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Cognitive–Experiential Self-Theory and Subjective Probability: Further Evidence for Two Conceptual Systems

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Three experiments (N = 1,331) demonstrated that research findings on suspiciousness about coincidences (Miller, Turnbull, & McFarland, 1989) can be accounted for in terms of subjective probability, as predicted by cognitive–experiential self-theory (CEST) but in contrast with the norm theory (NT) account offered by Miller et al. (1989). Ss participated in a hypothetical (Experiments 1 and 2) or real (Experiment 3) lottery game in which they chose between 2 bowls offering equivalent probabilities of winning or losing but differing with respect to absolute numbers (e.g., 1 in 10 vs. 10 in 100). Responses across 4 conditions (2 probability levels × 2 outcome types) and across the 3 experiments supported predictions derived from CEST but not those derived from NT. Results are discussed in terms of 2 conceptual systems, rational and experiential, that operate by different rules of inference.

Cognitive psychologists over the past several decades have adopted and investigated an explanation for irrational decision making based on a model of humans as limited-capacity information processors who use cognitive shortcuts, or *heuristics*, to solve problems that arise in everyday living (for reviews, see Fiske & Taylor, 1991; Kahneman, Slovic, & Tversky, 1982; Tversky & Kahneman, 1973). Our research is motivated by an alternative approach to irrational thinking and behavior that is compatible with, but distinct from, this tradition.

Cognitive–experiential self-theory (CEST) posits a distinction between two partially independent information-processing systems, a *rational system* that operates according to a person's understanding of conventionally established rules of logic and evidence and an *experiential system* that processes information automatically and more simply. According to CEST, the experiential system, which has a much longer evolutionary history than the rational system, represents events in the form of concrete exemplars rather than abstract symbols, is shaped by emotionally significant past experience, is outcome- rather than process-oriented, and operates automatically outside of or at the fringes of conscious awareness (Epstein, 1990). Heuristics exemplify the operation of the experiential system as a rapid, action-oriented system. However, within limits, subjects are able to switch to a more analytic, logical mode of thought when they are motivated to do so. In the language of CEST, this represents a switch from experiential to rational thinking (see Epstein, 1983, 1990, 1991, for more detailed reviews of the operation of the experiential and rational systems).

In a previous article (Epstein, Lipson, Holstein, & Huh, 1992), we demonstrated that CEST can account for many findings generated by research on norm theory (NT; Kahneman & Miller, 1986), one recent and influential variant of the social-cognitive tradition, as well as some findings for which norm theory has no explanation. The previous research provided evidence in support of two ways of processing information, one consistent with the experiential system and the other with the rational system. The present research was undertaken to provide further evidence for the existence of two systems of information processing. More specifically, we wished to demonstrate that, by using techniques that bypass the implicit demand characteristic to present oneself as rational, or that effectively engage the experiential system, we would obtain increasingly strong evidence of the heuristic responding characteristic of the experiential system. We used an experimental paradigm adapted from a study by Miller, Turnbull, and McFarland (1989) in which subjects had been shown to regard certain outcomes as more likely than others despite their objective probabilities being identical.

In the sections that follow, we review the Miller et al. (1989) research, discuss several shortcomings of the NT explanation for these findings, and explain how CEST offers an alternative account for the same results. We then present a series of studies designed to demonstrate the usefulness of CEST for overcoming the limitations inherent in the NT account.

Suspiciousness About Coincidences

Miller et al. (1989) reported a series of vignette studies demonstrating that two equally improbable events evoked different levels of suspiciousness depending, presumably, on the number of ways in which the outcomes could be mentally replicated. In

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one study, subjects responded to a vignette in which a child successfully draws a preferred cookie from a jar containing either 1 preferred cookie and 19 nonpreferred ones or 10 preferred cookies and 190 nonpreferred ones. Subjects in the former condition reported that they were more suspicious that the child had cheated (by peeking) than in the latter condition. Similar results were obtained in four additional studies using a number of variations. In each study, probabilities described in terms of ratios of small numbers influenced subjects' judgments differently from the same probabilities described in terms of larger numbers.

According to the explanation of Miller et al. (1989), the differential levels of suspiciousness can be attributed to postoutcome processing: "The key to this account is the distinction between precomputed judgments of probability and postcomputed judgments of normality" (p. 582). That is, subjects' precomputed probability judgments are assumed to be identical for the two events. After learning of the outcome, however, subjects presumably engage in a mental simulation process in which they imagine other ways, referred to as *counterfactual alternatives,* in which the outcome might have occurred. The readiness with which alternatives can be imagined determines the "normality" of an event. According to Kahneman and Miller (1986), "an abnormal event is one that has highly available alternatives, whether retrieved or constructed; a normal event mainly evokes representations that resemble it" (p. 136). Abnormal events evoke more surprise, distress, and suspicion than normal ones. In the cookie-jar scenario, drawing the 1 desired cookie from a jar containing 19 other cookies was considered to be more abnormal, and therefore it was expected to arouse greater suspicion than drawing 1 of the 10 desired cookies from a jar containing 190 other cookies.

Problems With the NT Explanation for Suspiciousness

We do not question the value of NT for elucidating postoutcome processing of events, in general. When people miss a flight by a few minutes, it is understandable that they think about what they might have done to avoid the unfortunate outcome. Such hindsight under many circumstances has obvious adaptive advantages. These are the kinds of situations that NT was originally meant to explain (Kahneman & Miller, 1986), and it has made a valuable contribution in doing so. In the case of the suspiciousness paradigm, however, we believe that NT has been extended beyond its range of applicability. In the following sections we outline three problems with the account offered by Miller et al. (1989).

Similar Versus Dissimilar Counterfactual Alternatives

According to NT, postcomputed normality judgments are predicated on the number of ways the outcome might have occurred otherwise. However, the theory seems ambiguous with respect to which counterfactual alternatives subjects are presumed to consider. Previous applications of norm theory (Kahneman & Miller, 1986; Kahneman & Tversky, 1982) have emphasized imagining counterfactual alternatives that are different from the outcome that actually occurred. For example, subjects regard narrowly missing a plane as particularly upsetting because they readily imagine an alternative scenario in which the protagonist reaches the plane on time.

In the suspiciousness paradigm, however, Miller et al. (1989) derived hypotheses by considering only the number of other ways in which an outcome *similar* to the actual outcome might have occurred. For example, they defined the normality of drawing a chocolate chip cookie in terms of the number of chocolate chip cookies in the jar, not the number of oatmeal cookies. According to previous statements of NT, it seems to us that subjects could just as well consider the possibility of drawing oatmeal cookies, which clearly would qualify as a "counterfactual alternative." This is a crucial point, because if subjects focused predominantly on the oatmeal cookies, the predictions derived from NT would be reversed, and if they focused equally on both alternatives, there would be no basis for making predictions one way or the other.

On what grounds, then, might NT be said to predict that subjects focus on chocolate chip rather than oatmeal cookies? The most reasonable interpretation is simply that one of the two possible outcomes was made salient by telling subjects that it had actually occurred. In the cookie-jar experiment, subjects were informed that a chocolate chip cookie had been selected and then asked how suspicious this seemed; presumably, this focused subjects' attention on chocolate chip cookies. In light of NT's ambiguity on this point, we regard this salience principle as the most reasonable basis for deriving predictions from NT in the experiments reported below.[1]

Subjective Probability

It seems to us that a more parsimonious explanation for the Miller et al. (1989) results is available. Miller et al. (1989) added a control condition in each of their first four studies to rule out an explanation for their findings in terms of subjective probability. In the cookie-jar experiment, control groups of 20 subjects each read one of the two scenarios, with information about the outcome omitted. One group read about the cookie jar containing 1 chocolate chip and 19 oatmeal cookies, whereas the other read about the jar containing 10 chocolate chip and 190 oatmeal cookies. In each condition subjects were asked to "estimate the likelihood that the child would select a chocolate chip cookie" on an 11-point scale ranging from 0% to 100%. The likelihood estimates did not differ significantly between the conditions, leading the authors to conclude that the suspiciousness results could not be explained in terms of differences in precomputed subjective probability.

However, the mathematically oriented questions and re-

[1] This salience explanation is also consistent with findings from previous NT experiments in which subjects presumably focused on alternatives different from the outcome that actually occurred. In the various studies reviewed by Miller, Turnbull, and McFarland (1990), the experimental manipulations were designed to focus subjects' attention on the outcome that did not occur—in their words, "what might have been"—rather than on the outcome that did occur. For example, missing a plane by only minutes is presumably more upsetting than missing it by a half hour because it calls attention to (i.e., makes salient) the outcome that almost occurred (but did not), namely, making it to the plane on time.

sponse scale used in these control conditions more likely assessed subjects' knowledge of statistics rather than their subjective, or intuitive, impressions about the chances offered by the respective jars. Subjects' estimates of objective probability can be very different from their experience of subjective probability. From the perspective of CEST, it is not paradoxical to say that a person might understand, rationally, that two ratios are mathematically equivalent but at the same time may feel subjectively (experientially) that the odds described by one ratio are more favorable than by the other. In fact, it is just such findings that would provide experimental evidence for two distinct ways of processing information.

According to CEST, given identical ratios of a winning outcome among other outcomes, the odds will appear more favorable when the ratio is expressed in terms of larger (e.g., 10 in 200) than in terms of smaller (e.g., 1 in 20) absolute numbers. This hypothesis follows from two attributes of the experiential system, the concretive principle and the experiential learning principle. According to the concretive principle, people encode information in the experiential system primarily in the form of concrete representations. Because absolute numbers are more concrete than ratios, it follows that subjects will be unduly influenced by absolute numbers. Moreover, ratios between large numbers may seem (experientially) less extreme than ratios between small numbers. This also follows from the concretive principle, because large numbers of items are less articulated in memory (i.e., are less concrete) than small numbers and are therefore more apt to be perceived as closer to a ratio of equal quantities. This follows, in part, from the fact that people can keep only about seven bits of information in short-term memory. They can therefore represent 1 versus 10 items in memory fairly accurately, but the same is not true for 10 versus 100 (e.g., try imagining 1 vs. 10 matchsticks, then 10 vs. 100.) Support for the assumption that small numbers are encoded in a more articulated manner than large numbers is provided by research that has indicated that people judge the distance between smaller numbers as greater than that between larger numbers (Banks, Fujii, & Kayra-Stuart, 1976; Holyoak, 1978).

According to the experiential learning principle, the schemata in the experiential system represent, to a considerable extent, generalizations from emotionally significant experiences (Epstein, 1973, 1983, 1985, 1990; Epstein et al., 1992). Individuals are likely to have learned that any event with, for example, a 1-in-20 (or a 1-in-any-large-number) probability of occurrence is highly unlikely to occur. Life is full of experiences in which people face long odds as one individual among many, for example, one among a host of job candidates. Moreover, the phrase "1 in *X* odds" is a common part of everyday speech and is generally understood to mean "unlikely." In short, we suspect that, based on emotionally significant personal experience, the subjective probability of a 1-in-10 outcome is smaller than that of a 10-in-100 outcome. Thus, the experiential learning principle supplements the concretive principle in supporting the prediction that an unusual event with a given objective probability of occurrence will have a higher subjective probability when it is represented by larger than by smaller absolute numbers.

Inefficiency of Imagining Counterfactual Alternatives

The essence of heuristic procedures is that they are efficient cognitive shortcuts for processing information quickly, with minimum cognitive effort. This is clearly not the case when choice decisions of the kinds investigated by Miller et al. (1989) are made through imagining counterfactual alternatives, which would be much more effortful and time consuming than other procedures that could readily be used, ones that we will show are associated with subjective probability estimates.

Disentangling the Two Explanations

The preceding discussion indicates that NT and CEST yield similar predictions for Miller et al.'s (1989) five studies: Both theories, for example, predict that subjects will be more surprised or suspicious when an event occurs against 1-in-10 odds than against 10-in-100 odds. However, two kinds of critical tests can be conducted to disentangle the two explanations.

Examination of Preoutcome Judgments

Most important, the CEST account does not restrict the phenomenon to postoutcome processing. That is, it should be possible to detect pre- as well as postoutcome differences in subjective probabilities for these event pairs, and they should operate by the same principles of subjective probability. Consider the following variation on the Miller et al. (1989) cookie-jar experiment. Subjects are presented with two bowls of lottery tickets: A "large bowl" contains 10 winning tickets and 90 blank (nonwinning) tickets and a "small bowl" contains 1 winning ticket and 9 blanks. Given the choice, which bowl would most people prefer to draw from? NT predicts that subjects should have no preference, as it is only after the outcome of the draw is known that the crucial factor of postcomputed counterfactual alternatives comes into play. CEST, on the other hand, predicts that subjects will prefer the large bowl because the subjective probability of selecting a preferred cookie is greater for that bowl.

Of course, it is possible that NT is incorrect in assuming that postoutcome processing is a necessary condition for the biases observed but that the other principles it assumes are correct. In that case, both theories would agree, although for different reasons, that subjects will prefer the large bowl. We refer to NT modified to eliminate the assumption that postoutcome processing is a critical factor as *modified NT.*

Varying the Probability Levels

Second, the principles postulated by CEST for explaining the cookie-jar results differ from those of NT, and situations can be constructed in which the predictions of the theories diverge. Imagine another version of the lottery scenario in which the odds are reversed: One bowl now contains 9 winners and 1 blank; the other contains 90 winners and 10 blanks. Now which bowl would most people choose? Disregarding the pre- versus postoutcome issue, if modified NT is consistent in assuming that subjects imagine only the number of ways that the more salient outcome can occur, it should again predict that subjects will favor the large bowl because it contains more winners, that is, getting a winner is more "normal" for that bowl. CEST, on the other hand, predicts that subjects will favor the small bowl because *1-in-10* describes the odds of drawing a nonwinner from that bowl, an outcome that is subjectively regarded as highly unlikely according to the concretive and experiential learning principles. Although we assumed that modified NT would be consistent with previous research (Miller et al., 1989) in assuming that subjects would attend to whichever outcome was made salient (in this case, winning tickets), we remind the reader that NT is ambiguous with respect to which alternative subjects focus on.

Varying the Valence of Outcomes

The two scenarios described earlier represent two of the four conditions used in the experiments reported below. A switch from cookies to lottery tickets was made, in part, to accommodate another variation in which we were interested, namely, the difference between positive and negative outcomes. Two additional conditions were constructed in which winning tickets were replaced by losing tickets. In Condition 3, one bowl contained 1 losing ticket and 9 blanks and the other 10 losing tickets and 90 blanks. In Condition 4, one bowl contained 9 losing tickets and 1 blank and the other 90 losing tickets and 10 blanks.

It is not clear from modified NT whether subjects in these conditions would be expected to focus on the number of losing tickets or on the number of blank tickets. One possibility is that because losing money is an attention-grabbing prospect, losing tickets would be more salient than blanks; if so, subjects should favor the small bowl in both Conditions 3 and 4, as the small bowl contains fewer losing tickets in each case. Conversely, if blanks are more salient to subjects—perhaps because they are concentrating on trying to get one—subjects should favor the large bowl in both conditions because it contains more blanks than the small bowl. In either case, however, the modified NT principle requires the same prediction to be made for Conditions 3 and 4.

In contrast, CEST predicts that subjects will favor the small bowl in Condition 3 because, according to the concretive and experiential learning principles, the 1-in-10 odds of drawing a losing ticket from the small bowl seem remote compared with the odds of drawing a losing ticket from the large bowl. Conversely, according to the same principles, subjects should favor the large bowl in Condition 4, as the odds of drawing a losing ticket from the small bowl (that contains 9 in 10 losing tickets) seem compellingly large.

Varying Experiential Engagement

Finally, the CEST explanation for the original Miller et al. (1989) results, and for the variations described earlier, posits that subjects can experience definite preferences at an intuitive (experiential) level, while recognizing that on a rational basis there are no legitimate grounds for the preferences. From this perspective, we suspect that the suspiciousness question in the Miller et al. (1989) cookie-jar scenario effectively tapped experiential thinking (and therefore produced significant results), whereas the likelihood question in the control condition tapped rational responding (and therefore yielded null results). Conditions that foster experiential thinking and responding should yield stronger evidence of subjective probability effects than conditions that foster rational thinking. As will become apparent, our studies were designed to illustrate this principle in several ways.

Overview

Although CEST and NT generate identical predictions regarding subjects' postoutcome decisions in Miller et al.'s (1989) suspiciousness scenarios, NT predicts that irrational preferences should be exhibited only for postoutcome processing, whereas CEST predicts the phenomenon should also be exhibited for preoutcome processing. CEST and modified NT (applicable to preoutcome processing) make different predictions regarding subjects' differential decisions in response to low and high probabilities of various anticipated outcomes. CEST bases its predictions on subjective probability estimates that are influenced by concretive and experiential learning principles, whereas modified NT bases its predictions on subjects' visualization of alternatives that are unrelated to subjective probability estimates. Finally, based on the CEST assumption that there are two modes of processing information, one associated with an experiential and the other with a rational conceptual system, different results should be obtained depending on the degree to which the experiential conceptual system is engaged and the rational system bypassed. So far as we know, NT has no prediction to make in this regard, as it should be possible to entertain the possibility of counterfactual alternatives intuitively (without awareness) or rationally (with awareness). Following are the results of three studies designed to examine these predictions.

Experiment 1

Experiment 1 was designed to (a) test the hypothesis that differences in response to the same ratios expressed in different absolute numbers (e.g., 1-in-10 vs. 10-in-100) can be observed in preoutcome judgments and (b) compare the predictions of CEST and modified NT across four conditions in which odds and valence of outcome are varied. The four conditions were arranged in a 2 × 2 experimental design for odds (10% vs. 90%) and valence of outcome (win vs. lose). The dependent variable was choice of bowl (large vs. small).

The critical test was the interaction of Outcome Valence × Outcome Odds in predicting bowl choice. Whereas CEST predicts an interaction, modified NT predicts no interaction and, instead, predicts either (a) an absence of a valence effect in which subjects manifest an overall preference for the large bowl across all four conditions or (b) a main effect for outcome valence in which subjects prefer the large bowl in win conditions and the small bowl in lose conditions.

In addition to obtaining information on subjects' preference of bowls, we also had them report whether and, if so, how much they would be willing to pay for the privilege of drawing from the bowl of their choice. On a strictly rational basis, subjects should be willing to pay nothing. Thus, the amount they indicate they would pay provides information on the degree to which they acknowledge that they would behave nonrationally (and in a manner consistent with the operation of the experiential system).

Method

Subjects. A total of 649 patrons of a cafeteria on a large, northeastern university campus participated in the study. Virtually all of those approached agreed to participate.

Procedure. Cafeteria patrons were approached by one of four experimenters and asked to spend a few minutes participating in a study of decision making. Consenting subjects were given a brief paragraph to read, which described one of four conditions. The vignette for the 10% win condition was as follows:

> Imagine that you are presented with two bowls of folded tickets. One bowl contains 1 ticket marked "winner" and 9 blank tickets. The other bowl contains 10 tickets marked "winner" and 90 blank tickets. You must draw one ticket (without peeking, of course) from either bowl: If you draw a ticket marked "winner" you win $8.00, otherwise you win nothing and the game is over.

The vignette was identical for the 90% win condition except that the respective bowls were described as containing (a) 9 winners and 1 blank and (b) 90 winners and 10 blanks. The 10% lose and 90% lose conditions were identical to the respective win conditions except that the word *winners* was replaced by the word *losers,* so that drawing a losing ticket meant that the subject would lose $8.[2]

In each condition, two questions were listed below the vignette: "If you were given the choice, which bowl would you choose from?" and "How much would you be willing to pay for the privilege of choosing which bowl you will draw from, rather than having the bowl picked for you? (Check the largest amount you would be willing to pay.)" The response alternatives were *nothing, 1 cent, 5 cents, 10 cents, 25 cents, 50 cents,* and *$1 or more.* After examining the frequency distribution for this variable, we decided to collapse the data into a simple pay–no-pay dichotomy. Experimenters asked a subsample of approximately 40 subjects per condition to record their thoughts during the decision-making process on the backs of the forms.

Results

Choice of bowls. Table 1 displays the numbers and percentages of subjects choosing the large versus the small bowl in each of the four conditions along with the results of a 2 × 2 logit analysis predicting bowl choice from outcome valence and outcome odds. As predicted by CEST, the interaction of Outcome Valence × Outcome Odds was highly significant (see Table 1). A significant main effect for outcome odds was also observed, according to which subjects' preference for the large bowl was stronger in the 90% odds conditions than in the 10% odds conditions, but this effect can only be meaningfully interpreted in light of the interaction. The main effect of outcome valence failed to approach significance. The intercept term was marginally significant ($p < .07$). Across the four conditions, a slight majority of subjects (53.6%) tended to choose the small rather than the large bowl.

The significant Outcome Valence × Outcome Odds interaction was examined further by testing the effect of outcome odds separately within each outcome valence condition. As predicted by CEST, a significant difference was observed between the 10% and 90% lose conditions (34.6% vs. 54.1%, respectively, picked the large bowl), $\chi^2(1, N = 316) = 12.24$, $p < .001$. However, the difference that was predicted by both CEST and modified NT between the two win conditions (49.4% vs. 47.5%) did not approach significance.

Examination of the individual conditions revealed that in the 10% win condition, the responses were evenly divided between preference for the large and small bowl (Table 1). However, in accord with our prediction, subjects' preference for the small bowl (65.4%) in the total sample for the 10% lose condition was significantly greater than chance ($Z = 3.80$, $p < .001$).

Willingness to pay. A logit analysis of the pay variable revealed significant main effects for outcome valence, outcome odds, and the intercept term. Overall, most subjects were unwilling to pay. The intercept term indicated that the proportion of subjects willing to pay (25.1%) was significantly less than 50%, $\chi^2(1, N = 649) = 145.51$, $p < .001$. The main effect for outcome valence resulted from more subjects being willing to pay in the win condition (29.9%) than in the lose condition (20.3%), $\chi^2(1, N = 649) = 8.49$, $p < .01$. The main effect for outcome odds resulted from more subjects being willing to pay in the 10% (28.5%) than in the 90% odds conditions (21.7%), $\chi^2(1, N = 649) = 4.60$, $p < .05$. The interaction of Outcome Valence × Outcome Odds was not significant ($p > .25$).

Discussion

Some of the results supported predictions based on the CEST concretive and experiential learning principles but not the NT principle of imagining counterfactual alternatives. However, although the critical tests were statistically significant in the overall analyses, the effect sizes were less than overwhelming, particularly for individual conditions. For example, the proportion of subjects favoring one bowl over the other in the total sample was significantly different from .5 in only one condition.

We suspect that the primary reason the results were not stronger is the failure of the task to adequately tap experiential system responding. The demand characteristics of the situation, in which subjects were asked to choose between two bowls with objectively identical probabilities of winning or losing, may have led many subjects to choose arbitrarily, thereby contributing to the null results, a suspicion that was confirmed by subjects' spontaneous comments.

Analysis of the pay variable with respect to both qualitative and quantitative responses offered some interesting insights in its own right. First, it indicated that about three quarters of the subjects responded in a rational rather than an experiential manner by indicating they would not pay for the privilege of selecting between the two bowls with equal probabilities. Second, among the minority of those who responded irrationally, many did so in the form of associationistic thinking, one of the attributes of the experiential system. For example, these subjects made statements such as "I'm willing to pay to win, but why should I pay if I can only lose?" Similarly, they said they would pay in a 10% condition, but not in a 90% condition, because "the outcome in the 90% condition is almost certain, so I can't influence it like I can in the 10% condition." Here, they failed to realize that a 90% chance of one outcome is no more or less determined than a 10% chance of the opposite outcome.

Subjects' self-reports about their thought processes suggest that people are intuitively aware of the existence of rational and experiential systems that can be at odds with each other. Among those who made choices they were willing to pay for,

[2] Occasionally, a subject in the lose conditions would ask why anyone would participate in a trial in which they could only lose. They were told that, for reasons relating to the experiment, we wanted to know how people would respond if they had to participate in such a situation.

Table 1
Results of Experiment 1: All Subjects Included (N = 638)

Outcome odds	Win conditions 10%	Win conditions 90%	Lose conditions 10%	Lose conditions 90%	Total
No. choosing small versus large bowl	82/80	84/76	104/55	72/85	342/296
% choosing large bowl	49.4	47.5	34.6	54.1	46.4

Source	χ^2	*df*	*p*
Intercept	3.44	1	.06
Outcome valence	1.16	1	.28
Outcome odds	5.13	1	.02
Type × Odds	7.48	1	<.01

most attributed their preferences to the greater absolute number of winners, or to the lesser absolute number of losers, in one bowl than in the other. Typical comments were "I know the odds are the same, but 10 winners seem more hopeful than I" and "The odds are 1:10 in both bowls, so there's really no difference, but the chances of picking a winner seem better with the bowl that has 10 winners in it." A few others said they could give no reason for their preference, but simply "felt" that one bowl offered a better chance of winning. Most subjects (the "rational" responders) reported that, because the probabilities were identical, they made their selections arbitrarily and would pay nothing for guaranteeing them. Thus, people who behaved in a rational way were able to articulate their reasons. Those who responded in the mode of their experiential systems referred either to vague feelings or to differences in absolute numbers.

The emphasis on absolute numbers is consistent with CEST's assumption that the experiential system is biased toward processing information in terms of concrete exemplars rather than by more abstract representations, such as ratios. It is also consistent with the NT principle of imagining alternatives. However, not a single one of the self-reports we obtained described anything remotely resembling imagining counterfactual alternatives.

Experiment 2

From the perspective of CEST, the effectiveness of our procedures to detect differences in subjective probability hinges largely on the degree to which the task engages subjects' experiential rather than their rational systems. The results of Experiment 1 suggested that many subjects maintain a rational response set when asked to envision how they would actually respond.

Experiment 2 was designed to alter the implicit demand characteristics to present oneself as a rational person. We attempted to accomplish this by (a) explicitly informing subjects that the probabilities associated with the respective bowls are identical (thus eliminating subjects' need to prove to us that they knew this) and (b) informing them that, despite the equal probabilities, many people prefer one bowl over the other and that the subject's task was to predict which bowl most people prefer.

Method

Subjects. A total of 630 subjects was drawn from the same population as in Experiment 1. Again, virtually all patrons approached agreed to participate.

Procedure. The procedure was identical to Experiment 1, except for the focus on predicting others' choices rather than one's own. In the 10% win condition the vignette read

> Imagine that someone is presented with two bowls of folded tickets. One bowl contains 1 ticket marked "winner" and 9 blank tickets. The other bowl contains 10 tickets marked "winner" and 90 blank tickets. The person must draw one ticket (without peeking, of course) from either bowl: If he/she draws a ticket marked "winner" he/she wins $8.00, otherwise he/she wins nothing and the game is over.
>
> Even though the odds are identical for the two bowls, research shows that many people have a distinct preference as to which of these bowls they would rather draw from. Which bowl do you think most people choose in this situation?

The other three conditions were varied in the same way as in Experiment 1, yielding the same 2 (outcome valence) × 2 (outcome odds) experimental design. Below the vignette were listed the same two questions as in Experiment 1, modified appropriately for the new instructions. Subjects were first asked to indicate which bowl most people would select and then asked, "How much do you think the *average person* would be willing to pay for the privilege of choosing which bowl they will draw from, rather than having the bowl picked for him/her? (Check the largest amount he/she would pay.)" The response scale was identical to that in Experiment 1.

Results

Choice of bowls. Table 2 presents the numbers and percentages of subjects choosing the respective bowls and the results of a logit analysis of these responses. The pattern of percentages in row 2, reflecting the bowl choices of all subjects, follows the general pattern predicted by CEST: Subjects' preference for the large bowl was stronger in the 10% win and 90% lose conditions than in the other two conditions. The Outcome Valence × Outcome Odds interaction was highly significant (see Table 2). Neither main effect was significant. However, unlike Experiment 1, the intercept term was significant in this analysis, which resulted from most subjects preferring the large bowl to the small bowl across the four conditions. This effect was qualified, however, by a significant interaction.

Table 2
Results of Experiment 2: All Subjects Included (N = 628)

	Win conditions		Lose conditions		
Outcome odds	10%	90%	10%	90%	Total
No. choosing small versus large bowl	56/100	70/90	74/82	52/104	252/376
% choosing large bowl	64.1	56.3	52.6	66.7	59.9

Source	χ^2	*df*	*p*
Intercept	24.55	1	<.01
Outcome valence	0.01	1	.91
Outcome odds	0.64	1	.42
Type × Odds	7.83	1	<.01

As in Experiment 1, there was a significant effect for odds within the lose condition, $\chi^2(1, N = 312) = 6.44$, $p < .01$. A higher percentage of subjects reported that people would favor the large bowl in the 90% than in the 10% lose condition, in keeping with CEST. Although this pattern, as predicted by CEST, was reversed in the win conditions, the difference between the win conditions was short of significance, $\chi^2(1, N = 316) = 2.03$, $p = .15$. In the critical 10% win condition, 64.1% of subjects indicated that most people would choose the large bowl; this percentage differed significantly from the 50% value expected by chance ($Z = 3.44$, $p < .001$). Subjects' preference for the large bowl was also significantly different from chance in the 90% lose condition ($Z = 4.09$, $p < .001$).

Willingness to pay. A total of 379 of the 630 subjects (60.2%) indicated that most people would be willing to pay for their bowl choice. This was more than twice the rate of affirmative responses in Experiment 1. The difference between the two studies was highly significant, $\chi^2(1, N = 1,279) = 160.69$, $p < .001$. A logit analysis of the pay variable revealed that the overall percentage of affirmative pay responses (60.2%) was significantly greater than 50% in Experiment 2, $\chi^2(1, N = 630) = 25.73$, $p < .001$. Further analysis revealed that, as in Experiment 1, subjects believed that most people would be more likely to pay in the win (65.3%) than in the lose (55.0%) conditions.

Discussion

That we succeeded in reducing the demand characteristics for presenting oneself as rational was indicated by more than twice the number of people as in Experiment 1 endorsing some degree of payment for the privilege of drawing from a preferred bowl. Considering the two experiments together, most people reported that although they would not pay, most people would. They also reported that other people would have stronger preferences than they themselves would have.

Of particular interest are the results for the 10% win condition, as this condition is directly analogous to the Miller et al. (1989) cookie-jar experiment. Subjects reported that most people would choose the large bowl significantly more frequently than the small bowl. This result suggests that the Miller et al. (1989) suspiciousness results are attributable to differences between the bowls in terms of preoutcome subjective probability. The results are consistent with the interpretation that subjects find odds communicated by small numbers (e.g., 1/10 or 9/10) more compelling than the same odds communicated by larger numbers (10/100 or 90/100). Accordingly, they are motivated to select the small bowl in the condition in which it contains 9 desirable tickets out of 10, and they are motivated to avoid it in the condition in which it contains 9 undesirable tickets out of 10.

Experiment 3

Experiment 3 was designed to directly engage the experiential system by examining behavior in a real-life situation that had significant emotional stakes. Subjects picked from bowls from which they could win or lose real money. If our reasoning is correct, this situation should produce the strongest results of all for two reasons. First, the real-life situation should be far more effective than pencil-and-paper vignettes in engaging subjects' experiential systems. Second, subjects motivated by the opportunity to win real money should be more willing to ignore their rational thinking if it conflicts with compelling intuitive feelings. That is, the motivation to win should override the motivation to present oneself as rational.

Method

Subjects. Fifty-two students (15 men and 37 women) enrolled in psychology classes at a large northeastern state university participated in the study in exchange for course credit and an opportunity to win up to $8.

Materials. A number of transparent, plastic rectangular bowls contained various mixtures of red and white jelly beans. The bowls were arranged in pairs consisting of a large bowl (19 cm × 16 cm × 6 cm deep) that contained 100 jelly beans and a small bowl (15 cm × 12 cm × 5 cm deep) that contained 10 jelly beans. The bowls were of a size such that the jelly beans spread out in a single layer, and no beans were hidden from view. Each bowl was labeled with an index card identifying the respective numbers and percentages of white and red jelly beans it contained and the consequences of drawing a red or a white jelly bean (e.g., red = win $4 and white = win nothing).

The probabilities of winning in win trials or losing in lose trials in the four conditions of the experiment were as follows: Condition 1 = 10% win, Condition 2 = 90% win, Condition 3 = 10% lose, and Condition 4 = 90% lose. In Condition 1, one bowl contained 1 red and 9 white beans and the other contained 10 red and 90 white beans; drawing a red jelly bean meant winning $4, whereas drawing a white jelly bean meant winning nothing. White beans in every condition represented a null outcome (i.e., nothing won or lost); red beans represented winners (win $4) in the two win conditions and losers (lose $4) in the two lose conditions. In every condition the proportions of red and white beans were identical in the two bowls between which subjects had to choose.

Other materials used were (a) a data form used by experimenters to record subjects' responses; (b) a written summary of the procedure to be followed by the experimenters, which included instructions that were read verbatim to subjects at different points in the procedure; and (c) a duplicate version of the instructions, which subjects followed as the experimenter read the instructions aloud.

Procedure. After a subject read and signed an informed-consent form, the experimenter explained the procedure to be followed, emphasizing that "although the mathematical probabilities are identical" in the two bowls from which subjects would pick, "many people have a gut-level preference for one bowl or the other" and that our interest was in learning about the nature of such preferences. The instructions further emphasized that there would be no deception involved and that the amount of money won or lost by the subject would be in accordance with the explicitly stated probabilities.

The procedure involved four trials corresponding to the four conditions described earlier. On each trial the experimenter presented the subject with a pair of bowls containing identical proportions of red and white jelly beans, shook the bowls to randomly arrange the jelly beans, explained the respective outcomes, and asked the subject to indicate which of the two bowls he or she would prefer to draw from. Order of presentation of the four conditions was counterbalanced across subjects by a Latin square. Subjects were requested, for reasons they were told would become evident later, to indicate all four of their choices before the actual drawings took place.

After all choices were recorded, subjects were asked to describe "the automatic thoughts that went through your head as you were trying to decide which bowl to choose from." Because we were interested in following up the finding from Experiment 1 regarding subjects' tendency to focus on absolute numbers, the experimenters prompted subjects to indicate the color of the jelly beans (red or white) and the outcomes (e.g., win, lose, not win, or not lose) they focused on. Responses were recorded verbatim.

Having recorded their choices, subjects were informed that there was one additional aspect of the procedure that had not previously been explained to them, as we did not wish it to bias their choices. The subjects were then told that they would now be given four dimes to either keep or spend on the experiment. On each of the four trials, subjects were informed they could pay a dime to guarantee the opportunity to draw from the bowl that they had previously selected. If the subject wished, instead, to keep the dime, the bowl choice would be determined by the toss of a coin. The experimenter then reminded the subject of the choice he or she had made, and the subject decided whether to pay a dime to guarantee that choice. Subjects were asked to report their thoughts about whether to pay a dime.

The next step was the actual drawing. Subjects were given $8 in play money and eight real dimes. They were told that at the end of the four trials any play money they had above $8 would be exchanged for real money, which, along with their remaining dimes, was theirs to keep. The actual drawings then took place. The experimenter shook the bowl that the subject had chosen in a cardboard box so the subject could not see the location of the beans. The subject then drew, sight unseen, one of the jelly beans from the bowl, which remained in the box. At the end of the drawings, play money was exchanged for real money. The subject was then informed that the experiment was over except for a few brief questions. Subjects were then told that we were interested in how well they could estimate how most people would react in the experiment, "which can, of course, be different or the same as your own choices." The conditions of the four trials were then reviewed, and subjects' predictions of (a) which bowl most people would choose and (b) whether most people would be willing to pay a dime were recorded.

Results

Bowl choices. A repeated measures logit analysis examined bowl choice as a function of outcome valence (win vs. lose), outcome odds (10% vs. 90%), and their interaction. The Valence × Odds interaction was highly significant, $\chi^2(1, N = 52) = 26.63$, $p < .001$. All results were in the expected direction. Preference for the large bowl was significantly greater in the 10% win and 90% lose conditions than in the other two conditions (see Table 3). Neither main effect approached significance ($ps > .30$). In light of the significant interaction, analyses were conducted to test the effect of odds within the win and lose conditions separately. The odds effect was significant both in the win conditions, $\chi^2(1, N = 52) = 17.99$, $p < .001$, and in the lose conditions, $\chi^2(1, N = 52) = 19.60$, $p < .001$. It can be seen in Table 3 that subjects chose the large bowl far more often in the 10% than in the 90% win condition and that these results were reversed in the lose conditions.

Turning to individual conditions, it can be seen in Table 3 that in the 10% win condition, 76.9% of subjects chose the large bowl. This proportion differed significantly from .5 ($Z = 3.74$, $p < .001$). In the 90% win condition, 63.5% of subjects chose the small bowl ($Z = 1.81$, $p < .08$). In the 10% lose condition, 69.2% of subjects chose the small bowl ($Z = 2.63$, $p < .01$). Finally, in the 90% lose condition, 73.1% of subjects chose the large bowl ($Z = 3.19$, $p < .01$).

Roughly half the subjects chose to pay in each condition (see bottom row in Table 3). Across the four conditions the percentage of subjects who paid ranged from 46.2% to 66.7%. Overall, the mean number of dimes spent by subjects across the four conditions was 2.18 (21.8 cents). Thus, the average subject paid a dime on slightly more than half the trials.

Predictions of others' choices. The top half of Table 4 shows the distribution of subjects' predictions about which bowl most people would choose. In three of the conditions, subjects' bowl choices were significantly different from chance (i.e., a 50–50 split) and in the same direction as subjects' own bowl choices. A majority of subjects predicted that others would choose the

Table 3
Experiment 3: Subjects' Own Bowl Choices and Willingness to Pay a Dime

	Win conditions		Lose conditions	
Outcome odds	10%	90%	10%	90%
No. choosing small versus large bowl	12/40	33/19	36/16	14/38
% choosing large bowl	76.9	36.5	30.8	73.1
No. not paying versus paying a dime	26/26	17/34	23/29	28/24
% paying a dime	50.0	66.7	55.8	46.2

Table 4
Experiment 3: Subjects' Predictions About Other People's Bowl Choices and Willingness to Pay a Dime

	Win conditions		Lose conditions	
Outcome odds	10%	90%	10%	90%
No. choosing small versus large bowl	3/49	25/27	37/15	15/37
% choosing large bowl	94.2	51.9	28.8	71.2
No. not paying versus paying a dime	13/39	12/40	16/36	21/31
% paying a dime	75.0	76.9	69.2	59.6

large bowl in the 10% win condition ($Z = 6.24$, $p < .001$) and in the 90% lose condition ($Z = 2.92$, $p < .01$), but would choose the small bowl in the 10% lose condition ($Z = 2.92$, $p < .01$). The results are particularly striking in the 10% win condition—the condition that most directly parallels the Miller et al. (1989) cookie-jar experiment—in which 49 of 52 subjects indicated that most people would choose the large bowl. In the 90% win condition, subjects' predictions for others were split almost equally between the two bowls, and the results accordingly did not differ significantly from .5 ($Z = 0.14$). However, the repeated measures logit analysis yielded the predicted Outcome × Odds interaction, $\chi^2(1, N = 52) = 31.86$, $p < .001$, and the odds effect was significant when tested separately within the win conditions, $\chi^2(1, N = 52) = 25.89$, $p < .001$, and within the lose conditions, $\chi^2(1, N = 52) = 21.33$, $p < .001$, with all results in the predicted direction.

The mean number of dimes that subjects predicted most people would pay was 2.81 (or 28.1 cents), with a range of 59.6%–76.9%. This mean was significantly greater than the mean spent by the subjects, themselves (21.8 cents), $t(51) = 2.99$, $p < .01$. In Table 4, it can be seen that the subjects believed that most people would pay in every condition. When analyzed by chi-square against an equal division, the results indicated that this was significant ($p < .01$) in all conditions except the 90% lose condition, in which there was a nonsignificant tendency in the same direction as in the other conditions ($p = .15$).

Introspective self-reports. As in Experiment 1, many subjects commented that although they understood the odds to be equivalent for the two bowls, they felt a strong preference for one of the bowls. Consistent with the bias in bowl choices and the large number of people who paid to ensure their preferences, very few subjects said that they chose arbitrarily.

Because subjects were explicitly prompted for information, the majority of responses could be clarified in terms of which color jelly bean in which bowl was the primary focus of attention. Of the 40 subjects who chose the large bowl in the 10% win condition, 36 responses could be classified, and all but one of these (97.2%) indicated a focus on the red (winner) beans in the large bowl. The typical response was "there is more of a chance of winning because there are more red beans in the large bowl." Similarly, in the 90% lose condition, the responses of 35 of the 38 subjects who chose the large bowl were classifiable, and all but 1 of these (97.1%) indicated a focus on the white (nonloser) beans in the large bowl. Note that in both of these conditions the focus was on a desired outcome (red winners and white nonlosers, respectively) and on the beans that were in the minority (i.e., 1 in 10 or 10 in 100). This suggests that the focus of attention was determined either by an orientation toward favorable outcomes (attending to winners or nonlosers) or by a figure–ground relationship (minority beans standing out against majority beans).

Among the 33 subjects who chose the small bowl in the 90% win condition, 25 were classifiable; 20 of these (80.0%) indicated a focus on the one white (loser) bean in the small bowl. Similarly, among the 38 subjects who chose the small bowl in the 10% lose condition, 21 of the 30 classifiable responses (70.0%) indicated a focus on the one red (loser) bean in the small bowl. Note that in these conditions, attention was focused on either the undesirable beans or the minority beans. Putting this together with the findings from the two other conditions (where it could not be decided whether the focus was on the desirable or on the minority beans), it appears that people focus on whichever beans are in the minority, which stand out as figure against the background of the majority beans.

We now consider how the combined influence of the figure–ground relationship and the focus on absolute numbers can account for the findings in all four conditions. In the win condition, where subjects had to select between bowls with 1 in 10 versus 10 in 100 winning red jelly beans, they focused on the red beans, as they stood out as figure against ground, and they selected the large bowl because it had more of them. In the win condition, where subjects had to select between bowls with 9 in 10 versus 90 in 100 winning red jelly beans, they focused on the white beans, as they stood out as figure against ground, and they selected the small bowl because it had fewer white beans (nonwinners). In exactly the same manner in the two loser conditions, they attended to the absolute number of minority beans (figure against ground) and selected the bowl that offered the more desirable number.

Discussion

The results of Experiment 3 provide particularly strong support for the hypotheses derived from CEST. As predicted by CEST and modified NT, subjects preferred the large bowl to the small bowl in the 10% win condition. However, as predicted by CEST, but opposite the prediction of modified NT, subjects preferred the small bowl in the 90% win condition. The findings for the 10% and 90% lose conditions, for which NT predictions were not apparent, were completely in accord with the predictions of CEST.

Condition 1, the 10% win condition, might be thought of as the ideal control condition for the Miller et al. (1989) cookie-jar study for determining whether subjective probability can account for their findings. The findings in this study clearly demonstrate that the phenomenon does not depend on postoutcome processing, as proposed by Miller et al. (1989), but can be reproduced in a preoutcome processing experimental paradigm and therefore can be attributed to the effect of subjective probability on choice behavior.

The findings in this study provide compelling evidence of the existence of a nonrational mode of processing that differs from a rational mode. Subjects readily made choices that, by their own account, they recognized were irrational. Moreover, they even paid for the privilege of acting on these irrational choices. As in Experiment 1, many commented on the conflict they experienced between their understanding of the mathematical probabilities between the two choices and their desire to behave in an intuitively compelling manner. Our favorite response, in this respect, was from a subject who said he had taken several statistics courses and was very knowledgeable about probability. He pointed out to the assistant who tested him that although the odds of winning were clearly identical for 1 winner versus 9 nonwinners and 10 winners versus 90 nonwinners, this was true only for the results over the long run. On a single trial, he insisted, there was a better chance of picking a winner when the absolute number of favorable outcomes was greater. He was so persuasive that we learned of the incident only because our assistant told us he was convinced the subject was right and we were wrong. Parenthetically, it might be noted that this person's explanation provides an impressive example of how the experiential system can distort people's rational thinking (Epstein et al., 1992). Having strong feelings that a decision is correct, people often feel compelled to prove it is rational.

General Discussion

The key to understanding the irrational responses in the studies reported by Miller et al. (1989) is not, in our view, the postoutcome imagination of alternatives, as they propose, but subjective probability. We demonstrated that the results that Miller and his associates claim can only be obtained with postoutcome processing can readily be obtained with preoutcome processing and, therefore, are consistent with an explanation that attributes both sets of findings to judgments based on subjective probability estimates. Miller et al. (1989) argued that an NT explanation was necessary precisely because the phenomenon could not be explained by the consideration of subjective probability. They were apparently incorrect in this assumption. However, this does not mean that the principles of NT cannot be applied to preoutcome processing, as it is certainly possible that people can arrive at subjective probability estimates by visualizing alternatives to an imagined outcome. We have referred to this adaptation of NT to preoutcome processing as *modified NT.*

The question remains as to whether modified NT principles can account for the responses in the kinds of situations we investigated. We believe not for the following reasons. First, NT (and therefore modified NT) provides no basis for determining which alternatives in a choice situation are more likely to be the focus of subjects' attention. Our interpretation of previous NT research suggested that subjects should focus on whichever outcome was made salient by the instructions, and we generated NT predictions based on this assumption. This interpretation of modified NT led to correct predictions in only half of the experimental conditions. Although post hoc arguments might be constructed to retrospectively derive correct predictions from NT, it is evident that NT needs to be augmented by principles for specifying which alternatives are imagined in which circumstances and that this applies no less to postoutcome than to preoutcome decisions.

Even if modified NT were further modified by making additional assumptions, such as that the alternatives imagined are influenced by figure–ground relationships, we believe it would still not provide a compelling explanation of either our findings or those in the Miller et al. (1989) suspiciousness studies. This is because imagining alternatives is a highly inefficient procedure for making decisions in such situations, and it is therefore clearly inconsistent with an understanding of heuristics as rapid, relatively effortless ways of processing information. Moreover, not a single subject in any of our experiments reported using a procedure that remotely suggested such a way of processing the data. On the other hand, the results in our real-life situation could very well be accounted for by another much more efficient process, namely, that subjects attended to the absolute number of beans that were in the minority (and that therefore were figure against the ground of the majority beans) and then chose the bowl that offered more favorable choices. This, in fact, is exactly what many subjects said they did. Moreover, it is consistent with the view that the experiential system, as a relatively concretive system, is particularly responsive to perceptual phenomena, such as figure–ground relationships, and is more responsive to absolute numbers than to ratios.

Evidence for Two Systems

The present findings provide qualitative and quantitative support for independent experiential and rational systems. The support consists of the following evidence within studies: (a) people made systematically biased choices that make no sense from a rational perspective but that conform to the principles of the experiential system and (b) they willingly paid money to honor these choices, while recognizing that such behavior was irrational.

Support between studies consists of evidence that people predicted that they (Experiment 1), unlike others (Experiment 2), would behave rationally in vignette descriptions of the situations. Yet, when subjects were placed in a real-life situation (Experiment 3), they responded even more irrationally than subjects in Experiment 2 estimated others would. Having observed how irrationally they behaved in the situations, the subjects in Experiment 3 estimated that others would behave even more irrationally. These findings indicate that as techniques are used that are designed to bypass people's need to present themselves as rational or that strongly engage their experiential system, people increasingly behave in a way that conforms to the principles of the experiential system.

The choices made by subjects in all three experiments conformed as expected to previously identified principles of the experiential system. The significant interaction effects observed in the three studies were predicted on the basis of two principles, the concretive principle and the experiential learning principle. Although the principles are assumed to operate in a supplementary manner in the situations that were investigated, the concretive principle seems particularly pertinent in Experiment 3, the real-life (jelly bean) experiment, where perceptual figure–ground relationships were salient. Because Experiments 1 and 2 presented stimulus materials in a written format rather than in a visual one, the experiential learning principle seems a more reasonable explanation for these results. The present research was not designed to disentangle or assess the relative merits of these two principles, so this question is left open for future research.

The qualitative data provided further support for the operation of two systems. Many subjects reported that they had two opposite views about how to proceed, one based on their knowledge that the proportions in the two bowls were equal and the other based on their strong intuitive impression that they were not. Often, to their bemusement, they found that the latter was more compelling to the extent that they were willing to part with their dimes to secure their intuitive choices, while simultaneously acknowledging that they were well aware that such behavior was foolish.

Conclusion

Norm theory has justifiably proven itself to be a useful and influential model in a variety of research applications, but we believe that it has been extended beyond its range of applicability in the kind of situations described here and by Miller et al. (1989). A subjective probability explanation, based on CEST, of decision making in these situations is more parsimonious than an NT account and, moreover, accounts for several findings in our studies for which NT offers no obvious explanation.

In general, the CEST account is highly compatible with other social–cognitive views regarding, for example, the role of heuristics in information processing. However, important differences also exist, such as CEST's emphasis on the existence of two organized conceptual systems. We believe this distinction is useful because (a) it can account for phenomena typically explained in terms of traditional social–cognitive theories such as norm theory; (b) it can also account for a variety of other observations for which traditional social–cognitive theories have no obvious explanations—for example, conflicts between the two modes of processing information and the effects of procedures designed to bypass the rational system or to engage the experiential system; and (c) it is consistent with people's subjective experience. It remains a task for future research to explore the similarities and differences between these two theoretical approaches.

References

Banks, W. P., Fujii, M., & Kayra-Stuart, F. (1976). Semantic congruity effects in comparative judgments of magnitudes of digits. *Journal of Experimental Psychology: Human Perception and Performance, 2,* 435–447.

Epstein, S. (1973). The self-concept revisited, or a theory of a theory. *American Psychologist, 28,* 404–416.

Epstein, S. (1983). The unconscious, the preconscious and the self-concept. In J. Suls & A. Greenwald (Eds.), *Psychological perspectives on the self* (Vol. 2, pp. 219–247). Hillsdale, NJ: Erlbaum.

Epstein, S. (1985). The implications of cognitive–experiential self-theory for research in social psychology and personality. *Journal for the Theory of Social Behavior, 15,* 283–310.

Epstein, S. (1990). Cognitive–experiential self-theory. In L. Pervin (Ed.), *Handbook of personality theory and research* (pp. 165–192). New York: Guilford Press.

Epstein, S. (1991). Cognitive–experiential self-theory: An integrative theory of personality. In R. Curtis (Ed.), *The self with others: Convergences in psychoanalytic, social, and personality psychology* (pp. 111–137). New York: Guilford Press.

Epstein, S., Lipson, A., Holstein, C., & Huh, E. (1992). Irrational reactions to negative outcomes: Evidence for two conceptual systems. *Journal of Personality and Social Psychology, 62,* 328–339.

Fiske, S. T., & Taylor, S. (1991). *Social cognition* (2nd ed.). New York: McGraw-Hill.

Holyoak, K. J. (1978). Comparative judgments with numerical reference points. *Cognitive Psychology, 10,* 203–243.

Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review, 93,* 136–153.

Kahneman, D., Slovic, P., & Tversky, A. (Eds.). (1982). *Judgment under uncertainty: Heuristics and biases.* Cambridge, England: Cambridge University Press.

Kahneman, D., & Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 201–208). Cambridge, England: Cambridge University Press.

Miller, D. T., Turnbull, W., & McFarland, C. (1989). When a coincidence is suspicious: The role of mental simulation. *Journal of Personality and Social Psychology, 57,* 581–589.

Miller, D. T., Turnbull, W., & McFarland, C. (1990). Counterfactual thinking and social perception: Thinking about what might have been. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 23, pp. 305–331). San Diego, CA: Academic Press.

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

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