BBS: Cell phone	.107	.158	.091	.148	−.006	.180	—					
8. BBS composite	.551	.655	.611	.571	.510	.639	.424	—				
9. CRT	.021	.149	.118	.013	.096	−.007	−.014	.096	—			
10. SAT total	.059	.226	.150	.125	.114	.030	−.003	.176	.449	—		
11. NFC	.233	.181	.094	.152	.075	.236	.053	.260	.111	.120	—	
12. AOT	.092	.174	.093	.027	.094	.092	−.112	.119	.081	.172	.219	—

Note. $N = 482$. BBS = bias blind spot; CRT = Cognitive Reflection Test; NFC = Need for Cognition Scale; AOT = Actively Open-Minded Thinking Scale. $r = .090$, $p < .05$; $r = .118$, $p < .01$; $r = .150$, $p < .001$ (two-tailed).

of the matrix displays the correlation between the composite blind spot score and the four measures of cognitive sophistication: the CRT, SAT total score, Need for Cognition Scale, and AOT Scale. All four of these correlations (.096, .176, .260, and .119) were statistically significant. Interestingly, however, all four of the correlations were positive in direction—indicating that more cognitively sophisticated participants showed larger bias blind spots. This somewhat surprising finding extended to six of the seven biases individually. Of the 28 possible correlations (seven biases crossed with four measures of cognitive sophistication), 24 were in the positive direction and 17 were statistically significant. Only the cell phone hazard bias had a significant negative correlation with a measure of cognitive sophistication (the AOT).

The finding that the bias blind spot is more apparent among the more cognitively sophisticated individuals is contrary to much of the rest of the heuristics and biases literature where most biases are negatively correlated (or at least independent) with cognitive abilities (Bruine de Bruin et al., 2007; Chiesi et al., 2011; Del Missier et al., 2010, 2011; Finucane & Gullion, 2010; Kokis, Macpherson, Toplak, West, & Stanovich, 2002; Stanovich & West, 1998, 2000; Toplak et al., 2011; Weller, Levin, & Denburg, 2011; West et al., 2008). Given the rarity of the result, it is important to consider alternative explanations for it, and an obvious one suggests itself. Perhaps more cognitively sophisticated individuals actually are less likely to display these classic cognitive biases. Such a finding would in fact cause a positive correlation if more cognitively able individuals correctly perceived that they were less prone to bias. This alternative explanation has diminished likelihood, however, when we reflect on the fact that these cognitive biases have been found in another study to be independent of cognitive ability (see Stanovich & West, 2008b, Table 1). Nonetheless, the possibility remains that there are relationships between cognitive ability and the presence of actual bias in this specific sample (thus rendering the cognitively sophisticated individuals correct in their judgments and causing a positive correlation between ability and the magnitude of the bias blind spot). We can test this possibility, because the presence of the actual cognitive biases were assessed in our study. The next set of analyses explores this alternative explanation of the positive correlations between cognitive sophistication and the presence of the bias blind spot.

Table 3 displays, for each of the classic heuristics and biases tasks, the mean response as a function of Condition (A versus B). In each case, the difference between Condition A and Condition B operationalizes a particular cognitive bias. In each case, the bias was statistically significant, and in all cases it was moderate to high in magnitude, as indicated by Cohen's *d*. The table also contains, for each of the classic experimental tasks, an analysis that examines whether the magnitude of the effect or bias varied as a function of cognitive ability. The table presents, for each of the items, the correlation between SAT total score and response on the particular item in that condition. The slope of this association will differ significantly if the magnitude of the bias varies as a function of cognitive ability.[1] This was tested by examining the Condition × SAT interaction in a hierarchical regression analysis; that is, by examining the Condition × SAT cross-product when entered third in the equation predicting item response after condition and SAT.

The first analysis in Table 3 indicates that there was a significant outcome bias effect, $t(480) = 3.90$, $p < .001$, $d = .356$. The next row of the table indicates that the slope of the response as a function of SAT score was steeper for the negative outcome condition (.254) than for the positive outcome condition (.072). The direction of the effect is indicating that participants of higher SAT displayed smaller outcome bias effects. As shown in the next row, although the interaction term in the hierarchical regression analysis was significant, the effect was not large. It only reached significance at the .05 level and accounted for only 1.0% of the variance. In the last column of the table, we used a Bayes factor analysis to directly assess the evidence both for and against the null hypothesis of no interaction. As derived from the website provided by Rouder, Speckman, Sun, Morey, and Iverson (2009) and the default assumptions suggested in their article and in Liang,

[1] Results were similar when parallel analyses were done with the three other measures of cognitive sophistication (CRT, AOT Scale, Need for Cognition Scale).

Table 3

Heuristics and Biases Task Effects in Study 1 and Statistical Tests of Whether the Task Effect Interacted With Cognitive Ability and the Bias Blind Spot Tendency

Heuristic and biases task	Condition		$t(480)$	d	$F(1, 478)$	R^2 change	JZS Bayes factor
Outcome bias	Positive outcome	Negative outcome					
M (*SD*)	5.78 (1.05)	5.40 (1.09)	3.90***	0.356			
Correlation with SAT	.072	.254					
Condition × SAT					5.17*	.010	43.90
Correlation with BBS$^{\text{Comp}}$	.064	.081					
Condition × BBS$^{\text{Comp}}$					0.01	.000	420.96
Correlation with BBS$^{\text{Out}}$	−.098	.057					
Condition × BBS$^{\text{Out}}$					2.926	.006	116.36
Base-rate problem (engineer–lawyer problem)	30 engineers	70 engineers					
M (*SD*)	59.96 (27.70)	74.09 (20.01)	−6.43***	−0.587			
Correlation with SAT	.023	.127					
Condition × SAT					0.87	.002	296.65
Correlation with BBS$^{\text{Comp}}$	.005	.054					
Condition × BBS$^{\text{Comp}}$					0.14	.000	420.96
Correlation with BBS$^{\text{Base}}$	.008	.075					
Condition × BBS$^{\text{Base}}$					0.32	.001	374.63
Framing problem (Asian disease)	Gain frame	Loss frame					
M (*SD*)	3.00 (1.29)	3.74 (1.18)	−6.59***	−0.600			
Correlation with SAT	−.027	.033					
Condition × SAT					0.43	.001	374.63
Correlation with BBS$^{\text{Comp}}$	−.049	.000					
Condition × BBS$^{\text{Comp}}$					0.37	.001	374.63
Correlation with BBS$^{\text{Fram}}$	−.063	.114					
Condition × BBS$^{\text{Fram}}$					5.49*	.010	43.90
Conjunction problem (Linda problem)	Bank teller	Feminist bank teller					
M (*SD*)	2.42 (1.04)	3.73 (1.18)	−12.95***	−1.179			
Correlation with SAT	.033	.037					
Condition × SAT					0.02	.000	420.96
Correlation with BBS$^{\text{Comp}}$	.019	.025					
Condition × BBS$^{\text{Comp}}$					0.04	.000	420.96
Correlation with BBS$^{\text{Conj}}$	−.028	.071					
Condition × BBS$^{\text{Conj}}$					1.17	.002	296.65
Anchoring (African countries)	Large anchor	Small anchor					
M (*SD*)	42.52 (25.31)	14.04 (8.94)	16.61***	1.516			
Correlation with SAT	.068	−.040					
Condition × SAT					1.36	.002	296.65
Correlation with BBS$^{\text{Comp}}$	−.023	.123					
Condition × BBS$^{\text{Comp}}$					0.89	.001	374.63
Correlation with BBS$^{\text{Anch}}$	−.014	.034					
Condition × BBS$^{\text{Anch}}$					0.14	.000	420.96
Anchoring (Redwoods)	Small anchor	Large anchor					
Mean (*SD*)	118.17 (61.34)	884.45 (572.09)	−20.46***	−1.868			
Correlation with SAT	.207	−.144					
Condition × SAT					7.00**	.008	72.77
Correlation with BBS$^{\text{Comp}}$	.083	−.069					
Condition × BBS$^{\text{Comp}}$					1.24	.001	374.63
Correlation with BBS$^{\text{Anch}}$	−.001	−.012					
Condition × BBS$^{\text{Anch}}$					0.02	.000	420.96
Myside bias (Explorer vs. German car)	Ban German car	Ban Ford Explorer					
M (*SD*)	2.74 (1.30)	3.57 (1.21)	−7.24***	−0.663			
Correlation with SAT	.138	−.090					
Condition × SAT					6.25*	.012	27.07
Correlation with BBS$^{\text{Comp}}$	.138	−.090					
Condition × BBS$^{\text{Comp}}$					1.22	.001	374.63
Correlation with BBS$^{\text{Mys}}$	.093	.063					
Condition × BBS$^{\text{Mys}}$					0.28	.001	374.63

Note. JZS = Jeffreys–Zellner–Siow; BBS = bias blind spot; Comp = composite of seven BBS items; Out = outcome bias; Base = base-rate problem; Fram = framing problem; Conj = conjunction problem; Anch = anchoring; Mys = myside bias.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Paulo, Molina, Clyde, and Berger (2008), the magnitude of the interaction produced a Jeffreys–Zellner–Siow (JZS) Bayes factor for null model over alternative model of 43.90. That is, the data are more than 43 times more likely to support the null hypothesis than the alternative. The Bayes factor analysis is consistent with the impression given by the small amount of unique variance explained by the interaction (1.0%) that there is little evidence here indicating the cognitive ability attenuates the bias.

The same is true for the other classic cognitive biases that we tested. As is clear from Table 3, there was no significant SAT × Condition interaction for base-rate task, framing task, conjunction problem, and African countries anchoring problem. There was a significant interaction in the expected direction for the Redwoods anchoring problem and the myside bias problem (*p*s $< .05$), but the percentage of unique variance explained by the interaction was quite low on both cases (0.8% and 1.2%, respectively). Furthermore, the JZS Bayes factor favored the null model strongly in both cases (72.77 and 27.07, respectively).

Thus, across all the regression analyses, only three of the seven interactions between condition and cognitive ability were statistically significant. In these three cases, the variance explained by the interaction was extremely small (1.2% or less). In all seven cases, the Bayes factor analyses favored the null by a factor of at least 27 to 1. Taken collectively, these data produced very little evidence indicating that cognitive ability was related to the classic judgmental biases in this sample, a result that converges with those from a totally different sample in another study (Stanovich & West, 2008b) that did not involve assessment of the bias blind spot. Thus, the positive correlations in Table 2 indicating that more cognitively sophisticated subjects had larger bias blind spots cannot be explained by positing that these individuals actually do display smaller cognitive biases.

Another question that we may ask of these data is whether people who are more aware of their own biases are better able to overcome them. Perhaps because of some metacognitive awareness of the possibilities of bias, are people less prone to display a bias blind spot also less prone to the classic cognitive biases themselves? The second regression analysis under each task in Table 3 addresses this question by presenting a set of regressions parallel to those just discussed except that the composite bias blind spot score is substituted for cognitive ability. Table 3 displays, for each of the experimental tasks, the slope of the response in each condition as a function of composite bias blind spot score, as well as the interaction term in the hierarchical regression. We used a Bayes factor analysis to directly assess the evidence both for and against the null hypothesis of no interaction—that is, no differential bias susceptibility as a function of the composite blind spot score.

Across all seven of these regression analyses, none of the interactions between condition and composite bias blind spot were statistically significant. In all seven cases, the Bayes factor analyses favored the null by a factor of at least 374 to 1. In short, the analyses reported in Table 3 provide no evidence whatsoever for the notion that people who are more aware of their own biases are better able to overcome them. Those low in the bias blind spot across all seven tasks were just as likely to display each of the classic cognitive biases. One caveat to these findings, however, is that they employed the composite bias blind spot score in our analyses. Perhaps it is the case that those more self-aware with respect to a specific cognitive bias will display less bias on that particular task. Thus, in the last regression analysis under each task in Table 3 repeats the previous analysis, only substituting the bias blind spot on that particular task for the composite bias blind spot score in the regression.

Across all seven of these regression analyses, only one of the interactions between condition and specific bias blind spot score was statistically significant—that for the disease framing problem ($p < .05$). The framing effect was lower in those showing a smaller bias blind spot for this bias. However, the variance explained by the interaction term was quite low (1.0%), and the JZS Bayes factor favored the null model over the alternative model by a factor of 43.90. In summary, the analyses of specific bias blind spots converged with those on the composite variable to indicate that there is little evidence that people who are more aware of their own biases are better able to overcome them.

Study 2

Study 1's results add to previous work on the bias blind spot by showing that this metacognitive bias extended to biases in the cognitive domain. In addition, cognitive ability did not attenuate this metacognitive bias. Furthermore, people who were aware of their own biases were not better able to overcome them. In Study 1, however, we used a fairly young and homogeneous sample: college students with a mean age of only 18.7 years ($SD = 0.98$). In Study 2, we examined whether the findings could be generalized to a broader range of people. We investigated the generalizability of Study 1's findings by collecting responses from a substantially more heterogeneous sample composed of Amazon Mechanical Turk workers (see Paolacci, Chandler, & Ipeirotis, 2010; Sprouse, 2011).

Method

Participants. Two hundred and sixty-five Amazon Mechanical Turk workers (115 men, 150 women) who were residents of the United States were paid $1 to participate in this online study. Their mean age was 36.2 years ($SD = 11.4$; range: 18–66). The great majority of these participants (227, or 85.7%) reported that they were not currently college students. The highest level of education received was reported to be a high school education by 30, some college by 88, a BA or BS degree by 95, and a graduate or advanced college degree by 51 of the participants (one participant left this question blank).

Cognitive Reflection Test. Because reporting of SAT scores might not be reliable from this older sample, we used the three-item CRT that was described in Study 1 as our measure of cognitive sophistication. The CRT has relevant psychometric properties, such as a substantial correlation with cognitive ability and the capacity to function as a unique predictor of performance on a number of heuristics and biases tasks (Toplak et al., 2011). A composite of the three items was formed (mean number of correct items = 1.48, $SD = 1.25$). This mean was significantly higher than the composite for the same three CRT items in Study 1 ($M = 0.79$, $SD = 0.92$), $t(745) = 8.56$, $p < .001$).

Bias blind spot questionnaire. The first six of the seven bias blind spot items listed in the Appendix were administered as described in Study 1, with the exception that all participants rated themselves first and "the average person" second. A composite of the six bias blind spot items was formed by summing the differ-

ences between the ratings for self and the average person for each item ($M = 4.74$, $SD = 4.12$).

Heuristics and biases tasks. The outcome bias and the conjunction problem tasks described in Study 1 were used to assess whether participants high on the CRT were less prone to display either of these cognitive biases. One hundred and sixty-two participants received the negative outcome form of the outcome bias task and the feminist bank teller form of the conjunction problem. One hundred and three participants received the positive outcome form of the outcome bias task and the bank teller form of the conjunction problem. The resulting two groups had very similar CRT composite scores (1.48 versus 1.47), $t(263) = 0.10$, *ns*.

Results and Discussion

Table 4 displays the bias blind spot main effects for Study 2. The overall pattern of data in this table closely mirrored that in Study 1 (see Table 1). For each of the six potential biases, participants rated the average person as more likely to commit the bias than themselves. Each bias blind spot effect was significant at the .001 level, and all the effect sizes were either moderate or large, ranging from 0.664 to 0.934 (mean effect size = 0.782).

In Study 2, the correlation between the CRT and the composite bias blind spot score failed to reach a level of significance, $r(263) = .102$, $p = .10$. The corresponding correlation in Study 1 was nearly identical, although it reached a level of significance due to that study's larger sample, $r(480) = .096$, $p = .03$. Because the sign of the correlation was positive in both studies (rather than negative, as might be expected), it can be unequivocally said that neither study provided any evidence that the bias blind spot is attenuated by cognitive sophistication.

As in Study 1, the six bias blind spot effects in Study 2 were positively correlated with one another. All 15 possible zero-order correlations between the six items were significant at the .001 level (*r* ranged from .223 to .497). The median correlation between bias blind spots was .395, and the mean was .377.

For reasons previously discussed in the context of Study 1, it is important to assess whether more cognitively sophisticated individuals actually are less likely to display these classic cognitive biases. In Study 2, we assessed two classic biases (outcome bias and the conjunction effect) for such an association. Table 5 displays analyses on the two heuristics and biases tasks that parallel those reported in Table 3. Highly significant cognitive bias effects were found for both the outcome bias and conjunction problem tasks ($p < .001$). Regression analyses indicated that the Condition × CRT interactions for the outcome bias and conjunction problem tasks were not significant and accounted for very modest proportions of variance explained (0.8% in both cases). The JZS Bayes factor favored the null model over alternative model by a factor of over 93 in both cases. Thus, these data produced very little evidence indicating that cognitive ability was related to judgmental bias in Study 2, a finding that replicated those of Study 1 with a considerably more heterogeneous sample.

Table 4
The Bias Blind Spot Main Effect in Study 2: Mean Judgments About the Extent to Which Others and Self Display Various Cognitive Biases

	Other		Self			
Bias	*M*	*SD*	*M*	*SD*	*t*(264)	*d*
Outcome bias	4.84	0.86	4.09	1.15	12.65***	0.739
Base-rate neglect	4.75	0.81	3.75	1.28	14.26***	0.934
Framing bias	5.07	0.80	4.22	1.12	13.64***	0.873
Conjunction effect	4.52	0.87	3.82	1.21	12.17***	0.664
Anchoring bias	4.50	0.87	3.80	1.11	13.30***	0.702
Myside bias	4.99	0.83	4.25	1.05	12.08***	0.782

*** $p < .001$.

Table 5 also contains the results of regression analyses that parallel those in Table 3 with the composite bias blind spot scores and the individual bias blind spot scores for the particular cognitive bias. Replicating the findings of Study 1, in each case the Condition × Bias Blind Spot interaction failed to reach a level of significance and accounted for very modest proportions of variance explained (ranging from 0.1% to 0.6%). Bayes factors in all cases strongly favored the null hypothesis of no interaction.

In summary, Study 2's findings produced strong evidence for the existence of the bias blind spot in the cognitive domain, and very little evidence that cognitive ability was related to this metacognitive bias, or that people who were aware of their own biases were better able to overcome them. Thus, the findings with Study 2's more heterogeneous sample converged strongly with those obtained in Study 1.

General Discussion

In two studies, we have demonstrated robust indications of a bias blind spot regarding many classic cognitive biases (Kahneman, 2011; Tversky & Kahneman, 1974, 1983). This itself is an important finding because although much previous research has documented the bias blind spot in the social domain, less is know about blind spots in cognitive domains. Additionally, in both studies we found indications of moderate domain generality for the bias blind spot across cognitive domains. In Study 1, across the six cognitive biases tested (i.e., minus the cell phone item), all 15 of the correlations among bias blind spots were statistically significant, and the median correlation was .244. In Study 2, again, all 15 correlations between bias blind spots were statistically significant, and the median correlation was an even higher .395. This amount of covariance is nonnegligible in light of the fact that each bias is measured by a difference score between just two items.

Most cognitive biases in the heuristics and biases literature are negatively correlated with cognitive sophistication, whether the latter is indexed by development, by cognitive ability, or by thinking dispositions (Bruine de Bruin et al., 2007; Chiesi et al., 2011; Finucane & Gullion, 2010; Kokis et al., 2002; Toplak & Stanovich, 2002; Toplak et al., 2011; Weller et al., 2011; West et al., 2008). This was not true for any of the bias blind spots studied here. As opposed to the social emphasis in past work on the bias blind spot, we examined bias blind spots connected to some of the most well-known effects from the heuristics and biases literature: outcome bias, base-rate neglect, framing bias, conjunction fallacy, anchoring bias, and myside bias. We found that none of these bias blind spot effects displayed a negative correlation with measures of cognitive ability (SAT total, CRT) or with measures of thinking dispositions (need for cognition, actively open-minded thinking). If anything, the correlations went in the other direction.

Table 5

Heuristics and Biases Task Effects in Study 2 and Statistical Tests of Whether the Task Effect Interacted With Cognitive Ability and the Bias Blind Spot Tendency

Heuristic and biases task	Condition		$t(263)$	d	$F(1, 261)$	R^2 change	JZS Bayes factor
Outcome bias	Positive outcome	Negative outcome					
M (*SD*)	5.89 (0.84)	5.31 (1.32)	4.02***	0.503			
Correlation with CRT	−.074	.116					
Condition × CRT					2.16	.008	93.91
Correlation with BBS^{Comp}	.061	.120					
Condition × BBS^{Comp}					0.64	.002	206.35
Correlation with BBS^{Out}	.065	.098					
Condition × BBS^{Out}					0.34	.001	235.17
Conjunction problem (Linda problem)	Bank teller	Feminist bank teller					
M (*SD*)	2.49 (1.04)	3.38 (1.12)	−6.54***	−0.820			
Correlation with CRT	.066	−.136					
Condition × CRT					2.57	.008	93.91
Correlation with BBS^{Comp}	−.191	.001					
Condition × BBS^{Comp}					1.96	.006	122.15
Correlation with BBS^{Conj}	−.042	.027					
Condition × BBS^{Conj}					0.29	.001	235.17

Note. JZS = Jeffreys–Zellner–Siow; CRT = Cognitive Reflection Test; BBS = bias blind spot; Comp = composite of six BBS items; Out = outcome bias; Conj = conjunction problem.
*** $p < .001$.

We explored the obvious explanation for the indications of a positive correlation between cognitive ability and the magnitude of the bias blind spot in our data. That explanation is the not unreasonable one that more cognitively sophisticated people might indeed show lower cognitive biases—so that it would be correct for them to view themselves as less biased than their peers. However, as the analyses in Tables 3 and 5 indicate, we found very little evidence that these classic biases were attenuated by cognitive ability. More intelligent people were not actually less biased—a finding that would have justified their displaying a larger bias blind spot.

Whatever explains the slightly positive correlation, a conservative way to characterize the findings here is to say that cognitive ability provides no inoculation at all from the bias blind spot—the tendency to believe that biased thinking is more prevalent in others than in ourselves. In our data, cognitive ability did not attenuate the tendency toward a blind spot at all. Thus, the bias blind spot joins a small group of other effects such as myside bias and noncausal base-rate neglect (Stanovich & West, 2008b; Toplak & Stanovich, 2003) in being unmitigated by increases in intelligence.

That cognitive sophistication does not mitigate the bias blind spot is consistent with the idea that the mechanisms that cause the bias are quite fundamental and not easily controlled strategically—that they reflect what is termed Type 1 processing in dual-process theory (Evans, 2008; Evans & Stanovich, in press). Two of the theoretical explanations of the effect considered by Pronin (2007)—naive realism and defaulting to introspection—posit the bias as emanating from cognitive mechanisms that are evolutionarily and computationally basic. Much research on the bias blind spot describes the asymmetry in bias detection in self compared to others as being spawned by a belief in naive realism—the idea that one's perception of the world is objective and thus would be mirrored by others who are open-minded and unbiased in their views (Griffin & Ross, 1991; Pronin et al., 2002; Ross & Ward, 1996). Naive realism is developmentally primitive (Forguson & Gopnik, 1988; Gabennesch, 1990) and thus likely to be ubiquitous and operative in much of our basic information processing.

It is likewise with self-assessment based on introspective information, rather than behavioral information (Pronin & Kugler, 2007). The bias blind spot arises, on this view, because we rely on behavioral information for evaluations of others, but on introspection for evaluations of ourselves. The biases of others are easily detected in their overt behaviors, but when we introspect we will largely fail to detect the unconscious processes that are the sources of our own biases (Ehrlinger et al., 2005; Kahneman, 2011; Pronin et al., 2004; Wilson, 2002). When we fail to detect evidence of bias, we are apt to decide no bias has occurred and that our decision-making process was indeed objective and reasonable. This asymmetry in bias assessment information has as its source a ubiquitous and pervasive processing tendency—introspective reliance—that again is developmentally basic (Dennett, 1991; Sterelny, 2003).

The cognitive primitiveness of some of the processes causing the bias blind spot might be consistent with the failure of intelligence to attenuate the bias. However, this cannot explain the (albeit modest) positive correlations of the bias blind spot with cognitive sophistication that we found (see Table 2). The most likely explanation of this finding would probably be what we might term the "justified rating" account. Adults with more cognitive ability are aware of their intellectual status and expect to outperform others on most cognitive tasks. Because these cognitive biases are presented to them as essentially cognitive tasks, they expect to outperform on them as well. However, these classic biases happen to be ones without associations with cognitive ability. Not all classic cognitive biases show such a dissociation, however (Stanovich & West, 2008b), and these individuals with higher cognitive ability would have been correct in their assessment that they were more free of the bias. In short, our tasks

created what might be termed a hostile environment (see Stanovich, 2009) for higher ability people to do self-assessments. Nonetheless, the finding of a lack of calibration in the domain of cognitive bias is important to reveal, however, because the heuristics and biases literature samples the space of cognitive tasks that are least connected to cognitive ability as measured by traditional intelligence tests (Stanovich, 2009, 2011).

The justified rating account of the positive correlations between cognitive sophistication and the magnitude of the bias blind spot is not incompatible with other explanations. For example, the bias blind spot might be a type of self-enhancing bias that is rational or at least has some kind of efficacy—an idea proposed as an explanation for other self-enhancing effects in psychology (Fast, Gruenfeld, Sivanathan, & Galinsky, 2009; Scheier, 1992; Sharot, 2011; Taylor & Brown, 1988, 1994). With respect to other effects in the psychology of reasoning, it has been argued that correlations with cognitive ability are a partially diagnostic pointer to the rationality of responses (Stanovich, 2011; Stanovich & West, 2000). If so, then these findings indicate a reinterpretation of the bias blind spot as an efficacious processing strategy rather than its more common interpretation as a processing flaw. Perhaps it results from some type of evolutionary-based egocentrism that is efficacious. However, the efficacy of this kind of self-deception might be only temporary (and have long-term negative consequences; see Chance, Norton, Gino, & Ariely, 2011), and it may only represent efficacy in an evolutionary sense rather than a personal utility sense (Haselton & Nettle, 2006; Johnson & Fowler, 2011; Stanovich, 2004; van Veelen & Nowak, 2011).

References

Amsel, E., Klaczynski, P. A., Johnston, A., Bench, S., Close, J., Sadler, E., & Walker, R. (2008). A dual-process account of the development of scientific reasoning: The nature and development of metacognitive intercession skills. *Cognitive Development, 23,* 452–471. doi:10.1016/j.cogdev.2008.09.002

Baron, J., & Hershey, J. C. (1988). Outcome bias in decision evaluation. *Journal of Personality and Social Psychology, 54,* 569–579. doi:10.1037/0022-3514.54.4.569

Bruine de Bruin, W., Parker, A. M., & Fischhoff, B. (2007). Individual differences in adult decision-making competence. *Journal of Personality and Social Psychology, 92,* 938–956. doi:10.1037/0022-3514.92.5.938

Buss, D. M. (1999). *Evolutionary psychology: The new science of the mind.* Boston. MA: Allyn and Bacon.

Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. G. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin, 119,* 197–253. doi:10.1037/0033-2909.119.2.197

Campitelli, G., & Labollita, M. (2010). Correlations of cognitive reflection with judgments and choices. *Judgment and Decision Making, 5,* 182–191.

Cassady, J. C. (2001). Self-reported GPA and SAT: A methodological note. *Practical Assessment, Research & Evaluation, 7*(12). Retrieved from http://pareonline.net/getvn.asp?v=7&n=12

Chance, Z., Norton, M. I., Gino, F., & Ariely, D. (2011). Temporal view of the costs and benefits of self-deception. *Proceedings of the National Academy of Sciences of the United States of America, 108,* 15655–15659. doi:10.1073/pnas.1010658108

Chiesi, F., Primi, C., & Morsanyi, K. (2011). Developmental changes in probabilistic reasoning: The role of cognitive capacity, instructions, thinking styles, and relevant knowledge. *Thinking & Reasoning, 17,* 315–350. doi:10.1080/13546783.2011.598401

Cokely, E. T., & Kelley, C. M. (2009). Cognitive abilities and superior decision making under risk: A protocol analysis and process model evaluation. *Judgment and Decision Making, 4,* 20–33.

Dawes, R. M. (1976). Shallow psychology. In J. S. Carroll & J. W. Payne III (Eds.), *Cognition and social behavior* (pp. 3–11). Hillsdale, NJ: Erlbaum.

Del Missier, F., Mäntyla, T., & Bruine de Bruin, W. (2010). Executive functions in decision making: An individual differences approach. *Thinking & Reasoning, 16,* 69–97. doi:10.1080/13546781003630117

Del Missier, F., Mäntyla, T., & Bruine de Bruin, W. (2011). Decision-making competence, executive functioning, and general cognitive abilities. *Journal of Behavioral Decision Making.* Advance online publication. doi:10.1002/bdm.731

Dennett, D. C. (1991). *Consciousness explained.* Boston, MA: Little Brown.

Ehrlinger, J., Gilovich, T., & Ross, L. (2005). Peering into the bias blind spot: People's assessments of bias in themselves and others. *Personality and Social Psychology Bulletin, 31,* 680–692. doi:10.1177/0146167204271570

Epley, N., & Gilovich, T. (2004). Are adjustments insufficient? *Personality and Social Psychology Bulletin, 30,* 447–460. doi:10.1177/0146167203261889

Evans, J. St. B. T. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology, 59,* 255–278. doi:10.1146/annurev.psych.59.103006.093629

Evans, J. St. B. T. (2010). *Thinking twice: Two minds in one brain.* Oxford, England: Oxford University Press.

Evans, J. St. B. T., & Frankish, K. (Eds.). (2009). *In two minds: Dual processes and beyond.* Oxford, England: Oxford University Press. doi:10.1093/acprof:oso/9780199230167.001.0001

Evans, St. J. B. T., & Stanovich, K. E. (in press). Dual-process theories of higher cognition: Advancing the debate. *Perspectives in Psychological Science.*

Fast, N. J., Gruenfeld, D. H., Sivanathan, N., & Galinsky, A. D. (2009). Illusory control: A generative force behind power's far-reaching effects. *Psychological Science, 20,* 502–508. doi:10.1111/j.1467-9280.2009.02311.x

Finucane, M. L., & Gullion, C. M. (2010). Developing a tool for measuring the decision-making competence of older adults. *Psychology and Aging, 25,* 271–288. doi:10.1037/a0019106

Forguson, L., & Gopnik, A. (1988). The ontogeny of common sense. In J. W. Astington, P. L. Harris, & D. R. Olson (Eds.), *Developing theories of mind* (pp. 226–243). New York, NY: Cambridge University Press.

Frantz, C. M. (2006). I AM being fair: The bias blind spot as a stumbling block to seeing both sides. *Basic and Applied Social Psychology, 28,* 157–167. doi:10.1207/s15324834basp2802_5

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19,* 25–42. doi:10.1257/089533005775196732

Frey, M. C., & Detterman, D. K. (2004). Scholastic assessment or *g*? The relationship between the Scholastic Assessment Test and general cognitive ability. *Psychological Science, 15,* 373–378. doi:10.1111/j.0956-7976.2004.00687.x

Gabennesch, H. (1990). The perception of social conventionality by children and adults. *Child Development, 61,* 2047–2059. doi:10.2307/1130858

Gilhooly, K. J., & Fioratou, E. (2009). Executive functions in insight versus non-insight problem solving: An individual differences approach. *Thinking & Reasoning, 15,* 355–376. doi:10.1080/13546780903178615

Gilhooly, K. J., & Murphy, P. (2005). Differentiating insight from non-insight problems. *Thinking & Reasoning, 11,* 279–302. doi:10.1080/13546780442000187

Griffin, D. W., & Ross, L. (1991). Subjective construal, social inference, and human misunderstanding. In M. P. Zanna (Ed.), *Advances in exper-*

imental social psychology (Vol. 24, pp. 319–359). San Diego, CA: Academic Press.

Haselton, M. G., & Nettle, D. (2006). The paranoid optimist: An integrative evolutionary model of cognitive biases. *Personality and Social Psychology Review, 10,* 47–66. doi:10.1207/s15327957pspr1001_3

Higgins, D. M., Peterson, J. B., Pihl, R. O., & Lee, A. G. M. (2007). Prefrontal cognitive ability, intelligence, Big Five personality, and the prediction of advanced academic and workplace performance. *Journal of Personality and Social Psychology, 93,* 298–319. doi:10.1037/0022-3514.93.2.298

Johnson, D. D. P., & Fowler, J. H. (2011). The evolution of overconfidence. *Nature, 477,* 317–320. doi:10.1038/nature10384

Kahneman, D. (2011). *Thinking, fast and slow.* New York, NY: Farrar, Straus & Giroux.

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 49–81). New York, NY: Cambridge University Press.

Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80,* 237–251. doi:10.1037/h0034747

Koehler, D. J., & James, G. (2010). Probability matching and strategy availability. *Memory & Cognition, 38,* 667–676. doi:10.3758/MC.38.6.667

Kokis, J. V., Macpherson, R., Toplak, M. E., West, R. F., & Stanovich, K. E. (2002). Heuristic and analytic processing: Age trends and associations with cognitive ability and cognitive styles. *Journal of Experimental Child Psychology, 83,* 26–52. doi:10.1016/S0022-0965(02)00121-2

Kruger, J., & Gilovich, T. (2004). Actions, intentions, and self-assessment: The road to self-enhancement is paved with good intentions. *Personality and Social Psychology Bulletin, 30,* 328–339. doi:10.1177/0146167203259932

Kuncel, N. R., Credé, M., & Thomas, L. L. (2005). The validity of self-reported grade point averages, class ranks, and test scores: A meta-analysis and review of the literature. *Review of Educational Research, 75,* 63–82. doi:10.3102/00346543075001063

Levy, J., Pashler, H., & Boer, E. (2006). Central interference in driving: Is there any stopping the psychological refractory period? *Psychological Science, 17,* 228–235. doi:10.1111/j.1467-9280.2006.01690.x

Liang, F., Paulo, R., Molina, G., Clyde, M. A., & Berger, J. O. (2008). Mixtures of *g* priors for Bayesian variable selection. *Journal of the American Statistical Association, 103,* 410–423. doi:10.1198/016214507000001337

Lieberman, M. D. (2007). Social cognitive neuroscience: A review of core processes. *Annual Review of Psychology, 58,* 259–289. doi:10.1146/annurev.psych.58.110405.085654

Lieberman, M. D. (2009). What zombies can't do: A social cognitive neuroscience approach to the irreducibility of reflective consciousness. In J. St. B. T. Evans & K. Frankish (Eds.), *In two minds: Dual processes and beyond* (pp. 293–316). Oxford, England: Oxford University Press. doi:10.1093/acprof:oso/9780199230167.003.0013

McEvoy, S. P., Stevenson, M. R., McCartt, A. T., Woodward, M., Haworth, C., Palamara, P., & Cercarelli, R. (2005). Role of mobile phones in motor vehicle crashes resulting in hospital attendance: A case-crossover study. *British Medical Journal, 331,* 428–430. doi:10.1136/bmj.38537.397512.55

Nichols, S., & Stich, S. P. (2003). *Mindreading: An integrated account of pretence, self-awareness, and understanding other minds.* Oxford, England: Oxford University Press.

Nisbett, R. E., & Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment.* Englewood Cliffs, NJ: Prentice-Hall.

Noftle, E. E., & Robins, R. W. (2007). Personality predictors of academic outcomes: Big Five correlates of GPA and SAT scores. *Journal of Personality and Social Psychology, 93,* 116–130. doi:10.1037/0022-3514.93.1.116

Oechssler, J., Roider, A., & Schmitz, P. W. (2009). Cognitive abilities and behavioral biases. *Journal of Economic Behavior & Organization, 72,* 147–152. doi:10.1016/j.jebo.2009.04.018

Paolacci, G., Chandler, J., & Ipeirotis, P. G. (2010). Running experiments on Amazon Mechanical Turk. *Judgment and Decision Making, 5,* 411–419.

Pronin, E. (2007). Perception and misperception of bias in human judgment. *Trends in Cognitive Sciences, 11,* 37–43. doi:10.1016/j.tics.2006.11.001

Pronin, E., Gilovich, T., & Ross, L. (2004). Objectivity in the eye of the beholder: Divergent perceptions of bias in self versus others. *Psychological Review, 111,* 781–799. doi:10.1037/0033-295X.111.3.781

Pronin, E., & Kugler, M. B. (2007). Valuing thoughts, ignoring behavior: The introspection illusion as a source of the bias blind spot. *Journal of Experimental Social Psychology, 43,* 565–578. doi:10.1016/j.jesp.2006.05.011

Pronin, E., Lin, D. Y., & Ross, L. (2002). The bias blind spot: Perceptions of bias in self versus others. *Personality and Social Psychology Bulletin, 28,* 369–381. doi:10.1177/0146167202286008

Reber, A. S. (1992a). The cognitive unconscious: An evolutionary perspective. *Consciousness and Cognition, 1,* 93–133. doi:10.1016/1053-8100(92)90051-B

Reber, A. S. (1992b). An evolutionary context for the cognitive unconscious. *Philosophical Psychology, 5,* 33–51. doi:10.1080/09515089208573042

Ross, L., & Ward, A. (1996). Naive realism in everyday life: Implications for social conflict and misunderstanding. In E. S. Reed, E. Turiel, & T. Brown (Eds.), *Values and knowledge* (pp. 103–135). Hillsdale, NJ: Erlbaum.

Rouder, J. N., Speckman, P. L., Sun, D., Morey, R. D., & Iverson, G. (2009). Bayesian *t* tests for accepting and rejecting the null hypothesis. *Psychonomic Bulletin & Review, 16,* 225–237. doi:10.3758/PBR.16.2.225

Scheier, M. F., & Carver, C. S. (1992). Effects of optimism on psychological and physical well-being: Theoretical overview and empirical update. *Cognitive Therapy and Research, 16,* 201–228. doi:10.1007/BF01173489

Sharot, T. (2011). *The optimism bias: A tour of the irrationally positive brain.* New York, NY: Pantheon.

Smith, S. M., & Levin, I. P. (1996). Need for cognition and choice framing effects. *Journal of Behavioral Decision Making, 9,* 283–290. doi:10.1002/(SICI)1099-0771(199612)9:4<283::AID-BDM241>3.0.CO;2-7

Sperber, D. (1994). The modularity of thought and the epidemiology of representations. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 39–67). Cambridge, England: Cambridge University Press. doi:10.1017/CBO9780511752902.003

Sprouse, J. (2011). A validation of Amazon Mechanical Turk for the collection of acceptability judgments in linguistic theory. *Behavior Research Methods, 43,* 155–167. doi:10.3758/s13428-010-0039-7

Stanovich, K. E. (1999). *Who is rational? Studies of individual differences in reasoning.* Mahwah, NJ: Erlbaum.

Stanovich, K. E. (2003). The fundamental computational biases of human cognition: Heuristics that (sometimes) impair decision making and problem solving. In J. E. Davidson & R. J. Sternberg (Eds.), *The psychology of problem solving* (pp. 291–342). New York, NY: Cambridge University Press.

Stanovich, K. E. (2004). *The robot's rebellion: Finding meaning in the age of Darwin.* Chicago, IL: University of Chicago Press.

Stanovich, K. E. (2009). *What intelligence tests miss: The psychology of rational thought.* New Haven, CT: Yale University Press.

Stanovich, K. E. (2011). *Rationality and the reflective mind.* New York, NY: Oxford University Press.

Stanovich, K. E., & West, R. F. (1997). Reasoning independently of prior belief and individual differences in actively open-minded thinking. *Journal of Educational Psychology, 89,* 342–357. doi:10.1037/0022-0663.89.2.342

Stanovich, K. E., & West, R. F. (1998). Individual differences in rational thought. *Journal of Experimental Psychology: General, 127,* 161–188. doi:10.1037/0096-3445.127.2.161

Stanovich, K. E., & West, R. F. (1999). Discrepancies between normative and descriptive models of decision making and the understanding/acceptance principle. *Cognitive Psychology, 38,* 349–385. doi:10.1006/cogp.1998.0700

Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences, 23,* 645–726. doi:10.1017/S0140525X00003435

Stanovich, K. E., & West, R. F. (2007). Natural myside bias is independent of cognitive ability. *Thinking & Reasoning, 13,* 225–247. doi:10.1080/13546780600780796

Stanovich, K. E., & West, R. F. (2008a). On the failure of cognitive ability to predict myside and one-sided thinking biases. *Thinking & Reasoning, 14,* 129–167. doi:10.1080/13546780701679764

Stanovich, K. E., & West, R. F. (2008b). On the relative independence of thinking biases and cognitive ability. *Journal of Personality and Social Psychology, 94,* 672–695. doi:10.1037/0022-3514.94.4.672

Sterelny, K. (2003). *Thought in a hostile world: The evolution of human cognition.* Malden, MA: Blackwell.

Strayer, D. L., & Drews, F. A. (2007). Cell-phone-induced driver distraction. *Current Directions in Psychological Science, 16,* 128–131. doi:10.1111/j.1467-8721.2007.00489.x

Strayer, D. L., & Johnston, W. A. (2001). Driven to distraction: Dual-task studies of simulated driving and conversing on a cellular telephone. *Psychological Science, 12,* 462–466. doi:10.1111/1467-9280.00386

Taylor, S. E. (1981). The interface of cognitive and social psychology. In J. H. Harvey (Ed.), *Cognition, social behavior, and the environment* (pp. 189–211). Hillsdale, NJ: Erlbaum.

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin, 103,* 193–210. doi:10.1037/0033-2909.103.2.193

Taylor, S. E., & Brown, J. D. (1994). Positive illusions and well-being revisited: Separating fact from fiction. *Psychological Bulletin, 116,* 21–27. doi:10.1037/0033-2909.116.1.21

Toates, F. (2005). Evolutionary psychology—Towards a more integrative model. *Biology and Philosophy, 20,* 305–328. doi:10.1007/s10539-004-0756-3

Toates, F. (2006). A model of the hierarchy of behaviour, cognition, and consciousness. *Consciousness and Cognition, 15,* 75–118. doi:10.1016/j.concog.2005.04.008

Tooby, J., & Cosmides, L. (1992). The psychological foundations of culture. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 19–136). New York, NY: Oxford University Press.

Toplak, M., & Stanovich, K. E. (2002). The domain specificity and generality of disjunctive reasoning: Searching for a generalizable critical thinking skill. *Journal of Educational Psychology, 94,* 197–209. doi:10.1037/0022-0663.94.1.197

Toplak, M. E., & Stanovich, K. E. (2003). Associations between myside bias on an informal reasoning task and amount of post-secondary education. *Applied Cognitive Psychology, 17,* 851–860. doi:10.1002/acp.915

Toplak, M. E., West, R. F., & Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. *Memory & Cognition, 39,* 1275–1289. doi:10.3758/s13421-011-0104-1

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185,* 1124–1131. doi:10.1126/science.185.4157.1124

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211,* 453–458. doi:10.1126/science.7455683

Tversky, A., & Kahneman, D. (1983). Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review, 90,* 293–315. doi:10.1037/0033-295X.90.4.293

Unsworth, N., & Engle, R. W. (2007). The nature of individual differences in working memory capacity: Active maintenance in primary memory and controlled search from secondary memory. *Psychological Review, 114,* 104–132. doi:10.1037/0033-295X.114.1.104

van Veelen, M., & Nowak, M. A. (2011). Evolution: Selection for positive illusions. *Nature, 477,* 282–283. doi:10.1038/477282a

Weller, J. A., Levin, I. P., & Denburg, N. L. (2011). Trajectory of risky decision making for potential gains and losses from ages 5 to 85. *Journal of Behavioral Decision Making, 24,* 331–344. doi:10.1002/bdm.690

West, R. F., & Stanovich, K. E. (1991). The incidental acquisition of information from reading. *Psychological Science, 2,* 325–330. doi:10.1111/j.1467-9280.1991.tb00160.x

West, R. F., & Stanovich, K. E. (2003). Is probability matching smart? Associations between probabilistic choices and cognitive ability. *Memory & Cognition, 31,* 243–251. doi:10.3758/BF03194383

West, R. F., Toplak, M. E., & Stanovich, K. E. (2008). Heuristics and biases as measures of critical thinking: Associations with cognitive ability and thinking dispositions. *Journal of Educational Psychology, 100,* 930–941. doi:10.1037/a0012842

Williams, E. F., & Gilovich, T. (2008). Do people really believe they are above average? *Journal of Experimental Social Psychology, 44,* 1121–1128. doi:10.1016/j.jesp.2008.01.002

Wilson, T. D. (2002). *Strangers to ourselves: Discovering the adaptive unconscious.* Cambridge, MA: Harvard University Press.

Wilson, T. D., Houston, C. E., Etling, K. M., & Brekke, N. (1996). A new look at anchoring effects: Basic anchoring and its antecedents. *Journal of Experimental Psychology: General, 125,* 387–402. doi:10.1037/0096-3445.125.4.387

(*Appendix follows*)

Appendix

Bias Blind Spot Questionnaire

1. Outcome Bias

Psychologists have found that people tend to judge the quality of a decision based on how the decision worked out. That is, people sometimes forget that the quality of the decision must be judged on what was known at the time the decision was made, not how it worked out, because the outcome is not known at the time of the decision. It is a mistake to judge a decision maker's ability, after the fact, based mostly on the outcome of that decision. When people do this, it is called outcome bias.

a. To what extent do you believe that you are likely to commit outcome bias?

b. To what extent do you believe that the average JMU student is likely to commit outcome bias?

2. Framing Effect

Psychologists have shown that people tend to evaluate statements, arguments, or policies differently depending on the choice of words. This means that people's opinions of the very same policy or decision or product can be manipulated by slight changes in wording that don't change the meaning. For example, a food item labeled "98% fat free" is judged more attractive than one labeled "contains 2% fat." When people's opinions are manipulated based on a rewording that does not change the meaning, this is termed a framing effect.

a. To what extent do you believe that you are likely to be susceptible to framing effects?

b. To what extent do you believe that the average JMU student is likely to be susceptible to framing effects?

3. Base-Rate Neglect

Psychologists have shown that people tend to ignore overall probabilities when judging how likely something is and instead focus too much on the specific situation. For example, when judging the likelihood of a shark attack, people tend to focus on a news report of a single attack, rather than on the fact that although several million of people swim in ocean water, only a few people are killed by sharks every year. When people focus on the specific example and ignore the overall probability, this is termed base-rate neglect.

a. To what extent do you believe that you are likely to commit base-rate neglect?

b. To what extent do you believe that the average JMU student is likely to commit base-rate neglect?

4. Conjunction Error

Psychologists have found that people tend to rate conjunctions of events (situations where two or more events must each happen) as too likely. Conjunctions of events become less likely as the number of events grows. For example, (A) people might estimate that next year there is a 1% chance that a fire in California will kill 200 people. At the same time, (B) they might estimate that next year there is a 3% chance that an earthquake in California will cause a fire that will kill 200 people. However, if Event B (both earthquake and fire) happens, then Event A (fire) also happens, so Event A can't be less likely. When people fail to lower the probabilities as the number of conjoined events grows, this is called a conjunction error.

a. To what extent do you believe that you are likely to be susceptible to conjunction effects?

b. To what extent do you believe that the average JMU student is likely to be susceptible to conjunction effects?

5. Anchoring and Adjustment

Psychologists have found that people making numerical estimations tend to focus on any number that is available to help them. This is a good strategy, except in situations where the available numbers are unrelated to the quantity we are trying to estimate. For example, people report fewer headaches when they are asked: "How many headaches do you have a month—0, 1, 2—how many?" than when they are asked: "How many headaches do you have a month—5, 10, 15—how many?" When our estimations are affected by quantities that are irrelevant to what we are estimating, this is called an anchoring effect.

a. To what extent do you believe that you are likely to be susceptible to anchoring effects?

b. To what extent do you believe that the average JMU student is likely to be susceptible to anchoring effects?

6. Myside Bias

Psychologists have found that people do not evaluate the evidence fairly when they already have an opinion on the issue. That is, they tend to evaluate the evidence as being more favorable to their own opinion than it actually is. When people do this, it is called myside bias.

a. To what extent do you believe that you are likely to be susceptible to myside bias?

b. To what extent do you believe that the average JMU student is likely to be susceptible to myside bias?

7. Cell Phone Hazard

Researchers have found that drivers are four times more likely to be involved in a serious auto accident during those times when they are talking on cell phones. This effect has been called the cell phone hazard.

a. To what extent do you believe that you are (or would be more likely to be) more hazardous during times when you drive while using a cell phone?

b. To what extent do you believe that the average JMU student is (or would be more likely to be) more hazardous during times when they drive while using a cell phone?

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