

The Motivating-Uncertainty Effect: Uncertainty Increases Resource Investment in the Process of Reward Pursuit

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Can a reward of an uncertain magnitude be more motivating than a reward of a certain magnitude? This research documents the motivating-uncertainty effect and specifies when this effect occurs. People invest more effort, time, and money to qualify for an uncertain reward (e.g., a 50% chance at \$2 and a 50% chance at \$1) than a certain reward of a higher expected value (e.g., a 100% chance at \$2). This effect arises only when people focus on the process of pursuing a reward, not when they focus on the outcome (the reward itself). When the focus is on the process of reward pursuit, uncertainty generates positive experience such as excitement and hence increases motivation. Four studies involving real rewards lend support to the motivating-uncertainty effect. This research carries theoretical implications for research on risk preference and motivation and practical implications for how to devise cost-efficient consumer incentive systems.

Consumers often invest resources such as effort, time, or money toward a reward of an uncertain magnitude. We seek to answer a foundational question in consumer psychology: how reward uncertainty affects resource investment. Does uncertainty increase or decrease motivation?

Previous research offers contradictory answers. On the one hand, both normative theories (e.g., Expected-Utility Theory; Bernoulli 1738; von Neumann and Morgenstern

1944) and descriptive theories (e.g., Prospect Theory; Kahneman and Tversky 1979) predict that when facing gain options, people are risk averse and prefer a reward of a certain magnitude over a reward of an uncertain magnitude. This preference is robust and universal in evaluations of outcomes, and thus it is possible that people would express higher motivation toward a reward of a certain magnitude. On the other hand, research on affective experience shows that people sometimes enjoy uncertainty (Marschak 1950; Pascal 1670; Vosgerau, Wertenbroch, and Carmon 2006; Wagenaar 1989; Wilson et al. 2005), and thus it is also possible that people would express higher motivation toward a reward of an uncertain magnitude.

In this research, we propose that a reward of an uncertain magnitude can be more motivating than a reward of a certain magnitude, even if the uncertain reward is objectively worse. We focus on the uncertainty about the magnitude of the reward; that is, we compare rewards of a fixed and known magnitude with rewards of a probabilistic (i.e., uncertain) magnitude. We define motivation as the investment of resources, including time, money, and effort, that people expend to acquire a reward (Touré-Tillery and Fishbach 2014). For example, we compare how high bidders will bid for an item of an uncertain magnitude (e.g., a bag that contains either 10 or 5 chocolate truffles with even chances) with how high they will bid for an item of a certain magnitude

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(e.g., a bag that contains 10 chocolates for sure). Meanwhile, we hold constant the degree of certainty with which they will successfully complete the actions and thereby qualify for the reward.

In the following sections, we first introduce our “dominated-uncertainty paradigm,” in which we compare the effectiveness of certain rewards with uncertain rewards of a lower expected value. We explore why and when uncertainty increases motivation in this paradigm. We then report four studies that demonstrate a boost in motivation when people focus on the process of pursuing a reward of an uncertain magnitude, but not when they focus on the outcome of reward pursuit. We further identify that the positive experience during the reward pursuit underlies the boost in motivation.

REWARDS OF AN UNCERTAIN MAGNITUDE

People invest effort, time, and money in pursuit of rewards (Amir and Ariely 2008; Hsee, Yu, et al. 2003; Kivetz 2005; Kivetz, Urminsky, and Zheng 2006; Koo and Fishbach 2010; Nunes and Drèze 2006; Soman 1998; Zhang and Huang 2010; Zhang et al. 2011). We distinguish between two basic types of rewards that people pursue: certain and uncertain. A certain reward has a fixed and known magnitude, V ; an uncertain reward has several (i.e., at least two) potential magnitudes with known or unknown probabilities. We compare motivation toward a certain reward, for example, a 100% chance of getting V , to motivation toward an uncertain reward, for example, a 50% chance of getting V and a 50% chance of getting c . In our paradigm, we only compare positive values (i.e., V is always positive), and the largest reward magnitude is held constant across the certain- and uncertain-reward conditions (i.e., c is always a positive value smaller than V).

This paradigm provides a strong test for the motivational impact of uncertainty because the best-case scenario—receiving V —is the same across both the certain and uncertain rewards and the certain reward always has a higher expected value. Alternatively, if we had kept the expected value constant by introducing a probable option of a higher magnitude (e.g., certain reward: a 100% chance at \$10; uncertain reward: a 50% chance at \$15 and a 50% chance at \$5), a stronger motivation toward the uncertain reward could have been the result of the desire for the best possible outcome (\$15 in the example above; see research on consumer optimism: Dhar, Gonzales-Vallejo, and Soman 1995, 1999; Goldsmith and Amir 2010).

In our dominated-uncertainty paradigm, a person needs to meet a performance standard in order to qualify for a reward. The performance standard can be known, unknown, or revealed in the course of pursuing the reward. For example, people may need to meet a given standard, do better than others without information on others' performance, or exceed others' bids in a multiple-round unsealed auction. Regardless of performance standards, a greater investment of resources

increases the chance of qualifying for a reward and indicates stronger motivation. Although the investment of resources is under personal control, the size of the reward is not. For those qualifying for an uncertain reward, the exact reward magnitude is determined by chance. It is completely independent of their motivation, and all people are aware that the magnitude of the reward is out of their personal control. In fact, our paradigm reflects many everyday situations in which the final reward depends on a combination of motivation (effort) and uncontrollable factors (luck).

Existing motivation research has explored other types of uncertainty. Specifically, research on achievement motivation has varied the probability of successful goal attainment and found that people express strong motivation for moderately difficult tasks (Atkinson 1957; Brehm and Self 1989; Locke and Latham 2006). A moderate probability of success increases motivation because the task poses a challenge, which increases physiological arousal (Brehm et al. 1983). Our paradigm is different because we do not manipulate the likelihood of successful performance; however, we share the intuition that uncertainty, albeit from a different source, can trigger positive feelings and physiological arousal.

FOCUS ON THE PROCESS VERSUS THE OUTCOME OF REWARD PURSUIT

We suggest that uncertainty is exciting and predict that uncertainty increases motivation by generating positive experience during the pursuit of a reward of an uncertain magnitude. Research has shown that uncertainty about positive outcomes stimulates positive feelings and arousal (i.e., excitement and enjoyment; Bar-Anan, Wilson, and Gilbert 2009; Berns et al. 2001; Lee and Qiu 2009; Moon and Nelson 2014; Schultz, Dayan, and Montague 1997; Wilson et al. 2005; Zillmann 1983). Thus, uncertainty can be a source of positive experience. Other research, in turn, has suggested that positive feelings increase motivation (Erez and Isen 2002; Fishbach, Shah, and Kruglanski 2004; Klein and Fishbach 2014; Kuhl and Kazén 1999). That is, people prefer to pursue actions that are associated with positive feelings and work harder in those actions than in affect-neutral actions (Custers and Aarts 2005; Czikszentmihalyi 1990; Ferguson 2008; Fishbach and Choi 2012).

Importantly, positive experience should matter when people focus on pursuing the reward and not when they focus on evaluating reward outcomes. People naturally attend to the process during the reward pursuit (e.g., in goal striving), and during this phase, consummatory and affect-rich aspects increase motivation (Andrade and Iyer 2009; Choi and Fishbach 2011; Deci and Ryan 1985; Jeffrey 2009; Kivetz 2003; Le Menestrel 2001; Millar and Tesser 1986; Sansone et al. 1992). By contrast, people spontaneously attend to the outcome of their actions when prospectively deciding whether and how much to invest in pursuit of a reward (e.g., in goal setting; Bagozzi and Dholakia 1999; Touré-Tillery and Fishbach 2012). The focus on the outcome elicits a deliberative mind-set in which instrumental and affect-poor aspects are

central to the evaluation of actions (Gollwitzer 2012; Heckhausen 1987; Higgins, Kruglanski, and Pierro 2003; Hsee and Rottenstreich 2004). Thus, uncertainty decreases motivation when people focus on the outcome of the pursuit.

Preliminary evidence for our theory comes from work by Goldsmith and Amir (2010). These authors documented that promotions offering uncertain rewards often have a similar appeal to promotions offering certain rewards because people are innately optimistic. For example, participants in their studies were similarly interested in an uncertain promotion that offered either a desirable can of soda or a less desirable bag of microwave popcorn as they were in a certain promotion that offered a can of soda, because those faced with the uncertain promotion optimistically expected to receive the desirable outcome. The authors also mentioned excitement as an additional mechanism other than optimism but left it untested. By contrast, we predict greater resource investment in pursuit of an uncertain reward than a certain reward. That is, we explore situations in which people respond even more positively to the dominated uncertain reward than to the certain reward. Moreover, we empirically show that uncertainty brings excitement and boosts motivation.

Notably, an increase in motivation when people pursue a reward of uncertain magnitude might also reflect an illusion of control (Langer 1975), or an illusory belief that good things happen to those who work hard (Callan, Ellard, and Nicol 2006). Although such illusory beliefs can also result in an increase in motivation when uncertainty is involved, we argue that based on research on the unsealed-fate superstition (Strickland, Lewicki, and Katz 1966), these illusory beliefs would predict that uncertainty increases motivation only if the size of the reward is yet to be determined. By contrast, we predict that uncertainty increases motivation regardless of whether the size of the uncertain reward is determined before or after the qualifying action is taken.

We further note that our hypothesis may seem incongruent with theory and research on risk aversion, which has documented a reliable preference for certainty in choice and evaluation of gains (Arrow 1965; Bernoulli 1738; Gneezy, List, and Wu 2006; Holt and Laury 2002; Hsee and Weber 1997; Kivetz 2003; Rabin 2000; Rabin and Thaler 2001; Simonsohn 2009). However, research on risk aversion assesses evaluations of outcomes; we, on the other hand, study motivation in the process of reward pursuit.

To recapitulate, we use a dominated-uncertainty paradigm in which we measure individuals' motivation in an activity that, if they succeed, will qualify them for a reward of either a certain or an uncertain magnitude. The uncertain reward always has a lower expected value than the certain reward, and we assess motivation by the amount of effort, time, and money individuals invest. We propose three specific hypotheses:

- H1:** *The motivating-uncertainty effect:* a reward of an uncertain magnitude can be more motivating than a reward of a certain magnitude, even if the uncertain reward has a lower expected value.

- H2:** The motivating-uncertainty effect occurs when the focus is on the process of reward pursuit rather than on the outcome (the reward itself).

- H3:** The positive experience in the process of reward pursuit mediates the effect of reward uncertainty on motivation.

We next report four studies that tested these hypotheses across a variety of tasks in which successful performance, if achieved, was rewarded with a real reward of either a certain or an uncertain magnitude. Study 1 provides an initial demonstration that uncertainty can increase motivation (hypothesis 1). Study 2 generalizes the motivating-uncertainty effect to a range of reward probabilities (from 1% to 99%). Study 3 demonstrates that uncertainty increases motivation during rather than before pursuing a reward (hypothesis 2). Finally, study 4 examines the mechanism underlying the motivating-uncertainty effect: uncertainty generates positive experience in the process, thereby boosting motivation (hypotheses 2 and 3).

STUDY 1: UNCERTAINTY BOOSTS MOTIVATION

To test whether uncertain rewards increase motivation (hypothesis 1), study 1 compared the percentages of participants who completed a water-drinking task across two conditions: in the certain-reward condition, the reward was \$2; in the uncertain-reward condition, the reward was either \$2 or \$1, determined by a coin toss. The task difficulty was held constant across the two conditions, but the probability of getting the more desirable reward (\$2) varied and was neither contingent on the participants' efforts nor within their control. We predicted that a higher percentage of participants would complete the task for the uncertain reward than for the certain reward, even though the uncertain reward had a lower expected value.

Method

Eighty-seven college students (47 women, 40 men) from the University of Chicago took part in this study. Their task was to drink 1.4 liters (about 1.48 quarts) of water in 2 minutes for different cash rewards. Drinking this amount of water is challenging but possible for most people and does not pose health risks, as would be the case for a significantly larger amount of water.

The study adopted a 2 (reward certainty: certain vs. uncertain) between-participants design. Participants completed the study in individual sessions. They were sitting in front of a table on which we presented a \$1 bill, a stack of two \$1 bills, a straw, and a large (3.8 liter) pitcher of water. The experimenter explained the participants' task: they must drink some of the water using the straw over a period of 2 minutes in return for a cash reward. In the certain-reward condition, if the participants drank down to an indicated line on the pitcher (corresponding to 1.4 liters of water, although

participants did not know the exact amount), they would receive \$2. While giving these instructions, the experimenter pointed to the stack of two \$1 bills. In the uncertain-reward condition, if the participants drank down to the indicated amount, they would receive a reward. The experimenter would then flip a coin to determine whether the reward would be \$2 or \$1. While giving these instructions, the experimenter pointed to both the \$1 bill and the stack of two \$1 bills. Because a \$2 reward could appear larger when one compares it to \$1 (Ariely, Loewenstein, and Prelec 2003; Hsee and Zhang 2010; Hsee et al. 2009, 2013; Zhang 2014), we let participants in both conditions see the \$2 reward with the \$1 reward as a reference. In a pretest ($N = 76$) that used the same presentation formats, the subjective evaluation of the \$2 reward did not vary across two reward conditions (on a 7-point scale of reward attractiveness: $M_{\text{uncertain}} = 5.27$, $SD_{\text{uncertain}} = 1.35$; $M_{\text{certain}} = 5.30$, $SD_{\text{certain}} = 1.24$; $t < .01$, $p > .90$). As our dependent variable, we measured whether the participant successfully completed the task by drinking up to or more than the indicated amount.

Results and Discussion

In support of hypothesis 1, 70% of the participants in the uncertain-reward condition successfully completed the drinking task, whereas only 43% of the participants in the certain-reward condition successfully completed the task ($\chi^2(1, N = 87) = 6.25$, $p = .012$). This finding suggests that uncertainty increases motivation even though the uncertain reward had a lower expected value and was therefore dominated by the certain reward. Merely adding reward uncertainty motivated an additional 27% of participants to finish drinking the indicated amount of water.

This study employed a performance standard and measured whether participants met that standard (a discrete variable). The motivating-uncertainty effect should also apply to “do your best” goals, such as drinking as much water as possible, which further allows us to measure motivation as a continuous variable. In a follow-up study ($N = 50$), we used a similar procedure, except that it contained an unknown performance standard to make participants’ likelihood of qualifying for a reward increase continuously as they worked harder. Specifically, participants learned that if they drank more than the average of the participants who already completed the study, they would receive a reward. To implement the unknown standard, we informed participants about the average amount only after they had finished the task. The findings in this follow-up study were consistent with the main study. Participants who were incentivized by an uncertain reward drank more water than those who were incentivized by a certain reward ($M_{\text{uncertain}} = 1.20$ liter, $SD_{\text{uncertain}} = .33$ liter; $M_{\text{certain}} = .95$ liter, $SD_{\text{certain}} = .43$ liter; $t(48) = 2.21$, $p = .032$); that is, the objectively worse uncertain reward increased consumption by 25%.

Taking the findings in the main and follow-up studies together, we found that the prospect of acquiring an uncertain reward increased effort investment. Because the uncertain options had lower expected values, and because re-

search participants (and people in general) aspire for higher expected values, we can further conclude that uncertainty increased motivation even more than lower expected value decreased motivation.

Study 1 adopted 50% as the probability for the uncertain reward. A question remains of whether the motivating-uncertainty effect is specific to a particular reward probability, such as 50%, or is generalizable to different reward probabilities. Because the motivating-uncertainty effect is based on the positive feelings stimulated by uncertainty, we predict that any specific probabilities, as well as an unspecified probability, should lead to a boost in motivation.

STUDY 2: THE MOTIVATING-UNCERTAINTY EFFECT APPLIES TO DIFFERENT REWARD PROBABILITIES

Study 2 explored different probabilities of receiving a better reward outcome and compared the motivational effect of a certain reward with the motivational effect of each of these uncertain rewards. Specifically, participants evaluated a series of print advertisements in return for either a reward of a certain magnitude (two certain-reward conditions: \$0.20 and \$0.50) or a reward of an uncertain magnitude (six uncertain-reward conditions: a chance at \$0.50 instead of \$0.20 ranging from 1% to 99% or an unspecified probability). Based on hypothesis 1, we predicted that the participants would invest more effort and time (i.e., evaluate more advertisements) in the pursuit of an uncertain reward, regardless of reward probability, than in pursuit of a certain reward.

Method

Five hundred and thirty native English speakers (284 women, 246 men) in the United States completed the study on Amazon Mechanical Turk. They were asked to participate in a marketing survey in which they evaluated a number of print advertisements in return for \$1, and they had the opportunity to receive a bonus of either \$0.20 or \$0.50 by completing extra work. This study adopted an eight-condition (chance of receiving the larger instead of smaller bonus: 0%, 1%, 40%, 50%, 60%, 99%, 100%, and unspecified) between-participants design. We used the same task and possible incentives across all conditions and only varied the probability of getting the higher bonus.

The participants’ task was to view and evaluate print advertisements. Each print advertisement was displayed on the screen for 12 seconds before participants could provide their evaluation on a 10-point scale (1 = “it sucks”; 10 = “it’s awesome”). Participants received a flat payment of \$1 for the first 60 print advertisements evaluated. Afterward, they could continue evaluating advertisements or stop at any point. We measured participants’ motivation as a continuous variable, using a procedure similar to the one in the follow-up to study 1. Participants read that to receive a bonus on top of their flat payment, they would need to do better than the average; that is, they would need to evaluate more ad-

vertisements than the average number evaluated by others who completed the survey. Participants did not know what that average was, and thus, by putting more work into evaluating advertisements, they increased their chances of receiving a bonus.

We manipulated the bonus; table 1 presents the bonus options. Of the eight conditions, two were certain-reward conditions (i.e., eligible participants received \$0.20 for sure and \$0.50 for sure) and six were uncertain-reward conditions. Of the six uncertain-reward conditions, five had a specified reward probability (e.g., eligible participants had a 50% chance of receiving \$0.50 and a 50% chance of receiving \$0.20), and one had an unspecified reward probability ("you will receive either \$0.50 or \$0.20, but the chance of receiving one or the other is unknown"). The dependent variable was the number of advertisements evaluated beyond the required 60 advertisements.

Results and Discussion

Because the distribution of the number of extra advertisements evaluated was highly skewed (Skewness = 3.24, $SD = .11$, $p < .001$), we log-transformed the responses prior to analyses and report means and standard deviations after reversed transformation. Notably, we obtained similar results using untransformed responses here and in subsequent studies. The number of extra advertisements varied across conditions ($F(7, 530) = 5.24$, $p < .001$; table 1). In support of hypothesis 1, a contrast analysis revealed that participants in the uncertain-

reward conditions (1%, 40%, 50%, 60%, 99%, and unspecified probability) evaluated more extra advertisements than those in the certain-reward conditions (0% and 100%; $M_{\text{uncertain}} = 6.08$, $SD_{\text{uncertain}} = 3.65$; $M_{\text{certain}} = 1.92$, $SD_{\text{certain}} = 3.09$; $t(528) = 5.86$, $p < .001$). In addition, participants in the uncertain-reward conditions evaluated more extra advertisements than those in the 100%-certain-reward condition ($M_{\text{uncertain}} = 6.08$, $SD_{\text{uncertain}} = 3.65$; $M_{100\%-certain} = 2.24$, $SD_{100\%-certain} = 3.31$; $t(467) = 3.97$, $p < .001$), suggesting that an uncertain \$0.30 increment had a larger effect on task motivation than a certain \$0.30 increment. Interestingly, although increasing the bonus by \$0.30 was not sufficient to motivate participants to evaluate significantly more advertisements (for the difference between the two certain rewards: $t < 1$), adding uncertainty, regardless of probabilities, to the bonus size increased motivation: all paired comparisons between each uncertain-reward condition and the 100%-certain-reward condition were significant (t 's > 2.5 , p 's $< .05$), and all paired-comparisons between any two uncertain conditions were not significant (t 's < 1.5 , p 's $> .3$). The similar results across all uncertain conditions could be due to probability neglect (Rottenstreich and Kivetz 2006; Sunstein 2003), in which case, although participants were sensitive to the probable nature of an outcome, they were insensitive to different probabilities.

We conducted further analyses to separate the effect on (a) the percentage of participants who continued the task beyond the required first 60 advertisements and (b) the average number of extra advertisements evaluated by those who continued. Results of these analyses, also presented in

TABLE 1
PERFORMANCE RESULTS FOR STUDY 2

Bonus	Combined analysis: Number of extra ads evaluated			Percentage of those evaluating extra ads	Separate analyses Number of extra ads evaluated among those evaluating extra ads	
	Mean	SD	N		Mean	SD
0% certain (\$0.20)	1.58	2.84	61	41	8.23	3.69
1% uncertain (1% chance at \$0.50 and 99% chance at \$0.20)	6.43**	3.66	62	69*	16.29	2.80
40% uncertain (40% chance at \$0.50 and 60% chance at \$0.20)	5.27*	4.34	75	63	16.92*	3.36
50% uncertain (50% chance at \$0.50 and 50% chance at \$0.20)	7.27***	3.40	68	75***	15.01	2.93
60% uncertain (60% chance at \$0.50 and 40% chance at \$0.20)	5.53**	3.42	62	73**	11.31	3.55
99% uncertain (99% chance at \$0.50 and 1% chance at \$0.20)	6.61**	4.45	69	67*	18.89*	3.42
p% uncertain (either \$0.50 or \$0.20, but the chance of receiv- ing either is unknown)	5.61**	2.70	62	77***	9.77	2.98
100% certain (\$0.50)	2.24	3.31	71	48	9.63	3.84

NOTE.—Means and standard deviations are presented after reversed transformation. For each reported variable, numbers with asterisks are significantly different at the given level from the 100%-certain-reward condition (i.e., our comparison standard).

* $p < .05$.

** $p < .01$.

*** $p < .001$.

table 1, suggest that, compared to the economically better and strictly dominating certain reward (\$0.50 for sure), all of the uncertain rewards increased either the percentage of participants who continued the task, the number of extra advertisements evaluated by those who continued the task, or both.

An uncertain reward magnitude can mean either that the probability of the large reward is known between 0 and 1 or that the probability of the large reward is unknown (Knight 1921; Tversky and Fox 1995). In this study, we examined both. We also explored different specific known probabilities. Regardless of whether the reward probability is specified, and regardless of what the specified probability is, adding uncertainty to rewards boosts motivation.

Studies 1 and 2 assessed motivation in the process of pursuing a reward. In the next study, we further assess motivation in planning an activity when the focus is on the outcome. Comparing the effect of uncertainty when the focus is on the process versus the outcome of reward pursuit allows us to explore the cause of the motivating-uncertainty effect—that uncertainty generates positive experience in the process. If uncertainty feels good, it should increase resource investment when people decide whether or not to continue investing resources but not when people evaluate the potential rewards prior to the pursuit of these rewards. Furthermore, it might be the case that putting participants in a situation in which goal achievement was uncertain made them more responsive to an uncertain reward because of a better perceived fit. In the next study, we rule out this alternative by introducing a moderator—the focus on outcome versus process—and predicting that uncertainty would only boost motivation when the focus is on the process.

STUDY 3: UNCERTAINTY INCREASES MOTIVATION IN THE PROCESS OF PURSUING A REWARD

Study 3 tested whether the focus on the process versus the outcome of working toward a reward moderates the motivating-uncertainty effect (hypothesis 2). We hypothesized that a reward of an uncertain magnitude is more motivating than a reward of a certain magnitude in the process of pursuing the reward but that the opposite pattern holds beforehand when the focus is on the outcome. To test this prediction, we set up an auction in which participants bid against each other to win an auction item. The auction item was either a bag of a certain number of Godiva chocolate truffles or a bag of an uncertain number of Godiva chocolate truffles. We manipulated how willingness to pay (WTP) was elicited. In one condition, participants generated their WTP through actual bidding (i.e., focus on the process) and in the other condition, they generated their WTP in advance, stating their reservation price before bidding (i.e., focus on the outcome). Presumably, actual bidding draws people's attention to the process (the experience of the auction), whereas an advance statement draws people's attention to the outcome (the value of the item; Cheema, Chakravarti,

and Sinha 2012; Hsee, Zhang et al. 2003). We predicted higher WTP for the uncertain (vs. certain) auction item when prices were solicited in the actual bidding rather than in the advance statement.

Our paradigm in study 3 contains several notable features. First, participants paid cash out-of-pocket for the auction item so the bids were consequential; either participants won the auction and paid for the auction item or they lost it. Second, we determined the outcome of the uncertain reward before the auction. The uncertain chocolate bag already had either a small or a large number of truffles, but the experimenter did not reveal the actual number to the participants until the end of the auction. This latter feature allowed us to rule out as a possible explanation the superstitious belief that good things happen to those who work hard (Callan et al. 2006; Converse, Risen, and Carter 2012; Langer 1975), that is, that by paying more, one can increase his/her chances of getting the larger number of truffles. Such magical belief should not occur if the reward is determined before the person invests resources (Strickland et al. 1966).

Method

One hundred and thirty-eight college students (79 women, 59 men) from the University of Chicago took part in this study for a nominal payment of \$2. This study adopted a 2 (reward certainty: certain vs. uncertain) $\times$ 2 (elicitation method: actual bidding vs. advance statement) between-participants design. Participants completed the study in groups of three. Their task was to bid on a bag of Godiva chocolate truffles.

The experimenter assumed the role of the auctioneer and ran each group separately. All participants saw a bag on the table. In the certain-reward condition, the auctioneer unwrapped the bag to reveal four truffles. In the uncertain-reward condition, the auctioneer did not reveal the content of the bag; instead, he announced that there was an equal chance that the bag contained two or four truffles. Participants in this condition saw a sample of a Godiva chocolate truffle and learned that they would find out the exact number of truffles in the bag by the end of the auction.

Participants then read the auction instructions: they would bid for eight rounds, and in each round, they could either repeat the bid from their last round or give a higher bid. They would write down their bid on the paper and show the bid to the auctioneer and other bidders after everyone had finished writing. No other communication was allowed during the auction. The winner of the auction would be the person who submitted the highest bid in the final round in the group. Then he/she would pay the second-highest bid in the final round in return for the truffles (this procedure incentivized bidders to bid on their true value; Vickrey 1961).

After reading the instructions, participants in the advance-statement condition stated their WTP in the upcoming auction ("the highest bid I would give to the auction item," i.e., their reservation price). Any bid that each participant subsequently gave should have been lower than or equal to this

WTP. Participants listed their WTP on a piece of paper and kept the paper with them until the end of the study. Participants in the actual-bidding condition did not list their WTP in advance. All participants then proceeded to the auction.

For our dependent variables, we measured the second-highest WTP of each group in all conditions. We used only one price per group because the process of bidding created a dependency between the values solicited by participants within each three-person group. Although advance statements were independent of each other, we needed to use the same measurement approach to compare them with final bids. Finally, although participants in the advance-statement condition continued to complete the auction, we used their actual bidding data only in an exploratory analysis because the procedure of advance statement meant that both outcome focus and process focus influenced these bids.

Results and Discussion

Because the distribution of the WTP responses was highly skewed (Skewness = 2.79, $SD = .35$, $p < .001$), we log-transformed the responses prior to analyses and report means and standard deviations after reversed transformation. In support of hypothesis 2, an ANOVA of WTP revealed an interaction between reward certainty and elicitation method ($F(1, 46) = 15.24$, $p < .001$; see fig. 1). The ANOVA revealed no main effects for reward certainty ($F < 1$), although a main effect for elicitation method did arise ($F(1, 46) = 12.97$, $p = .001$), indicating that advance statements were higher than actual bids (consistent with findings on inflation of stated WTP; Voelckner 2006; Wertenbroch and Skiera 2002).

A contrast analysis revealed that the WTP through actual bidding was higher for the uncertain bag (two or four truf-

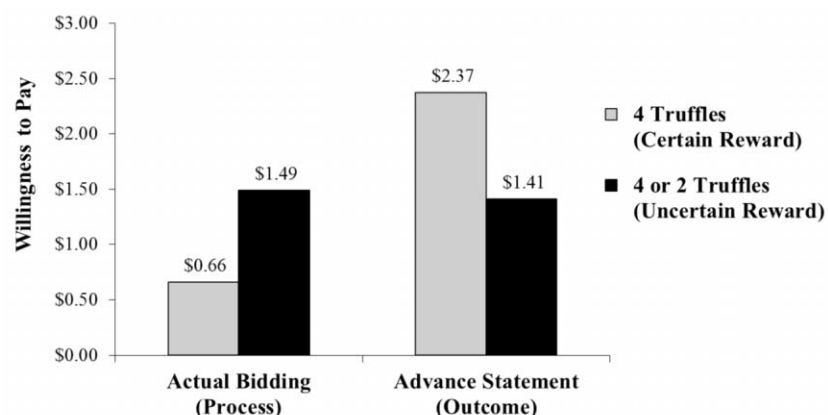
fles; $M = \$1.49$, $SD = \$1.55$) than for the certain bag (four truffles; $M = \$0.66$, $SD = \$1.85$; $t(21) = 3.62$, $p < .01$). By contrast, the WTP elicited through advance statements was higher for the certain bag (four truffles; $M = \$2.37$, $SD = \$1.67$) than for the uncertain bag (two or four truffles; $M = \$1.41$, $SD = \$2.00$; $t(21) = 2.01$, $p = .06$). These results suggest that advance statements appear to be sensitive to expected values and potentially reflect a preference for certainty. But, as a person went through the process of bidding, uncertainty led to higher bids. We note that in this design, a comparison of the certain-reward conditions across the advance-statement and actual-bidding conditions is not meaningful because we used a different method for eliciting WTP, which in turn had a main effect on elicited prices.

As an exploratory analysis, we looked at the final actual bid data of those who listed their WTP before the auction (in the advance-statement condition). An ANOVA of WTP on elicitation method (this time, within-subjects) $\times$ reward certainty revealed a main effect for elicitation method ($F(1, 21) = 13.56$, $p = .001$), no main effect for reward certainty ($F < 1$), and no interaction between elicitation method and reward certainty ($F(1, 21) = 2.80$, $p = .11$). The WTP elicited through advance statements for the certain bag was higher than that for the uncertain bag (as noted above), but the WTP through actual bidding was similar for certain and uncertain bags ($M_{\text{certain}} = \$0.87$, $SD_{\text{certain}} = \$2.93$; $M_{\text{uncertain}} = \$0.97$, $SD_{\text{uncertain}} = \2.27 ; $t < 1$). The latter null effect could be a combined effect of uncertainty undermining motivation in advance statements (i.e., outcome focused) and increasing motivation in actual bidding (i.e., process focused).

The results of study 3 demonstrate that uncertainty increases motivation when people invest resources in the ac-

FIGURE 1

BIDDING RESULTS IN STUDY 3



NOTE.—Bidders set a lower advance WTP for the uncertain auction item but paid a higher price after an eight-round auction.

tual pursuit of the reward rather than when they focus on the outcome of their actions and make decisions in prospect. Thus, the focus on the process versus outcome of pursuing a reward moderates the motivating-uncertainty effect.

By including the advance-statement condition, we were able to replicate the previously widely documented uncertainty aversion (Gneezy et al. 2006; Kahneman and Tversky 1979), but only when the focus was on the outcome of the action. In fact, almost all situations in which previous researchers found uncertainty aversion were in outcome-focused choices and judgments (e.g., Gneezy et al. 2006) and before pursuing a reward (e.g., Kivetz 2003). In addition, moderation by how the decision is elicited (advance judgment vs. actual action) hints at the mechanism for the motivating-uncertainty effect: the positive experience of pursuing a reward. In the next, and final, study, we seek more direct evidence that the positive experience from uncertainty underlies the motivating-uncertainty effect. In study 4, all participants are working toward the reward, but we direct their attention to either the process or the outcome of their actions. We expect uncertainty to generate positive experience, such as excitement and interest, and to boost motivation only when participants focus on the process.

STUDY 4: UNCERTAINTY GENERATES POSITIVE EXPERIENCE

In study 4, we examined whether uncertainty in a reward indeed makes the pursuit of the reward more exciting and interesting and hence more motivating (hypothesis 3). We used a mediation approach to test this hypothesis.

This study used an auction similar to the one used by shopping websites such as eBay. We elicited participants' WTP gradually until it reached the maximum, via actual bidding. Participants successfully purchased the auction item if their WTP was higher than the predetermined asking price (a procedure similar to the Becker-DeGroot-Marschak method; see Becker, DeGroot, and Marschak 1964). In this paradigm, a higher WTP reflected a greater motivation to get the auction item. We manipulated the focus on the process, the outcome, or neither (control condition) during the auction, and we expected this variable to moderate the motivating-uncertainty effect. We expected control (no treatment) participants to focus on the process as those in the previous studies did. Based on hypothesis 2, we predicted that, whereas participants who focused on the process spontaneously (control condition) or experimentally would be willing to pay a higher final price to purchase an item of an uncertain magnitude than an item of a certain magnitude, participants who focused on the outcome would be willing to pay a lower price for the uncertain item than the certain item.

To test whether positive experience underlies the motivating-uncertainty effect (hypothesis 3), we measured both the experience of the bidding process and the attractiveness of the auction item. According to our theorizing, process experience, rather than reward attractiveness, would predict bidding prices in the control and process conditions. That

is, process experience would mediate the effect of uncertainty on bidding prices in these conditions. By contrast, reward attractiveness, rather than process experience, would predict bidding prices in the outcome condition. That is, reward attractiveness would mediate the effect of uncertainty on bidding prices in this condition.

Method

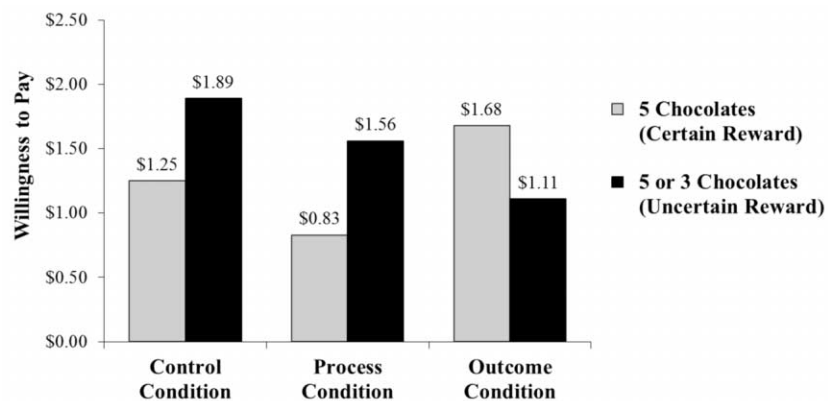
One hundred and eighty-five Chicago residents (102 women, 83 men) visited a downtown lab of the University of Chicago and participated in the study for a nominal payment of \$2. The study adopted a 2 (reward certainty: certain vs. uncertain) $\times$ 3 (focus: control vs. process vs. outcome) between-participants design. Participants bid on chocolate coins and purchased the chocolate coins if their WTP was equal to or higher than a preset (but unknown) seller's asking price.

As a buyer, each participant completed the study with only the experimenter, who assumed the role of the seller, in the room. Each participant (i.e., buyer) sat in front of a wide table, with the experimenter (i.e., seller) sitting on the side. The participant completed three auctions. In each auction, the experimenter placed an opaque cup covering some chocolate coins, a closed envelope containing the seller's price, and a bid card on the table. The participant placed a bid for the chocolate coins. All auctions used the same price-eliciting procedure, in which the experimenter announced a sequence of prices starting at \$0.10 and increasing in increments of \$0.05 (e.g., \$0.10, \$0.15, \$0.20, etc.). The participant answered "yes" if he/she found the price acceptable and "no" if he/she would not pay the price. The experimenter stopped asking after the first price that the participant indicated he/she would not be willing to pay. Then the experimenter asked the participant to specify his/her price for the auction item, which was between the last and the second-to-last prices on the bid card (e.g., \$1.08 between \$1.10 and \$1.05). The experimenter then moved on to the next auction.

The experimenter informed the participants that when setting the asking price, the seller had the same information as they did regarding the number of chocolate coins under the cup. The participants would not know the seller's asking price for each cup of chocolate coins until the end of all three auctions. At the end of all of the auctions, the participants opened the envelopes to find out the seller's asking price for each cup (cup 1: \$3.63, cup 2: \$3.45, and cup 3: \$3.66). If any of the buyer's elicited prices were as high as or higher than the seller's asking price, the participants paid the seller's asking price for the chocolate coins and took the chocolate coins home. If any of the buyer's elicited prices were lower than the seller's price, no transaction occurred. All transactions were real and binding.

We manipulated reward certainty. In the certain-reward conditions, each cup contained five chocolate coins, and in the uncertain-reward conditions, each cup contained either three or five chocolate coins, with equal probability. In the certain-reward conditions, the experimenter removed the cup before each auction and let the participant see the five choc-

FIGURE 2
WILLINGNESS-TO-PAY RESULTS IN STUDY 4



NOTE.—Bidding prices were a function of focus and uncertainty.

olate coins, whereas in the uncertain-reward conditions, the experimenter did not remove the cups until the end of all three auctions. The participant read about the entire procedure before starting the auctions, and the experimenter further read the instructions aloud to make sure everything was clear to the participant.

We manipulated the focus on process, outcome, or control. In the control conditions, the participants received the aforementioned auction instructions. In the process conditions, the participant further read, “Enjoy the auction” just before the auctions began. In the outcome conditions, the participant further read, “The auctions are a way to get the coins at a good price.”

Our main dependent variable was total WTP for all three auctions. A higher WTP for an auction reflects a higher investment (money) incentivized by the reward. Because participants in both the certain and uncertain conditions did not find out the seller’s price until the end of all auctions, and because the participants in the uncertain conditions did not find out the number of chocolate coins in each cup until the end, the three auctions combined were similar to the auction in study 3. Therefore, we used the sum of the WTP across all three auctions as our primary measurement of motivation.

To assess the experience of the bidding process, participants rated the extent to which they found the auction (a) interesting (1 = Not interesting at all, 9 = Very interesting) and (b) exciting (1 = Not exciting at all, 9 = Very exciting). To assess the attractiveness of the reward, we asked participants to rate the attractiveness of the auction item (i.e., the reward; 1 = Not attractive at all, 9 = Very attractive). Participants completed these questions after the three auctions were completed and before we revealed the auction items. (We also asked participants to rate the extent to which they found the auction item valuable, but this rating was

generally low across all conditions ($M = 3.91$, $SD = 2.22$) and thus was dropped from further analyses.)

A secondary measure of motivation was whether participants wanted to continue the bidding activity. Immediately after the three auctions, the experimenter provided an optional fourth auction for all participants. The fourth round followed the same bidding rules and (un)certain settings as the previous rounds, and all participants remained in their original condition. We coded whether participants chose to continue to a fourth round as a binary variable.

Results and Discussion

Willingness to Pay. We log-transformed WTP due to its positively skewed distribution (Skewness = 3.47, $SD = .18$, $p < .001$), and we report means and standard deviations after reversed transformation. As predicted, an ANOVA of WTP yielded an interaction between reward certainty and focus ($F(2, 185) = 9.44$, $p < .001$). The ANOVA further yielded a main effect for reward certainty ($F(1, 185) = 3.92$, $p = .049$), indicating a higher WTP in the uncertain- versus certain-reward conditions and a marginal main effect for focus ($F(2, 185) = 2.56$, $p = .08$), indicating different WTPs in the control, process, and outcome conditions. Figure 2 displays the results.

Contrast analyses within each focus condition indicate that the motivating-uncertainty effect occurred in both the control and the process conditions but not in the outcome condition. Specifically, participants in the control condition set higher bids for the uncertain chocolate coins ($M = \$1.89$, $SD = \$1.87$) than for the certain chocolate coins ($M = \$1.25$, $SD = \$1.81$; $t(53) = 2.51$, $p = .015$), as did the participants in the process condition ($M_{\text{uncertain}} = \$1.56$, $SD_{\text{uncertain}} = \2.00 ; $M_{\text{certain}} = \$0.83$, $SD_{\text{certain}} = \$2.61$; $t(62) = 3.03$, $p < .01$). However, participants in the outcome

condition set lower bids for the uncertain chocolate coins ($M = \$1.11$, $SD = \$1.67$) than for the certain chocolate coins ($M = \$1.68$, $SD = \$2.19$; $t(64) = 2.46$, $p = .017$). These findings confirm that uncertainty boosts motivation for those focusing on the process rather than the outcome of bidding.

Another ANOVA of WTP on the control and process conditions yielded no interaction between reward certainty and focus ($F < 1$), which suggests similar effects across these conditions. This result is consistent with our assumption that participants in the control condition may have naturally focused on process. Therefore, it allowed us to collapse the control and process conditions in subsequent mediation analyses.

Mediations by Process Experience and Reward Attractiveness. We averaged the ratings of excitement and interest into an index of process experience ($\alpha = .90$). Table 2 displays process experience ratings as well as reward attractiveness ratings by condition. To test whether process experience mediated the effects of reward certainty on WTP, and whether focus moderated such mediation, we tested the moderated-mediation model by following the procedure outlined in Preacher, Rucker, and Hayes (2007). The conditional indirect effect of reward certainty on WTP through process experience was significant in the combined control and process condition ($B_{\text{conditional indirect}} = .07$, $SE = .03$; 95% C.I. = [.02, .13]; based on 10,000 bootstrap samples) but not in the outcome condition ($B_{\text{conditional indirect}} = .01$, $SE = .02$; 95% C.I. = [−.03, .07]). Specifically, in the combined control and process condition, an uncertain (vs. certain) reward directly increased WTP ($B = .23$, $SE = .06$, $p < .001$). In addition, an uncertain (vs. certain) reward increased positive process experience ($B = 1.19$, $SE = .35$, $p = .001$), which in turn increased WTP ($B = .07$, $SE = .01$, $p < .001$). This result indicates that increased process experience mediated the effect of reward certainty on WTP but did so only when participants focused on the process of the auctions.

We further tested for attractiveness of the reward in a similar moderated-mediation model. We found that the conditional indirect effect of reward certainty on WTP through reward attractiveness was not significant in the combined control and process condition ($B_{\text{conditional indirect}} = -.02$, $SE = .02$; 95% C.I. = [−.06, .02]; based on 10,000 bootstrap samples) but that it was significant in the outcome condition ($B_{\text{conditional indirect}} = -.04$, $SE = .03$; 95% C.I. = [−.12, −.00]). Specifically, in the outcome condition, a certain (vs. uncertain) reward directly increased WTP ($B = -.18$, $SE = .07$, $p = .017$). In addition, a certain (vs. uncertain) reward directionally (though not significantly) increased reward attractiveness ($B = -.87$, $SE = .54$, $p = .11$), which in turn increased WTP ($B = .04$, $SE = .34$, $p < .01$). The result indicates that increased reward attractiveness mediated the effect of reward certainty on WTP only when participants focused on the outcome of the auctions.

Willingness to Continue. The results for willingness to continue, although less strong, were also consistent with

TABLE 2
RATING RESULTS FOR STUDY 4

	Process experience		Reward attractiveness	
	Mean	SD	Mean	SD
Control condition:				
Certain reward	4.87*	2.04	5.04	2.49
Uncertain reward	5.98	1.81	5.21	2.64
Process condition:				
Certain reward	5.03*	2.06	5.37	2.30
Uncertain reward	6.16	1.79	4.53	2.58
Outcome condition:				
Certain reward	5.50	2.11	5.78*	2.38
Uncertain reward	5.72	1.96	4.62	2.41

*For each comparison between certain and uncertain rewards the asterisk indicates a significant difference at $p < .05$.

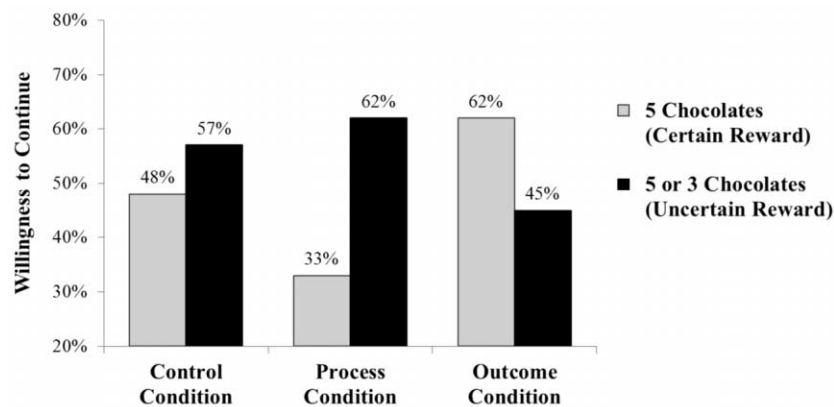
hypothesis 2 (fig. 3). We found a marginally significant main effect for reward certainty on willingness to continue (certain vs. uncertain: Wald's $\chi^2(1, N = 185) = 3.03$, $p = .082$), along with no main effect for focus (control vs. process vs. outcome: Wald's $\chi^2(1, N = 185) = 2.47$, $p = .116$) and no interaction (Wald's $\chi^2(1, N = 185) = 2.45$, $p = .117$). Contrast analyses revealed that more participants chose to have another uncertain (vs. certain) auction in the process condition (uncertain vs. certain: 62% vs. 33%, $\chi^2(1, N = 64) = 5.16$, $p = .023$) but not in the outcome condition (uncertain vs. certain: 45% vs. 62%, $\chi^2(1, N = 66) = 1.97$, $p = .16$). When the control and the process conditions were collapsed, the motivational effect of uncertainty again occurred for willingness to continue (uncertain vs. certain: 60% vs. 40%, $\chi^2(1, N = 119) = 4.44$, $p = .035$), although the control condition alone only directionally replicated the effect (uncertain vs. certain: 57% vs. 48%, $\chi^2 < 1$). These results provide additional support for the motivating-uncertainty effect (hypothesis 1) and its moderation effect (hypothesis 2).

In summary, study 4 not only demonstrated the motivating-uncertainty effect but also identified when and why this effect happens. Drawing people's attention to the process (vs. outcome) of reward pursuits makes them evaluate this experience more positively (i.e., increases the value of the process attribute) and care more about this experience (i.e., increases the decision weight of the process attribute). As a result, people invest more resources in pursuing uncertain rewards than certain rewards of a higher expected value.

Although we found similar results in the control and the process conditions, we want to be cautious about generalizing the similarities between the two. We do not want to speak for a null-result finding; the fact that the difference is minimal might be due to the subtle manipulation in the process conditions. We also do not claim that everyone spontaneously finds the experience of every activity positive. Some activities (e.g., auctions and gambles) have greater excitement potential than others, and some people have a stronger disposition to seek positive experience (e.g., sensation-seeking individuals; Zuckerman 2007).

FIGURE 3

WILLINGNESS-TO-CONTINUE RESULTS IN STUDY 4



NOTE.—Choices of an additional round were a function of focus and uncertainty.

GENERAL DISCUSSION

Life is full of uncertainties. Previous literature documents a preference for certain over uncertain rewards in evaluation of outcomes, specifically in the domain of gains (Arrow 1965; Bernoulli 1738; Kahneman and Tversky 1979). Moving beyond which outcomes people prefer, we ask what type of reward increases their motivation in the process of reward pursuit, and we find that a reward of an uncertain magnitude is more motivating than a reward of a certain magnitude, even when the uncertain reward has a lower expected value.

We demonstrated this motivating-uncertainty effect in a series of studies involving activities with real consequences. We found that more participants completed a water-drinking task in the pursuit of a reward of an uncertain magnitude than in the pursuit of a reward of a certain and larger magnitude (study 1) and that participants rated more advertisements in return for a reward of an uncertain magnitude, regardless of the specific reward probability (study 2). We further found in study 3 that the motivational boost from uncertainty occurred only for those focusing on the process of pursuing a reward, rather than those focusing on the outcome. Finally, in study 4, we demonstrated that in the process of bidding, uncertainty increased investment as long as participants' focus was on the process and not on the outcome of their actions. When participants focused on the outcome, uncertainty (coupled with lower expected value) decreased their investment. Importantly, we also found that uncertainty induced positive experience such as excitement, which in turn increased motivation to invest in the pursuit of uncertain rewards. In sum, uncertainty in rewards induces positive experience and increases investment of effort, time, and money in pursuing rewards.

In addition to the moderating conditions tested in the studies, other background conditions may exist for the mo-

tivating-uncertainty effect, and they await further research. For example, the effect may be more likely to arise for tedious activities than for interesting activities because boring tasks may have more room to benefit from uncertainty-generated excitement (though, notably, we observed the effect both for tedious activities such as evaluating ads in study 2 and for more interesting activities such as bidding in study 3). Another possible background condition for the effect is that the procedure of the task does not focus people's attention on the outcome. Indeed, in study 4, the motivating-uncertainty effect was attenuated when participants were instructed to attend to the outcome. A third possible background condition for the motivating-uncertainty effect is reward magnitude. We suspect that as the magnitude of the reward scales up, the effect might become weaker because large outcomes may shift people's attention from the process to the outcome.

Relationship with Prior Research

Decision research has largely viewed uncertainty as a negative influence in decision making (e.g., Gneezy et al. 2006; Rabin 2000; von Neumann and Morgenstern 1944). Although some have shown that uncertainty can have a positive impact on affective experience (Bar-Anan et al. 2009; Moon and Neilson 2014; Wilson et al. 2005; Whitchurch, Wilson, and Gilbert 2011), this impact does not seem to extend to choice or other consequential behaviors (Lee and Qiu 2009).

Recent research by Gneezy and colleagues (2006) showed that in the gain domain, people value an uncertain prospect even less than its worst possible outcome. Studies have replicated this effect across various choice and evaluation tasks (Markle et al. 2014; Moon and Nelson 2014; Simonsohn

2009; Sonsino 2008; Wang, Feng, and Keller 2014; Yang, Vosgerau, and Loewenstein 2013). These studies have explained it in terms of distaste for uncertainty such that uncertainty has a negative utility (Simonsohn 2009) and in terms of differential outcome framing (e.g., “lottery tickets” for uncertain gains and “gift certificate” for certain gains; Yang et al. 2013). The finding that an uncertain prospect is valued less than its worst possible outcome may appear to contradict our finding that an uncertain reward is more motivating than its best possible outcome. To explain this discrepancy, we distinguish between decisions with a focus on outcome and decisions with a focus on process (see also Higgins et al. 2003; Touré-Tillery and Fishbach 2011). We speculate that uncertainty aversion emerges in the former type of decisions, whereas motivating uncertainty emerges in the latter type. Focusing on process rather than outcome can change people’s feelings toward uncertainty from negative (aversion) to positive (excitement, interest). Indeed, in study 3, bidders valued the uncertain item less than the certain item before the auction, but they found the uncertain item more motivating than the certain item during the auction, although the comparison in our study is somewhat different than that in Gneezy et al.’s (2006).

Our excitement account has its root in existing literature. Cognitive research on achievement motivation finds that tasks with a moderate level of uncertainty energize people and stimulate their motivation (Atkinson 1957; Brehm and Self 1989; Brehm et al. 1983; Locke and Latham 2006). These researchers find that uncertainty about the likelihood of qualifying for a reward can be challenging and hence motivating. We add to this literature by suggesting that for those who qualified, uncertainty about reward magnitude also boosts motivation. In addition, personality research finds that gamblers seek excitement through uncertain games (Wagenaar 1989; Zuckerman 2007), and these findings on individual differences complement our (and other) research on situations in which uncertainty boosts motivation.

Using a similar paradigm of comparing a certain reward to a dominated uncertain reward, Goldsmith and Amir (2010) found no difference between these reward conditions, whereas we found a positive effect of uncertain rewards. Importantly, however, we only found this effect when participants focused on the process and not when they focused on the outcome. If we think of decisions as varying on a continuum, from those that are completely process-focused to those that are completely outcome-focused, the decisions in Goldsmith and Amir (2010) may have fallen somewhere in the middle of the continuum. We speculate that this would explain why those authors found no difference between the certain and uncertain reward conditions. Consistent with this speculation, those authors noted that when participants focused on the outcome, such as deliberately considering outcome probabilities in their study 2, they favored the certain gain over the uncertain gain.

Furthermore, most decision models have assumed independence between the value function and the probability function (e.g., Expected Utility Theory: Bernoulli 1738; von

Neumann and Morgenstern 1944; Prospect Theory: Tversky and Kahneman 1979, 1992; also see Coombs and Huang 1970; Markowitz 1987; Sharpe 1970). However, our research suggests that these two functions may be interdependent such that uncertainty brings additional value to the pursuit of the outcome (see Jia and Dyer [1996] and Slovic et al. [2007] for related arguments.) We look forward to better models to capture how people behave under uncertainty.

Marketing Implications

Our research documented the motivating-uncertainty effect, and in this section, we discuss its implications for real-world consumer behaviors. We argue that uncertain rewards can be beneficial for marketers and policy makers, and we analyze the conditions under which including uncertain rewards would likely be most beneficial.

Uncertain Rewards in Marketing. The benefits of uncertain rewards are threefold. First, as we have shown, from the motivation perspective, uncertain rewards can increase resource investment. Second, from an economic perspective, uncertain rewards can be less expensive because, as demonstrated in our studies, an uncertain reward can be more motivating than a certain reward of a higher expected value.

Third, from a hedonic perspective, uncertainty can be a source of positive experience and hence can increase consumer enjoyment and satisfaction. For example, compared to a promotion that offers a certain reward for qualified shoppers (e.g., “\$50 off if you spend over \$200”), a promotion that offers an uncertain reward (e.g., “\$30 or \$50 off if you spend over \$200”) feels like a game, making shopping fun and engaging. Thus, adding uncertainty into rewards, like other nudging ideas (Huang and Soman 2013; Thaler and Sunstein 2008), can be an effective marketing strategy.

How to Design Uncertain-Reward Programs. Although uncertainty might become less motivating as the reward magnitude increases, this does not undermine the importance or limit the applications of our research. In fact, uncertain rewards could still be effective at the aggregate level. For example, when adding uncertainty to small-value coupons, marketers may slightly increase each consumer’s spending, and such a slight increase in individual spending could have a large impact on the economy, such as a positive signal of recovery from a recession when Black Friday sales increase.

In applying our findings to reward programs, one should keep in mind that the motivating-uncertainty effect requires consumers to focus on the process of reward pursuit. Our findings suggest that uncertainty motivates people only while and not before engaging in the activity. This finding implies that before “working” (e.g., shopping in a store, eating in a restaurant, donating to a charity), consumers would be less likely to opt in to a reward program with uncertain rewards than to one with certain rewards, although they would work harder in the program with uncertain re-

wards. Accordingly, marketers should target different consumers with different types of incentives: certain rewards to potential new customers who are not yet part of the reward program and uncertain rewards to existing customers who are already in the “process” (the reward program). In fact, to maximize their customer base and to fully utilize both rewards, marketers can even combine both certain and uncertain rewards in a reward program, with the certain rewards highlighted when recruiting new members and the uncertain rewards highlighted when motivating existing customers.

Closing Remarks

For centuries, research on uncertainty has mainly investigated the negative impact on judgment (Gneezy et al. 2006) and choice (Bernoulli 1738; Kahneman and Tversky 1979). The present research shows that uncertainty can have a positive impact on behavior: it brings excitement and boosts motivation. We hope the current research will stimulate future researchers to further explore the topic and imbue them with the uncertainty, hence the excitement, of new discoveries.

DATA COLLECTION INFORMATION

The first author supervised the collection of data by research assistants at the University of Chicago’s Decision Research Lab (Campus) between the winter and spring of 2013 and the spring of 2014 for study 1 and between the winter and spring of 2011 for study 3. The first author also managed the collection of data for study 2 on Amazon Mechanical Turk in the spring of 2013 and supervised the collection of data for study 4 by research assistants at the University of Chicago’s Chicago Research Lab (Downtown) between the spring and summer of 2012. These data were analyzed by the first author with the support of a statistician at the University of Chicago.

REFERENCES

- Amir, On, and Dan Ariely (2008), “Resting on Laurels: The Effects of Discrete Progress Markers as Subgoals on Task Performance and Preferences,” *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34 (5), 1158–71.
- Andrade, Eduardo B., and Ganesh Iyer (2009), “Planned versus Actual Betting in Sequential Gambles,” *Journal of Marketing Research*, 46 (3), 372–83.
- Ariely, Dan, George Loewenstein, and Drazen Prelec (2003), “‘Coherent Arbitrariness’: Stable Demand Curves without Stable Preferences,” *Quarterly Journal of Economics*, 118 (1), 73–106.
- Arrow, Kenneth J. (1965), *Aspects of the Theory of Risk Bearing*, Helsinki: Yrjö Jahnssonin Säätiö.
- Atkinson, John W. (1957), “Motivational Determinants of Risk-Taking Behavior,” *Psychological Review*, 64 (6), 359–72.
- Bagozzi, Richard P., and Utpal Dholakia (1999), “Goal Setting and Goal Striving in Consumer Behavior,” *Journal of Marketing*, 63 (Special Issue), 19–32.
- Bar-Anan, Yoav, Timothy D. Wilson, and Daniel T. Gilbert (2009), “The Feeling of Uncertainty Intensifies Affective Reactions,” *Emotion*, 9 (1), 123–27.
- Becker, Gordon M., Morris H. DeGroot, and Jacobo Marschak (1964), “Measuring Utility by a Single-Response Sequential Method,” *Behavioral Science*, 9 (3), 226–32.
- Bernoulli, Daniel (1738), “Specimen Theoriae Novae de Mensura Sortis,” *Comentarii Academiae Scientiarum Imperialis Petropolitanae*, 5, 175–92 (translated by Louise Sommer [1954] in *Econometrica*, 22 [1], 23–36).
- Berns, Gregory S., Samuel M. McClure, Giuseppe Pagnoni, and P. Read Montague (2001), “Predictability Modulates Human Brain Response to Reward,” *Journal of Neuroscience*, 21 (8), 2793–98.
- Brehm, Jack W., and Elizabeth A. Self (1989), “The Intensity of Motivation,” *Annual Review of Psychology*, 40, 109–31.
- Brehm, Jack W., Rex A. Wright, Sheldon Solomon, Linda Siika, and Jeff Greenberg (1983), “Perceived Difficulty, Energization, and the Magnitude of Goal Valence,” *Journal of Experimental Social Psychology*, 19 (1), 21–48.
- Callan, Mitchell J., John H. Ellard, and Jennifer E. Nicol (2006), “The Belief in a Just World and Immanent Justice Reasoning in Adults,” *Personality and Social Psychology Bulletin*, 32 (12), 1646–58.
- Cheema, Amar, Dipankar Chakravarti, and Atanu R. Sinha (2012), “Bidding Behavior in Descending and Ascending Auctions,” *Marketing Science*, 31 (5), 779–800.
- Choi, Jinhee, and Ayelet Fishbach (2011), “Choice Is an End versus a Means,” *Journal of Marketing Research*, 48 (3), 544–54.
- Converse, Benjamin A., Jane L. Risen, and Travis J. Carter (2012), “Investing in Karma: When Wanting Promotes Helping,” *Psychological Science*, 23 (8), 923–30.
- Coombs, Clyde H., and Lily Huang (1970), “Tests of a Portfolio Theory of Risk Preference,” *Journal of Experimental Psychology*, 85 (1), 23–29.
- Custers, Ruudm, and Henk Aarts (2005), “Positive Affect as Implicit Motivator: On the Nonconscious Operation of Behavioral Goals,” *Journal of Personality and Social Psychology*, 89 (2), 129–42.
- Czikszentmihalyi, Mihalyi (1990), *Beyond Boredom and Anxiety: The Experience of Flow in Work and Games*, San Francisco, CA: Jossey-Bass.
- Deci, Edward L., and Richard M. Ryan (1985), *Intrinsic Motivation and Self-Determination in Human Behavior*, New York: Plenum.
- Dhar, Sanjay K., Claudia Gonzalez-Vallejo, and Dilip Soman (1995), “Brand Promotions as a Lottery,” *Marketing Letters*, 6 (3), 221–33.
- (1999), “Modeling the Effects of Advertised Price Claims: Tensile versus Precise Claims?” *Marketing Science*, 18 (2), 154–77.
- Erez, Amir, and Alice M. Isen (2002), “The Influence of Positive Affect on the Components of Expectancy Motivation,” *Journal of Applied Psychology*, 87 (6), 1055–67.
- Ferguson, Melissa J. (2008), “On Becoming Ready to Pursue a Goal You Don’t Know You Have: Effects of Nonconscious Goals on Evaluative Readiness,” *Journal of Personality and Social Psychology*, 95 (6), 1268–94.
- Fishbach, Ayelet, and Jinhee Choi (2012), “When Thinking about Goals Undermines Goal Pursuit,” *Organizational Behavior and Human Decision Processes*, 118 (2), 99–107.
- Fishbach, Ayelet, James Y. Shah, and Arie W. Kruglanski (2004), “Emotional Transfer in Goal Systems,” *Journal of Experimental Social Psychology*, 40 (6), 723–38.

- Gneezy, Uri, John A. List, and George Wu (2006), "The Uncertainty Effect: When a Risky Prospect Is Valued Less than Its Worst Possible Outcome," *Quarterly Journal of Economics*, 121 (4), 1283–1309.
- Goldsmith, Kelly, and On Amir (2010), "Can Uncertainty Improve Promotions?" *Journal of Marketing Research*, 47 (6), 1070–77.
- Gollwitzer, Peter M. (2012), "Mindset Theory of Action Phases," in *Handbook of Theories of Social Psychology*, Vol. 1, ed. Paul A. M. Van Lange, Arie W. Kruglanski, and E. Tory Higgins, London: Sage, 526–45.
- Heckhausen, Heinz (1987), "Wishing-Weighing-Willing," in *Jenseits des Rubikon: Der Wille in den Humanwissenschaften*, ed. Heinz Heckhausen, Peter M. Gollwitzer, and Franz E. Weinert, Heidelberg: Springer-Verlag, 3–9.
- Higgins, E. Tory, Arie W. Kruglanski, and Antonio Pierro (2003), "Regulatory Mode: Locomotion and Assessment as Distinct Orientations," in *Advances in Experimental Social Psychology*, Vol. 35, ed. James M. Olson and Mark P. Zanna, New York: Academic Press, 293–344.
- Holt, Charles A., and Susan K. Laury (2002), "Risk Aversion and Incentive Effects," *American Economic Review*, 92 (5), 1644–55.
- Hsee, Christopher K., and Yuval Rottenstreich (2004), "Music, Pandas, and Muggers: On the Affective Psychology of Value," *Journal of Experimental Psychology: General*, 133 (1), 23–30.
- Hsee, Christopher K., Fang Yu, Jiao Zhang, and Yan Zhang (2003), "Medium Maximization," *Journal of Consumer Research*, 30 (1), 1–14.
- Hsee, Christopher K., and Elke U. Weber (1997), "A Fundamental Prediction Error: Self-Other Discrepancies in Risk Preference," *Journal of Experimental Psychology: General*, 126 (1), 45–53.
- Hsee, Christopher K., Yang Yang, Naihe Li, and Luxi Shen (2009), "Wealth, Warmth, and Well-Being: Whether Happiness Is Relative or Absolute Depends on Whether It Is about Money, Acquisition, or Consumption," *Journal of Marketing Research*, 46 (3), 396–409.
- Hsee, Christopher K., and Jiao Zhang (2010), "General Evaluability Theory," *Perspectives on Psychological Science*, 5 (4), 343–55.
- Hsee, Christopher K., Jiao Zhang, Fang Yu, and Yiheng Xi (2003), "Lay Rationalism and Inconsistency between Predicted Experience and Decision," *Journal of Behavioral Decision Making*, 16 (4), 257–72.
- Hsee, Christopher K., Jiao Zhang, Liangyan Wang, and Shirley Zhang (2013), "Magnitude, Time, and Risk Differ Similarly between Joint and Single Evaluations," *Journal of Consumer Research*, 40 (1), 172–84.
- Huang, Wendy Hsin-Yuan, and Dilip Soman (2013), "A Practitioner's Guide to Gamification of Education," Behavioural Economics in Action Report Series, Rotman School of Management, University of Toronto.
- Jeffrey, Scott A. (2009), "Justifiability and the Motivational Power of Tangible Noncash Incentives," *Human Performance*, 22 (2), 143–55.
- Jia, Jianmin, and James S. Dyer (1996), "A Standard Measure of Risk and Risk-Value Models," *Management Science*, 42 (12), 1691–1705.
- Kahneman, Daniel, and Amos Tversky (1979), "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, 47 (2), 263–92.
- Kivetz, Ran (2003), "The Effects of Effort and Intrinsic Motivation on Risky Choice," *Marketing Science*, 22 (4), 477–502.
- (2005), "Promotion Reactance: The Role of Effort-Reward Congruity," *Journal of Consumer Research*, 31 (4), 725–36.
- Kivetz, Ran, Oleg Urminsky, and Yuhuang Zheng (2006), "The Goal-Gradient Hypothesis Resurrected: Purchase Acceleration, Illusionary Goal Progress, and Customer Retention," *Journal of Marketing Research*, 43 (1), 39–58.
- Klein, Nadav, and Ayelet Fishbach (2014), "Feeling Good at the Right Time: Why People Value Predictability in Goal Attainment," *Journal of Experimental Social Psychology*, 55 (2014), 21–30.
- Knight, Frank H. (1921), *Risk, Uncertainty, and Profit*, Boston: Hart, Schaffner & Marx, Houghton Mifflin.
- Koo, Minjung, and Ayelet Fishbach (2010), "A Silver Lining of Standing in Line: Queuing Increases Value of Products," *Journal of Marketing Research*, 47 (August), 713–24.
- Kuhl, Julius, and Miguel Kazén (1999), "Volitional Facilitation of Difficult Intentions: Joint Activation of Intention Memory and Positive Affect Removes Stroop Interference," *Journal of Experimental Psychology: General*, 128 (3), 382–99.
- Langer, Ellen J. (1975), "The Illusion of Control," *Journal of Personality and Social Psychology*, 32 (2), 311–28.
- Lee, Yih Hwai, and Cheng Qiu (2009), "When Uncertainty Brings Pleasure: The Role of Prospect Imageability and Mental Imagery," *Journal of Consumer Research*, 36 (4), 624–33.
- Le Menestrel, Marc (2001), "A Process Approach to the Utility for Gambling," *Theory and Decision*, 50 (3), 249–61.
- Locke, Edwin A., and Gary P. Latham (2006), "New Directions in Goal-Setting Theory," *Current Directions in Psychological Science*, 15 (5), 265–68.
- Markle, Alex, Yuval Rottenstreich, Jeff Galak, and Leif Nelson (2014), "Upper and Lower Violations of Internality in Risky Decisions," Working Paper, Hong Kong University of Science and Technology.
- Markowitz, Harry M. (1987), *Mean-Variance Analysis in Portfolio Choice and Capital Markets*, Oxford: Basil Blackwell.
- Marschak, Jacob (1950), "Rational Behavior, Uncertain Prospects, and Measurable Utility," *Econometrica*, 18 (2), 111–41.
- Millar, Murray G., and Abraham Tesser (1986), "Effects of Affective and Cognitive Focus on the Attitude-Behavior Relation," *Journal of Personality and Social Psychology*, 51 (2), 270–76.
- Moon, Alice, and Leif Nelson (2014), "Dissecting the Uncertainty Effect: Do People Really Dislike Uncertainty?" Working Paper, University of California, Berkeley.
- Nunes, Joseph C., and Xavier Drèze (2006), "The Endowed Progress Effect: How Artificial Advancement Increases Effort," *Journal of Consumer Research*, 32 (4), 504–12.
- Pascal, Blaise (1670), *Pensées*, Paris: Port-Royal.
- Preacher, Kristopher J., Derek D. Rucker, and Andrew F. Hayes (2007), "Addressing Moderated Mediation Hypotheses: Theory, Methods, and Prescriptions," *Multivariate Behavioral Research*, 42 (1), 185–227.
- Rabin, Matthew (2000), "Risk Aversion and Expected-Utility Theory: A Calibration Theorem," *Econometrica*, 68 (5), 1281–92.
- Rabin, Matthew, and Richard H. Thaler (2001), "Anomalies: Risk Aversion," *Journal of Economic Perspectives*, 15 (1), 219–32.
- Rottenstreich, Yuval, and Ran Kivetz (2006), "On Decision Making without Likelihood Judgment," *Organizational Behavior and Human Decision Processes*, 101 (1), 74–88.

- Sansone, Carol, Charlene Weir, Lora Harpster, and Carolyn Morgan (1992), "Once a Boring Task Always a Boring Task? Interest as a Self-Regulatory Mechanism," *Journal of Personality and Social Psychological*, 63 (3), 379–90.
- Schultz, Wolfram, Peter Dayan, and P. Read Montague (1997), "A Neural Substrate of Prediction and Reward," *Science*, 275 (March 14), 1593–99.
- Sharpe, William F. (1970), *Portfolio Theory and Capital Markets*, New York: McGraw-Hill.
- Simonsohn, Uri (2009), "Direct Risk Aversion: Evidence from Risky Prospects Valued below Their Worst Outcome," *Psychological Science*, 20 (6), 686–92.
- Slovic, Paul, Melissa L. Finucane, Ellen Peters, and Donald G. MacGregor (2007), "The Affect Heuristic," *European Journal of Operational Research*, 177 (3), 1333–52.
- Soman, Dilip (1998), "The Illusion of Delayed Incentives: Evaluating Future Effort-Money Transactions," *Journal of Marketing Research*, 35 (4), 427–37.
- Sonsino, Doron (2008), "Disappointment Aversion in Internet Bidding-Decisions," *Theory and Decision*, 64 (2), 363–93.
- Strickland, Lloyd, Roy J. Lewicki, and Arnold M. Katz (1966), "Temporal Orientation and Perceived Control as Determinants of Risk-Taking," *Journal of Experimental Social Psychology*, 2 (2), 143–51.
- Sunstein, Cass R. (2003), "Terrorism and Probability Neglect," *Journal of Risk and Uncertainty*, 26 (2–3), 121–36.
- Thaler, Richard H., and Cass R. Sunstein (2008), *Nudge: Improving Decisions about Health, Wealth, and Happiness*, New Haven, CT: Yale University Press.
- Touré-Tillery, Maferima, and Ayelet Fishbach (2011), "The Course of Motivation," *Journal of Consumer Psychology*, 21 (4), 414–23.
- (2012), "The End Justifies the Means, but Only in the Middle," *Journal of Experimental Psychology: General*, 141 (3), 570–83.
- (2014), "How to Measure Motivation: A Guide for the Experimental Social Psychologist," *Social and Personality Psychology Compass*, 8 (7), 328–41.
- Tversky, Amos, and Craig R. Fox (1995), "Weighing Risk and Uncertainty," *Psychological Review*, 102 (2), 269–83.
- Tversky, Amos, and Daniel Kahneman (1992), "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty*, 5 (4), 297–323.
- Vickrey, William (1961), "Counterspeculation, Auctions, and Competitive Sealed Tenders," *Journal of Finance*, 16 (1), 8–37.
- Voelckner, Franziska (2006), "An Empirical Comparison of Methods for Measuring Consumers' Willingness to Pay," *Marketing Letter*, 17 (2), 137–49.
- Von Neumann, John, and Oskar Morgenstern (1944), *Theory of Games and Economic Behavior*, Princeton, NJ: Princeton University Press.
- Vosgerau, Joachim, Klaus Wertenbroch, and Ziv Carmon (2006), "Indeterminacy and Live Television," *Journal of Consumer Research*, 32 (4), 487–95.
- Wagenaar, Willem Albert (1989), *Paradoxes of Gambling Behavior*, New York: Psychology Press.
- Wang, Yitong, Tianjun Feng, and L. Robin Keller (2014), "De-biasing the Uncertainty Effect: An Empirical Investigation," Working Paper, Tsinghua University.
- Wertenbroch, Klaus, and Bernd Skiera (2002), "Measuring Consumers' Willingness to Pay at the Point of Purchase," *Journal of Marketing Research*, 39 (2), 228–41.
- Whitchurch, Erin R., Timothy D. Wilson, and Daniel T. Gilbert (2011), "'He Loves Me, He Loves Me Not': Uncertainty Can Increase Romantic Attraction," *Psychological Science* 22 (2), 172–75.
- Wilson, Timothy D., David B. Centerbar, Deborah A. Kermer, and Daniel T. Gilbert (2005), "The Pleasures of Uncertainty: Prolonging Positive Moods in Ways People Do Not Anticipate," *Journal of Personality and Social Psychology*, 88 (1), 5–21.
- Yang, Yang, Joachim Vosgerau, and George Loewenstein (2013), "Framing Influences Willingness to Pay but Not Willingness to Accept," *Journal of Marketing Research*, 50 (6), 725–38.
- Zhang, Jiao (2014), "Joint versus Separate Modes of Evaluation: Theory and Practice," in *Blackwell Handbook of Judgment and Decision Making*, 2nd ed., ed. Gideon Keren and George Wu, Malden, MA: Blackwell.
- Zhang, Ying, and Szu-Chi Huang (2010), "How Endowed versus Earned Progress Impacts Consumer Goal Commitment and Motivation," *Journal of Consumer Research*, 37 (4), 641–54.
- Zhang, Ying, Jing Xu, Zixi Jiang, and Szu-chi Huang (2011), "Been There, Done That: The Impact of Effort Investment on Goal Value and Consumer Motivation," *Journal of Consumer Research*, 38 (1), 78–93.
- Zillmann, Dolf (1983), "Transfer of Excitation in Emotional Behavior," in *Social Psychophysiology: A Sourcebook*, ed. John T. Cacioppo and Richard E. Petty, New York: Guilford, 215–40.
- Zuckerman, Marvin (2007), *Sensation Seeking and Risky Behavior*, Washington, DC: American Psychology Association.