The Relation of Rational and Experiential Information Processing Styles to Personality, Basic Beliefs, and the Ratio-Bias Phenomenon

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A new version of the Rational–Experiential Inventory (REI), which measures rational and experiential thinking styles and includes subscales of self-reported ability and engagement, was examined in two studies. In Study 1, the two main scales were independent, and they and their subscales exhibited discriminant validity and contributed to the prediction of a variety of measures beyond the contribution of the Big Five scales. A rational thinking style was most strongly and directly related to Ego Strength, Openness, Conscientiousness, and favorable basic beliefs about the self and the world, and it was most strongly inversely related to Neuroticism and Conservatism. An experiential thinking style was most strongly directly related to Extraversion, Agreeableness, Favorable Relationships Beliefs, and Emotional Expressivity, and it was most strongly inversely related to Categorical Thinking, Distrust of Others, and Intolerance. In Study 2, a rational thinking style was inversely related and an experiential thinking style was unrelated to nonoptimal responses in a game of chance. It was concluded that the new REI is a significant improvement over the previous version and measures unique aspects of personality.

People commonly experience differences between what they think and feel; that is, they have conflicts between the head and the heart. From the perspective of cognitive–experiential self-theory (CEST; Epstein, 1994), what they are experiencing are the outcomes of two different information-processing systems, rational and experiential. The rational system is an inferential system that operates by a person's understanding of culturally transmitted rules of reasoning; it is conscious, relatively slow, analytical, primarily verbal, and relatively affect-free; and it has a very brief evolutionary history. The experiential system is a learning system that is preconscious, rapid, automatic, holistic, primarily nonverbal, intimately associated with affect, and it has a very long evolutionary history. Although researchers from various persuasions have provided evidence for two similar ways of processing information (see review in Epstein, 1994; see also Chaiken & Trope, 1999), only CEST places them within the context of a global theory of personality.

According to CEST, the two modes operate in an independent, parallel, and interactive manner, and together they contribute to behavior, with their relative contributions varying from none at all to complete dominance by either one of the modes. Under most circumstances, they operate synchronously, so people are only aware of what appears to them to be a single process. However, under other circumstances, as in conflicts between the heart and the head, their different qualities become apparent.

We have discovered an experimental procedure, the ratio-bias (RB) paradigm, that, by setting the two modes in conflict with each other, is well suited for examining their independent and interactive operation. As Study 2 will show, although some people consistently respond to the RB paradigm according to their rational reasoning, most respond in the form of compromises between the two systems. Despite reporting awareness of the rational way to respond, these people make decisions influenced to some extent by their experiential processing (Denes-Raj & Epstein, 1994; Kirkpatrick & Epstein, 1992; Pacini & Epstein, 1999a, 1999b; Pacini, Muir, & Epstein, 1998).

In previous research we have found that performance on the RB paradigm is related to a variety of variables, including self-reported gambling in real life (Denes-Raj & Epstein, 1994), heuristic responses to vignettes (Denes-Raj & Epstein, 1994), and depression (Pacini et al., 1998), thereby indicating its generalizability beyond the laboratory. We have also found that situational factors and individual differences influence the balance between the two modes of processing. However, although situational influences on heuristic processing (see reviews in Eagly & Chaiken, 1993; Petty & Cacioppo, 1981) and individual differences in rational processing (see the review in Cacioppo, Petty, Feinstein, Jarvis, & Blair, 1996) have been studied in some detail, very little research has been conducted on individual differences in processing in the experiential mode.

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In previous research, we demonstrated that there are reliable individual differences in rational and experiential thinking styles with a self-report instrument, the Rational–Experiential Inventory (REI; Epstein, Pacini, Denes-Raj, & Heier, 1996). We found, in common with others who used similar scales (Burns & D'Zurilla, in press; Paivio, 1971; Paivio & Harshman, 1983), that the two thinking styles are independent. However, we became aware of limitations in our instrument that could have compromised this finding. The purpose of the present article is to validate a new version of the REI (Epstein, Pacini, & Norris, 1998) and to test whether REI scores are related to a behavioral measure, performance in the RB paradigm.

The Previous Version of the REI

The previous version of the REI (Epstein et al., 1996) consisted of two scales, Need for Cognition (NFC) and Faith in Intuition (FI), which corresponded to rational and experiential thinking styles, respectively. The NFC scale, a shorter, modified version of the Cacioppo and Petty (1982) scale of the same name, measures engagement in and enjoyment of cognitive activities. The FI scale was constructed to be the intuitive-processing counterpart of the NFC scale. In support of the CEST assumption of two independent processing modes, the correlation between the two scales was small ($r = .07$) and nonsignificant (Epstein et al., 1996). Further evidence of the independence of the two modes of processing was provided by research with a short form of the REI (Norris, Pacini, & Epstein, 1998;[1] see also Norris & Epstein, 1999) that incorporated subscales of ability and engagement. In line with the assumption that the two modes operate in parallel and are interactive in determining behavior, it was found in the study by Epstein et al. (1996) that they made supplemental contributions to predicting a wide variety of self-reported personality, coping, and adjustment variables, as well as to predicting degree of heuristic thinking in responses to vignettes. They also showed discriminant relations. NFC had stronger direct relations than FI did to adjustment (e.g., self-esteem, absence of depression), and FI had stronger direct relations than NFC did to positive interpersonal relations.

The Present Research

We present two studies using a new version of the REI (Epstein, Pacini, & Norris, 1998). In the first study we tested the validity of the new REI by determining whether it (a) has the proposed orthogonal two-dimensional structure, (b) produces expected relations with measures of personality traits and basic beliefs, and (c) makes a unique contribution beyond other personality measures. In the second study, we examined behavioral compromises between rational and experiential processing in the RB paradigm as a function of individual differences in thinking style using the REI.

Study 1

Limitations of the previous version of the REI could provide alternative explanations for the independence of the NFC and FI scales and for their discriminant validity. One such limitation was that the two scales did not have completely parallel content. Most of the NFC items described a preference for engagement in cognitive activities (e.g., "I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought"), whereas most of the FI items referred to the ability to make effective intuitive judgments (e.g., "I trust my initial feelings about people"). In constructing the new REI, we decided that both the rationality and the experientiality scales should have subscales measuring ability and engagement in their respective modes (Epstein, Pacini, & Norris, 1998[2]).

Another content-related problem was that several FI items contained a social element, but none of the NFC items did. The social FI items required self-ratings of intuitive ability to obtain correct impressions of others. Although it is reasonable to include such items, as social interactions are most likely to be processed experientially, it seemed desirable to represent the experiential domain more broadly. Therefore, we added a number of nonsocial items to the experientiality item pool. We did not add social items to the rationality item pool because the pool was already broadly general, and social behavior is primarily in the experiential domain.

Another problem with the original REI was that the NFC scale was more reliable ($\alpha = .87$) than the FI scale ($\alpha = .77$; Epstein et al., 1996), which could be attributed to the greater length of the NFC scale (19 NFC items vs. 12 FI items). The difference in reliability could account for some of the discriminant validity of the NFC and FI scales. Because low reliability attenuates correlations, the strength of the relations of FI to other variables might have been underestimated. We therefore wished to make the new scales comparable in length and reliability.

The original REI scales were unbalanced in terms of item valence. Fourteen of the 19 NFC items were negatively worded, and all of the FI items were positively worded. The positive bias of the FI scale was not inadvertent. In its preliminary stages, the FI scale contained both negatively and positively worded items, but reliability analysis revealed low internal consistency. This may have occurred because the negatively worded items introduced a pejorative element that was not present in the positively worded items. To assert that one's intuitive impressions are almost always wrong is not the phenomenological opposite of saying that they are almost always right. Therefore, for the new version of the REI we constructed negatively worded items for the item pool of the experientiality scale that were as acceptable as the positively worded items, and we balanced both scales in the number of positively and negatively worded items.

The new REI items were administered to a college student sample in a questionnaire battery containing a variety of personality, thinking-style, and ideological-belief measures deemed theoretically relevant to rational and experiential thinking styles. We expected rationality and experientiality to be independent, in line with the assumption that they represent two independent modes of processing (Epstein et al., 1996). As both systems are assumed to contribute to behavior, we expected rationality and experientiality to jointly predict personality variables, including the Big Five personality traits and the four basic beliefs of CEST. We also

[1] Order of authorship is arbitrary. The construction of the scales was a joint, interactive effort from which the individual contributions can not be separated.

[2] Order of authorship is arbitrary. The construction of the scales was an interactive effort from which individual contributions cannot be separated.

expected the two processing modes to exhibit discriminant validity.

In presenting a new personality measure, it is important to demonstrate that it contributes beyond what established measures already offer. In personality psychology, the Big Five, derived from the factor analysis of trait terms (Goldberg, 1990), are the standard by which new trait scales are often judged. Therefore, we investigated whether the REI makes a unique contribution beyond the Big Five.

To determine the construct validity of a test, one must establish the test's relations with a wide range of conceptually relevant measures. To this end we used a variety of self-report measures in addition to the Big Five. We included the Basic Beliefs Inventory (Catlin & Epstein, 1992), because the beliefs measured by this test are assumed to identify the most fundamental schemas in a personal theory of reality according to CEST. We were interested in the extent to which such basic beliefs about the self and the world are related to the two thinking styles measured by the REI. We included the Emotional Expressivity Scale (Kring, Smith, & Neale, 1994), because experiential processing is assumed, according to CEST, to be intimately associated with emotions. In previous research (Epstein et al., 1996), we failed to find a relation between a measure of affective intensity (Larsen & Diener, 1987) and an earlier version of the FI scale, and we wished to determine if such a relation would emerge with a different measure of emotionality. In the Burns and D'Zurilla (in press) study, such a relation was found. We hoped to find a positive relation between the Emotional Expressivity Scale and the improved REI Experientiality scale. We included the Categorical Thinking Scale of the Constructive Thinking Inventory (Epstein & Meier, 1989), because it measures an important basic style of thinking that is related to negative attitudes toward others and is a highly constricted way of thinking, which, on conceptual grounds (Epstein, 1994), seemed to be indicative of a low level of rational processing, a high level of experiential processing, or both. We included measures of conservative ideology and religiosity, because we thought that a concrete style of thinking that emphasized immediate impressions and short-term gains, as is characteristic of conservative ideology, would be positively associated with an experiential thinking style, negatively associated with a rational thinking style, or both.

We included measures of adjustment and interpersonal relationships because we expected that, consistent with past research, rationality would have a stronger direct relationship with good adjustment (e.g., ego strength, favorable basic beliefs) and a stronger negative relation with measures of poor adjustment (e.g., neuroticism) than would experientiality, and that experientiality would have a stronger relationship with favorable interpersonal relationships (e.g., extroversion, agreeableness, low distrust of others, positive beliefs about relationships) than would rationality.

Method

Sample

Undergraduate students (N = 399; 315 women, 75 men, and 9 participants who did not indicate their gender) from a large northeastern state university completed several questionnaires for psychology course credit. The average age of the students in the sample was 20.52 years (SD = 1.98). Twenty-two percent were first-year students, 34% were sophomores, 26% were juniors, and 18% were seniors. Caucasians composed a considerable majority of the participants (81%). Minorities were distributed as follows: Asian Americans, 6%; African Americans, <4%; Latino Americans, <4%; all other minorities, each <1%; unstated affiliation, 3%.

Measures

Respondents rated all questionnaire items, unless otherwise noted, on a 5-point scale that ranged from 1 (*definitely not true of myself*) to 5 (*definitely true of myself*). All reliabilities that are reported were obtained with the current sample.

REI, long form. We began devising the new REI (Epstein et al., 1998) by sorting existing NFC and FI items into ability and engagement categories and writing new items to balance the numbers between these subdivisions as well as between the number of positively and negatively worded items. After we rejected redundant and poorly worded items, 56 items remained. We then selected the 10 best items within each of the four REI subscales. The subscales were named Rational Ability, Rational Engagement, Experiential Ability, and Experiential Engagement. Rational Ability refers to reports of a high level of ability to think logically and analytically (e.g., "I have no problem thinking things through carefully"). Rational Engagement refers to reliance on and enjoyment of thinking in an analytical, logical manner (e.g., "I enjoy thinking in abstract terms"). Experiential Ability refers to reports of a high level of ability with respect to one's intuitive impressions and feelings (e.g., "When it comes to trusting people, I can usually rely on my gut feelings"). Experiential Engagement refers to reliance on and enjoyment of feelings and intuitions in making decisions (e.g., "I like to rely on my intuitive impressions"). Overall Rationality and Experientiality scales were obtained by summing the appropriate ability and engagement subscales. Further information on the REI is presented in the *Results and Discussion* section.

The Basic Beliefs Inventory. The Basic Beliefs Inventory (Catlin & Epstein, 1992) is a 102-item measure of the following four basic beliefs proposed by CEST (Epstein, 1991): (a) the degree to which the world is viewed as being benign versus malevolent, (b) the degree to which the world is considered meaningful (i.e., predictable, controllable, and just) versus chaotic (i.e., unpredictable, uncontrollable, and unjust), (c) the degree to which relations with others are viewed as being supportive versus threatening, and (d) the degree to which the self is considered worthy (i.e., competent, good, and lovable) versus unworthy (i.e., incompetent, bad, and unlovable). The inventory consists of bipolar scales that range from extremely favorable to extremely unfavorable beliefs. It includes a global scale of Overall Favorability of Beliefs, α = .95, and four scales corresponding to the four basic beliefs: Favorable World Beliefs, with its subscales of Benign Actual World (e.g., "In general, the good things in my personal world outnumber the bad"; "The world has not been good to me," reverse scored), α = .87, and Benign Anticipated World, which corresponds to optimism (e.g., "I usually expect things to work out well"; "I have little hope for the future," reverse scored), α = .84; Meaningful World, α = .92, with its subscales of Personal Directedness (e.g., "I have clear-cut and interesting life goals"; "I don't know what I want out of life," reverse scored), α = .90, and Predictable, Controllable World (e.g., "I feel I'm pretty much in control of my own destiny"; "Life's so unpredictable that I seldom make plans," reverse scored), α = .79; Favorable Relationship Beliefs (e.g., "I am able to establish warm, meaningful relations with others"; "I find it a burden to interact with people," reverse scored), α = .86; and Favorable Self-Beliefs, which corresponds to self-esteem (e.g., "I usually feel really good about myself"; "I often feel that my faults outnumber my strengths," reverse scored), α = .89.

The Big Five. Form S of the NEO Five Factor Inventory (NEO-FFI; Costa & McCrae, 1989) was used to assess the Big Five personality traits. This version of the NEO-FFI has 12-item scales for each of five dimensions, for a total of 60 items. The traits included in the NEO-FFI are Neuroticism, α = .83; Extraversion, α = .78; Openness to Experience, α = .70; Agreeableness, α = .73; and Conscientiousness, α = .83.

The Emotional Expressivity Scale. The Emotional Expressivity Scale (α = .94; Kring et al., 1994) is a 17-item, Likert-format questionnaire that measures the extent to which people outwardly display their emotions (e.g., "I display my emotions to other people").

Categorical Thinking Scale. The Categorical Thinking Scale (α = .82) from the Constructive Thinking Inventory (Epstein, 1992; Epstein & Meier, 1989) measures the automatic tendency to think in black-and-white, polarized, and rigid terms and to be intolerant and distrustful of others. It has three facets: Polarized Thinking (e.g., "There are two possible answers to every question, a right one and a wrong one"), α = .78; Distrust of Others (e.g., "I have learned from bitter experience that most people are not trustworthy"), α = .73; and Intolerance (e.g., "I try to accept people as they are without judging them," reversed), α = .57.

Ego Strength and Defensiveness. The Ego Strength Scale (α = .83; Epstein, 1983) measures the tendency to behave in a responsible and effective manner, including being able to delay gratification (e.g., "Self control is no problem for me"), to resist impulsiveness (e.g., "My emotions rarely get out of hand"), and to confront difficult or challenging situations (e.g., "When confronted with a difficult or challenging situation, I tend to give up more easily than most," reversed). The Ego Strength inventory includes a Defensiveness scale (α = .78), which consists of social desirability items (e.g., "The thought of shoplifting has never crossed my mind"). Ego Strength has been shown to be positively related to measures of willpower, emotional stability, nonneuroticism, self-esteem, competence, and identity integration, and defensiveness to be positively related to defensive self-enhancement (Epstein, 1983).

Conservative Ideology and Punitive Attitude Toward Criminals. Thirteen items, measuring various aspects of religious and political ideology, were subjected to a factor analysis that yielded two main factors. The first factor, Conservative Ideology, consisted of 9 items (α = .63) measuring a variety of conservative attitudes, such as religious orthodoxy (e.g., traditional and conservative religious views, belief in a literal interpretation of the Bible, belief that there is only one true religion) and political conservatism (e.g., concern with immediate U.S. interests rather than long-term global welfare). The second factor, Punitive Attitude Toward Criminals, consisted of 4 items (α = .68) measuring favorable attitudes toward capital punishment and strong law enforcement rather than social programs to curb crime (e.g., "I think justice is better served by executing dangerous murderers than by trying to rehabilitate them"). On both scales high scores indicate conservative views.

Results and Discussion

Scale Construction

Selection of items for the REI was based on reliability analysis, scale breadth, balance in valence of items, and conceptual considerations.

Reliability analysis. Items were initially assigned to the four REI scales by face validity. The other considerations were then used to determine which of the 56 items should be selected for the best 10 items to be included in each subscale. The item composition of the final scales is presented in Table 1.

Reliabilities of the REI are reported in Table 2. The total scale reliabilities (Rationality scale, α = .90; Experientiality scale, α = .87) are comparable, and the Experientiality scale is considerably more reliable than it was previously (Epstein et al., 1996). As Table 2 shows, the correlation between the Rationality and Experientiality scales is nonsignificant, supporting the CEST assumption of the existence of two independent information processing modes. Within each mode, the ability and engagement subscales are moderately related, but their correlations are far below their reliabilities, thereby allowing us to justify combining them into overall Rationality and Experientiality main scales as well as retaining them as ability and engagement subscales.

Confirmation of two-factor structure. Factor analysis was used to confirm the distribution of the items in two independent main scales. The 40 REI items were entered into a principal components factor analysis with varimax rotation, and two factors were extracted. The two-factor solution confirmed that rationality and experientiality are independent and orthogonal. The first factor accounted for 19.4% and the second factor for 14.6% of the variance. As Table 1 shows, the first factor contained all the rationality items, and the second factor contained all the experientiality items.

Factor analysis was further used to examine the subscales. When a two-factor solution of the rationality items was conducted, the items were divided into ability and engagement factors. When a two-factor solution of the experientiality items was conducted, positively and negatively worded items composed separate factors. Moreover, the second factor explained only marginal variance. These results suggest that the ability and engagement division is more discriminating for the Rationality scale than for the Experientiality scale. This makes sense because, unlike having objective information about the quality of their rational ability, such as knowing their IQ or college entrance examination scores, people lack objective criteria for judging the quality of their intuitive ability, which therefore tends to be confounded with desirability. However, it would be premature to discard the ability–engagement division for the Experientiality scale because, as will be shown later, the subscales have discriminant validity.

Correlates of Rationality and Experientiality

Relations between the REI and other self-report scales. Correlations between the REI and other measures are presented in Table 3. Because of gender differences in REI scores (see the *Gender Comparisons* section on gender differences), gender was partialed out of all correlations.

Rationality was most strongly directly associated with (non)-Neuroticism, Openness to Experience, Conscientiousness, Ego Strength and Overall Favorability of Beliefs, including beliefs concerning a Benign Anticipated World; a Meaningful World; a Predictable, Controllable World; Personal Directedness; and Favorable Self-Beliefs. It was moderately positively associated with belief in a Benign Actual World, and it was moderately negatively associated with Conservative Ideology, Punitive Attitude Toward Criminals, Categorical Thinking, and Distrust of Others. With weak significance, it was positively associated with Extraversion and with Favorable Relationship Beliefs, and it was negatively associated (also with weak significance) with Polarized Thinking and Intolerance. Rationality was not significantly related to Agreeableness, Emotional Expressivity, and Defensiveness.

Experientiality was most strongly associated with Favorable Relationship Beliefs, and it was moderately positively associated with Extraversion, Overall Favorability of Basic Beliefs, and Emotional Expressivity. It was moderately negatively associated with Categorical Thinking and its facets of Polarized Thinking and Distrust of Others. With weak significance, it was positively related to Openness to Experience, Agreeableness, Conscientiousness, and the basic beliefs of Favorable Self-Beliefs, Benign Actual World, and Meaningful World. Experientiality was not sig-

Table 1
Study 1: Factor Analysis of Rational–Experiential Inventory Items

Items	Factor 1	Factor 2
Rationality scale		
I try to avoid situations that require thinking in depth about something. (re−)	.75	.07
I'm not that good at figuring out complicated problems. (ra−)	.74	.10
I enjoy intellectual challenges. (re)	.72	−.02
I am not very good at solving problems that require careful logical analysis. (ra−)	.71	−.04
I don't like to have to do a lot of thinking. (re−)	.70	.09
I enjoy solving problems that require hard thinking. (re)	.68	−.05
Thinking is not my idea of an enjoyable activity. (re−)	.65	.10
I am not a very analytical thinker. (ra−)	.64	−.09
Reasoning things out carefully is not one of my strong points. (ra−)	.61	−.01
I prefer complex problems to simple problems. (re)	.61	−.05
Thinking hard and for a long time about something gives me little satisfaction. (re−)	.58	.03
I don't reason well under pressure. (ra−)	.57	.04
I am much better at figuring things out logically than most people. (ra)	.56	−.19
I have a logical mind. (ra)	.56	−.19
I enjoy thinking in abstract terms. (re)	.49	−.01
I have no problem thinking things through carefully. (ra)	.47	.12
Using logic usually works well for me in figuring out problems in my life. (ra)	.46	−.22
Knowing the answer without having to understand the reasoning behind it is good enough for me. (re−)	.44	−.07
I usually have clear, explainable reasons for my decisions. (ra)	.40	−.11
Learning new ways to think would be very appealing to me. (re)	.30	.00
Experientiality scale		
I like to rely on my intuitive impressions. (ee)	−.16	.66
I don't have a very good sense of intuition. (ea−)	.17	.65
Using my gut feelings usually works well for me in figuring out problems in my life. (ea)	−.11	.65
I believe in trusting my hunches. (ea)	−.07	.64
Intuition can be a very useful way to solve problems. (ee)	.00	.59
I often go by my instincts when deciding on a course of action. (ee)	−.25	.56
I trust my initial feelings about people. (ea)	−.04	.55
When it comes to trusting people, I can usually rely on my gut feelings. (ea)	.00	.55
If I were to rely on my gut feelings, I would often make mistakes. (ea−)	.08	.54
I don't like situations in which I have to rely on intuition. (ee−)	.04	.54
I think there are times when one should rely on one's intuition. (ee)	−.02	.53
I think it is foolish to make important decisions based on feelings. (ee−)	−.13	.53
I don't think it is a good idea to rely on one's intuition for important decisions. (ee−)	.04	.51
I generally don't depend on my feelings to help me make decisions. (ee−)	−.15	.51
I hardly ever go wrong when I listen to my deepest gut feelings to find an answer. (ea)	−.11	.50
I would not want to depend on anyone who described himself or herself as intuitive. (ee−)	.13	.47
My snap judgments are probably not as good as most people's. (ea−)	.37	.46
I tend to use my heart as a guide for my actions. (ee)	−.39	.43
I can usually feel when a person is right or wrong, even if I can't explain how I know. (ea)	−.08	.40
I suspect my hunches are inaccurate as often as they are accurate. (ea−)	.15	.35

Note. $N = 398$. The name of the subscale to which each item belongs appears in parentheses. ee = Experiential Engagement; ea = Experiential Ability; re = Rational Engagement; ra = Rational Ability. A minus sign (−) with a scale name denotes reverse scoring.

nificantly related to Neuroticism; belief in a Predictable, Controllable World; Ego Strength; Defensiveness; and Conservative Ideology. In a study by Burns and D'Zurilla (in press), in which measures somewhat similar to those in the REI were correlated with the NEO-FFI, significant positive relations were found between rationality and Conscientiousness and between experientiality and Extraversion, which is consistent with the present findings. Although the other relations were not significant, they were in the same direction as in the present study.

In summary, rationality was most strongly associated with positive adjustment (e.g., low neuroticism, high ego strength and self-esteem); openness to new ideas and experience; a sense of control, meaningfulness, and direction in one's life; and conscientiousness. Experientiality was most strongly associated with interpersonal relationships including extroversion, trust, and emotional expressivity. It is noteworthy that the positive association between experientiality and interpersonal relations was conceptually replicated (see Epstein et al., 1996) despite the reduction of social items

Table 2
Study 1: Intercorrelations and Reliabilities of Rational–Experiential Inventory (REI) Scales

REI scale	1	2	3	4	5	6
1. Rationality	(.90)	.91***	.92***	−.04	.06	−.14**
2. Rational Ability		(.83)	.68***	−.06	.06	−.17**
3. Rational Engagement			(.84)	−.02	.05	−.09
4. Experientiality				(.87)	.90***	.89***
5. Experiential Ability					(.80)	.62***
6. Experiential Engagement						(.79)

Note. $N = 388$. Reliabilities appear on the diagonal in parentheses.
** $p < .01$. *** $p < .001$.

in the Experientiality scale. Conservative Ideology and Punitive Attitudes Toward Criminals were inversely associated with rationality and unassociated with experientiality.

Independent contributions of rationality and experientiality. To test the assumption that rational and experiential processing contribute jointly and independently to behavior, scores on the overall Rationality and Experientiality scales and the control variable of gender were entered into regression equations as predictors of the other variables. When scores on the Rationality and Experientiality scales were both significantly correlated with a target variable, they had an additive relationship in the regression analysis in predicting the target variable, which supports the prediction of joint, independent contributions of the two processing modes. As additional support for their independence, each processing mode was sometimes a unique predictor of a target variable. For example, Rationality scores were a unique predictor of Neuroticism; belief in a Predictable, Controllable World; and Ego Strength. Experientiality scores were a unique predictor of Agreeableness and Emotional Expressivity.

Independent contributions of ability and engagement subscales. Regression analyses were conducted to determine whether the ability and engagement subscales within the REI main scales make

Table 3
Study 1: Correlations Between Rational–Experiential Inventory Scores and the Big Five, Basic Beliefs, Categorical Thinking, Emotional Expressivity, Ego Strength, and Conservative Ideology

Personality and belief measure	Rationality			Experientiality		
	Total	Ability	Engagement	Total	Ability	Engagement
Big Five traits						
Neuroticism	−.38***	−.39***	−.30***	−.07	−.13**	.01
Extraversion	.17***	.19***	.12*	.21***	.20***	.17***
Openness to Experience	.44***	.28***	.53***	.17***	.13**	.17***
Agreeableness	.07	.07	.06	.18***	.14**	.19***
Conscientiousness	.32***	.33***	.27***	.14**	.22***	.02
Basic beliefs						
Overall Favorability	.39***	.38***	.33***	.23***	.26***	.15**
Favorable Self	.39***	.38***	.33***	.16***	.22***	.06
Favorable Relationships	.19***	.19***	.16***	.34**	.31***	.30**
Favorable World						
Benign Actual World	.21***	.20***	.18***	.19***	.18***	.17***
Benign Anticipated World	.39***	.37***	.34***	.20***	.23***	.13**
Meaningful World	.42***	.42***	.35***	.13**	.18***	.04
Personal Directedness	.41***	.41***	.36***	.15**	.20***	.06
Predictable, Controllable World	.33***	.34***	.26***	.04	.09	−.01
Categorical Thinking	−.24***	−.18***	−.27***	−.29***	−.20***	−.34***
Polarized Thinking	−.18***	−.12**	−.22***	−.27***	−.15**	−.33***
Distrust of Others	−.24***	−.20***	−.24***	−.23***	−.17***	−.25***
Intolerance	−.18***	−.15**	−.18***	−.19***	−.16***	−.18***
Emotional Expressivity	.01	−.03	.04	.27***	.19***	.29***
Ego Strength	.44***	.43***	.39***	.05	.11*	−.02
Defensiveness	.06	.05	.05	.02	.04	.00
Conservative Ideology	−.20***	−.14**	−.22***	−.05	.01	−.11
Punitive Attitude Toward Criminals	−.29***	−.19***	−.34***	−.06	−.04	−.07

Note. $N = 388$. Gender is partialed out of all correlations.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4
Study 1: Rational–Experiential Inventory Subscales Predicting the Big Five, Basic Beliefs, Categorical Thinking, Emotional Expressivity, Ego Strength, and Conservative Ideology

	β					
	Rationality subscales			Experientiality subscales		
Dependent measure	Gender	Ability	Engagement	Ability	Engagement	R^2
Big Five traits						
Neuroticism	.06	−.34***	−.06	−.13*	.03	.18
Extraversion	.14**	.23**	−.03	.10	.14*	.10
Openness to Experience	−.01	−.12*	.64***	−.03	.22***	.34
Agreeableness	.18***	.09	.00	.01	.19**	.09
Conscientiousness	.17***	.24***	.08	.25***	−.09	.17
Basic beliefs						
Overall Favorability	.08	.32***	.11	.17**	.11	.22
Favorable Self	−.04	.28***	.13*	.20***	.00	.19
Favorable Relationships	.15**	.19**	.04	.15*	.25***	.19
Favorable World						
Benign Actual World	.06	.19**	.06	.05	.17*	.09
Benign Anticipated World	.06	.27***	.16*	.14*	.10	.19
Meaningful World	.08	.33***	.12	.14*	.02	.20
Personal Directedness	.09*	.31***	.14*	.16**	.02	.21
Predictable, Controllable World	.03	.30***	.05	.07	.00	.12
Categorical Thinking	−.06	−.09	−.24***	.08	−.43***	.21
Polarized Thinking	−.04	−.04	−.23***	.12*	−.44***	.18
Distrust of Others	−.03	−.13*	−.18**	.04	−.32***	.14
Intolerance	−.14**	−.07	−.15*	−.03	−.18**	.10
Emotional Expressivity	.15**	−.04	.09	.02	.28***	.13
Ego Strength	.02	.31***	.17**	.09	−.01	.21
Defensiveness	.08	.01	.04	.04	−.03	.01
Conservative Ideology	−.02	−.04	−.22**	.17**	−.24***	.08
Punitive Attitude Toward Criminals	−.13	.04	−.38***	.08	−.14*	.14

* $p < .05$. ** $p < .01$. *** $p < .001$.

independent contributions to the prediction of a variety of other variables. The first variable entered into the regression equation was gender, which was treated as a control variable, followed by the four REI subscores, which were entered as a block, and finally the interactions of REI scores with gender and with each other. As the interaction terms did not contribute significantly beyond the main effects, they are omitted in Table 4 as well as from further discussion.

The discriminant validity of the subscales within a category is indicated by their independent contributions to the prediction of other variables. It can be seen in Table 4 that sometimes the independent contributions of the subscales within a main scale are in the same direction, and sometimes they are in the opposite direction. Examples of the former are that Rational Ability and Rational Engagement both directly predict Favorable Self-Beliefs, and that Experiential Ability and Experiential Engagement both directly predict Favorable Relationship Beliefs. Examples of the subscales within a main scale predicting in the opposite direction are that Rational Ability predicts Openness to Experience inversely, and Rational Engagement predicts it directly. Also, Experiential Ability predicts Polarized Thinking directly, and Experiential Engagement predicts it inversely. In other cases, only one of the subscales makes a significant independent contribution to a prediction. Examples are Rational Ability, but not Rational Engagement, directly predicting belief in a Meaningful World, and Experiential Engagement, but not Experiential Ability, inversely predicting Categorical Thinking. It is noteworthy that the two ability subscales are common predictors of certain kinds of variables, and the two engagement subscales are common predictors of other kinds of variables. For example, the two ability scales are significant predictors of Neuroticism, Conscientiousness, and Overall Favorability of Beliefs, and the two engagement scores are significant predictors of Punitive Attitude Toward Criminals, Categorical Thinking, Distrust of Others, and Intolerance. This pattern suggests that the ability scores are better predictors of self-reported adjustment and competence than are the engagement scores, which are better predictors of self-reported values and attitudes.

The finer grained analysis provided by the engagement and ability subscales helps to clarify the meaning of relations obtained with the main scales. For example, it can be seen in Table 3 that the positive relation of the main scale of Rationality with measures of adjustment (e.g., (non)Neuroticism, Overall Favorableness of Beliefs, Favorable Self-Beliefs) and of Rationality with measures of control (e.g., Ego Strength, Personal Directedness, Conscientiousness) can be attributed primarily to the Rational Ability subscale. Similarly, the negative relations of the main scale of Experientiality to Categorical Thinking and its subscales and its positive relation to Emotional Expressivity can be attributed mostly to the

Table 5
Study 1: Means and Standard Deviations of the Rational–Experiential Inventory (REI) Scales and Subscales

REI scale	Total sample M	Total sample SD	Men M	Men SD	Women M	Women SD	Gender difference $t(1,388)$
Rationality	3.39	0.61	3.54	0.54	3.36	0.63	2.35*
Ability	3.34	0.66	3.54	0.60	3.29	0.67	2.86**
Engagement	3.44	0.67	3.55	0.60	3.42	0.69	1.47
Experientiality	3.52	0.47	3.33	0.44	3.57	0.46	4.10***
Ability	3.49	0.54	3.35	0.53	3.53	0.53	2.72**
Engagement	3.55	0.51	3.31	0.51	3.61	0.50	4.67***

Note. $N = 399$. For men, $n = 75$; for women, $n = 315$. Nine participants did not report their gender.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

subscale of Experiential Engagement. These results support the discriminant validity of the subscales and therefore the desirability of retaining them as separate facets of experiential and rational processing.

Gender Comparisons

Means and standard deviations of the REI scales for men and women separately and for the combined group are presented in Table 5. There are significant, albeit small, gender differences on all of the REI scales except Rational Engagement. Men scored slightly higher than women on Rational Ability; women scored slightly higher than men on Experiential Ability and even more so on Experiential Engagement. In summary, the men were more likely than the women to identify themselves as rationally capable, and the women were more likely than the men to identify themselves as engaging in experiential processing and as being good at it.

Examination of correlations conducted separately for men and women revealed significant gender differences in only three correlations (all $Zs > 2.06$, $p < .05$, two-tailed). Because the differences were fewer than expected by chance, they should not be taken seriously until replicated. The negative correlation between scores on the Emotional Expressivity and Rationality scales was significantly greater for men ($r = -.27$, $p < .05$) than for women ($r = .04$, *ns*). The same was true for the positive correlation between the Emotional Expressivity and Experientiality scales (men, $r = .48$, $p < .001$; women, $r = .22$, $p < .01$). The negative correlation between the Rationality scale and Punitive Attitude Toward Criminals was significantly greater for women ($r = -.33$, $p < .001$) than for men ($r = -.06$, *ns*). In summary, despite a few questionable small differences the correlations between the REI thinking styles and the other variables of interest were mainly similar for men and women despite significant mean differences on the REI scales.

Does the REI Make a Contribution Beyond the Big Five?

To determine whether the REI measures aspects of personality not accounted for by the Big Five, we conducted regression analyses in which the Big Five traits were entered as predictors of each REI score. As Table 6 shows, four of the five traits—Openness to Experience, Conscientiousness, (non)Neuroticism, and (non)-Agreeableness—were significant direct predictors of Rationality and its subscales. However, as the four traits accounted for only 28–39% of the variance in the rationality scales, more than half the variance remains unexplained.

The Big Five accounted for only 9–12% of the variance in the Experientiality scales. Experiential Ability was significantly, albeit weakly, directly predicted by Openness to Experience, Extraversion, and Conscientiousness. Experiential Engagement was significantly but weakly directly predicted by all of the Big Five traits except Conscientiousness. That the Big Five scales are better predictors of rationality than of experientiality suggests that the

Table 6
Study 1: Predicting Rational–Experiential Inventory Scores Using the Big Five

Big Five Factor	β Rationality Total	Rationality Ability	Rationality Engagement	Experientiality Total	Experientiality Ability	Experientiality Engagement
Openness to Experience	.42***	.25***	.51***	.14**	.10*	.15***
Neuroticism	−.36***	−.38***	−.28***	.13*	.02	.21***
Extraversion	−.03	−.01	−.05	.19***	.14**	.20***
Agreeableness	−.16***	−.17***	−.14**	.15**	.07	.21***
Conscientiousness	.20***	.20***	.16***	.09	.17***	−.01
R^2	.37	.28	.39	.11	.09	.12

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

NEO-FFI is more appropriate for measuring self-reported rational aspects of personality than self-reported intuitive, experiential aspects. In summary, the REI scales appear to measure aspects of personality that are not captured by the Big Five, and this is particularly true of the experientiality scales.

Another way to examine whether the REI scales make a contribution beyond the Big Five is to conduct regression analyses in which scores on the NEO-FFI and the REI are both entered as predictors of the other variables. For 12 of the 16 dependent variables, at least one REI score made a significant independent contribution beyond the Big Five. Rational Ability uniquely predicted scores on the following scales at $p = .05$: positively with Meaningful World; Predictable, Controllable World; and Ego Strength Scale and negatively with Emotional Expressivity and Conservative Ideology. Rational Engagement uniquely positively predicted the Ego Strength Scale score ($p < .05$) and uniquely negatively predicted scores on Punitive Attitude Toward Criminals ($p < .001$) and Categorical Thinking ($p < .01$) and its facets of Distrust of Others ($p < .05$) and Intolerance ($p < .05$). Experiential Ability uniquely positively predicted Conservative Ideology ($p < .05$). Experiential Engagement uniquely positively predicted Favorable Relationship Beliefs, ($p < .01$), Benign Actual World ($p < .05$), and Emotional Expressivity ($B = .23, p < .001$). It also uniquely negatively predicted Conservative Ideology ($p < .01$) and Categorical Thinking ($p < .001$) and its facets of Polarized Thinking ($p < .001$) and Distrust of Others ($p < .001$).

Because we have established that the REI measures aspects of personality beyond the Big Five, the question may be reversed by asking what the Big Five measures beyond the REI. Needless to say, the NEO-FFI continues to be a highly significant predictor after partialing out the influence of the REI on almost all dependent variables for which it had been a significant predictor before the influence of the REI was removed. The effect of the REI was thus mainly to reduce, not eliminate, the relations of the NEO-FFI with other variables. This is to be expected, as the REI was not intended to replace the NEO-FFI but to provide an additional kind of information.

Summary and Conclusion

The reliability and validity of the new REI was supported. The orthogonal two-factor structure of the REI was replicated, indicating that individual differences in rational and experiential processing are independent. Factor analysis confirmed the ability–engagement subdivision for the Rationality scale but not for the Experientiality scale. Regression analysis showed that rationality and experientiality make unique contributions to predicting a variety of variables considered to represent basic dimensions of personality, such as the Big Five personality traits and the basic beliefs of CEST, as well as thinking-style variables such as categorical thinking and conservative values. The REI scales and subscales also showed discriminant validity, as indicated by the different relations we found with a variety of variables. The retention of the ability and engagement subdivisions of the main scales was therefore supported.

Study 2

The purpose of Study 2 was to examine the relation of rational and experiential thinking styles to compromises between the two modes of information processing in the RB paradigm. One way to demonstrate the construct validity of the REI is to show that people who report having a more rational and/or a less experiential thinking style exhibit behavioral compromises more heavily weighted in the rational direction than those who report the opposite thinking style.

As previously noted, the RB experimental paradigm produces a conflict between the two modes of information processing, rational and experiential. It will be recalled that the RB phenomenon refers to the subjective judgment of a low probability event (e.g., $p = .10$) as being more likely when the probability is presented in the form of a ratio of larger (e.g., 10 in 100) numbers than of smaller (e.g., 1 in 10) numbers. The experimental procedure consists of presenting two trays containing different numbers of red and white jelly beans. For example, a small tray may contain 10 jelly beans, one of which is red, and a large tray may contain 100 jelly beans, 10 of which are red. Participants are told that they can win money (e.g., $2) on each trial in which they draw a red jelly bean. They are then asked on each trial to indicate from which tray they prefer to draw. Epstein and his associates have found that despite knowing that the trays have the same odds, most participants report a preference for the large tray because it has more winning red jelly beans (Kirkpatrick & Epstein, 1992; Pacini & Epstein, 1999a, 1999b; Pacini et al., 1998). In other studies that used a version of the paradigm in which unequal ratios were paired, a substantial number of participants preferred the large tray although it offered less favorable odds than the small one (e.g., 7/100 vs. 1/10; Denes-Raj & Epstein, 1994; Pacini et al., 1998).

The RB effect can be explained by the principles of experiential processing. According to CEST, the experiential system is able to encode and comprehend concrete representations, such as absolute numbers, better than abstractions, such as relations between numbers. The responsiveness of those using the experiential system to the numerosity of the target items in the RB paradigm is consistent with work by others showing that sensitivity to frequency is a fundamental cognitive operation in both human and nonhuman species (Gallistel, 1989; Gallistel, 1990; Gallistel & Gelman, 1992; Geary, 1995; Hasher & Zacks, 1984; Staddon, 1988; Starkey, 1992). People tend to automatically attend to numerosity, or frequency information, and this tendency often prevails over more rational considerations, such as probability ratios and the total amount of an item or items independent of the number of particles into which it is divided (Pelham, Sumarta, & Myakovsky, 1994). A further consideration, according to CEST, is that small absolute numbers are easier than larger absolute numbers for people using the experiential system to comprehend because small numbers are more concrete (i.e., easier to visualize; Paivio, 1971). In an RB study in which participants rated how clearly they could visualize the jelly beans in the two trays, the overwhelming majority of participants reported that they could visualize the smaller quantity more clearly than the larger quantity (Pacini & Epstein, 1999b). It follows that if smaller numbers can be better comprehended at the experiential level than larger numbers, then ratios expressed in smaller numbers can be better comprehended at the experiential level than ratios expressed in larger numbers (Gallistel, 1990; Siegler, 1981; Surber & Haines, 1987).

One may ask why the experiential system attends to the numerosity of the red but not the white jelly beans in the RB paradigm. Two considerations provide an answer to this question: figure–

ground relations and the affirmative representation principle. In the RB experimental paradigm, the relatively few red jelly beans stand out as figure against the background of many more white jelly beans, so the red jelly beans are noticed and the white ones tend to be ignored (Pacini et al., 1998).

According to the affirmative representation principle, a facet of the concretive principle of CEST, a positive representation of an event (e.g., drawing a desirable jelly bean) is more concrete (i.e., easier to visualize) and therefore more comprehensible to a person using the experiential system than a negative representation (e.g., not drawing an undesirable jelly bean; Pacini et al., 1998). In support of the affirmative representation principle, when participants are told that they will lose money if they draw a red jelly bean, many report shifting their attention to the desired white jelly beans (Pacini et al., 1998). The affirmative representation principle is consistent with evidence showing that negation or absence is more difficult to process than affirmation or presence (e.g., Fletcher, 1984; Gilbert, 1991; Holden & Fekken, 1990; Matlin, 1983; Snyder & Swann, 1978).

The RB studies have shown that in certain situations where rational and experiential solutions are self-evident and therefore equally accessible, most people prefer the experiential response. However, the extent to which they do this is influenced by situational factors and individual differences. For example, the degree of nonoptimality of the large tray in the version of the RB paradigm in which uneven probabilities are presented has been found to be inversely related to nonoptimal responding. That is, although most people prefer to draw from a tray with 9/100 odds over one with 1/10 odds, few prefer to draw from a tray with 5/100 odds over one with 1/10 odds (Denes-Raj & Epstein, 1994; Kirkpatrick & Epstein, 1992; Pacini et al., 1998). We have also found that people make fewer nonoptimal responses in lose trials, in which the person drawing a red jelly bean is punished, than in win trials, in which the person drawing a red jelly bean is rewarded (Denes-Raj & Epstein, 1994; Kirkpatrick & Epstein, 1992; Pacini et al., 1998).

In terms of individual differences, in all our studies we have found that some people continuously behave optimally, whereas most behave somewhat nonoptimally. Moreover, the responses of the latter vary in degree of nonoptimality, with most making only slightly nonoptimal responses but a substantial number making extremely nonoptimal responses, such as selecting a 5% numerosity-advantaged choice over a 10% probability-advantaged choice. We have found interesting differences in the performance of depressed and nondepressed college students in RB studies (Pacini et al., 1998). Under low incentive conditions, the depressed students behaved more optimally than did the nondepressed students, consistent with the depressive-realism phenomenon. However, under higher incentive conditions, the depressed students behaved more nonoptimally and the nondepressed students behaved less nonoptimally, to the extent that the groups no longer differed.

In the present study, we examined the relationship between thinking style, as measured by the REI, and the number of nonoptimal responses in the RB paradigm as a function of the degree of nonoptimality of the large tray, valence (win vs. lose trials), and incentive level. We also examined the RB effect under conditions in which nonoptimality was not at issue by asking participants to choose between probabilities that were equal but expressed in different numbers (e.g., 1/10 vs. 10/100).

It is important to keep in mind the CEST assumption that the balance between experiential and rational processing determines overt responses, and that the same responses can therefore be achieved in different ways. Thus, RB effects can result from either strong experiential processing, weak rational processing, or both. Accordingly, the safest prediction that can be made when optimality is at issue is that nonoptimal responses will be inversely related to rationality, directly related to experientiality, or both. When optimality is not at issue, we predicted we would find a nonsignificant relation between RB responses (e.g., a preference for the large tray in win trials) and scores on the Rationality scale of the REI. This follows from the consideration that there is no rational basis for choosing between two equivalent alternatives. We therefore predicted that experientiality, as the only remaining source of influence, would be directly related to number of heuristic responses (i.e., selecting the tray with the most favorable absolute number of target items, which is the large tray in win trials and the small tray in lose trials).

As already noted, significant individual differences in responses to variations in incentive level have been observed in a comparison of nonoptimal responses of depressed and nondepressed college students. We have also observed individual differences in the influence of incentives on the nonoptimal responses of samples of unselected college students. Some participants consistently responded more optimally and others responded less optimally with an increase in incentive (Denes-Raj & Epstein, 1994; Pacini et al., 1998).

In the present experiment, we expected the relation of thinking style to nonoptimal responses to be influenced by incentive level. More specifically, we predicted that when the incentive level is increased from low to high, Rationality scores will be more strongly inversely associated, Experientiality scores will be more strongly directly associated, or both with the number of nonoptimal responses. This follows from the assumption that with increasing motivation, there is an increase in the influence of the dominant relative to the nondominant thinking style on behavior. For highly rational participants, this means greater reliance on their rational processing, and for highly experiential participants, it means greater reliance on their experiential processing. In trials in which equal probabilities are presented, and optimality, therefore, is not a consideration, we predicted that as incentive level increased from low to high, Rationality scores would be unassociated and Experientiality scores would be directly associated with the number of heuristic responses. If individual differences in the influence of incentives are demonstrated, they could account for the inconsistencies previously found for incentive effects across participants (e.g., Denes-Raj & Epstein, 1994; Pacini et al., 1998).

Summary of Predictions

We had the following predictions for the optimality trials (in which participants had a choice between 1/10 and 7/100 or 9/100).

1. Rationality scores will be inversely related, Experientiality scores will be directly related, or both to the number of nonoptimal responses.

2. An increase in incentive will be associated with a decrease in

nonoptimal responses in participants with high Rationality scores and with an increase in nonoptimal responses in participants with high Experientiality scores.

We had the following predictions for the trials in which optimality was not at issue (in which participants had a choice between 1/10 and 1/100).

1. Rationality scores will be unrelated and Experientiality scores will be directly related to the number of numerosity-advantaged choices for the target items (i.e., selection of the large tray on win trials and the small tray on lose trials).

2. With an increase in incentive, Rationality scores will remain unrelated and Experientiality scores will be more strongly directly related to the number of numerosity-advantaged choices for the target items.

Method

Sample

One hundred forty-four students (71 men, 73 women) from a large northeastern state university participated. The students were recruited by phone and offered course credit for participating in an experiment that included a game of chance and some questionnaires.

Measures

REI. Reliability analysis and factor analysis of the 40-item REI (Epstein et al., 1998) replicated what was found in Study 1. Rationality (M = 3.44, SD = .61) and experientiality scores (M = 3.47, SD = .49) were independent, $r(142) = .00$, and reliable (Rationality, α = 91; Rational Ability, α = .85; Rational Engagement, α = .87; Experientiality, α = .88; Experiential Ability, α = .80; Experiential Engagement, α = .82). There were no significant gender differences on either main scale. However, gender differences on two of the subscales replicated the findings of Study 1. Men obtained higher Rational Ability scores (M = 3.56, SD = 0.59) than did women (M = 3.34, SD = 0.66), $t(142) = 2.10$, $p < .05$, and women obtained higher Experiential Engagement scores (M = 3.66, SD = 0.51) than did men (M = 3.47, SD = 0.55), $t(142) = 2.12$, $p < .05$.

RB paradigm. Participants were presented with two rectangular transparent plastic trays containing different mixtures of red and white jelly beans. A large and a small tray were always presented together. The small tray always contained 10 jelly beans, 1 of which was red (10% red). The large tray always contained 100 jelly beans, among which the number of red jelly beans (10, 9, or 7) varied by trial. The jelly beans were spread in a flat layer in each tray so that all were visible. An index card stating the percentage of red jelly beans and the number of red and white jelly beans was placed in front of each tray.

Manipulation check. Four questions assessing the motivation to win and to not lose in the two incentive conditions ($0.10, $2) were administered to check reactions to the incentive manipulation (e.g., "How badly did you want to win in the $2 win trials?"). Responses were on a 5-point scale, ranging from 1 (*not at all*) to 5 (*extremely*).

Procedure

Participants were tested individually by one of three experimenters who were unaware of the REI scores of the participants. Participants first read and signed consent forms explaining that they would have the opportunity to win money. They then received instructions for the game of chance and were loaned cash to cover possible losses. The net amount that could be won ($10.50) was placed on the table in full view. They were told they could keep their earnings beyond the amount that had been loaned and that any net losses would be forgiven.

The game of chance consisted of 16 trials. The first 12 trials varied by valence (win, lose), percentage of red jelly beans in the large tray (7%, 9%, and 10%), and incentive ($0.10, $2). A Latin square design was used to vary the order of the first 12 trials. The last 4 trials were all win trials in which the large tray contained either 40% or 50% red jelly beans, and the small tray contained either 50% or 40% red jelly beans, respectively. These were included to increase the likelihood that all participants would win some money.

On each trial, the experimenter presented two labeled trays of jelly beans and read a script explaining the trial valence and the amount of money that could be won or lost on drawing a red jelly bean. The experimenter next asked the participant to indicate the tray from which he or she wished to draw a jelly bean. To control for a position effect (i.e., right or left), we alternated tray positions on every trial. After the participant chose a tray, the experimenter placed the tray behind a screen to obstruct the participant's view, scrambled the jelly beans, and then let the participant draw a jelly bean. Depending on the valence and outcome of each trial, the participant either got paid (won), returned money to the experimenter (lost), or had nothing happen (neither won nor lost because he or she drew a jelly bean that was not a designated winner or loser). After finishing the trials, the participant completed the manipulation check. The experimenter then debriefed and thanked the participant. The entire procedure took approximately 1 hr.

Results and Discussion

Median scores on Rationality (Mdn = 3.42) and Experientiality (Mdn = 3.49) were used to divide the sample into the following groups: high on both scales, low on both scales, high on one and low on the other, and the reverse.

Incentive Manipulation Check

The motivation to win in win trials and not to lose in lose trials as a function of valence and incentive level was measured with four manipulation check items. Responses to the four items were entered in a mixed-design analysis of variance (ANOVA), with Rationality scores (low, high), Experientiality scores (low, high), and gender as the between-subjects variables, and valence (win, lose), and incentive level (low, high) as the within-subjects variables. There were significant main effects for incentive, $F(1, 135) = 336.08$, $p < .000$, and valence, $F(1, 135) = 8.78$, $p < .01$, and a significant interaction of Gender × Valence, $F(1, 135) = 9.96$, $p < .01$. The participants reported higher motivation in high incentive (M = 3.51, SD = 0.81) than in low incentive (M = 2.17, SD = 0.69) trials. They also reported higher motivation in win (M = 2.93, SD = 0.64) than in lose (M = 2.76, SD = 0.78) trials. The interaction indicated that the main effect for valence was due mainly to the men.

The RB Effect

Responses to trials in which optimality was at issue (e.g., selecting 1/10 or 7/100) and not at issue (i.e., selecting 1/10 or 10/100) were analyzed separately.

Responses to trials in which optimality was at issue. Selection of the tray with less favorable odds—the large tray in win trials and the small tray in lose trials—constituted a nonoptimal response. The number of nonoptimal responses, indicating the magnitude of the RB effect, could range from 0 to 8. Only 16% of the

participants made uniformly optimal responses. The average participant made slightly less than 3 nonoptimal responses ($M = 2.85$, $SD = 2.11$), a rate comparable with that found previously (Pacini et al., 1998). A mixed-design ANOVA was conducted on the number of nonoptimal responses, with valence (win, lose), incentive ($0.10, $2), and percentage of red jelly beans in the large tray (7% or 9%) as the within-subjects variables and rationality, experientiality, and gender as the between-subjects variables. There were significant main effects of rationality, $F(1, 136) = 20.50, p < .001$; valence, $F(1, 136) = 4.35, p < .05$; and percentage of red jelly beans in the large tray, $F(1, 136) = 14.79, p < .001$. There were no significant main effects of gender, incentive, or experientiality. The rationality and percentage main effects were qualified by significant interactions with incentive, which are discussed below.

In line with earlier findings (Denes-Raj & Epstein, 1994; Kirkpatrick & Epstein, 1992; Pacini et al., 1998), there were more nonoptimal responses in win ($M = 1.55$, $SD = 1.25$) than in lose ($M = 1.30$, $SD = 1.30$) trials and in the 9% (1/10 vs. 9/100; $M = 1.62$, $SD = 1.23$) than in the 7% (1/10 vs. 7/100; $M = 1.23$, $SD = 1.20$) trials. The low rationality group ($M = 3.57$, $SD = 2.12$) made more nonoptimal responses than the high rationality group ($M = 2.12$, $SD = 1.85$).

We decomposed a significant interaction of rationality, experientiality, and incentive, $F(1, 136) = 5.27, p < .05$, by separately analyzing the low and high experientiality groups. In the low experientiality group, the only significant effect was that of rationality, $F(1, 70) = 7.85, p < .01$, which duplicated the overall main effect of rationality described earlier. In the high experientiality group, in addition to a similar main effect of rationality, $F(1, 70) = 10.91$, $p < .01$, there was a significant interaction of rationality and incentive, $F(1, 70) = 6.10, p < .05$. Within the high experientiality group, the low rationality group made significantly more nonoptimal responses in the high incentive trials ($M = 2.00$) than in the low incentive trials ($M = 1.62$), whereas the responses of the high rationality subgroup were nonsignificantly in the opposite direction (see Figure 1). Moreover, the two groups differed significantly only in the high incentive condition, with the low rationality group giving more nonoptimal responses ($M = 2.00$) than the high rationality group ($M = 0.92$). These findings provide support for the prediction of individual differences in rationality in response to incentive (Prediction 2), but only for those high in experientiality.

Another significant three-way interaction also included incentive. There was a significant interaction of rational group, percentage of red jelly beans in the large tray (7% or 9%), and incentive, $F(1, 136) = 8.42$, $p < .01$. We decomposed this interaction by examining the 7% and 9% trials separately. In the 7% trials, the low rationality group, as expected, gave more nonoptimal responses ($M = 0.82$, $SD = 0.72$) than did the high rationality group ($M = 0.39$, $SD = 0.62$), $F(1, 142) = 12.41, p < .001$. There were no other significant effects. In the 9% trials, in addition to a main effect of rationality, $F(1, 142) = 15.14$, $p < .001$, which reflected the main effect in the overall analysis, there was a significant interaction of rationality and incentive, $F(1, 142) = 6.80, p < .01$. The low rationality group responded significantly more nonoptimally on high ($M = 1.10$, $SD = 0.75$) than on low ($M = 0.90$, $SD = 0.75$) incentive trials, whereas the high rationality group showed a nonsignificant tendency to respond in the opposite direction ($M = 0.54$, $SD = 0.60$, and $M = 0.69$, $SD = 0.72$, respectively). The overall pattern suggests that low, but not high, rationality is associated with increasing nonoptimal responding with increasing incentive. This is most strongly demonstrated in the 9% trials, where the greatest number of nonoptimal responses are elicited.

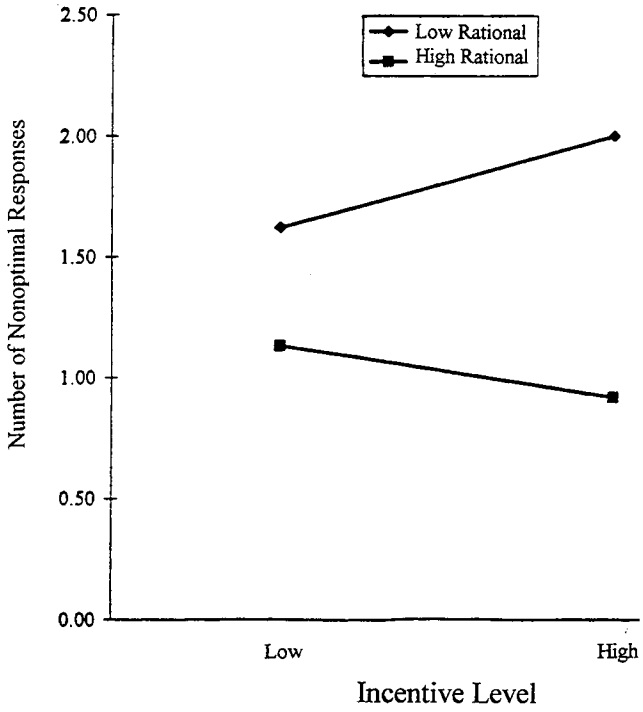

Figure 1. Nonoptimal responses as a function of rationality and incentive in the high experientiality group.

Responses to trials in which optimality was not at issue. In the trials in which both trays offered a 10% chance of winning or losing, tray selections were coded in the direction of the numerosity heuristic (selection of the large tray in win trials and the small tray in lose trials). The number of possible heuristic responses was 0 to 4. On average, the participants made 2.41 heuristic responses ($SD = 1.07$), with a mode of 3. To test for the RB effect in each incentive condition, we compared the number of small relative to large tray choices with an expectancy of an equal division by chi-square analysis. The RB effect was significant in both win-trial conditions at both incentive levels but at neither incentive level in the lose-trial conditions. In the $0.10 win condition, 69% of the participants selected the large tray, $\chi^2(1, N = 144) = 20.25, p < .000$, and in the $2 win condition, 68% selected the large tray, $\chi^2(1, N = 144) = 18.78, p < .000$. In the lose trials, 48% and 56%, respectively, selected the small tray.

We analyzed the number of heuristic responses across trials with a mixed-design ANOVA in which rationality, experientiality, and gender were the between-subjects variables and incentive and valence were the within-subjects variables. More heuristic responses were made in win ($M = 1.37$, $SD = 0.69$) than in lose ($M = 1.04$, $SD = 0.78$) trials, $F(1, 136) = 15.35$, $p < .001$, consistent with previous findings (Denes-Raj & Epstein, 1994; Kirkpatrick & Epstein, 1992). This strong main effect was quali-

fied by a weak three-way interaction of experientiality, incentive, and valence, $F(1, 136) = 4.74$, $p < .05$, which we could not interpret. There were no other significant main effects or interactions.

Conclusion

When optimality is not at issue, the results suggest that there is a strong tendency for people to engage in heuristic processing that is consistent across individuals apart from rational and experiential thinking styles. When optimality is at issue, responses to an increase in incentive depend on individual differences in both rational and experiential thinking styles. The nature of the qualifications of the main effect of rationality suggests that an important function of rational processing is to control the influence of maladaptive experiential processing when incentive is high, particularly in people with strong experiential tendencies. The absence of significant main effects of experientiality suggests that reactions to numerosity in the RB paradigm may be of such a fundamental nature that nearly everyone experiences them to roughly the same degree. The result is that rationality becomes the determining factor in the degree of nonoptimal responding manifested.

General Discussion

The present studies were undertaken for two main purposes. The first was to construct a psychometrically improved version of the REI, a self-report inventory for measuring rational and experiential thinking styles. The second was to verify and extend previous findings by examining the relation of rational and experiential thinking styles, as measured by the REI, to personality variables, including the Big Five personality traits, basic beliefs about the self and the world, and conservative versus liberal ideation. We also examined the relations of Rationality and Experientiality scores to a different kind of heuristic processing than we had previously investigated, namely, the RB phenomenon, to determine the generality of the earlier findings.

Psychometric Improvement of the REI Scales

REI main scales. The new REI is a considerable improvement over the old version. The scales in the new REI are balanced in the number of items per scale (20 items) and in the number of positively and negatively worded items. The reliabilities of the new REI scales are higher than before and similar to each other, so differential reliabilities are no longer a concern when comparing correlations. The Rationality and Experientiality scales have more parallel content than before. Taking all of this into account, it may be concluded that the problems with the old REI have been successfully eliminated from the new version.

The thinking-style subscales. The ability and engagement subscales of the REI are useful for elucidating what the main scales measure as well as for providing more detailed information than the main scales do that is important in its own right. Although factor analysis failed to support a distinction between the subscales of experiential (unlike rational) processing, correlations with other variables provided support for the discriminant validity of the experientiality subscales and therefore justification for retaining them. It is noteworthy that the two ability subscales are both associated with self-esteem related variables, and the two engagement scales are both associated with attitude and value-related variables.

Verification and Extension of Previous Findings

In the previous research (Epstein et al., 1996), in which an earlier version of the REI was used, we found that a rational thinking style was more strongly related to adjustment and coping ability than was an experiential thinking style, and that an experiential thinking style was more strongly related to the establishment of favorable interpersonal relationships than was a rational thinking style. We had also previously found that scores on the REI Rationality and Experientiality scales were differentially related to heuristic responses to vignettes that described arbitrary outcomes, with the relation being much stronger for the Experientiality score. This raised the question of whether the stronger relation of experiential thinking style, as compared with rational thinking style, with heuristic responses was general across situations or was specific to the situation we had previously investigated, a question that we sought to answer in Study 2 and that we will discuss shortly.

Verification of previous findings. It was reassuring to find that despite the limitations of the previous REI, the new version confirmed previous findings. Factor analysis of the items and the correlation of the main scales with each other indicated that the new Rationality and Experientiality main scales were independent. Further evidence of the independence of the two processing modes was provided in other recent research by findings with a short form of the REI that also included subscales of ability and engagement (Norris et al., 1998). In the present study, correlations of the new scales with a variety of variables indicated that as in the other research (Epstein et al., 1996; Norris et al., 1998), both thinking styles contributed jointly to many personality attributes. We also verified that rationality was more strongly associated with various measures of good adjustment than was experientiality, and that experientiality was more strongly associated with favorable interpersonal relationships than was rationality.

Extension of findings. It is important when introducing a new measure to demonstrate that it makes a contribution beyond what is already available from established measures. In the present research, we demonstrated that the new REI contributes to the measurement of various personality attributes beyond the contribution of a broadly based, general personality inventory, the NEO-FFI (Costa & McCrae, 1992). The combined NEO-FFI scales accounted for less than half of the variance of the REI rationality scales and an even smaller proportion of the variance of the experientiality scales. Parenthetically, this provides interesting information about what the NEO-FFI mainly measures and fails to measure. These findings suggest that the revised REI, a theoretically derived measure of thinking style, is a useful addition to other personality measures.

The relation of the two thinking styles to personality measures that had not previously been examined provided interesting new information about the nature of experiential and rational thinking styles. The new measures included the basic beliefs about the self and the world proposed by CEST, categorical thinking, emotional expressiveness, ego strength, defensiveness, and conservative versus liberal attitudes. Rationality was significantly positively related

to favorable basic beliefs about interpersonal relationships, the impersonal world, the meaningfulness of life, personal directedness, the existence of a predictable and controllable world, and the ability to exercise self-control as well as environmental control. Rationality was also directly associated with conscientiousness, ego strength, open-mindedness, liberal ideology, and an absence of categorical thinking. Experientiality was most strongly directly associated with favorable beliefs about relationships and trusting others and with extroversion, emotional expressivity, and an absence of categorical thinking. Neither REI scale was significantly related to defensiveness, indicating that social desirability is not a significant problem for the REI.

In summary, the self-picture of a rational person that emerged is of someone who is emotionally well-adjusted, has a positive view of the self and the world, is able to exert self-control and control of events, can delay gratification and assume responsibility, is a flexible thinker, and has liberal values. The self-picture of an experiential person that emerged is of someone who relates well to others, communicates emotions readily, and is tolerant, trusting, spontaneous, and open-minded. As rationality and experientiality are orthogonal, it is possible for a person to be high on both or on neither of these sets of attributes. A caveat is in order with respect to the generality of these findings: It remains to be seen whether similar results will be found in groups other than college students.

In Study 2, we examined the relation of heuristic, nonoptimal responding in the RB paradigm to thinking style, as measured by the REI. We found that a rational thinking style is associated with control of nonoptimal, experiential response tendencies. This is consistent with the picture of a rational person being self-controlled and well-adjusted that emerged from the self-report data in Study 1 as well as from the previous research (Epstein et al., 1996).

Taking into account previous as well as present findings, we found that no general statement can be made about whether one style of thinking is generally more strongly associated with heuristic processing than the other. Rather, the relations appear to vary with the kind of heuristic processing. In the previous research (Epstein et al., 1996), an experiential thinking style was a stronger positive predictor than a rational thinking style was a negative predictor of heuristic responding to vignettes with arbitrary outcomes. In the present study, in which heuristic responses consisted of nonoptimal responses in a game of chance, only a rational thinking style was significantly related (negatively) to heuristic processing. The reason proposed for this was that everyone responds automatically to the numerosity of the target items at a very fundamental and therefore somewhat similar level. It follows that the manifest responses are therefore determined primarily by the degree of rational control that is exerted over the experiential response tendencies. It may be concluded that the relative contribution of rational and experiential thinking styles to the prediction of heuristic processing depends, in large part, on the nature of the heuristic processing that is involved.

We also learned from Study 2 that rational processing serves to moderate inappropriate experiential processing, particularly at higher levels of motivation in people who are particularly prone to process information in the experiential mode. This observation has important implications for understanding and controlling impulsive behavior in individuals who are high on experiential processing.

The question may be raised as to how seriously one can take generalizations from an artificial laboratory paradigm that involves jelly beans. The answer is that the RB experimental paradigm produces theoretically meaningful results, because it presents a unique situation in which people are confronted with a conflict between their experiential and rational processing tendencies in which the outcomes of both processing modes are immediately and equally accessible. Under these circumstances, although many people behave consistently rationally, most respond in a nonoptimal manner suggestive of compromises between the two processing modes. Among these, some consistently make more extremely nonoptimal responses than others. The results of the present research, as well as those of previous research, show that the demonstration of such individual differences is not an isolated phenomenon lacking in general significance. In the present study, behavior in response to the RB paradigm was coherently related to self-reported thinking styles as measured by the REI. As noted in the introduction, we have found in other research that RB behavior is related to self-reported gambling in everyday life (Denes-Raj & Epstein, 1994), to heuristic responses to certain kinds of vignettes (Denes-Raj & Epstein, 1994), and to the notorious depressive realism phenomenon (Alloy & Abramson, 1979), which it has helped to elucidate (Pacini et al., 1998). It may be concluded that the RB experimental paradigm is not just an inconsequential laboratory demonstration. Rather, it has significant real-world behavioral as well as theoretical implications.

The improved REI provided new findings about gender differences. With the old REI, results were inconsistent across two studies, so no general conclusion could be drawn (Epstein et al., 1996). The findings in the present investigation revealed that men view themselves as having greater rational ability than do women, and women view themselves as valuing and engaging in experiential processing more than do men. It remains to be seen, of course, if these results will be upheld in future research with other populations.

Future Directions

Establishing the construct validity of a new instrument is a continuous process, and any study can accomplish only so much. Obviously, much remains to be done with the REI. One important direction for future research is to expand the scales of rational and experiential processing so that they include all theoretically relevant elements, which could be represented in the form of subscales. A guideline for accomplishing this is provided by CEST, which lists the basic principles of experiential and rational processing (Epstein, 1994).

A second important direction for future research is to relate the REI scales to other measures that are similar to the REI rational and experiential scales to establish the unique characteristics of the REI. For example, it would be desirable to relate the REI to the Myers–Briggs Type Indicator (Briggs & Myers, 1976), a popular test in personnel selection that provides several scales conceptually relevant to the REI scales. As the Myers–Briggs Type Indicator presents its scales in bipolar form, it can be expected that its scales will be related to both the rational and the experiential scales of the REI. The REI should also be related to the Modes of Processing Inventory (Burns & D'Zurilla, in press), a recently constructed test modeled after the REI that provides scales of rational and experi-

ential processing associated with coping with stress and to the Individual Differences Questionnaire (Paivio & Harshman, 1983) that provides scales of verbal and of imagistic processing. We are unaware of any other tests that include a scale similar to the REI experiential scale. However, there are a variety of tests that measure individual differences relevant to rational processing (see review in Cacioppo et al., 1996). It would be interesting to determine how they relate to the two scales of the REI.

In addition to examining the relation of the REI scales to similar tests, it is important to determine how the REI scales relate to measures that are relevant at a broader conceptual level. For example, it would be informative to relate the REI to the full NEO-FFI, rather than just its short form. It would also be interesting to determine the relative degree to which ego-resiliency and ego-control (Block & Block, 1980) involve experiential and rational thinking styles. According to a study comparing the attributes associated with ego-resiliency and IQ (Block & Kremen, 1996), a reasonable expectation is that high levels of ego-resiliency require an effective combination of high levels of both rational and experiential processing.

Understanding of the relation of the REI scales to emotionality could benefit from further investigation. For theoretical reasons, a positive relation between an experiential thinking style and emotionality can be expected (Epstein, 1994). Yet, in a previous study (Epstein et al., 1996), the relation between the earlier measure of experiential processing and a measure of affect intensity (Larsen & Diener, 1987) was nonsignificant. In a study by Burns and D'Zurilla (in press) in which scales similar to those in the REI were investigated, rationality was significantly positively associated with positive affect, and experientiality was significantly positively associated with negative affect and affect intensity. In the present study, experiential processing was significantly positively related to emotional expressivity. Further research with the new REI is required to establish which of these findings are replicable and to determine the sources of the differences between the studies.

Of particular importance in further research with the REI is establishing the relations of its scales to more non–self-report, objective measures. Studies are currently underway in which participants' rationality and experientiality thinking styles are assessed by acquaintances, and other studies are being conducted in which the relations between REI scores and performance on behavioral tasks that require primarily rational or experiential processing are examined (Norris & Epstein, 1999).

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