*Research Article*

# Numeracy and Decision Making

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ABSTRACT—***A series of four studies explored how the ability to comprehend and transform probability numbers relates to performance on judgment and decision tasks. On the surface, the tasks in the four studies appear to be widely different; at a conceptual level, however, they all involve processing numbers and the potential to show an influence of affect. Findings were consistent with highly numerate individuals being more likely to retrieve and use appropriate numerical principles, thus making themselves less susceptible to framing effects, compared with less numerate individuals. In addition, the highly numerate tended to draw different (generally stronger or more precise) affective meaning from numbers and numerical comparisons, and their affective responses were more precise. Although generally helpful, this tendency may sometimes lead to worse decisions. The less numerate were influenced more by competing, irrelevant affective considerations. Analyses showed that the effect of numeracy was not due to general intelligence. Numerical ability appears to matter to judgments and decisions in important ways.***

Although many judgments and decisions rely heavily on understanding basic mathematical concepts, little research has examined the role of numerical ability, or numeracy, in decision tasks. Numeracy is defined as the ability to process basic probability and numerical concepts. Making good decisions in the real world requires some numerical ability. For example, Hamm, Bard, and Scheid (2003) found that greater numeracy was associated with more accuracy in making judgments about probabilities associated with prostate cancer screening. Gurmankin, Baron, and Armstrong (2004) found that less numerate individuals trusted verbal risk information more than numeric risk information from physicians, whereas more numerate individuals showed the opposite effect. Paulos (1988) argued that the inability to deal "rationally" with small likelihoods of large outcomes (e.g., a highly unlikely but catastrophic outbreak of a disease) results in misinformed government policies, confused personal decisions, and an increased susceptibility to pseudoscience. Recent research in numeracy (e.g., Lipkus, Samsa, & Rimer, 2001; Woloshin, Schwartz, Black, & Welch, 1999) suggests that people differ substantially in numerical ability and that many people are "innumerate" (Paulos, 1988). Data from the National Literacy Survey indicate that about half of Americans lack the minimal mathematical skills needed to use numbers embedded in printed materials (Kirsch, Jungeblut, Jenkins, & Kolstad, 2002). In today's increasingly technical world, innumeracy may be a critical obstacle to making good decisions in financial, medical, and other domains.

One goal of the present research was to relate numeracy to performance on decision problems that appear to rely on participants' ability to retrieve and use appropriate numerical principles. We suggest that some of the best-known effects in judgment and decision research, such as framing effects, may result particularly from those participants who are least likely to apply these numerical principles.

Studies 1 and 2 examined the hypothesis that the framing of numerical information has greater effects on the less numerate than the highly numerate. Studies 3 and 4 introduce the idea that numeracy influences affect and the clarity of affect toward numerical information in ways that matter to decision making.

## STUDY 1: NUMERACY AND ATTRIBUTE FRAMING

Results of framing studies suggest that information providers (e.g., physicians, advisors, con artists) can influence decisions without distorting information, merely by how they frame outcomes. In Study 1, we focused on attribute framing (Levin, Schneider, & Gaeth, 1998), in which a single attribute is the subject of framing. Levin and Gaeth (1988), for example, found that perceptions of the quality of ground beef depended on whether the beef was labeled as "75% lean" or "25% fat" (the beef was rated as better tasting and less greasy when given the former label).

Previous research has examined whether math skill is related to framing effects. For example, Stanovich and West (1998) found that decision makers with higher SAT scores were less likely to show a within-subjects effect of presenting risky choices in positive versus negative frames (e.g., the number of

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**TABLE 1**

*The 11 Items in the Numeracy Scale Developed by Lipkus, Samsa, and Rimer (2001) and Used in All Four Studies*

| Item | Percentage correct in Study 1 |
|---|---|
| 4. Which of the following numbers represents the biggest risk of getting a disease? 1 in 100, 1 in 1000, 1 in 10 | 96 |
| 5. Which of the following represents the biggest risk of getting a disease? 1%, 10%, 5% | 94 |
| 8A. If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 100? | 90 |
| 8B. If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1000? | 84 |
| 9. If the chance of getting a disease is 20 out of 100, this would be the same as having a ____% chance of getting the disease. | 84 |
| 6. If Person A's risk of getting a disease is 1% in ten years, and Person B's risk is double that of A's, what is B's risk? | 83 |
| 7. If Person A's chance of getting a disease is 1 in 100 in ten years, and Person B's risk is double that of A, what is B's risk? | 74 |
| 2. In the BIG BUCKS LOTTERY, the chances of winning a $10.00 prize are 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single ticket from BIG BUCKS? | 69 |
| 1. Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)? | 61 |
| 10. The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them are expected to get infected? | 56 |
| 3. In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets of ACME PUBLISHING SWEEPSTAKES win a car? | 46 |

**Note.** In Study 1, the mean score was 8.4, and the median was 9.

lives saved vs. the equivalent number of lives lost). Simon, Fagley, and Halleran (2004) found that among individuals high in need for cognition, those who rated their math skills as high were not influenced as much by the framing of risky choices as were those who rated their skills as low. To the best of our knowledge, no studies have examined the effects of actual number performance on the influence of frames, and especially attribute frames.

### Method

Participants ($N$ = 100, 45% female, mean age = 26) were recruited using a campus newspaper and were paid $10. Our measure of numeracy was the total number of correct responses to 11 items testing comprehension of probabilistic information (see Table 1). Framing effects were tested by presenting participants with the exam scores of five psychology students and asking them to rate each student's quality of work on a 7-point scale ranging from −3 (*very poor*) to +3 (*very good*). The framing of exam scores was manipulated between subjects; the scores were presented in terms of either the percentage correct or the percentage incorrect, so that "Emily," for example, was described as receiving either 74% correct or 26% incorrect on her exam. We predicted that the difference in ratings between the positive- and negative-frame conditions would be greatest among the least numerate individuals.

This study was administered as part of a series of paper-and-pencil experiments, with the numeracy measure and demographic items presented last. This same order (decision tasks, numeracy measure, and demographic items) was used for all the studies reported in this article.

### Results

The mean numeracy score was 8.4 (median = 9) out of 11 possible (range = 2–11; $\alpha$ = .68). Because the distribution was highly skewed, we performed a median split on the measure. Note that the results for the numeracy measure were similar in Studies 2 through 4, and we used a median split for analyses in those studies as well (sample sizes were small in two of our studies, making quartile and other splits less viable). Thus, our analyses compared the participants who were most numerate (9, 10, or 11 correct) with those who were less numerate (2–8 items correct). Although we recognize that dichotomous splits are associated with problems such as loss of power, the skewness in the variable justifies our choice (MacCallum, Zhang, Preacher, & Rucker, 2002). Results with quartile splits of numeracy were similar to those with median splits in Studies 1 and 4, which had the largest sample sizes.

In a repeated measures analysis of variance (ANOVA) of the performance ratings, the usual framing effect was found. The more positive frame elicited more positive ratings: Mean performance ratings were 0.7 and −0.1 for the percentage-correct (positive) and percentage-incorrect (negative) frames, respectively, $F(1, 96) = 26.3$, $p < .0001$, $\eta^2 = .54$. Numeracy did not have a significant main effect. The interaction of numeracy with frame, however, was significant, $F(1, 96) = 5.6$, $p < .05$, $\eta^2 = .11$. As hypothesized, less numerate participants showed a stronger framing effect than highly numerate participants[1] (see Fig. 1). This finding is consistent with the highly numerate being

[1]A numeracy quartile split showed a stronger framing effect among the less numerate. Mean differences between positive and negative frames were 1.3, 0.7, 0.5, and 0.3 for the lowest through highest quartiles, respectively.

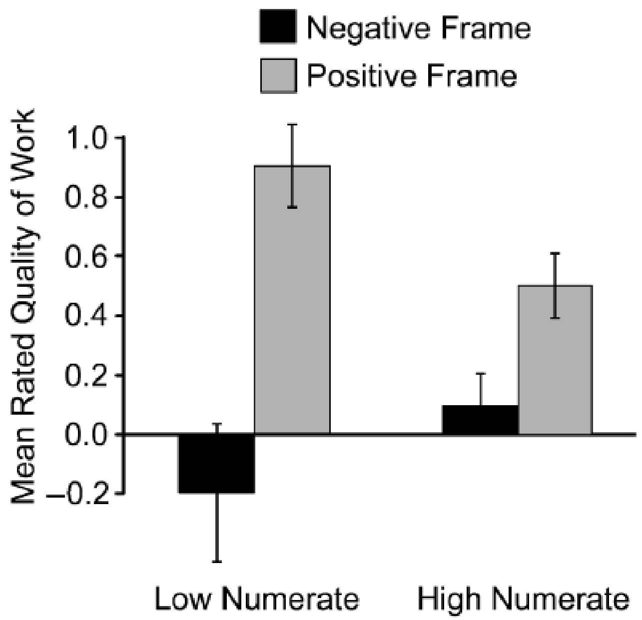


**Fig. 1.** Numeracy and attribute framing. Error bars represent standard errors of the mean.

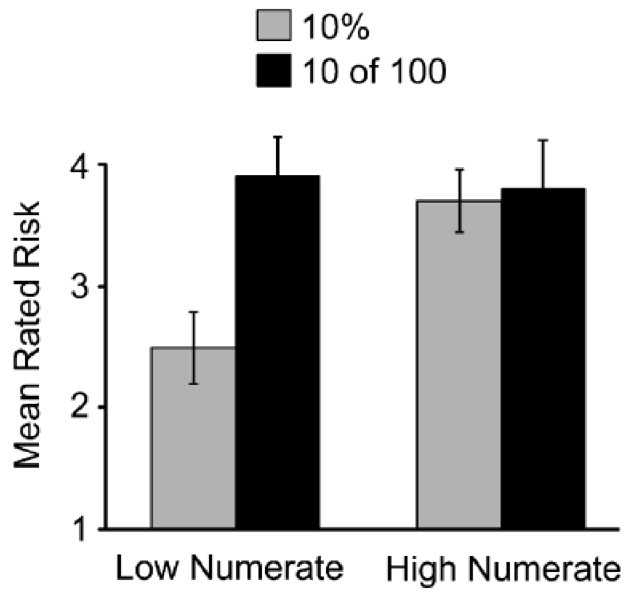


**Fig. 2.** Numeracy and percentage (10% of 100) versus frequentistic (10 out of 100) representations of risk. Error bars represent standard errors of the mean.

more likely to transform numbers from one frame to a different frame.

## STUDY 2: NUMERACY AND RISK REPRESENTATION

Dehaene (1997) suggested that although children spend considerable time learning the mechanics of math, they may not really understand how to apply those mechanics even in adulthood. We propose, however, that the likelihood of such application increases with numeracy, so that the highly numerate should find alternative frames of the same number more equally influential in judgments compared with the less numerate. In Study 2, we tested this hypothesis using a paradigm developed by Slovic, Monahan, and MacGregor (2000). They conducted studies in which experienced forensic psychologists and psychiatrists were asked to judge the likelihood that a mental patient would commit an act of violence. Clinicians told that "20 out of every 100" similar patients would likely commit an act of violence (a frequency frame) were more likely to refuse to discharge the patient than were clinicians told that the patient had a "20% chance" of committing an act of violence (a percentage frame).

We hypothesized that highly numerate participants, presented with a scenario similar to that used by Slovic et al. (2002), would be more likely than less numerate participants to retrieve the appropriate numerical principle and transform numbers from one format to another (i.e., 20 out of 100 = 20%). Thus, we expected that the format of presentation would affect judgments less among the more numerate than among the less numerate.

### Method

Participants were 46 volunteers from a psychology course who read the mental-patient scenario in either a frequency format ("Of every 100 patients similar to Mr. Jones, 10 are estimated to commit an act of violence to others during the first several months after discharge") or a percentage format that used the identical wording but substituted "10% are estimated" for "10 are estimated." Using a scale ranging from 1 (*low risk*) to 6 (*high risk*), they rated the level of risk that Mr. Jones would harm someone. They also responded to the same numeracy and demographic items used in Study 1. In addition, they reported their verbal and quantitative SAT scores, which served as a proxy measure for intelligence.

### Results

High-numeracy participants in both conditions and low-numeracy participants given the frequency frame rated Mr. Jones as presenting a medium risk. However, low-numeracy participants given the percentage format rated Mr. Jones as presenting a significantly lower risk (see Fig. 2); this interaction between format and numeracy was significant, $F(1, 42) = 4.0$, $p < .05$, $\eta^2 = .42$.

Is the numeracy effect due to intelligence rather than numeracy per se? Using SAT scores as a proxy for intelligence, we found that higher SAT scores (verbal and quantitative scores combined) were associated with greater numeracy ($r = .26$). However, after numeracy scores were regressed onto SAT scores, the numeracy residuals showed a significant pattern of results similar to the pattern in Figure 2, specific contrast $F(1, 30) = 6.9$, $p < .05$. We also obtained similar results when we controlled only for SAT quantitative scores (the results were somewhat weaker) and when we controlled for SAT verbal scores.

We suspect that high-numeracy participants have relatively equal access to the percentage and frequency formats regardless of the format in which information is presented to them, whereas low-numeracy participants consider only the format they are given. Unpublished follow-up studies by Slovic showed that representations of risk in the form of probabilities (10% of 100 patients) led to relatively benign images of one person, whereas the "equivalent" frequentistic representations (10 out of 100 patients) created frightening images of violent patients (e.g., "Some guy going crazy and killing someone"). He suggested that these affect-laden images likely induced greater perceptions of risk in response to the frequency frame, compared with the probability frame (Slovic, Finucane, Peters, & MacGregor, 2004). Although we did not test this idea directly in the present study, it is possible that less numerate participants are influenced greatly by the affective imagery elicited by the frequentistic format and do not have access to this affective imagery when given the percentage format. At the same time, highly numerate participants may access the affect and affective imagery regardless of whether they receive information in the frequency or probability format, so that their risk perceptions do not vary by format.

## STUDY 3: DOES COMPETING AFFECTIVE INFORMATION INFLUENCE THE LESS NUMERATE MORE THAN THE HIGHLY NUMERATE?

Information in decision making appears to be processed using two different modes of thinking: deliberative and affective-experiential (Epstein, 1994; Loewenstein, Weber, Hsee, & Welch, 2001; Sloman, 1996). How might differences in numerical ability influence how information is processed?

The deliberative mode is conscious, reason based, and relatively slow. In order to deliberate effectively in decisions involving numbers, the individual must have the ability, motivation, and capacity to process numerical information accurately even though the logic of "mental arithmetic poses serious problems for the human brain" (Dehaene, 1997, p. 118). When it comes to deliberating about numbers, the highly numerate clearly have an advantage. The experiential mode of thinking is primarily affective[2]; it is automatic, associative, and fast. It is likely related to gist processing in fuzzy-trace theory (Reyna & Brainerd, 1991) and may underlie humans' fuzzy and approximate concept of number (Dehaene, 1997). One of affect's primary functions is to provide meaning and motivation to choice processes (Damasio, 1994; Peters, in press). We explored the link between numeracy and affect in Studies 3 and 4.

In Study 3, we provided participants with two different representations of the same number (frequency and probability) and tested whether numeracy affected decisions nonetheless. We also began to examine whether numerical ability may influence the affective meaning of numbers. We measured both affect (the valence of feelings) and affective precision (the clarity of those feelings). Past studies have shown affective precision to predict judgments independently of affect (Hsee, 1996; Mellers, Richards, & Birnbaum, 1992).

We used a paradigm developed by Denes-Raj and Epstein (1994), who showed that when offered a chance to win a prize by drawing a red jelly bean from a bowl, participants often elected to draw from a bowl containing a greater absolute number, but a smaller proportion, of red beans (e.g., 9 in 100 or 9%) rather than from a bowl with fewer red beans but a better probability of winning (e.g., 1 in 10 or 10%). For these individuals, affective images of 9 winning beans in the large bowl appeared to dominate the image of 1 winning bean in the small bowl. When interviewed, many participants who had made nonoptimal choices reported a conflict between what they objectively knew were the better odds and how they felt about the bowl that offered a greater number of winners. A number of subjects indicated that the larger bowl "looked more inviting."

Affect can be a direct "hit" from an object (similar to Zajonc's, 1980, notion that affect comes before conscious deliberation), or it can be the result of prior deliberation. We propose that in this task, affect as a direct hit from the number of winning beans conflicts with affect from thinking about the stated probability. We hypothesized that compared with the less numerate, the highly numerate would be more likely to deliberate about and compare probabilities and would draw from this deliberation a more precise affective reaction that would guide their decisions. Lacking a clear affective understanding of numbers, the less numerate would rely instead on readily available but less relevant affective sources, such as the number of winning beans.

Thus, we predicted that less numerate adults, compared with highly numerate adults, would draw more often from the larger, affectively appealing bowl with less favorable objective probabilities. We also expected that affective reactions to the larger bowl, with its smaller probability of winning, would be more precise and more negative among the highly numerate than among the less numerate.

### Method

Participants ($N = 46$) from Study 2 also completed Study 3 during the same session. They were shown two drawings of bowls of colored and white jelly beans and told to imagine that they could select 1 bean, and if they selected a colored jelly bean, they would win $5. The larger bowl, A, contained 100 jelly beans, 9 of which were colored, and was labeled as having "9% colored jelly beans"; the smaller bowl, B, contained 10 jelly beans, 1 of which was colored, and was labeled as having "10% colored jelly beans." Participants were asked from which bowl they would prefer to choose (on a scale that ranged from 6, *strong*

[2]Affect is defined as positive and negative feelings about a stimulus (e.g., a bet).

*preference for A*, on the left, to 0 in the middle, to 6, *strong preference for B*, on the right); preferences for A were recorded as negative numbers prior to analysis. Participants were told to imagine that once they chose a bowl, it would be placed behind a screen, the beans would be mixed, and then they would draw a bean blindly from their chosen bowl.

After indicating their preference, participants were asked a question about their affective precision ("How clear a feeling do you have about the goodness or badness of Bowl A's 9% chance of winning?"), which they responded to on a scale ranging from 0, *completely unclear*, to 6, *completely clear*. Finally, they were asked about their affect ("How good or bad does Bowl A's 9% chance make you feel?"), indicating their response on a 7-point scale ranging from −3, *very bad*, to +3, *very good*.

### Results

Lower numeracy was linked to more suboptimal choices; the less numerate were significantly more likely to choose Bowl A than were the highly numerate (33% and 5%, respectively), $\chi^2(1, N = 46) = 5.2, p < .05$; mean scaled preference was 1.7 for the less numerate and 4.1 for the highly numerate, $t(44) = -2.5$, $p < .05$, $d = 0.75$. As in Study 2, we controlled for the effect of our proxy for intelligence. In this analysis, the less numerate were still more likely to make an objectively worse choice than the highly numerate (the difference was significant when controlling for SAT verbal scores and was marginally significant when controlling for overall or quantitative SAT scores).

Analysis of the affect variables revealed that numeracy was not significantly associated with affect about Bowl A's 9% chance (mean affect = −0.5 and −1.1 for low- and high-numeracy participants, respectively, $p = .13$, $d = .46$). However, the less numerate had less precise feelings about the 9% chance than the highly numerate did (affective precision = 3.7 and 5.0, respectively), $t(44) = -2.6$, $p < .01$, $d = 0.78$.

## STUDY 4: DO THE HIGHLY NUMERATE AND LESS NUMERATE RETRIEVE DIFFERENT AFFECT FROM PROBABILITIES AND NUMERICAL COMPARISONS?

In this study, we examined whether the highly numerate may sometimes make less "rational" responses than the less numerate precisely because they focus on the detail of numbers and draw more affective meaning from numerical comparisons. We used a paradigm (reported in Slovic et al., 2004) in which one group of subjects rates the attractiveness of a simple gamble (7 chances out of 36 to win $9; otherwise, win $0) on a scale from 0 through 20; a second group uses the same scale to rate a similar gamble with a small loss (7 chances out of 36 to win $9; 29 chances out of 36 to lose 5¢). With this paradigm, Slovic et al. obtained data that were anomalous from the perspective of economic theory. The mean rating of the first gamble was 9.4. When the possible loss of 5¢ was added to the gamble, the mean attractiveness jumped to 14.9, and there was almost no overlap between the distributions of responses for the two groups.

We hypothesize that these curious findings can be explained by affect and affective precision. According to this view, a probability maps relatively precisely onto the attractiveness scale, because it has an upper and lower bound and people know where a given value falls within that range. The highly numerate, who are expected to deliberate more about numbers than the less numerate, should draw a more precise affective reaction from probability's boundedness. In contrast, the mapping of a dollar outcome (e.g., $9) onto the scale is less precise, reflecting a failure to know whether $9 is good or bad, attractive or unattractive. Thus, the impression of the gamble offering a win of $9 and no losing payoff is dominated by the rather unattractive impression produced by the 7/36 probability of winning. However, adding a very small loss to the payoff dimension puts the $9 payoff in perspective (i.e., it makes the payoff more affectively precise to the subject) and gives it meaning. The combination of a possible $9 gain and a possible 5¢ loss has a very attractive win/lose ratio, leading to a relatively precise mapping onto the upper part of the attractiveness scale. Whereas the imprecise mapping of the $9 when it is not combined with a loss carries little weight, the more precise and favorable impression of the $9 in the context of the small loss carries more weight, thus leading to an increase in the overall favorability of the gamble. We reasoned, however, that the ease of mapping results from the $9: −5¢ bet creating a perception of upper and lower bounds similar to probability's boundedness and similar to comparing the 9% and 10% probabilities in Study 3. On the basis of the results in Study 3, we hypothesized that the highly numerate would draw more affective meaning from the $9:−5¢ comparison than the less numerate would, and thus would show a greater difference in their ratings of the two bets.

### Method

Participants were 171 volunteers from a psychology department's subject pool (54% female; mean age = 19). In a between-subjects design, participants were asked to rate their opinion about the attractiveness of playing a bet, using a 21-point scale ranging from 0, *not at all an attractive bet*, to 20, *extremely attractive bet*. Half of the participants responded to a bet that consisted of "7/36 chances to win $9 and 29/36 chances to win nothing" (the no-loss bet), and the other half of the participants responded to the bet "7/36 chances to win $9 and 29/36 chances to lose 5¢" (the loss bet). Participants were then asked to rate their affect and affective precision toward both the $9 win and the 7/36 chance of winning, using the same scales described in Study 3. They reported SAT verbal and quantitative scores and completed the numeracy scale and demographic items last.

### Results

Participants high in numeracy rated the objectively better no-loss bet as less attractive than the loss bet, $t(89) = 3.1, p < .01$

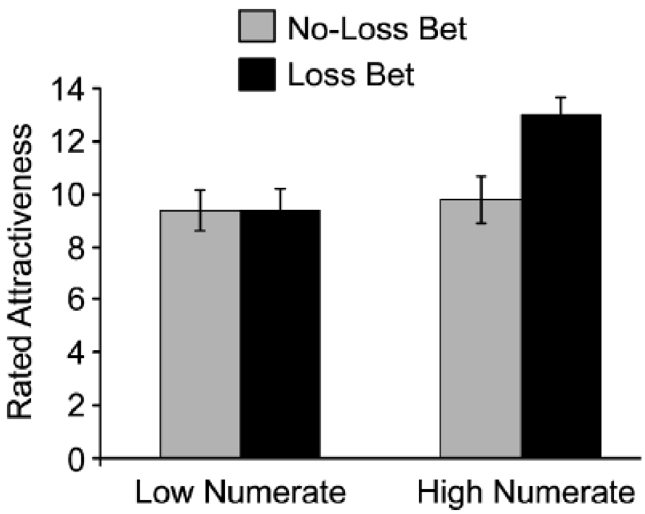


**Fig. 3.** Numeracy and rated attractiveness of a bet with and without a small loss. Error bars represent standard errors of the mean.

(see Fig. 3), whereas those lower in numeracy rated the two bets the same on average. A regression using the attractiveness rating as the dependent variable and bet condition (coded as no loss = 0 and loss = 1), numeracy (0 = low and 1 = high), and their interaction as independent variables revealed only a significant interaction, $t(1) = 2.2, p < .05, d = 0.34$. The analysis controlling for SAT scores showed that the highly numerate who responded to the loss bet rated their bet as more attractive than did the other three groups, specific contrast $F(1, 151) = 9.1, p < .01$.

The highly numerate had less negative feelings about the 7/36 chances of winning than the less numerate did (mean affect = 0.0 and −0.6, respectively), $t(169) = 2.7, p < .01, d = 0.44$. They also reported more clear feelings about the 7/36 chances of winning (mean affective precision = 4.5 and 3.9, respectively), $t(149) = 2.4, p < .05, d = 0.38$. The highly numerate had more positive affect toward the $9 win in the loss condition than in the no-loss condition, whereas the less numerate showed no significant differences in affect between the conditions, mean affect = 1.9 and 1.3 for the highly numerate in the loss and no-loss conditions, $t(89) = 2.3, p < .05, d = 0.47$, and mean affect = 1.0 and 1.3 for the less numerate in the same conditions, n.s. Affective precision to the $9 showed no significant differences.

In summary, the highly numerate found the loss bet more attractive than the no-loss bet; participants lower in numeracy rated the loss and no-loss bets as equally attractive. These findings suggest that the highly numerate may sometimes make worse decisions than the less numerate (although it could be argued that the small loss allowed only the highly numerate to recognize the goodness of this positive expected-value bet). The difference between the groups was linked with different feelings that they derived from the numbers. The highly numerate had more clear and less negative affect toward the 7/36 chances of winning. In addition, they had greater positive affect toward the $9, particularly in the loss condition.

These results are consistent with our hypothesis that compared with the less numerate, the highly numerate tend to derive more affective meaning (generally stronger or more precise affective meaning) from probabilities and numerical comparisons. We were also interested, however, in whether these affective differences mediated the impact of numeracy on the attractiveness ratings. To do this, we examined whether ratings of affect toward the 7/36 chance of winning mediated any main effect of numeracy on attractiveness ratings. First, a regression of the attractiveness scores indicated a significant main effect of numeracy on attractiveness, $F(1, 169) = 8.0, p < .01$. Second, in a regression of affect toward the 7/36 chances of winning, high-numeracy participants had less negative affect toward the 7/36 chances than those who were less numerate, $F(1, 169) = 7.2$, $p < .01$. A final regression of attractiveness ratings included affect to the 7/36 chances and numeracy as independent variables. Consistent with the hypothesized mediation, the influence of numeracy on attractiveness was no longer significant, but participants with greater positive affect toward the 7/36 chance rated the bet as more attractive, $b = 1.4, t(1) = 5.3, p < .001$; Sobel $z = 2.4$, $p < .05$. Precision of affect toward the 7/36 chance did not demonstrate mediation.

Finally, we tested whether ratings of affect toward the $9 win mediated the effect of high numeracy on the differential attractiveness of the loss and no-loss bets. We first demonstrated that high-numeracy participants in the loss condition rated their affect toward the $9 win as more positive than other participants did, $F(1, 169) = 8.5, p < .01$. A second regression showed that both the numeracy-by-condition interaction and affect toward the $9 were significant predictors of attractiveness ratings. Affect toward the $9 appeared to partially mediate the relation between the numeracy-by-condition interaction and attractiveness ratings, Sobel $z = 1.7, p < .10$. There was no evidence that affective precision toward the $9 mediated attractiveness ratings.

## GENERAL DISCUSSION

A series of four studies explored how the ability to understand and transform probability numbers relates to performance on judgment and decision tasks. Each task involved the processing of numbers; some tasks involved the processing of affect from the numbers themselves or from a competing source. Findings from Studies 1 and 2 were consistent with our hypothesis that compared with low-numeracy adults, high-numeracy adults are more likely to retrieve and use appropriate numerical principles and transform numbers presented in one frame to a different frame. We believe that low-numeracy decision makers are left with information that is less complete and less understood, lacking in the complexity and richness available to the more numerate. Results from Studies 3 and 4 were consistent with our hypothesis that the highly numerate tend to draw more affective meaning from probabilities and numerical comparisons than the less numerate do. Study 3 demonstrated that the less numerate were more influenced by an irrelevant affective source, perhaps because they drew less precise affective meaning from relevant numbers. In Study 4, the influence of numeracy on the attractiveness of the bet was partially mediated by affect. The alternative hypothesis that numeracy's effect on decisions is due to general intelligence was not supported by these studies.

The present research is an initial attempt to examine the roles of numeracy and affect in decision making. We examined the extent to which numerical ability serves as a mediator of decision performance (helping performance in some situations and hurting performance in others). Our measure of numeracy requires further development, but demonstrated fairly strong relations with decisions nonetheless. We also examined whether numeracy influences affect and affective precision and found that affect partially mediates the influence of numeracy in some decisions. This research adds to the growing body of knowledge concerning how affective and deliberative ways of thinking may influence important effects in decision making. It also demonstrates that individuals may differ in the type of assistance they need in making decisions. Those low in numerical ability may need different decision aids than those high in numerical ability.

*Acknowledgments*—We thank Yuval Rottenstreich, Isaac Lipkus, Robert Mauro, and Barbara Fasolo. This work was supported by the National Science Foundation (0339204).

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(RECEIVED 4/15/05; ACCEPTED 7/14/05;
FINAL MATERIALS RECEIVED 8/3/05)