

Regulatory Focus and the Probability Estimates of Conjunctive and Disjunctive Events

Joel Brockner, Srikanth Paruchuri, Lorraine Chen Idson, and
E. Tory Higgins

Columbia University

Prior research has shown that people overestimate the likelihood of conjunctive events and underestimate the likelihood of disjunctive events. We evaluated whether people's regulatory focus success was related to the magnitude of these judgmental biases. Regulatory focus theory posits that people are guided by two distinct motivational systems—promotion focus and prevention focus. When people are promotion focused they attempt to bring their actual selves into alignment with their ideal selves (standards reflecting wishes and aspirations). When people are prevention focused they attempt to bring their actual selves into alignment with their ought selves (standards reflecting duties and obligations). As predicted, promotion success (i.e., congruence between actual and ideal selves) was positively related to the accuracy of disjunctive probability estimates, whereas prevention success (i.e., congruence between actual and ought selves) was not. Also as predicted, greater prevention success led to more accurate conjunctive probability estimates, whereas greater promotion success did not. © 2001 Elsevier Science

Behavioral decision theory examines how people's reliance on cognitive heuristics influences (and often distorts) their judgments and decisions (e.g., Tversky & Kahneman, 1974). Because cognitive heuristics can operate automatically, their impact may depend on people's level of access to their judgment and decision processes. For example, one of several possible ways to reduce the biasing effects of heuristics is to train people to be more cognizant of their judgment and decision processes (e.g., Arkes, 1991). If people could only be more aware of these processes, the logic goes, the biasing influence of cognitive heuristics may be reduced.

The present research focuses on the judgmental bias in which people misperceive the likelihood of conjunctive and disjunctive events (Bazerman, 1998). Prior research has shown that people generally overestimate the probability of conjunctive events and underestimate the probability of disjunctive events (Bar-Hillel, 1973). The theoretical approach guiding the present study suggests that people's (mis-)perceptions of the likelihood of conjunctive and disjunctive events do not depend merely on their level of access to their judgment and decision processes. Rather, the motivational orientations central to Higgins' (1998) regulatory focus theory also can influence people's perceptions of the likelihood of conjunctive and disjunctive events.

THEORETICAL OVERVIEW

Both conjunctive and disjunctive events consist of multiple components. The likelihood of a conjunctive event is the probability that *all* components in question materialize. For example, Bazerman (1998) suggests that when doctoral students enter the "final" year of their graduate programs, in which the last remaining hurdle is the completion of their dissertation, they typically underestimate the amount of time needed to complete the program. Completing the program is a conjunctive event, in which all component tasks must be accomplished (e.g., proposing the dissertation, gathering data, statistically analyzing the data, writing, and defending it before a committee). Even if each component task has a high probability of completion, the probability that all tasks actually will be completed is lower (and often considerably lower) than the probability of completion of the typical task. Unfortunately, however, people tend not to recognize this fact; instead, they tend to overestimate the likelihood of conjunctive events (Bar-Hillel, 1973).

The likelihood of a disjunctive event is the probability that *any one* of the multiple components in question materialize. For example, consider the case of an MBA student in the throes of a job search. Finding a good job is a disjunctive task. While the receipt of many offers is flattering (and may boost one's negotiating power), people ultimately can select only one job. Even if the probability of getting each offer is quite low, the probability of getting at least one offer is higher (and often considerably higher) than the probability of the typical offer. However, people tend not to recognize this fact, and, instead underestimate the likelihood of disjunctive events (Bar-Hillel, 1973).

Conjunctive and disjunctive events occur regularly. Furthermore, the consequences of misperceiving the likelihood of these events could be considerable. Citing Perrow (1984), Bazerman (1998) provides some particularly compelling examples: "In *Normal Accidents*, Perrow (1984) argues against the safety of technologies like nuclear reactors and DNA research. He fears that society significantly underestimates the likelihood of system failure because of our judgmental failure to realize the multitude of things that can go wrong in these incredibly complex and interactive systems" (pp. 31–32). Given the frequency,

and significance of the consequences associated with misperceiving the likelihood of conjunctive and disjunctive events, it is both theoretically and practically important to determine why and when misperceptions occur.

While there is anecdotal and empirical evidence that people misperceive the likelihood of conjunctive and disjunctive events, much less is known about the factors that make these misperceptions more versus less likely to occur. The present research seeks to redress this deficiency. Behavioral decision theorists posit that one basis of the shortcomings in people's judgments and inferences is their lack of access to the distorting influence of cognitive heuristics. While people's lack of access to cognitive heuristics may be one basis of judgmental biases, it may not completely account for their tendencies to misperceive the likelihood of conjunctive and disjunctive events. We suggest that motivational orientations (central to Higgins', 1998, regulatory focus theory) also may be influential.

Regulatory Focus Theory

Self-regulation is the process in which people seek to bring themselves (their behaviors and self-conceptions) into alignment with relevant goals and standards. Extending the basic hedonic principle that people approach pleasure and avoid pain, Higgins (1997, 1998) proposed that people are guided by two distinct self-regulatory systems, one with a promotion focus and the other with a prevention focus. Three factors differentiate a promotion focus from a prevention focus: the needs that people seek to satisfy, the standards with which people try to bring themselves into alignment, and the outcomes which are salient to them.

Needs. Maslow (1955), Bowlby (1969), and others have suggested that people are driven by a variety of needs, some pertaining to growth, development, and nurturance, on the one hand, and others referring to safety, protection, and security, on the other. According to regulatory focus theory, the hedonic principle of approaching pleasure and avoiding pain operates differently, depending upon the nature of the underlying needs. Growth/development/nurturance needs are at work when people are promotion focused, whereas safety/protection/security needs are at work when people are prevention focused.

Standards. Certain standards that people try to meet refer to their hopes, wishes, and aspirations (e.g., the industrial scientist who is trying to create a new product); these are known as *ideal* selves. Other standards refer to people's duties, obligations, and responsibilities (e.g., the regulatory standards imposed upon organizations by a governmental agency); these are known as *ought* selves. When people are promotion focused they are trying to bring themselves into alignment with their ideal selves, whereas when they are prevention focused they are trying to bring themselves into alignment with their ought selves.

Outcomes. Human behavior is motivated by people's desires to (a) attain positive outcomes which make them better off and (b) avoid negative outcomes

which make them worse off. The attainment of positive outcomes is emphasized by people who are promotion focused. The more that promotion-focused persons bring themselves into alignment with their ideal selves, the more they experience the pleasure of a gain. If they fail to do so, they experience the pain of a non-gain. The avoidance of negative outcomes is emphasized by people who are prevention focused. The more that prevention focused persons bring themselves into alignment with their ought selves, the more they experience the pleasure of a non-loss. If they fail to do so, they experience the pain of a loss.

In summary, when promotion focused people's growth/development/nurturance needs motivate them to attempt to bring their actual selves into alignment with their ideal selves; positive outcomes to be attained are emphasized. When prevention-focused people's safety/protection/security needs motivate them to attempt to bring their actual selves into alignment with their ought selves, negative outcomes to be avoided are emphasized.

Regulatory Focus and the Perception of Conjunctive and Disjunctive Events

Imagine that the event for which people have to make a probability estimate consists of four components (A, B, C, and D). In estimating the likelihood of the conjunctive event, people must judge the probability that Component A will occur *and* Component B will occur *and* Component C occur *and* Component D will occur. In estimating the likelihood of the disjunctive event, people must judge the probability that Component A will occur *or* Component B will occur *or* Component C will occur *or* Component D will occur. A central tenet of the present study is that regulatory focus success influences people's strategic orientations toward these two types of problems. For the reasons set forth below, we suggest that greater success in the domain of promotion focus leads people to be more accurate in their estimates of disjunctive events, whereas greater success in the domain of prevention focus leads people to be more accurate in their estimates of conjunctive events.

Promotion focus is associated with the belief that any of a number of action steps are sufficient for goal attainment. As Friedman (1999) suggested:

Consider the goal of seeking accomplishment by means of accumulating vast wealth. This promotion goal can be attained in a variety of ways, such as by becoming a successful Wall Street trader, *or* by winning the state lottery, *or* . . . Once the individual has successfully pursued one route to this promotion goal (i.e., wealth acquisition) he or she need not pursue alternative routes. . . . Any successful route to a promotion goal is a sufficient route. (p. 25, our emphases added).

In contrast, prevention focus is associated with the belief that all action steps are necessary for goal attainment. As Friedman (1999) put it:

Consider the goal of securing one's home from burglars, murderers, and other societal riffraff. Means of attaining this prevention goal include keeping windows *and* doors locked while asleep or away from home. . . . In prevention, danger (e.g., the prospect of a break-in) can not be averted with certainty unless *all* paths to danger are effectively overcome (pp. 25–26, our emphases added).

In short, people's regulatory focus influences their strategic orientation toward goal attainment. Promotion focus leads people to attend to the sufficiency

of any of a number of courses of action to bring about goal attainment. Prevention focus leads people to attend to the necessity of multiple courses of action to bring about goal attainment (Roese, Hur, & Pennington, 1999). Put differently, promotion focus leads people to think disjunctively, whereas prevention focus leads people to think conjunctively.

If this reasoning is correct, then people's success or effectiveness in achieving the goals associated with a given regulatory focus should predict how well they do in estimating the probability of conjunctive and disjunctive events. Those who have been more successful in achieving their promotion goals should do better (be more accurate) in estimating the probability of disjunctive events. In contrast, those who have been more successful in achieving their prevention goals should do better (be more accurate) in estimating the probability of conjunctive events.

The present study examined the relationships between people's regulatory focus success and their estimates of the probabilities of both conjunctive and disjunctive events. After completing measures of their regulatory focus success, participants performed the probability estimation task used by Bar-Hillel (1973), in which people on average were found to overestimate conjunctive events and underestimate disjunctive events.

Hypothesis 1: Greater success in the domain of promotion focus will lead to greater accuracy in peoples' estimates of the probabilities of disjunctive events. That is, the greater the promotion focus success, the less likely are people to underestimate the probabilities of disjunctive events.

Implicit in Hypothesis 1 are several subsidiary predictions which posit that the expected relationship between promotion focus success and the accuracy of disjunctive event probability estimates will be greater than (a) the relationship between prevention focus success and the accuracy of disjunctive event probability estimates and (b) the relationship between promotion focus success and the accuracy of conjunctive event probability estimates.

Hypothesis 2: Greater success in the domain of prevention focus will lead to greater accuracy in peoples' estimates of the probabilities of conjunctive events. That is, the greater the prevention focus success, the less likely are people to overestimate the probabilities of conjunctive events.

Implicit in Hypothesis 2 are several subsidiary predictions which state that the expected relationship between prevention focus success and the accuracy of conjunctive event probability estimates will be greater than (a) the relationship between promotion success and the accuracy of conjunctive event probability estimates and (b) the relationship between prevention focus success and the accuracy of disjunctive event probability estimates.

METHOD

Participants

Eighty-one students at Columbia University took part in the study. Each was paid \$8 for doing so.

Procedure

Prior to assessing participants' probability estimates of conjunctive and disjunctive events, we measured their regulatory focus success with a computerized version of the frequently used "Selves Questionnaire" (Higgins, 1989). The Selves Questionnaire is an idiographic measure in which participants describe certain self-representations (e.g., Higgins, Shah, & Friedman, 1997). Participants were first provided with a definition of their ideal self and ought self. Their ideal self was defined as the type of person they ideally would like to be; the type of person they hoped, wished, or aspired to be. Their ought self was defined as the type of person they believed they ought to be, the type of person they believed it was their duty, obligation, or responsibility to be. They were told that they would be asked to provide attributes that described their ideal and ought selves. The attributes describing the ideal self had to be different from those describing the ought self, and all attributes were to be provided as quickly and as accurately as possible.

Participants then listed three ideal attributes and three ought attributes in a seemingly random order: one ideal attribute followed by two ought attributes, another ideal attribute, another ought attribute, and a final ideal attribute. After listing each of the ideal attributes, participants were asked to rate the extent to which they ideally would like to possess the attribute (ideal extent) and the extent to which they actually possessed the attribute (actual/ideal extent) on a 4-point scale ranging from 1 to 4. Response options were *slightly*, *moderately*, *a great deal*, and *extremely*. Similarly, after listing each of the ought attributes, they were asked to rate the extent to which they ought to possess the attribute (ought extent) and the extent to which they actually possessed the attribute (actual/ought extent) on the same 4-point scales.

As is customary in many previous studies of regulatory focus (see Higgins, 1997, 1998, for reviews), success in the two domains of regulatory focus was based on the degree of congruence between people's actual selves and their ideal (promotion) and ought (prevention) selves. Thus, for each participant we computed separate measures of their promotion focus success and their prevention focus success.

Promotion focus success. Each actual/ideal extent rating was subtracted from its corresponding ideal extent rating. The resultant three difference scores were then summed, such that lower scores reflected more congruence between self and standard; the greater the congruence between actual self and ideal self, the stronger the promotion focus success.

Prevention focus success. Each actual/ought extent rating was subtracted from its corresponding ought extent rating. The resultant three difference scores were then summed such that lower scores reflected more congruence between self and standard; the greater the congruence between actual self and ought self, the stronger the prevention focus success.

After completing the measures of regulatory focus success participants were given a questionnaire which included the items used to assess their estimates

of conjunctive and disjunctive events. The instructions informed participants that the questionnaire was “designed to look at physical perception.” The stimulus materials were taken from those used by Bar-Hillel (1973). Further information about the stimuli (including examples of each) are provided in Tables 1–3. The instructions were as follows: “Take a look at the display of X’s and O’s which appear below. We want to know your impression of the *paths*. A *path* is

TABLE 1
An Example of a Conjunctive Event Stimulus

Row 1	X	O	X	O	X	X	X	O	X	X
Row 2	O	X	X	X	X	O	X	X	O	X
Row 3	X	X	O	X	O	X	X	O	X	X
Row 4	O	X	X	O	X	X	O	X	X	X
Row 5	X	O	X	X	X	O	X	X	X	O

Note. The above example has five rows, 10 columns, and 70% X’s in each row.

TABLE 2
An Example of a Disjunctive Event Stimulus

Row 1	O	O	O	O	O	O	O	X	O	O
Row 2	O	O	O	O	X	O	O	O	O	O
Row 3	X	O	O	O	O	O	O	O	O	O
Row 4	O	O	X	O	O	O	O	O	O	O
Row 5	O	O	O	O	O	O	O	O	X	O
Row 6	O	O	O	O	O	X	O	O	O	O
Row 7	O	O	O	X	O	O	O	O	O	O
Row 8	O	O	O	O	O	O	O	O	O	X
Row 9	O	O	O	O	O	O	X	O	O	O

Note. The above example has nine rows, 10 columns, and 10% X’s in each row.

TABLE 3
Description of Conjunctive and Disjunctive Event Stimuli

Stimulus	Number of rows	Number of columns	Proportion of X’s in each row (%)	Correct probability (%)	Mean estimate of sample (%)
Conjunctive A	3	5	60	22	45
Conjunctive B	7	10	90	48	77
Conjunctive C	4	5	80	41	76
Conjunctive D (shown in Table 1)	5	10	70	17	66
Disjunctive A	5	5	40	92	65
Disjunctive B	7	10	30	92	48
Disjunctive C	6	5	20	74	34
Disjunctive D (shown in Table 2)	9	10	10	61	26

Note. Version 1 consisted of the A and B stimuli, whereas Version 2 consisted of the C and D stimuli.

any line which begins at any place (that is, with any X or any O) on the first row of the display, connects with any X or any O on the second row of the display, and so on, until it has reached any X or any O on the last row of the display." For the conjunctive tasks (e.g., see Table 1), the instructions continued, "Out of all of the possible paths that could be drawn on the display below, please indicate the percentage of paths that are composed *only of Xs*. Since this is a percentage your answer must range anywhere from 0–100%." For the disjunctive tasks (e.g., see Table 2), the instructions were "Out of all of the possible paths that could be drawn on the display below, please indicate the percentage of paths that include at *least one X*. Since this is a percentage, your answer must range anywhere from 0–100%."

Four different conjunctive stimuli and four different disjunctive stimuli were used. As in Bar-Hillel (1973), the stimuli differed in terms of the number of rows, the number of columns, and the proportions of Xs and Os within a given row. Information about all stimuli is presented in Table 3. Each participant only made probability estimates for half of the stimuli (i.e., two conjunctive and two disjunctive). Thus, two different versions of the stimulus materials were used. Version was treated as a control variable in the ensuing statistical analyses. The order in which participants responded to the stimuli was counter-balanced. Half of the participants completed two disjunctive stimuli followed by two conjunctive stimuli; the other half completed two conjunctive stimuli followed by two disjunctive stimuli.

Dependent variables. We first examined participants' probability estimates of the conjunctive and disjunctive events. We then computed the difference between the objectively correct probability and the estimates participants gave. For example, for the conjunctive event graphically illustrated in Table 1 the objectively correct answer is $(.7)^5$, or 17%, whereas for the disjunctive event graphically illustrated in Table 2 the objectively correct answer is $1 - (.9)^9$, or 61%. For the conjunctive stimuli, the difference score was participants' responses minus the objectively correct answer. For the disjunctive stimuli, the difference score was the objectively correct answer minus participants' responses. (Different subtraction methods were used because we expected participants to overestimate the conjunctive events and underestimate the disjunctive events. By using different subtraction methods for the two events, we were able to create dependent variables in both instances in which higher scores reflected more of a discrepancy in the expected direction.)

Separate indices of the accuracy of conjunctive and disjunctive estimates were calculated for each person. The conjunctive index consisted of the average difference between the actually correct answers and participants' estimates of their two conjunctive stimuli (coefficient $\alpha = .74$), while the disjunctive event index consisted of the average difference between the actually correct answers and participants' estimates of their two disjunctive stimuli (coefficient $\alpha = .86$).¹

¹ Note that the measures of accuracy described to this point consisted of directional difference scores. That is, we assessed the extent to which participants' actual estimates deviated from objectively correct answers in the direction set forth by Bar-Hillel (1973) (overestimation in the

TABLE 4
Means, Standard Deviations, and Correlations

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. Promotion success	3.32	1.80							
2. Prevention success	2.87	2.04	.46**						
3. Probability/statistics courses	0.79	1.13	.02	-.01					
4. Conjunctive overestimation (directional)	32.61%	23.80	-.02	.21	-.11				
5. Disjunctive underestimation (directional)	35.44%	25.52	.16	.03	-.22*	.14			
6. Conjunctive estimates (absolute difference)	36.72%	18.40	.03	.23*	-.17	.87**	.17		
7. Disjunctive estimates (absolute difference)	39.32%	21.00	.22*	.10	-.23*	.14	.88**	.25*	

Note. For promotion and prevention success, higher scores reflect *less* success (more of a discrepancy between actual self and the ideal/ought standards). For conjunctive and disjunctive estimates, higher scores reflect *less* accuracy (more of a discrepancy between estimates given and the objectively correct probabilities).

* $p < .05$.

** $p < .01$.

Additional control variable. Because participants' probability estimates may be influenced by their knowledge of probability/statistics, they were asked (at the very end of the questionnaire) to indicate the number of courses in probability or statistics they had taken (ranging from 0 to 5 or more).

RESULTS

Summary statistics for all of the variables are presented in Table 4. Among the more noteworthy findings was that promotion focus success and prevention focus success were moderately related to one another, $r(79) = .46$, $p < .01$. While this relationship may reflect a generalized self-evaluation (akin to a measure of global self-esteem), we examine the distinct impact of the two constructs by entering both of them as predictors in multiple regressions.

Prior to testing the hypotheses, we examined whether participants tended to overestimate the probability of conjunctive events and underestimate the probability of disjunctive events. This enabled us to evaluate whether our findings replicated those shown by Bar-Hillel (1973) more than 25 years ago. In fact, they did. Table 3 shows the objectively correct probabilities along with the average probability estimate made by participants. For all four of the

case of conjunctive events and underestimation in the case of disjunctive events). Analyses also were conducted on absolute difference scores, in which we examined the extent to which participants' actual estimates deviated from the objectively correct answers, regardless of whether such differences were in the direction found by Bar-Hillel. As is shown in the upcoming results, the findings were quite similar regardless of whether directional or absolute difference scores were analyzed.

conjunctive stimuli, participants overestimated the probabilities, often to a great extent. For all four of the disjunctive stimuli, they underestimated the probabilities, again, often to a considerable extent.

Tests of Hypotheses

Multiple regressions were used to test Hypotheses 1 and 2 that (a) greater promotion focus success would lead to less of a tendency to underestimate the probability of disjunctive events and (b) greater prevention focus success would lead to less of a tendency to overestimate the probability of conjunctive events. Predictor terms in the analyses of both dependent variables were the independent variables of promotion focus success and prevention focus success and the control variables of number of probability/statistics courses taken and survey version.

Estimation of disjunctive events. An additional control variable in these analyses was the dependent variable of participants' estimates of conjunctive events. The regression results are shown in Table 5. Of greatest importance, there was a significant effect of promotion focus success, $t(75) = 1.68, p < .05$. In support of Hypothesis 1, the stronger the promotion focus success, the less likely were participants to underestimate the likelihood of disjunctive events. The only other significant finding was the effect associated with the number of courses taken in probability or statistics. As might be expected, participants who had more courses showed less of a tendency to underestimate the probability of disjunctive events ($p < .05$).

To illustrate further the nature of the effect due to promotion focus success, we classified participants as relatively high, medium, or low in their promotion focus success on the basis of a tertile split. We then computed the mean level of these groups in their tendencies to underestimate the likelihood of disjunctive events (adjusted for the other predictors in the regression analysis). Directional difference scores were used in this analysis. The results are shown in the bottom portion of Table 5. The magnitude of participants' faulty estimates of

TABLE 5
Regression Results for Estimates of Disjunctive Events

Predictors	Standardized β s	t	p
Promotion success	.21 (.25)	1.68 (2.05)	.05 (.05)
Prevention success	-.12 (-.09)	0.95 (-0.75)	.35 (.46)
Probability/statistics courses	-.22 (-.21)	1.95 (1.87)	.05 (.05)
Survey version	-.01 (.01)	0.07 (0.06)	.95 (.95)
Conjunctive estimates	.10 (.15)	0.84 (1.14)	.40 (.26)

Note. Numbers in parentheses are for the analysis of absolute difference scores. For analysis of directional differences scores, overall $F(5, 75) = 1.46, p < .22$; total $R^2 = .09$. For analysis of absolute difference scores, overall $F(5, 75) = 2.04, p < .08$; total $R^2 = .12$. Mean level of underestimation of disjunctive events as a function of promotion focus success: high success ($M = 30.65\%$), medium success ($M = 35.20\%$), low success ($M = 42.67\%$).

the probabilities of the disjunctive events was approximately 40% greater among those least successful in the promotion domain (42.67%), relative to those who were most successful (30.65%).

Estimation of conjunctive events. An additional control variable in these analyses was the dependent variable of participants' estimates of disjunctive events. The results of the regression analysis appear in Table 6. Of greatest importance, the analysis yielded a significant effect of prevention focus, $t(75) = 2.02, p < .05$. Confirming Hypothesis 2, we found that stronger prevention focus success led to less of a tendency to overestimate the likelihood of conjunctive events.

To illustrate further the nature of the effect due to prevention focus success, we classified participants as high, medium, or low in their prevention focus success on the basis of a tertile split. We then computed the mean level of the three groups' tendencies to overestimate the likelihood of conjunctive events, adjusted for the other predictor terms in the regression analysis. Directional difference scores were used in this analysis. The results are shown in the bottom of Table 6. Participants with the least prevention focus success made conjunctive probability estimates that were 77% more inaccurate ($M = 44.08\%$), relative to those with the most prevention focus success ($M = 24.84\%$).

The only other variable to have a significant influence in the regression analysis was the survey version. Participants were less likely to overestimate the probability of conjunctive events if they had been given Version 2 rather than Version 1, $p < .001$; see Table 3 for a description of the items comprising the two versions. Bar-Hillel (1973) also found that the tendency toward overestimating conjunctive probabilities was greater on the items comprising Version 2 rather than Version 1.

The more important question is whether the effect of prevention focus success was moderated by version. To examine this possibility, we added an additional term to the regression analysis consisting of the interaction between prevention focus and version. In both the directional and absolute difference score analyses, the interaction effect did not even approach significance (p values $> .20$). In

TABLE 6
Regression Results for Estimates of Conjunctive Events

Predictors	Standardized β s	t	p
Prevention success	.24 (.21)	2.02 (2.03)	.05 (.05)
Promotion success	-.16 (.13)	1.35 (1.17)	.18 (.25)
Probability/statistics courses	-.06 (-.11)	0.58 (1.10)	.56 (.27)
Survey version	.34 (.51)	3.22 (5.39)	.01 (.01)
Disjunctive estimates	.09 (.11)	0.84 (1.14)	.40 (.26)

Note. Numbers in parentheses are for the analysis of absolute difference scores. For analysis of directional difference scores, overall $F(5, 75) = 3.31, p < .01$; total $R^2 = .18$. For analysis of absolute difference scores, overall $F(5, 75) = 7.85, p < .01$; total $R^2 = .34$. Mean level of overestimation of conjunctive events as a function of prevention focus success: high success ($M = 24.84\%$), medium success ($M = 32.95\%$), low success ($M = 44.08\%$).

other words, the finding of primary theoretical significance—the tendency for greater prevention focus success to lead to less of a tendency to overestimate the probability of conjunctive events—did not depend upon the version that participants completed.

Decomposing the predictor difference scores. Note that the measures of regulatory focus success consisted of difference scores. Promotion success was computed by subtracting people's actual ideal self ratings from their ratings of how they would ideally like to be. Prevention success was determined by subtracting actual ought self ratings from ratings of how they believed they ought to be. As a result, it is not known if the significant effects were attributable to one component, the other, or a combination of the two. To address this question we reran the regression analyses reported in Tables 5 and 6, in which the significant discrepancy predictor was replaced by its two component parts. Thus, in the analysis of disjunctive events promotion focus success was replaced as a predictor by actual ideal self and the ideal self standard. In the analysis of conjunctive events prevention focus success was replaced as a predictor by actual ought self and the ought self standard.

Four analyses were conducted (in which the prevention and promotion components were used as predictors of directional and absolute difference scores). In three of the four instances, the actual self component was significantly related to accuracy of probability estimates (at the .05 level) such that more positive actual self-evaluations led to more accurate probability estimates. In the fourth instance (actual ought self as a predictor of the absolute difference score of conjunctive estimates), the effect was in the same direction, but was only marginally significant ($p < .06$).

The effect of the standards component was less consistent. The ought standard was significantly related to the accuracy of conjunctive estimates, as measured by the absolute difference scores ($p < .05$), and the ought standard was marginally related to the accuracy of conjunctive estimates, as measured by the directional difference score ($p < .06$). In both cases, higher ought standards were associated with less accurate probability estimates of the conjunctive events. However, the ideal self standard was unrelated to the accuracy of estimates of the disjunctive events (p values $> .10$).

In sum, the actual self components of the measures of regulatory focus success were more consistently related to the accuracy of participants' probability estimates than were the ideal self and ought self standards. Note that the ratings of the ideal and ought self standards differed in two ways from the ratings of the actual self, which may explain why the former were less consistently predictive of participants' probability estimates. First, the ideal and ought self standards generally were rated quite highly ($M_s = 10.08$ and 9.70 , respectively, on a scale that ranged from 3 to 12), considerably higher than the ratings of actual ideal self and actual ought self (which were closer to the middle of the scale; $M_s = 6.73$ and 6.83 , respectively). Second, the variance was somewhat lower in the case of the ideal self standard and ought self

standard ($SDs = 1.46$ and 1.62 , respectively) than it was for the actual ideal self and actual ought self ($SDs = 1.89$ and 1.86 , respectively).²

Tests of subsidiary predictions. Thus far the results show that promotion success was positively related to the accuracy of disjunctive estimates, whereas prevention success was not, and that prevention success was positively related to the accuracy of conjunctive estimates, whereas promotion success was not. Another way to state these findings is that the relationships between regulatory focus success and judgmental accuracy were significant when regulatory focus success was congruent (as theoretically defined) with the nature of the judgment to be made (e.g., promotion focus success and disjunctive events), but that they were nonsignificant when regulatory focus success was incongruent (as theoretically defined) with the nature of the judgment to be made (e.g., promotion focus success and conjunctive events).

The subsidiary predictions posited that the significant relationships which emerged when there was congruence between regulatory focus success and the nature of the judgment would be greater than the relationships which emerged when there was incongruence between regulatory focus success and the nature of the judgment to be made. To evaluate the subsidiary predictions we computed partial correlations between regulatory focus success and probability estimates on congruent tasks (e.g., promotion focus and disjunctive estimates) and then compared them to the partial correlations between regulatory focus success and probability estimates on incongruent tasks (e.g., prevention focus and disjunctive estimates). All partial correlations were derived from the regression analyses, in which we looked at the relationship between regulatory focus success and probability estimates, controlling for the other predictors that had been entered into the regression. Fisher z statistics were computed to compare the partial correlations to determine whether the difference between them was significant.

The results showed support for all subsidiary predictions. As can be seen in Table 7, the positive relationship between promotion focus success and accuracy

² The method and results of a study by Moretti and Higgins (1990) provide further suggestive evidence that it was the relationship between the actual self and ideal/ought standards (rather than either component alone) that was most predictive of participants' probability estimates. Moretti and Higgins examined whether nomothetic and idiographic measures of the difference between actual self and ideal self predicted self-esteem, independent of actual self-ratings. The nomothetic measure required participants to rate their actual and ideal selves on personality attributes provided by the experimenter (e.g., popularity and honesty). The idiographic measure consisted of the Selves Questionnaire used in the present study, in which participants generated personally relevant ideal-self attributes before rating how much they would ideally like to have the attributes and the extent to which they actually had the attributes. Moretti and Higgins found that the relation between actual-ideal discrepancy on the nomothetic measure and self-esteem was not significant, beyond that portion of the variance in self-esteem that could be accounted for by the actual self measure. However, the relationship between actual-ideal discrepancy on the idiographic measure and self-esteem was significant, even when actual self ratings were held constant. As in the Moretti and Higgins study, the actual self-ratings made in the present study were idiographic. Moreover, they were assessed in a "relational" context, in that participants rated their actual selves after having rated their corresponding ideal self and ought self standards.

TABLE 7
Tests of Subsidiary Predictions (Congruent Relationships vs Incongruent Relationships)

	<i>Partialr</i>	<i>z</i> - scores			
		1 vs 3	1 vs 4	2 vs 3	2 vs 4
Congruent relationships					
1. Promotion Success-Disjunctive	.19 (.23)	2.15 (2.30)	1.87 (1.99)	2.40 (2.28)	2.11 (1.98)
2. Prevention Success-Conjunctive	.23 (.23)				
Incongruent relationships					
3. Promotion Success-Conjunctive	-.15 (-.13)				
4. Prevention Success-Disjunctive	-.11 (-.09)				

Note. Numbers in parentheses are for the analyses based on absolute difference scores. In all instances the partial correlations are significant at the .05 level for the congruent relationships and are not significant for the incongruent relationships. All *z*- scores comparing congruent to incongruent relationships are significant at least at the .05 level.

in estimates of disjunctive events was significantly greater than (a) the relationship between prevention focus success and accuracy in estimates of disjunctive events and (b) the relationship between promotion focus success and accuracy in estimates of conjunctive events. Moreover, the positive relationship between prevention focus success and accuracy in estimates of conjunctive events was significantly greater than (a) the relationship between promotion focus success and accuracy in estimates of conjunctive events and (b) the relationship between prevention focus success and accuracy in estimates of disjunctive events.³

DISCUSSION

At the outset we suggested that promotion focus is associated with a tendency to “think disjunctively,” whereas prevention focus is associated with a tendency to “think conjunctively.” That is, the former leads to the perception that any of multiple courses of action may be sufficient for goal attainment, whereas the latter leads to the perception that all of multiple courses of action are

³ One-tailed significance tests were used because Hypotheses 1 and 2, as well as the subsidiary predictions, always were directional. It should be noted, however, that with only two exceptions, the effects would have been significant at least at the .05 level had two-tailed significance tests been used. The exceptions were (a) the relationship between promotion focus success and estimates of the disjunctive events (directional difference score only), in which the effect would have been significant at the .10 level with a two-tailed test (see Table 5); and (b) the difference in the relationship between promotion focus success and estimates of the disjunctive events versus the relationship between prevention focus success and estimates of the disjunctive events (directional difference score only), in which the effect would have been significant at the .06 level with a two-tailed test (see Table 7).

necessary for goal attainment. If this reasoning is correct, then people should make more accurate or less biased probability estimates when the event is congruent with the domain in which their self-regulatory efforts have been successful (promotion focus and disjunctive events and prevention focus and conjunctive events) than when the event is incongruent with the domain in which their self-regulatory efforts have been successful (promotion focus and conjunctive events and prevention focus and disjunctive events). The results lent support to all of these hypotheses. The stronger people's regulatory focus success, the more accurate or less biased were their probability estimates on the congruent tasks (Hypotheses 1 and 2). Moreover, in support of the subsidiary predictions, the positive relationships between regulatory focus success and accuracy of probability estimates on congruent events were stronger than the relationships between regulatory focus success and accuracy of probability estimates on the incongruent events.

Implications for Behavioral Decision Theory

The tendencies to overestimate the probability of conjunctive events, and to underestimate the probability of disjunctive events, have been well established for quite some time in the behavioral decision theory literature (e.g., Bar-Hillel, 1973; Tversky & Kahneman, 1974). Relatively few studies have examined, however, factors that make these tendencies more versus less likely to occur. Thus, the present findings are among the first to identify factors associated with people's proneness to misperceiving the likelihood of conjunctive and disjunctive events.

Moreover, by describing when such misperceptions occur, the present findings also help to explain why they occur. Cognitive heuristics can bias people's judgments and decisions by operating automatically and subtly, sometimes without any awareness on the decision maker's part. This viewpoint implies that several factors should influence the degree to which cognitive heuristics lead to biased judgments and decisions. One possibility is that heuristic-induced bias depends upon the extent to which people have access to or are aware of their heuristic-based thought processes. Greater access or awareness should enable decision-makers to catch themselves in the act of making faulty judgments and correct accordingly. In a related vein, training people to think in ways that run contrary to heuristic thinking also may reduce the likelihood of heuristic-induced bias. In the present study the judgments that participants made could be determined objectively based on fundamental principles of probability. In fact, the number of courses that participants took in probability or statistics had a significant debiasing effect on their disjunctive probability estimates. (Number of courses in probability/statistics also reduced bias in participants' conjunctive estimates, though not to a significant extent.)

Our findings highlight an additional class of factors (besides awareness and training) which predict heuristic-induced errors in judgment: the motivational orientations inherent to regulatory focus theory. Regulatory focus theory suggests that it is not necessarily the level of motivation that affects people's

tendencies to estimate accurately the probabilities of conjunctive and disjunctive events. That is, it is not simply the case that people will do better at these tasks by trying harder. Rather, it is the *type* of motivation that is influential. As the present findings suggest, probability estimates will be more accurate when people have been more successful in their self-regulatory efforts in the domain congruent with the nature of the event (promotion focus for disjunctive events and prevention focus for conjunctive events), but not when their self-regulatory efforts have been more successful in domains incongruent with the event (prevention focus for disjunctive events and promotion focus for conjunctive events). Put differently, people who have more mastered the art of being promotion (prevention) focused will be more successful on judgments that require disjunctive (conjunctive) thinking.

Implications for Regulatory Focus Theory

Promotion and prevention focus are gaining prominence as determinants of important cognitions, emotions, and behaviors (see Higgins, 1998, for a review). For example, the behavioral decision theory principle that “losses loom larger than gains” depends on people’s regulatory focus; it holds when people are prevention focused, but not when they are promotion focused (Lieberman, Idson, Camacho, & Higgins, 1999). Moreover, the classic expectancy-valence model of human motivation also has been shown to depend on people’s regulatory focus (Shah & Higgins, 1997). According to Vroom (1964) and others, expectancies and valences combine interactively to influence motivation. The nature of the interaction effect is that the relationship between expectancy for success and motivation is greater when valence is high rather than low. In a recent series of studies, Shah and Higgins showed that the classic expectancy theory prediction is moderated by regulatory focus; it holds when people are promotion focused, but not when they are prevention focused. Even the nature of people’s emotional experience depends upon their regulatory focus. When promotion focused, people feel joy when they succeed in their self-regulatory efforts and dejected when they fail. When prevention focused, people feel calm when they succeed and agitated when they fail (Higgins, Shah, & Friedman, 1997).

The present findings expand the range of phenomena which may be accounted for by regulatory focus. The strategic orientation associated with a promotion focus makes the latter adaptive when the situation requires disjunctive thinking, as in creativity tasks (Crowe & Higgins, 1997), or more generally, the *planning* stage of activities in which equifinality exists (e.g., crafting an organizational vision). The strategic orientation associated with a prevention focus makes the latter adaptive when the situation requires conjunctive thinking. For example, the *implementation* stage of certain activities (e.g., organizational change) often requires that all action steps be successfully completed. In these circumstances, greater success in prevention focus should lead to increased understanding of the need to succeed at *all* of the activities, along with, as the present findings suggest, a more realistic estimate of the likelihood of doing so.

Alternative Explanations

The present findings show that regulatory focus success (promotion and prevention, respectively) is associated with the accuracy of participants' probability estimates of compound events (disjunctive and conjunctive, respectively). An alternative possibility is that it is not regulatory focus success, but rather the salience or strength of the regulatory focus that is associated with the accuracy of people's probability estimates. Put differently, people who assign greater significance to reaching their promotion goals may do better at estimating disjunctive events, independent of their success in reaching such goals. Similarly, people who assign greater significance to reaching their prevention goals may do better at estimating conjunctive events, regardless of their success in attaining such goals. In a related vein, the accuracy of people's probability estimates may be determined by the interaction between regulatory focus success and regulatory focus strength.

Fortunately, we did include a measure of regulatory focus strength in the present study which enabled us to evaluate these alternative possibilities. As in prior research on attitude accessibility (e.g., Fazio, 1995), regulatory focus strength was conceptualized in terms of the degree of access that people had to judgments about their ideal and ought selves. As Higgins (1998) has suggested, "Accessibility is activation potential and knowledge units with higher activation potentials should produce faster responses to knowledge-related inputs" (p. 18). Recall that participants in the present study were asked to list attributes describing their ideal and ought selves. They also indicated the extent to which they (a) would like to have their ideal self attributes, (b) should have their ought self attributes, (c) actually had their ideal self attributes, and (d) actually had their ought self attributes. Response latencies were assessed for each of these judgments. For all participants, we computed separate average latency scores, one for their various ideal self-judgments and the other for their various ought self-judgments. Regulatory focus strength was based on these measures of response latency, with greater strength being reflected in lower response latencies. For theoretical and empirical evidence of the construct validity of this measure of regulatory focus strength, see Higgins (1998) and Higgins, Shah, and Friedman (1997).

The measures of promotion and prevention strength were then added to the previously described regression analyses of estimates of disjunctive and conjunctive events. The effect of regulatory focus strength was not significant in all analyses of both directional and absolute difference scores; all p values were $>.25$. Importantly, however, the effect of regulatory focus *success* always remained significant in these analyses at least at the .05 level.

We then added the corresponding interaction between regulatory focus success and regulatory focus strength to the various regression analyses. That is, in the analyses of disjunctive events we added the interaction between promotion success and promotion strength, and in the analyses of conjunctive events we added the interaction between prevention success and prevention strength. In no instance did the interaction effect approach significance (all p values $>.15$).

Taken together, these additional analyses including regulatory focus strength show that it had neither a main effect nor a moderating influence in the present study. Rather, it was regulatory focus success that predicted the accuracy of participants' probability estimates of disjunctive and conjunctive events.

Limitations/Suggestions for Future Research

The present study has a number of limitations. In calling attention to them, we simultaneously are suggesting avenues for future research. First, the internal validity of the present findings is limited. Because regulatory focus was measured, all of our findings are correlational. The fact that the relationships between regulatory focus success and accuracy of probability estimates were significantly stronger when the event was congruent rather than incongruent is somewhat reassuring that regulatory focus had a causal impact on the accuracy of participants' probability estimates. Nevertheless, future research is needed which uses designs that allow for stronger forms of causal inference (e.g., in which regulatory focus success is experimentally manipulated). Second, the external validity of our findings is restricted in that the participants were college students, the task was abstract, and the setting was a research laboratory. At the outset we suggested that in everyday life people often have to make judgments of the likelihood of conjunctive and disjunctive events. Future research is needed to evaluate whether regulatory focus success influences the accuracy of people's estimates of conjunctive and disjunctive events in more naturalistic settings.

Finally, future research is needed to explain more precisely why promotion success predicts the accuracy of disjunctive (but not conjunctive) estimates and why prevention success predicts the accuracy of conjunctive (but not disjunctive) estimates. We suggested at the outset that a promotion focus may predispose people to think disjunctively, whereas a prevention focus may predispose people to think conjunctively. Thus, greater success in a respective regulatory focus domain will lead to greater success (accuracy) in the probability estimates for the corresponding type of judgment. This is not to say that the process of trying to achieve promotion goals never requires conjunctive judgments. For certain promotion goals, or for certain aspects of the process of trying to achieve promotion goals, the assumption that any one of multiple courses of action is sufficient may not be warranted. Consider, for example, the promotion-focused goal of accumulating vast wealth. Once people make the transition from formulating the goal and determining that it may be accomplished through any of a number of routes (e.g., Wall Street trading or winning the lottery) to trying to *implement* the goal through the chosen route, they are likely to find that the implementation process requires a conjunction of elements. For example, for the Wall Street trading route the conjunction could include picking good stocks *and* raising capital to invest *and* selling at the right time *and* reinvesting wisely. Whenever it is not sufficient to choose one of several possible alternatives to attain a promotion goal, (e.g., during the implementation process of a promotion goal), then greater promotion success should not necessarily lead to more accurate probability estimates. If anything, if the implementation

process requires a conjunction of necessary actions, then greater prevention success may lead to a more accurate probability estimate. The present findings suggest that people who are successful in the promotion domain are more likely to set promotion goals and identify equifinal ways to achieve the goals, but then leave the implementation process, which requires a conjunction of events, to (the thought processes of) others.

Nor are we saying that the process of trying to achieve prevention goals can never be associated with disjunctive thinking. For certain aspects of the process of trying to achieve prevention goals, the assumption that multiple courses of action are necessary may not be warranted; instead, any one of the multiple courses of action may be sufficient. Consider, for example, the prevention-focused goal of trying to heighten home security. Each step of the implementation of this goal could entail disjunctive thinking. For example, to keep burglars out one could install window bars *or* buy a security system *or* hire an armed guard *or* move to a safer neighborhood. While it is theoretically possible for this stage of the implementation of this prevention goal to allow for disjunctive thinking, we speculate that quite often it is not necessary for the person to engage in this type of analysis. Indeed, doing so could be quite onerous. That is, imagine the amount of cognitive effort required if, for *each* of the multiple elements needed for successful implementation, the prevention focused person engaged in a disjunctive process of considering his/her various alternatives. The number of decisions to be made could be paralyzing. Given that people often do not develop multiple alternatives for single decisions, it seems even less likely that they would do so for a decision process with multiple components; i.e., they would experience “choice overload.”⁴

In summary, we have assumed that the pursuit of promotion goals requires disjunctive reasoning (in which the successful enactment of one of several courses of action is sufficient for goal attainment). Moreover, we have assumed that the pursuit of prevention goals requires conjunctive reasoning (in which the successful enactment of multiple courses of action is necessary for goal attainment). However, under those conditions in which these assumptions are not warranted, the present findings showing greater disjunctive (conjunctive) accuracy among persons with greater promotion (prevention) success should be less likely to emerge.

CONCLUSION

The present study shows that people’s regulatory focus success is related to the accuracy of their probability estimates of both conjunctive and disjunctive tasks. These findings have important implications both for behavioral decision theory and for regulatory focus theory. Although regulatory focus theory is prominent in social/personality psychology (Higgins, 1997, 1998), it has received far less attention from organizational scholars. We hope that the present

⁴ We are grateful to an anonymous reviewer for the suggestions made in this paragraph and the preceding one.

study and related theorizing (Brockner & Higgins, in press) stimulates students of organizational behavior to explore the role that regulatory focus processes play in shaping people's work attitudes and behaviors.

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