

# The Effects of Effort and Intrinsic Motivation on Risky Choice

Ran Kivetz

Graduate School of Business, Columbia University, 3022 Broadway, New York, New York 10027  
rk566@columbia.edu

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People often need to trade off between the probability and magnitude of the rewards that they could earn for investing effort. The present paper proposes that the conjunction of two simple assumptions (relating effort-induced reward expectations to prospect theory's value function) provides a parsimonious theory that predicts that the nature of the required effort will have a systematic effect on such trade-offs. Using the case of frequency (or loyalty) programs, a series of five studies involving both real and hypothetical choices demonstrated that (a) the presence (as opposed to absence) of effort requirements enhances the preference for sure-small rewards over large-uncertain rewards; (b) the preference for reward certainty is attenuated when the effort activity is intrinsically motivating; and (c) continuously increasing the effort level leads to an inverted-U effect on the preference for sure-small over large-uncertain rewards. The studies also employ process measures and examine the mechanisms underlying the impact of the effort stream on the trade-off between the certainty and magnitude of rewards. The final section discusses the theoretical implications of this research as well as the practical implications with respect to frequency programs and other types of incentive systems.

*(Effort and Reward; Decisions Under Uncertainty; Frequency/Loyalty/Reward Programs; Incentive Systems; Intrinsic Motivation; Psychology of Rewards; Risky Choice)*

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"If someone tells you, 'I have made an effort and did not find,' do not believe it... 'I have made an effort and did find,' believe it."

*Babylonian Talmud (Megillah 6b)*

People often need to trade off between the probability and magnitude of the rewards that they could earn for investing effort. Do we choose a job with stable income or with potentially larger, albeit uncertain, compensation? Do we relegate a laborious manuscript to become an invited book chapter (a guaranteed publication) or submit it instead to a top journal (a risky but higher-impact outlet)? Consumers, too, often face effort-contingent promotions and offers that differ in terms of payoff and likelihood, such as when they

are enticed with rewards and (uncertain) prizes to complete surveys or participate in customer panels.

A fundamental question, then, is what influences people's trade-offs between the certainty and magnitude of effort-contingent rewards. This issue is closely related to past research on decision under risk, which has examined, for example, how people weigh probability versus payoff and choose among risky gambles (e.g., Kahneman and Tversky 1979, March and Shapira 1987, Payne et al. 1980, Sagristano et al. 2002, Slovic et al. 1977, Thaler and Johnson 1990). Nevertheless, the impact of effort on the trade-off between the certainty and magnitude of reward is not addressed in that research or in the voluminous psychological work related to effort and reward,

such as behaviorism (e.g., Hilgard and Bower 1975), achievement motivation (e.g., Atkinson 1957, Lewin 1951), and goal setting (Locke and Latham 1990). The present research proposes that the level and intrinsic interest of effort have a predictable effect on preferences toward the probability and magnitude of outcomes (e.g., choices between sure-small and large-uncertain rewards).

This proposition is tested using the case of frequency (or loyalty) programs. Such programs have become ubiquitous in the marketplace and a key component of customer relationship management, serving a critical role in developing relationships, stimulating product and service usage, and retaining customers (e.g., Borenstein 1996, Deighton 2000, Drèze and Hoch 1998, Kim et al. 2001). Frequency programs (hereafter, FPs) share a common underlying structure, whereby customers need to invest a stream of efforts (e.g., purchasing products and services, rating products, or completing surveys) to earn future rewards. These rewards often vary in terms of their magnitude and probability; for instance, some FPs offer a choice between small rewards and entries into lotteries with (uncertain) large rewards (e.g., iWon), whereas other programs employ one type of incentive system exclusively (i.e., stochastic or deterministic).

To analyze how the trade-off between the certainty and magnitude of rewards can depend on the characteristics of the required effort stream, two simple assumptions are made: (1) effort requirements create an expectation for reward (i.e., a reference point for evaluating the actual FP rewards), with higher requirements leading to greater expectations; and (2) the valuation of program rewards vis-à-vis the expectation follows the principles of prospect theory's value function. Combined, these two assumptions provide a parsimonious and unifying framework that leads to a broad set of predictions, which have not been recognized before, regarding the impact of effort on risky choice. These hypotheses state that (a) the presence (as opposed to absence) of effort requirements enhances the preference for sure-small rewards over large-uncertain rewards; (b) the preference for reward certainty is attenuated when the effort activity is intrinsically motivating; and (c) continuously increasing the effort level leads to an inverted-U effect

on the preference for sure-small over large-uncertain rewards.

The paper is organized as follows. The next section provides a theoretical analysis of the impact of effort on the valuation of rewards, using the two foregoing assumptions. This analysis leads to several hypotheses concerning the trade-off between the certainty and magnitude of rewards. The hypotheses are tested in a series of five studies involving both real and hypothetical decisions, with approximately 1,800 participants. The final section discusses the theoretical implications of this research as well as the practical implications with respect to the design of FPs and other types of incentive systems.

## The Impact of Effort on the Evaluation of Rewards

In this section, the impact of effort on customer valuation of rewards is analyzed using the context of FPs. First, the underlying structure of such programs is discussed, and two simple assumptions are made regarding the relationship between effort and the valuation of rewards. This analysis leads to the prediction that effort requirements sensitize consumers to the presence versus absence of rewards, which is tested in a preliminary study. The subsequent sections build on this analysis and examine the effect of effort on the trade-off between the certainty and magnitude of rewards.

Frequency programs have two main components: required efforts and earned rewards. That is, earning rewards typically requires consumers to invest effort (see also Soman 1998, Kivetz and Simonson 2002). In many cases, such efforts are extended over time, and rewards are contingent on reaching a certain requirement level (e.g., the amount of required points or frequent-flyer miles, completed surveys or product ratings, or purchases before reward attainment). Perceived (program) effort is defined here as any inconvenience inherent in complying with the program requirements, such as making a special effort to buy at a particular store, purchasing more than one would have otherwise bought, or repeatedly engaging in a certain task (e.g., completing surveys or browsing Web sites).

Recent research has begun exploring the relationship between FP efforts and rewards. For example, Kivetz and Simonson (2002) showed that consumers use the required program effort to justify choosing luxury over necessity rewards. In addition, Hsee et al. (2003) demonstrated that a program's currency (e.g., points or miles) can mask an undesirable effort-reward relationship (e.g., diminishing returns to effort). Although this research has improved our understanding of customer preference toward FPs (see also Kivetz and Simonson 2003, van Osselaer et al. 2004), the more fundamental question of whether and how the nature of the required earning activity influences the trade-off between the certainty and magnitude of rewards has not yet been studied. To explore this question, two simple assumptions are made, as discussed next.

#### **Effort as a Determinant of Reward Expectations: Assumption 1**

Requiring consumers to invest a stream of future efforts is likely to raise expectations regarding the fair or appropriate size of the reward. Indeed, previous research on equity and justice (e.g., Adams 1965, Walster et al. 1978) suggests that people expect their outcomes (rewards) to be proportional to their inputs (efforts). For example, equity theory's merit principle assumes that perceptions of (un)fairness are determined by the balance (or lack of balance) between people's contributions and their rewards. Moreover, equity theory proposes that both satisfaction and behavior are linked not to objective outcomes, but rather to outcomes received relative to those judged to be equitable.

In the context of FPs, a simple assumption (hereafter, Assumption 1) is that increasing the required effort level will lead consumers to expect larger rewards. Further, rewards that fail to meet the expectation raised by the concomitant effort level will likely be coded as unfair losses, whereas rewards that meet or exceed the expectation level will be coded as gains. The assumption that consumers will evaluate the objective reward relative to some psychological expectation level is consistent with a great deal of prior research on reference-dependence (e.g., Kahneman and Tversky 1979, Thaler 1985, Winer 1986).

Next, the basic assumption that effort gives rise to expectations is combined with the value function as a unifying framework for analyzing the impact of effort on preferences toward the certainty and magnitude of rewards. Although other conceptualizations may account for the effects of effort on reward preferences, this paper demonstrates that the conjunction of (effort-induced) reference shifts with the properties of the value function can account for a wide range of previously unrecognized behaviors relating to risky choice.

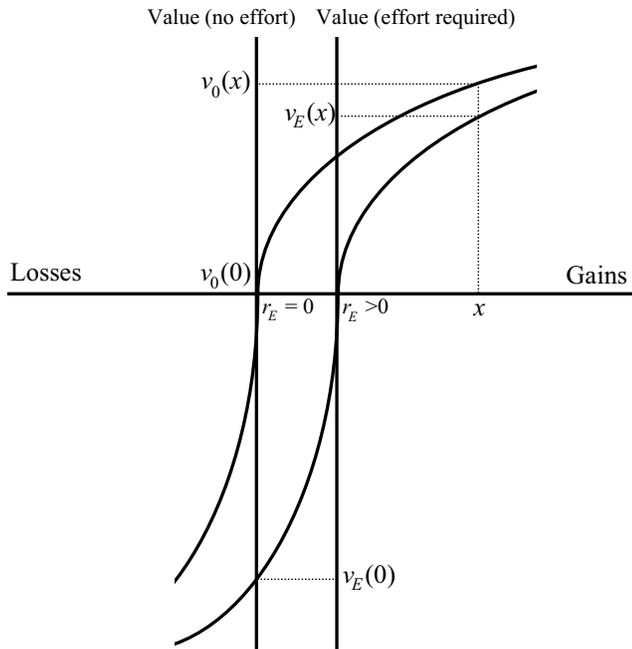
#### **A Value-Function-Based Model for the Assessment of Rewards: Assumption 2**

Prospect theory's value function (Kahneman and Tversky 1979; see also Thaler 1985, Tversky and Kahneman 1991) incorporates three behavioral principles that are essential for the analysis of the impact of effort on reward preferences: (1) options are coded as gains and losses relative to a neutral reference outcome, which is assigned a value of zero; (2) the value function is steeper for losses than for gains (i.e., loss aversion); and (3) the marginal value of both gains and losses decreases with their magnitude (i.e., diminishing sensitivity). These three characteristics lead to an asymmetric value function that is concave for gains and convex for losses.

Although Kahneman and Tversky suggest that the reference point typically corresponds to the status quo or current asset position, they also recognize that "there are situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo" (Kahneman and Tversky 1979, p. 286). The present paper argues that FP effort requirements raise reward expectations that induce a shift in the reference away from the neutral status quo. Rewards are then coded as gains or losses relative to this labile, effort-contingent reference point; rewards that exceed the expectation level are perceived as gains, whereas those below are perceived as losses. Further, it is assumed that the valuation of program rewards vis-à-vis the expectation follows the principles of prospect theory's value function (hereafter, Assumption 2).

Figure 1 illustrates this analysis. Consumers who are not required to invest any effort to obtain a possible future award,  $x$ , will perceive this award as a

Figure 1 Reference Shifts due to Required Effort



(free) gain with a subjective value of  $v_0(x)$ .<sup>1</sup> These consumers will construe not receiving a reward as the natural status quo and not as a loss (i.e.,  $v_0(0) = 0$ ). By contrast, consumers who are required to invest effort will expect to be compensated, and thus their relevant reference point will increase from zero to  $r_E > 0$ . For these consumers, a lack of reward represents a loss (i.e.,  $v_E(0) \ll 0$ ). This analysis gives rise to the notion that effort requirements sensitize consumers to the absence of rewards. That is, given Assumptions 1 and 2, loss aversion and concavity of gains imply that  $v_E(x) - v_E(0) > v_0(x) - v_0(0)$ , which means that the difference in subjective value between being rewarded and not being rewarded is greater when consumers are required to invest effort. Next, before proceeding to the development of specific hypotheses, a pilot study testing the conjunction of Assumptions 1 and 2 is reported.

<sup>1</sup>This and the following analyses employ the value function  $v(\cdot)$  from prospect theory. For example,  $v_E(x)$  denotes the subjective value of outcome (or reward)  $x$ , given the reference  $r_E$  (i.e., effort  $E$  is required to obtain  $x$ ).

### A Preliminary Test of Assumptions 1 and 2

The respondents in the pilot study were 116 travelers who were waiting for trains at sitting areas in a major train station. The idea was to present respondents with either a gift (no-effort) or a FP (effort) scenario and to ask them how happy they would be with winning [or not winning] a reward. Respondents were randomly assigned to one of four conditions in a 2 (effort level: gift versus FP)  $\times$  2 (reward outcome: win versus not win) between-subjects design. Based on the earlier analysis and the conjunction of Assumptions 1 and 2, it was predicted that the difference in happiness between winning and not winning the reward would be greater in the effort as opposed to no-effort conditions; that is, respondents would be more sensitive to the presence versus absence of reward when they were required to invest effort.

The scenarios given to the respondents in the gift conditions were:

Imagine that you receive a free gift from a car rental company. The gift consists of a free entry into a lottery in which you could win seven free night stays at your choice of any luxury hotel chain. The chances of winning are one in fifty.

You now receive your lottery entry. As it turns out, you [do not] win.

By contrast, in the FP effort conditions, respondents received the following scenarios:

Imagine that you participate in a frequency program offered by a car rental company. According to this program, you are required to rent a car 10 times before earning a free entry into a lottery in which you could win seven free night stays at your choice of any luxury hotel chain. The chances of winning are one in fifty.

You now complete the required 10 car rentals and earn your lottery entry. As it turns out, you [do not] win.

Respondents were asked to rate how unhappy or happy they would be with the outcome they were assigned to, using an 11-point scale ranging from (-5) "Very Unhappy" to (5) "Very Happy" (the midpoint of the scale was denoted with 0 and labeled as "Neither unhappy nor happy"). The results were consistent with the two underlying assumptions and supported the notion that effort requirements sensitize consumers to the difference between winning and not

winning a reward. Specifically, the difference in the mean happiness rating between winning and not winning the reward was greater in the effort conditions (3.8 versus  $-1.8$ , respectively; difference = 5.6) than it was in the no-effort (gift) conditions (4.1 versus  $-0.3$ , respectively; difference = 4.4), as indicated by the significant interaction between effort level and reward outcome ( $F = 4.4$ ;  $df = 1$ ;  $p < 0.05$ ). The data also supported the other premises underlying the preceding analysis and Figure 1 (i.e.,  $v_E(0) \ll 0 = v_0(0)$ ;  $v_E(x) < v_0(x)$ ).<sup>2</sup> Next, building on the notion of effort-induced reference shifts, the impact of effort on the trade-off between the certainty and magnitude of rewards is considered using the case of sure-small and large-uncertain rewards.

### The Impact of Effort on Preferences Between Sure-Small Rewards and Large-Uncertain Rewards

Consumer choice between sure-small rewards (e.g., a guaranteed winning of \$10) and large-uncertain rewards (e.g., a 1% chance to win \$1,000) is common in everyday life and, increasingly, in marketing promotions and programs. Accordingly, such choices have received a great deal of attention from consumer and decision researchers (see, e.g., Kahneman and Tversky 1979, 1981; Thaler and Johnson 1990). Normative theory indicates that decisions under risk should be influenced by consumers' risk preferences, as determined by the shape (concavity) of their utility functions (Arrow 1971). However, previous research has revealed a number of behavioral factors that

<sup>2</sup>Specifically, respondents assigned to the loss condition were significantly more *unhappy* when the (unattained) reward was contingent on complying with a FP effort stream than when it was a gift ( $M = -1.8$  versus  $M = -0.3$ ,  $t = 3.9$ ;  $p < 0.001$ ; *medians* =  $-2.0$  versus 0). Moreover, while the average happiness rating of respondents in the effort-loss condition was significantly lower than the zero midpoint of the scale ( $t = 5.4$ ;  $p < 0.001$ ), the average happiness rating of respondents in the gift-loss condition was not ( $t = 1.5$ ;  $p > 0.1$ ). In addition, respondents assigned to the gain condition were directionally happier when the reward was a gift than when it was contingent on complying with effort ( $M = 4.1$  versus  $M = 3.8$ ,  $t = 0.6$ ;  $p > 0.1$ ; both significantly greater than zero; *medians* = 5.0 versus 4.0).

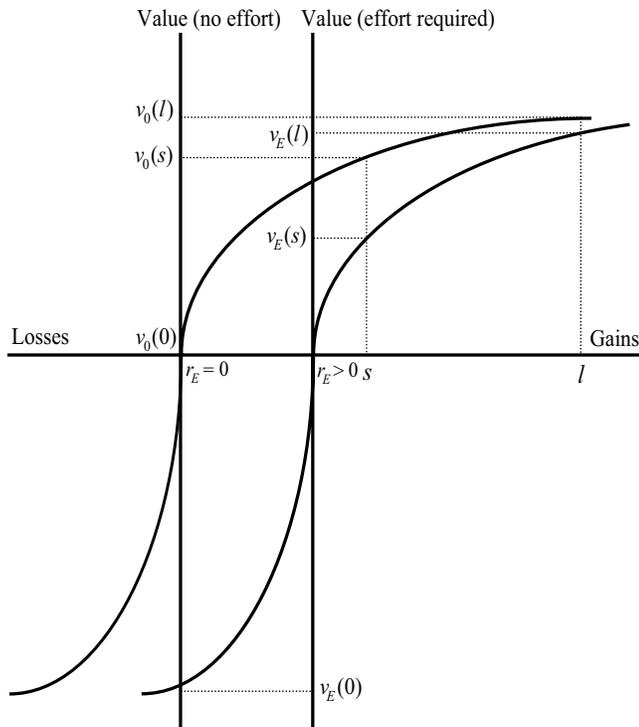
influence such decisions, including the framing of the decision problem (Kahneman and Tversky 1979, 1981) and prior outcomes (Laughunn and Payne 1984, Thaler and Johnson 1990). In this article, it is argued that an important yet unrecognized determinant of risky choice is the level and intrinsic interest of the required effort.

Specifically, building on the earlier analysis that effort sensitizes consumers to the presence (versus absence) of rewards, it is posited that the introduction of effort requirements will enhance the preference for sure-small rewards over larger-uncertain rewards. That is, as long as the sure-small reward is perceived as sufficient compensation for the required effort, ensuring that one does not work for nothing will serve as a compelling reason for choosing the sure-small reward. By contrast, selecting the large-uncertain reward leaves open the possibility of exerting effort in return for no reward, an outcome that is coded as a loss relative to the effort-induced reward expectation.

The notion that the presence (as opposed to absence) of effort requirements will shift consumer choice in favor of the certain reward can be predicted using the conjunction of the two assumptions discussed earlier (i.e., (1) effort creates an expectation or reference point, and (2) the valuation of FP rewards relative to the reward expectation is consistent with the value function). To illustrate this argument, consider outcomes  $s$  and  $l$  shown in Figure 2, where  $l > s$ , but the probability of obtaining outcome  $l$  is considerably smaller than the certainty of attaining outcome  $s$  (i.e.,  $p_l \ll p_s = 1$ ). When no effort is required to obtain a choice between the sure-small and large-uncertain rewards, the difference in subjective value between these two rewards is equal to  $v_0(s) - [p_l * v_0(l) + (1 - p_l) * v_0(0)]$ .<sup>3</sup> Conversely, when earning a choice between these rewards is contingent on effort, the shift in the reference point (due to a positive reward expectation) will result in a different relative reward valuation,  $v_E(s) - [p_l * v_E(l) + (1 - p_l) * v_E(0)]$ .

<sup>3</sup>This and the subsequent analyses assume that consumers adopt the explicit probabilities (i.e.,  $p$ ) stated for the various rewards. Replacing these probabilities with prospect theory's decision weights (i.e.,  $\pi(p)$ ) does not alter the nature or conclusions of the analyses.

**Figure 2** The Impact of Effort-Induced Reference Shifts on Choices Between Sure-Small and Large-Uncertain Rewards



This shift in reference from zero to  $r_E > 0$  leads to two opposing effects regarding the relative value of the sure-small and large-uncertain rewards. On one hand, loss aversion means that the possibility  $(1 - p_l)$  of not being rewarded for investing efforts (inherent in the large-uncertain reward) will enhance the relative preference for the sure-small reward, which guarantees winning (note that  $v_E(0) < v_0(0) = 0$ ). On the other hand, the concavity of the gain function implies that the perceived difference between  $l$  and  $s$  will be greater under the new reference point  $r_E > 0$  (i.e.,  $v_E(l) - v_E(s) > v_0(l) - v_0(s)$ ).

The relative strength of these two opposing effects will be determined by the probability of winning  $l$ ; the lower  $p_l$  is, the greater the impact of the loss-aversion effect relative to the concavity effect. Appendix A (Proposition 1) shows that under a highly plausible condition, namely a coefficient of loss aversion of at least two (e.g., Tversky and Kahneman 1991), the loss aversion effect always outweighs the concavity effect if the probability of winning  $l$  is

smaller than 0.5. Thus, as long as  $p_l < 0.5$  and the sure-small reward meets or exceeds the expectation for reward raised by the effort requirement (i.e.,  $s \geq r_E$ ), the introduction of effort will enhance the relative preference for the sure-small reward over the large-uncertain reward. This conveys the intuition that, compared to a no-effort condition, consumers who are required to invest efforts will prefer a sure compensation ( $s$ ) over a potentially larger reward ( $l$ ) that is more likely to end up as a perceived loss (i.e., because  $(1 - p_l) = p_0 > 0.5$  and  $v_E(0) < 0$ ).

The discussion leads to the following hypothesis:<sup>4</sup>

**HYPOTHESIS 1.** *Consumers are more likely to prefer sure-small rewards over large-uncertain rewards when they are rewarded for the expenditure of effort compared to when they are provided with effort-free rewards.*

This prediction, of course, does not mean that higher effort will always enhance the relative share of the sure-small reward, considering that greater effort requirements can lead at some point to expectations that are not met by the sure-small reward. Thus, the condition that the sure-small reward satisfies consumers' expectations is later relaxed by examining the effects of an extended range of increases in the required effort. These investigations reveal a systematic and conceptually rich association between required effort and risky choice. Next, a study designed to test Hypothesis 1 is discussed.

## Study 1: Choices Between Sure-Small and Large-Uncertain Rewards as a Function of Effort

### Method

**Participants.** The participants in the study were 436 travelers who were waiting for trains at sitting areas in a major train station. They were between 18 and 70 years old and represented a wide range of demographic characteristics.

<sup>4</sup> This hypothesis, as well as Hypotheses 2 and 3 discussed subsequently, assume that the conditions delineated above are satisfied (i.e.,  $p_l < 0.5$  and  $s \geq r_E$ ).

**Figure 3** Test of Hypothesis 1—Frequent Cereal-Eater ScenarioEffort Condition:Frequent-Cereal Eater Program

Imagine that a national brand of cereals offers you the opportunity to participate in a “frequent-cereal eater” program. According to this program, after you purchase ten boxes of this brand of cereal, you will earn a choice between the two rewards below:

<u>Reward A</u> 1000 frequent-flyer miles (accepted by any frequent-flyer program)	<u>Reward B</u> One in fifty chance to win 50,000 frequent-flyer miles (accepted by any frequent-flyer program)
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Circle the reward that you prefer to receive if you complete ten purchases of cereal boxes:

A

B

No-Effort Condition:Frequent-Cereal Eater Program

Imagine that a national brand of cereals offers a friend of yours the opportunity to participate in a “frequent-cereal eater” program. According to this program, after your friend purchases ten boxes of this brand of cereal, s/he will earn a choice between the two rewards below. However, your friend is not interested in airline miles, and therefore, tells you that if s/he earns the reward, s/he will give it to you:

<u>Reward A</u> 1000 frequent-flyer miles (accepted by any frequent-flyer program)	<u>Reward B</u> One in fifty chance to win 50,000 frequent-flyer miles (accepted by any frequent-flyer program)
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Circle the reward that you prefer to receive from your friend if s/he completes ten purchases of cereal boxes:

A

B

**Procedure and Design.** Hypothesis 1 was tested in three scenarios involving a frequent cereal-eater program (98 respondents), a grocery store problem (152 respondents), and a hotel problem (186 respondents).<sup>5</sup> In each scenario, respondents were randomly assigned to one of two (between-subjects) conditions, either an (FP) effort condition or a no-effort condition. Specifically, in the frequent cereal-eater program (see Figure 3), effort was manipulated by informing respondents that they would receive

a choice between two rewards after either they or their friend purchased 10 cereal boxes (i.e., presence vs. absence of personal effort, respectively). In the grocery store problem (see Appendix B), respondents received a choice between two rewards, either after they completed five grocery purchases or as an appreciation gift. And, in the hotel problem (see Appendix B), respondents could obtain a choice between rewards by participating in either an FP (that required 10-night stays) or an (effortless) free raffle. As shown in Figure 3 and Appendix B, the three problems had a similar format, with respondents choosing between a sure-small reward and a large-uncertain reward.<sup>6</sup> In the hotel scenario, respondents also had the option of not participating in the

<sup>5</sup> Although the scenarios were run separately, all three appear under Study 1 because they employed a similar methodology. Of the 131 participants in the frequent-cereal eater program, 33 respondents were not included in the analysis (leaving 98 respondents) because these respondents indicated that they did not participate in any frequent-flyer program, and therefore the rewards (frequent-flyer miles) were irrelevant to them.

<sup>6</sup> In the frequent cereal-eater program and in the hotel problem, the expected values of the sure-small and large-uncertain rewards

FP (or raffle) (see Dhar and Simonson 2003). As a check for the effort manipulation, after making their choices respondents in all three problems rated the degree to which attaining the reward involved effort for them, using an 11-point scale ranging from (0) "No effort at all" to (10) "Very high effort."

## Results

**Manipulation Checks.** In all three problems, the manipulation of effort produced the expected effort perceptions, with respondents in the FP effort condition indicating higher mean perceived effort compared to respondents in the no-effort condition ( $\bar{X} = 3.8$  versus  $\bar{X} = 1.4$  in the frequent cereal-eater program, and  $\bar{X} = 5.3$  versus  $\bar{X} = 2.8$  in the hotel problem, both  $p < 0.05$ ;  $\bar{X} = 3.4$  versus  $\bar{X} = 2.6$  in the grocery store problem,  $p = 0.06$ ).

**Reward Choices.** The results of all three problems supported Hypothesis 1. More specifically, in the frequent cereal-eater program, the choice share of the sure-small reward was higher in the effort condition than in the no-effort condition (77% (36 out of 47 respondents) versus 61% (31 out of 51 respondents);  $t = 1.7$ ;  $p < 0.05$ ). Similarly, in the grocery store problem respondents were significantly more likely to choose the sure-small reward in the effort condition than in the no-effort condition (73% (60/82) versus 49% (34/70);  $t = 3.2$ ;  $p < 0.001$ ). Finally, in the hotel problem, the introduction of effort led to a significant increase in the relative share of the sure-small reward from 46% (i.e., 46 out of 99 respondents who chose a reward) in the no-effort condition to 74% (i.e., 51 out of 69 respondents who chose a reward) in the effort condition ( $t = 3.8$ ;  $p < 0.001$ ).

## Discussion

The results provide support for the role of effort in determining risky choice, indicating that when rewards are contingent on complying with an effort stream, consumers' preferences shift in favor of sure-small rewards at the expense of large-uncertain

rewards. It is important to note that these results were obtained regardless of whether or not a no-choice option was available. Next, two studies are presented that address more directly the mechanisms underlying the impact of effort on the trade-off between the certainty and magnitude of rewards. In particular, these studies investigate whether the preference for sure-small rewards over large-uncertain rewards is greater among consumers with lower intrinsic motivation to engage in the required effort activity. A second way in which the theoretical explanation is tested is by manipulating (rather than measuring) the intrinsic interest of an effort activity and examining the impact of effort (relative to a no-effort condition) on the preferred reward.

## The Role of Intrinsic Motivation

The impact of effort on preference for sure-small rewards was predicted based on the notion that effort requirements give rise to reward expectations, and therefore to a feeling of loss when no reward is afforded. However, people who see themselves as intrinsically motivated to engage in an effort activity are less likely to make the attribution that they are engaging in the activity only to obtain some extrinsic incentive and are rather more likely to attribute their participation to the enjoyment, satisfaction, and/or interest inherent in the effort activity (see, e.g., Deci and Ryan 1985, Lepper 1981, Lepper and Greene 1978). Further, because the expectation for (extrinsic) reward is likely to be lower for intrinsically motivated individuals, it is predicted that the preference for sure-small rewards will be weaker among such individuals. Thus:

*HYPOTHESIS 2. Relative to individuals with high intrinsic motivation to engage in an effort activity, individuals with low intrinsic motivation are more likely to prefer sure-small rewards over large-uncertain rewards.*

Relatedly, when an effort activity is inherently enjoyable (i.e., intrinsically motivating), it is likely to lead to lower reward expectations and, therefore, have a weaker effect on FP reward preferences. For instance, a program that requires consumers to review products (e.g., Epinions.com) is less likely to raise an

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were equal. In the grocery store problem, the expected value of the large-uncertain reward was greater than that of the sure-small reward.

expectation of reward if consuming (and reviewing) the relevant products is enjoyable. Accordingly, it is predicted that the introduction of an effort requirement will have a stronger positive effect on the relative share of the sure-small reward when the effort activity is not intrinsically motivating. This leads to the following interaction hypothesis:

**HYPOTHESIS 3.** *The positive impact of effort (compared to an effort-free condition) on the preference for sure-small over large-uncertain rewards is stronger for effort activities that are not intrinsically motivating.*

Hypotheses 2 and 3 were examined in the following two studies. The first study tests the role of intrinsic motivation in determining reward preferences by measuring participants' pre-existing interests in the required effort activity.

## Study 2: Intrinsic Motivation as a Determinant of Reward Preferences

Hypothesis 2 was tested by measuring participants' intrinsic motivation to engage in an effort activity. Moreover, to allow for a strong test of the role of intrinsic motivation, the participants in this study made real choices. In addition, to further explore the mechanisms underlying the impact of effort on reward preferences, the choice explanations provided by these participants are subsequently examined.

### Method

**Participants.** The participants were 232 students at an East Coast high school. Participants were recruited by schoolteachers at the beginning of a regular classroom session. As explained later, the participants were randomly assigned to conditions.

**Procedure and Design.** At the beginning of a regular classroom session, several of the high school teachers informed their classes that the school was considering introducing some new learning materials. Therefore, these students have been selected to participate in a four-week study during which they will have to use and evaluate these learning materials. The teachers then distributed to their students

a (supposedly) official survey from the high school. Students were randomly assigned to one of two possible versions of the survey, regarding either a new math curriculum or a new poetry curriculum. In both survey conditions, students were informed that they would be asked to solve three math problems [read and critically analyze three poems] per week for four consecutive weeks. Further, once a week, after solving the math problems [reading and analyzing the poems], they would need to complete a survey evaluating the math workbook [poetry collection]. In order to familiarize students with their future task, both survey versions asked students to review a set of sample math problems [poems] and evaluation questions, which were printed on a separate sheet of blue card-stock paper. The sample math problems were taken from the January 2001 Mandelbrot Competition Greater Testing Concepts company and from the Round 4, Academic Year 2000–2001 USA Mathematical Talent Search. The sample poems were taken from the Real SAT II: Subject Tests (College Board 1998).

Students in both conditions were informed that completion of the required effort would earn one of two rewards, either \$20 in cash (a sure-small reward) or a 1 in 25 chance to win \$600 in cash (a large-uncertain reward). Students were asked to indicate in advance which reward they choose to earn upon completion of the required effort, so that the school could plan ahead. After they chose a reward, students were asked to return their survey to the teacher. Students were then given an additional page on which they were asked to rate how much they like math and poetry. The ratings were on a seven-point scale ranging from "I like math [poetry] much *less* than typical students" (1) to "I like math [poetry] much *more* than typical students" (7). These math/poetry-liking ratings served as a measure of participants' intrinsic motivation to engage in the effort activity. In addition, students were asked to indicate how many times they solved a math problem [read a poem] in a typical month. Students were also asked to explain their choice of reward in writing. Students next listed, in free response, any other thoughts they had about the curriculum survey. None of the participants expressed suspicion about the survey's purpose or articulated the actual hypotheses being tested.

## Results

Participants assigned to the math task were divided into two groups, "math haters" and "math lovers," based on a median split of their reported liking of math (means and standard deviations of math-liking ratings in the "math haters" versus "math lovers" groups were 2.8 (*s.d.* = 1.1) versus 5.7 (*s.d.* = 0.7), respectively). Similarly, participants assigned to the poetry task were divided into two groups, "poetry haters" and "poetry lovers," based on a median split of their reported liking of poetry (means and standard deviations of poetry liking ratings in the "poetry haters" versus "poetry lovers" groups were 2.7 (*s.d.* = 1.1) versus 5.9 (*s.d.* = 0.8), respectively).

Participants' reward choices were then examined to test H2, which predicts that math [poetry] haters will be more likely to choose the sure-small reward compared to math [poetry] lovers. Consistent with the intrinsic motivation hypothesis, the choice share of the sure-small reward was higher among "math haters" than among "math lovers" (79% versus 64%;  $t = 1.8$ ;  $p < 0.05$ ). Similarly, the share of the sure-small reward was higher among "poetry haters" than among "poetry lovers" (84% versus 70%;  $t = 1.8$ ;  $p < 0.05$ ).

In addition, students were asked to indicate whether they participated in the school's math team (a math club involving yearlong national competitions in math). Consistent with the notion that individuals are less likely to expect an extrinsic reward for engaging in an activity that they view as intrinsically interesting, in the math condition, students who were members of the math team were less likely to choose the sure-small reward compared to students who were not members of the math team (56% versus 74%;  $t = 1.6$ ;  $p < 0.06$ ). This result cannot be explained as reflecting a greater tendency of math team members to calculate the expected value of the rewards (which was lower for the sure-small reward) because, in the poetry condition, math team members were not less likely to prefer the sure-small reward compared to nonmembers (84% versus 76%;  $t = 0.9$ ;  $p > 0.1$ ).

In summary, this study demonstrated the impact of intrinsic motivation using an unobtrusive measure of task liking, in the context of an actual rewards program with real potential consequences.

Consistent with the notion that intrinsically motivated individuals are less likely to expect a reward, the results indicate that the preference for the sure-small reward is significantly weaker among such participants. Next, a study is reported that further examines the role of intrinsic motivation and tests Hypothesis 3, which predicts that enjoyable effort has a weaker effect on preferences for sure-small rewards.

## Study 3: Intrinsic Motivation as a Moderator of the Impact of Effort on Preferred Rewards

Hypothesis 3 was tested by manipulating the enjoyment inherent in an effort task (reading and reviewing magazines) and examining the interaction between intrinsic motivation and the level of effort with respect to preferences between sure-small and large-uncertain rewards. To vary the level of task enjoyment, a pretest was conducted in which respondents (148 travelers waiting for trains) were asked which weekly magazines they read most often and which magazine topic most interests them. On the basis of the pretest results, two magazines were chosen of low versus high intrinsic interest for the respondent population (i.e., *Better Homes & Gardens* versus *Time*, respectively).

### Method

The participants in the study were 311 travelers who were waiting for trains at sitting areas in a major train station. Participants were randomly assigned to one of four conditions in a 2 (effort level: no effort versus FP effort)  $\times$  2 (interest level: low versus high) between-subjects design. Respondents were first asked to familiarize themselves with the magazine they were assigned to, either *Better Homes & Gardens* (low intrinsic interest) or *Time* (high intrinsic interest). They received a description and photograph of the magazine, adopted with minor adjustments from MagazineOutlet.com and Epinions.com. After reading about the magazine, respondents considered either a free promotion or a frequency program, both offered by the magazine they read about earlier. In the free promotion (no-effort) condition, respondents

were told that in an attempt to increase awareness of the magazine, the publishers are sending them four free issues as well as a free gift, which consisted of a choice between two rewards. In the FP effort condition, respondents were told that in an attempt to improve the magazine's content and design, the publishers are offering them the option of earning a reward in return for reading and providing feedback on four (free) issues of the magazine (once a week, after reading the magazine, they would need to complete a three-minute phone survey). In both conditions, respondents were asked to choose between two alternative rewards, either two free movie tickets (a sure-small reward) or a free entry into a lottery with a 1 in 100 chance to win a vacation package for two in Hawaii (a large-uncertain reward). Respondents were also given the option of not participating.

As a check for the manipulation of intrinsic interest, a subsample of respondents rated (after making their choice) the extent to which they enjoyed (or would enjoy) reading the two magazines on an 11-point scale ranging from "I would *not* enjoy it at all" (0) to "I would enjoy it *greatly*" (10). These respondents also indicated how many times they read each magazine in a typical month. As expected, reading *Time* was rated as significantly more enjoyable than reading *Better Homes & Gardens* ( $M = 6.0$  versus  $M = 4.0$ ,  $t = 4.2$ ;  $p < 0.001$ ); further, the average enjoyment rating for *Time* was significantly higher than the scale midpoint of five ( $t = 2.4$ ;  $p < 0.05$ ), whereas the average rating for *Better Homes & Gardens* was significantly lower ( $t = 2.4$ ;  $p < 0.05$ ). The enjoyment ratings were also significantly correlated with the frequency of reading the magazines ( $r = 0.5$  and  $r = 0.6$  for *Time* and *Better Homes & Gardens*, respectively; both  $ps < 0.001$ ). Combined, these checks confirm that the manipulation of magazine type affected respondents' intrinsic motivation in the expected direction.

## Results

Consistent with Study 1 and Hypothesis 1, in both magazine versions, the relative choice share of the sure-small reward was higher in the FP effort condition than in the no-effort (gift) condition. Pooled

across the level of intrinsic motivation, there was a significant main effect of effort level on the preference for the sure-small reward (60% versus 43%;  $t = 2.9$ ;  $p < 0.005$ ). More importantly, consistent with Hypothesis 3, whereas the effect of effort in the *Better Homes & Gardens* condition (low intrinsic motivation) was statistically significant, the effect in the group that considered *Time* magazine (high intrinsic motivation) was weaker and not statistically significant.

Specifically, in the low intrinsic motivation condition, when the reward was not contingent on effort (i.e., it was a gift), 38% (27 out of 71) of respondents chose the sure-small reward over the large-uncertain reward. However, when earning the reward required investing effort, 66% (41 out of 62) preferred the sure-small reward, an increase of 28% ( $t = 3.4$ ;  $p < 0.001$ ). By contrast, in the high intrinsic motivation condition, when the reward was a gift, 48% (35 out of 73) of respondents chose the sure-small reward over the large-uncertain reward. However, when the reward required investing efforts, the relative share of the certain reward was 55% (41 out of 74), an increase of only 7% ( $t = 0.9$ ;  $p > 0.1$ ). The difference between the two intrinsic motivation conditions in the impact of effort on reward choice was statistically significant (28% versus 7%;  $t = 1.8$ ;  $p < 0.05$ ). In addition, respondents assigned to the FP effort conditions were more likely to choose the sure-small reward when the effort activity was not intrinsically motivating (reading and reviewing *Better Homes & Gardens*) than when the effort activity was intrinsically motivating (reading and reviewing *Time*). This effect, which was marginally significant (66% versus 55%;  $t = 1.3$ ;  $p < 0.1$ ), is consistent with Hypothesis 2 and the results of Study 2.

## The Role of Intrinsic Motivation: Discussion

Using two methodologies, it was demonstrated that the preference between sure-small and large-uncertain rewards depends on the intrinsic motivation to engage in the required effort activity. Consistent with the notion that intrinsically motivating effort is less likely to lead to an expectation of extrinsic reward, it was shown that individuals who liked a particular effort activity (e.g., solving and reviewing math

problems) were less likely to prefer the sure-small reward compared to individuals who disliked this activity. While this demonstration was based on a measurement of participants' pre-existing tastes, a second study involved a manipulation of the interest inherent in the effort task (using low versus high-enjoyment magazines). As suggested by the notion that engaging in intrinsically motivating (or rewarding) effort lowers the expectation for extrinsic reinforcement, the findings indicate that the positive impact of an effort requirement (compared to a no-effort condition) on the preference for reward certainty was attenuated when the effort was enjoyable.

To further examine the proposed account for effort-contingent reward preferences and the role of intrinsic motivation, the choice explanations from Study 2 were analyzed; these explanations were provided by the 232 high school students who made a real choice between \$20 in cash (a sure-small reward) and a 1 in 25 chance to win \$600 in cash (a large-uncertain reward). Two independent judges who were unaware of the study's predictions coded the choice explanations; the interjudge reliability was 92%, and disagreements were resolved by discussion. Given that the results pertaining to the poetry and math tasks were similar, the analysis is pooled across these two conditions. This analysis contrasts the reasons provided by participants with low versus high intrinsic motivation to engage in the required effort activity.

Among participants with low intrinsic interest in the effort task (math and poetry "haters") who chose the sure-small reward (94/115), 31% explained their choice based on the notion that they expect a guaranteed reward in return for investing (dislikable) efforts. By contrast, among participants with high interest in the effort activity (math and poetry "lovers") who chose the sure-small reward (78/117), only 4% used this explanation. The following are examples of explanations for choosing the sure-small reward that were coded as reflecting effort-contingent reward preferences:

- "I would want to be guaranteed the money because I don't like poetry that much."
- "\$20 is guaranteed. \$600 is nice, but big chance of getting NOTHING in return. That would be horrible."

- "I'm lazy as hell about math. I only do things that I like, such as reading, acting, or critiquing films. So I want a definite reward."

The finding that participants were more likely to explain choosing the sure-small reward based on the required effort when they disliked rather than liked the effort activity supports the notion of effort-contingent reward preferences and the moderating role of intrinsic motivation.

In addition, analysis of the reasons provided by intrinsically motivated participants who chose the large-uncertain reward indicated that 33% explained their choice based on the notion that the (likable) effort activity is rewarding in itself, and therefore a lack of extrinsic reinforcement would not constitute a loss or disappointment. Conversely, none of the participants with low intrinsic motivation who chose the uncertain reward used this explanation. Examples of such reasons include:

- "I like math so it would be okay if I didn't win anything and why not have the chance to win \$600."
- "At first I thought \$20, but changed my mind—\$20 isn't that much money and I'd be reading poetry anyway, so I don't feel like I'd HAVE to be compensated for it."
- "To me, math is pretty much nothing—in fact, I like doing math. So getting paid for doing something I like to do is a bonus."

Interestingly, however, among participants who chose the uncertain reward, those with lower intrinsic motivation were much more likely (43% versus 3%) to explain their choice as an attempt to "break even" (Thaler and Johnson 1990). That is, these participants indicated that the sure-small reward was *insufficient* as a compensation for the (dislikable) effort involved, using reasons like: "Twenty dollars is not enough to compensate for reading poetry for four weeks. Six-hundred dollars is"; "\$20 is not significant enough for the amount of work involved. Maybe if the reward was \$50+ I would take it, but I would rather take a chance (1/25 isn't too bad) at the big cash prize." Accordingly, the next section examines the effect of a systematic manipulation of required efforts, whereby beyond a certain effort level, the impact of effort on preferences between sure-small and large-uncertain rewards reverses.

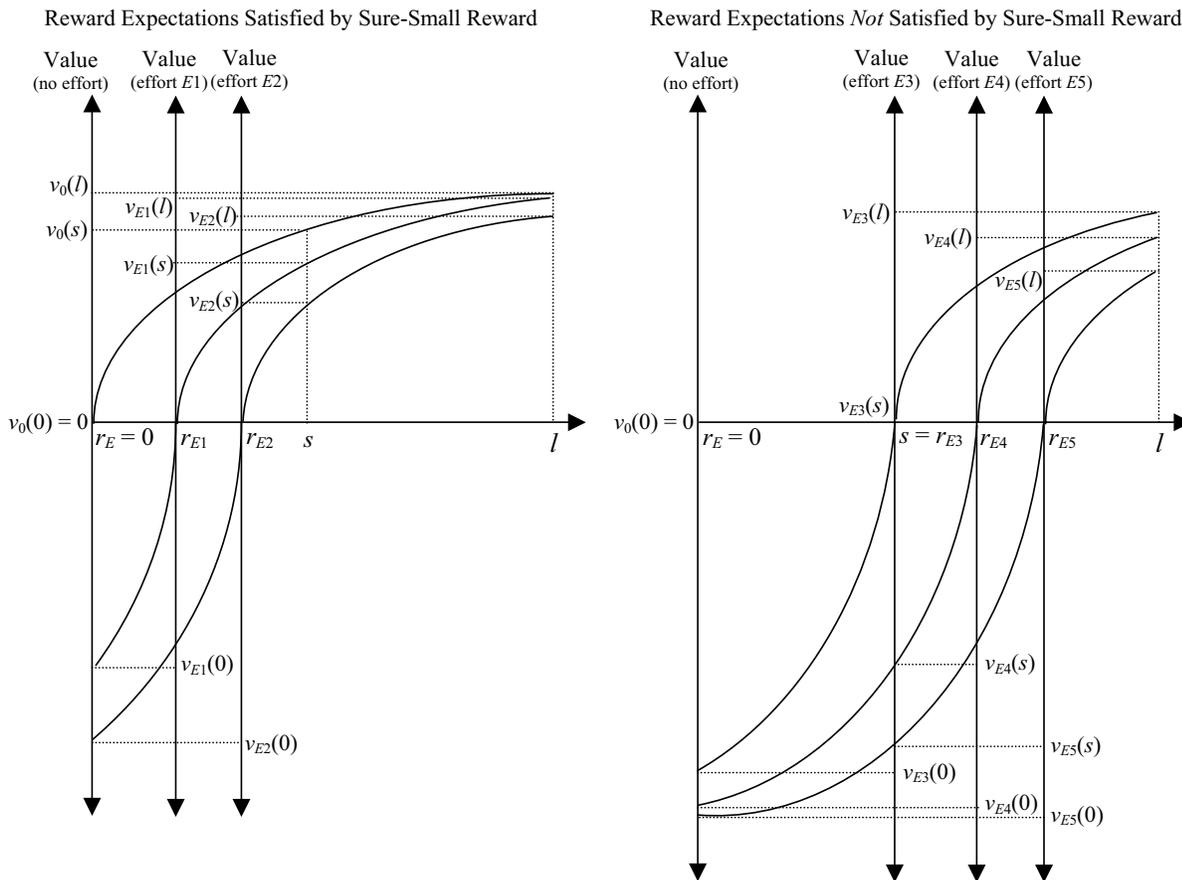
### The Curvilinear Relationship Between Effort and Preference for Sure-Small Over Large-Uncertain Rewards

So far, we have focused on situations in which most consumers perceived the sure-small reward as sufficiently large relative to the effort-induced reward expectation and examined the impact of the presence versus absence of effort on reward preferences. Here, it is suggested that, as long as the sure-small reward is satisfactory, further increasing the required efforts and the concomitant reward expectations will enhance the aversion and perceived loss related to the potential absence of reward (inherent in the large-uncertain reward). Thus, because the sure-small reward eliminates the possibility of such a (perceived) loss, the

preference for this reward is predicted to increase with greater effort.

This intuition is illustrated in the left-hand side of Figure 4, which depicts incremental effort-induced reference shifts that do not exceed the magnitude of the sure-small reward (i.e.,  $s > r_{E2} > r_{E1} > 0$ ). As discussed earlier, under this condition, increasing the reference point leads to two opposing forces regarding the relative value of the sure-small and large-uncertain rewards. The concavity of the gain function implies an increasing difference between the perceived values of  $l$  and  $s$ . However, as long as the probability of obtaining the large-uncertain reward is reasonably low (i.e.,  $p_l < 0.5$ ), this effect will be outweighed by the impact of loss aversion. That is, as the reference point increases, the considerable possibility  $(1 - p_l)$  of not being rewarded for investing

Figure 4 The Curvilinear Relationship Between Effort and Preference for Sure-Small over Large-Uncertain Rewards



efforts becomes more aversive and looms larger than the enhanced sensitivity to the size of rewards (see Appendix A, Proposition 2 for a formal proof).<sup>7</sup>

However, reward expectations that exceed the magnitude of the sure-small reward give rise to a diametrically opposed effect. Specifically, in such cases, the sure-small reward is perceived as a sure loss, whereas the large-uncertain reward provides the possibility (albeit low) of avoiding such a loss and receiving adequate compensation. Thus, to escape what they perceive as a certain loss, consumers may switch to the large-uncertain reward when their reward expectations surpass the sure-small reward. In such situations, further increasing the effort requirements is predicted to enhance the preference for the large-uncertain reward because the rising expectations increase the perceived loss associated with the unsatisfactory small reward. The notion that consumers will prefer the large-uncertain reward when the sure-small reward does not meet their expectations is supported by the findings of risk seeking in the domain of losses (e.g., Kahneman and Tversky 1979, Payne et al. 1980) and break-even effects (Thaler and Johnson 1990), whereby consumers tolerate more risk when they are offered the opportunity to eliminate prior losses.

This conceptualization is depicted in the right-hand side of Figure 4, in which the effort-based reference shifts occur to the right of the sure-small reward (i.e.,  $s = r_{E3} < r_{E4} < r_{E5}$ ). In this case, increasing the reference point leads to two consistent effects, namely loss aversion and diminishing sensitivity of the gain and loss functions; both of these effects enhance the value of the large-uncertain reward relative to the sure-small reward.

The discussion leads to the following hypothesis:

**HYPOTHESIS 4.** *The preference for sure-small rewards over large-uncertain rewards is an inverses U-function of the required effort level.*

<sup>7</sup> As shown in Appendix A (Proposition 2), because the gain function may become very steep close to the reference point, the range of reference shifts (increases) in which this effect will occur may have an upper bound of  $s/2$  as opposed to  $s$ . The essence of the argument made in this section holds even with this lower limit.

This prediction, of course, does not mean that once the expectation exceeds the sure-small reward, higher effort will always enhance the relative share of the larger reward, considering that greater effort requirements can lead at some point to heightened expectations that overshadow even the larger reward (see Appendix A, Proposition 2) and can eliminate participation in the program (see also Dhar 1997, Dhar and Simonson 2003). Next, two studies are described that were designed to test Hypothesis 4 by systematically increasing the level of required effort and eliciting reward choices with real consequences.

## **Study 4: The Curvilinear Effect of Effort on Reward Preferences—The Online Music Program**

### **Method**

The participants in the study were 161 students at a large East Coast university, recruited outside of the main university library. Participants were informed that a group of MBA students were launching a new online (Internet) music site that would reward users for reviewing and rating songs and would provide free news and information about concerts and other music events. Participants were asked to complete a questionnaire that was described as part of an effort to determine the best rewards for the music Web site.

Participants were randomly assigned to one of four conditions. Three (effort) conditions involved reviewing and rating (5, 30, or 70) songs over the Internet. In these three conditions, completion of the required effort would earn a choice between two rewards, either a free music CD of the participant's choice (a sure-small reward) or a free entry into a lottery with a 1 in 30 chance to win a portable MP3-CD player (a large-uncertain reward). The fourth condition did not involve any effort, but rather a choice between two (effort-free) rewards (described above) that were part of a free promotion. In all four conditions, respondents were also given the option of not choosing either reward and not participating in the FP or promotion (in each of the four conditions, no more than one respondent chose this option). The information provided to participants about the music Web site was held constant across the four conditions.

**Table 1** Perceived-Effort Ratings in the Online Music Program

No. of Required Song Ratings	Mean Perceived-Effort Rating	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
0	3.3	0.34	2.7	4.0
5	4.3	0.36	3.6	5.0
30	5.6	0.32	5.0	6.2
70	6.4	0.32	5.8	7.1

Note. Dependent variable: Perceived-effort rating (0–10).

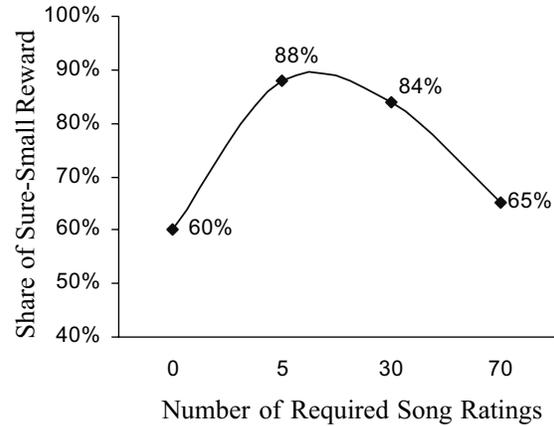
After making their choice, participants were given an additional page on which they rated the degree to which attaining the reward involved effort for them, using an 11-point scale ranging from (0) “No effort at all” to (10) “Very high effort.” These ratings served as a check for the effort manipulation.

## Results

Participants’ effort ratings confirmed that the manipulation affected perceived effort in the expected direction. Specifically, the mean perceived-effort rating strictly increased with the number of required song ratings, with each requirement condition perceived as significantly more effortful than the adjacent lower-effort condition (see Table 1).

A logistic regression was used to test Hypothesis 4, which predicts that the preference for the sure-small reward over the large-uncertain reward will be an inverse U-function of the required effort level. The (dummy) dependent variable received a value of 1 [0] if the sure-small [large-uncertain] reward was chosen. The independent variables included the effort requirement level (0, 5, 30, or 70 song ratings) and a (mean-centered) quadratic effort term. As predicted by Hypothesis 4, the quadratic term was statistically significant and in the hypothesized direction ( $\text{wald-}\chi^2 = 5.2; p < 0.05$ ), indicating a significant curvilinear effect of effort.<sup>8</sup> Specifically, in the no-effort condition, the relative choice share of the sure-small reward was 60% (24 out of 40 participants), whereas in the 5-, 30-, and 70-song ratings (effort) conditions, the relative share of this reward increased to 88% (29/33), but then decreased to 84% (36/43) and 65% (28/43), respectively (see Figure 5).

<sup>8</sup> Wald- $\chi^2$  is the statistical test used in logistic regressions throughout the article.

**Figure 5** The Curvilinear Effect of Effort Requirements on Preference for Sure-Small over Large-Uncertain Rewards—The Online Music Program

To further examine the relationship between the construct of effort and reward preferences, a logistic regression was used in which the independent variables were the 11-point perceived-effort ratings and a (mean-centered) quadratic perceived-effort term. Consistent with Hypothesis 4, the quadratic perceived-effort term was statistically significant and in the hypothesized direction ( $\text{wald-}\chi^2 = 4.1; p < 0.05$ ), indicating that the share of the sure-small reward was an inverse U-function of the perceived-effort ratings.

## Study 5: The Curvilinear Effect of Effort on Reward Preferences—The Online Survey Program

The results of the previous study supported the hypothesis that effort has a curvilinear effect on the preference for sure-small over large-uncertain rewards. However, only a limited number of effort levels were used. Accordingly, the present study was designed to allow for a stronger test of the inverse-U hypothesis by employing a greater number of effort levels (i.e., seven). In addition, a process measure was used to investigate more directly the notion that higher effort requirements increase consumers’ reward expectations.

The current study was also used to examine the effect of a systematic manipulation of whether the

rewards are the primary or secondary motivation for engaging in the effort activity. Specifically, when consumers are directly compensated (e.g., with substantial monetary payments) for their efforts, the expectation of additional extrinsic reward is likely to be attenuated. In such cases, consumers are predicted to be less averse to the possibility of not receiving an FP reward.

### Method

The participants in the study were 465 travelers who were waiting for trains at sitting areas in a major train station. Participants were informed that the business school (of a large East Coast university) was implementing a program in which people complete short surveys online in return for rewards. Participants were asked to complete a questionnaire that was described as part of an effort to determine the best reward for the program.

Participants were randomly assigned to one of seven conditions. Five (effort) conditions involved completing (3, 5, 8, 10, or 15) surveys over the Internet (each survey was described as taking about five minutes to answer). In these five conditions, completion of the required effort would earn a choice between two rewards, either two movie tickets (a sure-small reward) or an entry into a lottery with a 1 in 30 chance to win 80 movie tickets (a large-uncertain reward). A sixth condition did not involve any effort, but rather a choice between the two rewards as part of a free promotion. A seventh condition was designed to test the prediction that reward expectations are attenuated when consumers have another primary motivation for engaging in the required efforts. This condition was identical to the five-survey condition mentioned earlier, except that completing each survey earned \$50 (a total of \$250 for five surveys). Completion of the five surveys also earned a choice between the two rewards discussed above. It was expected that the preference for the sure-small reward would be stronger when no (\$50) monetary compensation was given on a per-survey basis. In all seven conditions, respondents were also given the option of not choosing a reward. The information provided about the program was held constant across the seven conditions.

After making their choice, participants were asked to indicate whether or not each of the two rewards was sufficiently large. The binary (yes/no) responses served as a measure for participants' reward expectations. It was expected that greater effort requirements would decrease the share of participants for whom 2 movie tickets would suffice, but would have no effect regarding the 80 movie tickets (assuming these 80 tickets are guaranteed). Participants also rated the degree to which attaining the reward involved effort for them, using the 11-point perceived effort scale discussed earlier.

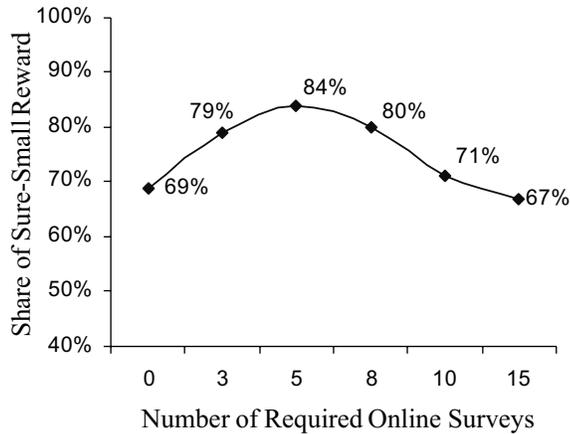
### Results

Participants' effort ratings confirmed that the manipulation affected the perceived effort in the expected direction. Specifically, a planned contrast indicated a significant linear trend in the mean perceived-effort rating as a function of higher number of required surveys ( $p < 0.01$ ; see Table 2). Moreover, as expected, the share of participants who indicated that the sure-small reward was sufficient decreased with both the number of required online surveys (see Table 2) and with the perceived-effort ratings (wald- $\chi^2 = 18.9$ ,  $p < 0.001$ ; and wald- $\chi^2 = 26.3$ ,  $p < 0.001$ , respectively). It is noteworthy that there was no curvilinear effect of required surveys or perceived effort on the tendency to view the sure-small reward as sufficient. Further, as expected, the percentage of participants who indicated that the large-uncertain reward was sufficient remained high (over 80%) across all requirement conditions. These results suggest that higher required efforts increased consumers' reward expectations (and reference points) for evaluating the program rewards.

**Table 2** Perceived-Effort Ratings and Reward Satisfaction in the Online Survey Program

No. of Required Surveys	Mean Perceived-Effort Rating (0-10)	Percent Satisfied with Sure-Small Reward (%)	Percent Satisfied with Large-Uncertain Reward (%)
0	3.3	76	92
3	4.4	62	84
5	4.6	62	83
8	4.7	55	85
10	4.9	54	83
15	5.4	38	80

**Figure 6** The Curvilinear Effect of Effort Requirements on Preference for Sure-Small over Large-Uncertain Rewards—The Online Survey Program



Consequently, greater effort requirements increased the chances that the sure-small reward would not suffice as a compensation, whereas the uncertain reward was apparently large enough to satisfy the reward expectations of most consumers across the range of effort requirements.

Hypothesis 4, which predicts an inverse-U effect of effort on the preference for the sure-small reward, was tested using a logistic regression; the independent variables included the effort requirement level (0, 3, 5, 8, 10, or 15 online surveys) and a (mean-centered) quadratic effort term. Consistent with Hypothesis 4, the quadratic term was significant and in the hypothesized direction ( $\text{wald-}\chi^2 = 4.1$ ;  $p < 0.05$ ), indicating a significant curvilinear effect of effort. In particular, in the no-effort condition, the relative choice share of the sure-small reward was 69% (47 out of 68 participants), whereas in the three and five online surveys (effort) conditions, the share of this reward increased to 79% (42/53) and 84% (42/50), respectively. However, when the effort requirements were further raised to 8, 10, and 15 online surveys, the relative share of the sure-small reward declined to 80% (47/59), 71% (47/66), and 67% (34/51), respectively (see Figure 6).

To further examine the relationship between the effort construct and consumers' reward preferences, a logistic regression was used in which the independent variables were the 11-point perceived-effort ratings and a (mean-centered) quadratic perceived-effort

term. Consistent with Hypothesis 4, the quadratic perceived-effort term was statistically significant and in the hypothesized direction ( $\text{wald-}\chi^2 = 3.9$ ;  $p < 0.05$ ), indicating that the share of the sure-small reward was an inverse U-function of the perceived effort.

The results also supported the prediction that the preference for the sure-small reward would be weaker when completing (five) surveys is linked to a direct (\$50 per survey) monetary compensation. Specifically, whereas 84% of participants in the five-survey condition chose the sure-small over the large-uncertain rewards, only 62% (34/55) chose the certain reward when completion of the five surveys also earned \$250 ( $t = 2.7$ ;  $p < 0.005$ ). Apparently, when consumers have a primary motivation for engaging in the efforts, the expectation of (additional) FP rewards is attenuated, thereby increasing the tolerance of risk.

#### The Curvilinear Relationship Between Effort and Preference for Sure-Small Rewards: Discussion

Building on the notion that greater effort requirements increase the expectation of reward, thereby inducing a shift in the reference used to evaluate the actual program rewards (Assumptions 1 and 2), it was predicted that effort would have a curvilinear effect on the preference for sure-small over large-uncertain rewards. Specifically, as long as the sure-small reward is sufficient relative to consumers' reward expectations, a higher reference point means that the considerable possibility (inherent in the large-uncertain reward) of not receiving any compensation would be coded as a greater (aversive) loss. Therefore, the attraction of the sure-small reward, which eliminates the possibility of such a perceived loss, was predicted to increase with greater effort requirements. However, the effect of effort was expected to reverse once consumers perceived the sure-small reward as insufficient relative to the effort-contingent expectation. In such a case, the large-uncertain reward offers the possibility of escaping the increasing certain loss (i.e., due to higher effort) inherent in the sure-small reward. Appendix A provides a formal proof of the curvilinear effect of effort based on this conceptualization and Assumptions 1 and 2.

The empirical evidence provides strong support for the inverted-U hypothesis. In particular, the results of two studies that elicited FP choices with real consequences demonstrated that greater effort requirements had a curvilinear effect on the preference for reward certainty. Process measures supported the notion that the mechanism underlying this effect is the effort-induced shifts in the reward expectations. In particular, the results of the online survey study showed that greater effort requirements (and perceived-effort) had a negative linear effect on the likelihood of perceiving the sure-small reward as sufficient. The choice explanations (from Study 2) are also consistent with the conceptual framework.

## General Discussion

The fruits of effort often vary in terms of their likelihood and size. A fundamental question, then, is what determines preferences toward the certainty and magnitude of effort-contingent rewards. The present paper investigates this question in the context of FPs, which have been widely adopted by companies and have received a great deal of attention from marketers, consultants, and, to a lesser degree, academics. Two simple assumptions are made: (1) Effort leads to reward expectations, and (2) the valuation of actual rewards vis-à-vis the expectation is consistent with the value function. The conjunction of these two assumptions is shown to provide a parsimonious and unifying theory that predicts a wide range of findings regarding the impact of effort on risky choice. This section briefly reviews the key results and discusses their theoretical and practical implications for FPs and other types of incentive systems.

### Key Findings and Theoretical Implications

**Review of Key Findings.** A series of studies involving both real and hypothetical decisions demonstrated that the required effort stream influences consumers' trade-offs between the certainty and magnitude of rewards. Specifically, it was shown that (a) the presence (as opposed to absence) of effort requirements increases consumer preference for sure-small rewards over large-uncertain rewards (Study 1), and (b) when required efforts are further increased

the preference for sure-small reward reverses; that is, the preference for sure-small rewards over large-uncertain rewards is an inverse U-function of the effort level (Studies 4 and 5). These results were predicted based on the conjunction of the two simple assumptions mentioned earlier.

Process measures, including analyses of choice explanations and satisfaction with rewards, provided support for the idea that reward choices are motivated by effort-contingent expectations.<sup>9</sup> Moreover, a key test of the conceptual framework involved examining the impact of intrinsic motivation on reward preferences. It was posited that intrinsic motivation decreases the expectation of extrinsic reinforcement, thus attenuating the impact of effort on FP reward preferences. Consistent with this analysis, Study 2 demonstrated that individuals with high versus low intrinsic interest in the required effort activity (e.g., "math lovers" versus "math haters") were less likely to choose a sure-small reward over a large-uncertain reward. Study 3 further tested this account by manipulating rather than measuring participants' intrinsic motivation. And, as expected, the results demonstrated that the positive impact of effort (compared to a no-effort condition) on the relative preference for sure-small rewards was weaker for an effort activity that was intrinsically motivating (enjoyable) than for a similar activity that was not motivating.

The curvilinear effect of effort on the trade-off between the certainty and magnitude of rewards and the moderation of this relationship by intrinsic motivation are consistent with the conceptualization of shifts in the reference point. Of course, there may exist other (complementary) frameworks that can account for a subset of the findings. For instance, self-perception theory (Bem 1967), which provides the foundation for the literature on intrinsic motivation (see, e.g., Lepper and Greene 1978), can help account for the moderating role of intrinsic motivation. In addition, the sunk-cost effect (e.g., Arkes and Blumer 1985, Thaler 1980, Zeelenberg and van Dijk 1997) is related to the finding that the anticipation of future

<sup>9</sup> This conclusion was further supported by an analysis of the choice explanations provided in the grocery and hotel problems (Study 1). Detailed results can be obtained upon request.

effort (as opposed to a lack of such anticipation) increases choices of sure-small rewards over large-uncertain rewards. Nevertheless, the wide range of findings regarding the complex effects of effort and intrinsic motivation on risky choice cannot be easily predicted by such alternative accounts.

It is important to note that these findings have important implications that extend beyond FPs. First, the basic structure of an effort stream that leads to (potential) future rewards is ubiquitous (e.g., other types of motivational incentive systems). Second, choice between (risky) outcomes or rewards is often contingent on effort. Third, the analysis of shifts in the reference point is more general than the particular, yet important, case of effort-contingent rewards. Specifically, the neutral reference point can be influenced by multiple other factors besides effort (see also Kahneman and Tversky 1979, Thaler and Johnson 1990). The present paper provides a systematic analysis of the effects of reference shifts on risky choice. This analysis includes a formal proof (shown in Appendix A) that specifies the boundary conditions under which the conjunction of a reference shift with the properties of the value function can account for the observed findings. Such conditions relate to the relative location of the reference point and the offered rewards (or outcomes), the coefficient of loss aversion, and the probability of winning the rewards. Future research can build on this theoretical analysis, for instance, by estimating and validating the reference-dependent model of Appendix A and by generalizing the framework to account for the effects of other costs and investments besides effort (e.g., expending money, time, or information; tolerating physical pain).

**Antecedents and Consequences of Effort-Induced Reward Expectations.** The notion that consumers' choice of rewards is contingent on the level and type of required effort can be seen as another illustration of the construction of preferences (e.g., Bettman et al. 1998, Payne et al. 1992). Here, consumers appear to evaluate rewards relative to an effort-induced reward expectation that serves as a malleable reference point. This conceptualization is related to a growing body of diverse research on the reference- and context-dependence of consumer choice (e.g., Heath et al. 1999, Hoch and Loewenstein 1991, Prelec

and Loewenstein 1998, Simonson and Tversky 1992, Thaler 1985, Tversky and Kahneman 1991, Winer 1986). The present paper sheds light on the important yet under-researched issue of how consumers construct reference points, and highlights the key role of effort.

A question that naturally arises is what factors influence the degree to which effort requirements affect the reward expectation (or reference point). The present research has underscored one such moderator, namely the level of intrinsic motivation for engaging in the required effort activity. Specifically, higher intrinsic motivation weakens the expectation of extrinsic reward and consequently attenuates the effect of effort on reward choice. Relatedly, the expectation of FP rewards is likely to be lower when these rewards serve as the secondary rather than primary motivation for engaging in the effort stream. Support for this conjecture was found in Study 4 (online survey program), in which the preference for a sure-small over a large-uncertain reward was significantly lower when consumers received an additional direct compensation (\$50/survey) for their efforts (completing five online surveys).

Moreover, some consumers may intrinsically value the effort activity so much that the effort requirements do not increase their reward expectations, but rather may even decrease them (e.g., movie aficionados who are asked to preview and critique unreleased films). For these consumers, the effort requirements may lead to a "negative" reward expectation (i.e., a left shift in the neutral reference point), consequently enhancing their risk tolerance. Essentially, a left shift in the reference point implies that the prospect of *no* (FP) reward is still coded as a gain relative to the "negative" reward expectation. Consistent with this conceptualization, participants in the online survey program chose the large-uncertain reward more often when they were required to complete five surveys for an (exaggerated) fee of \$250 than when they received an effort-free reward.

Future research can examine whether the framing of the program and its communications can lower the (reference) reward expectation, for example, by suggesting that consumers are lucky to be selected for an exclusive program. Relatedly, because extrinsic

rewards may distract consumers from their intrinsic motivations (e.g., Deci and Ryan 1985, Lepper 1981), consumers may be more likely to invest effort when no (extrinsic) reward is offered compared to when an inadequate (i.e., too small or unlikely) reward is provided. The antecedents and consequences of reward expectations raise a variety of other important and interesting conceptual questions relating to such issues as (1) whether obtaining the reward was the intention or rather an incidental by-product of investing the effort, (2) whether the choice of reward is performed before or after complying with the effort requirements, and (3) whether the consumer is in a prevention or promotion regulatory focus (see Higgins 2002).

Effort-induced reward expectations also have important implications for consumers' sensitivity (or responsiveness) to the magnitude of sure rewards (i.e., rewards that are guaranteed upon completion of the required effort activity). In a different paper (Kivetz 2003), it is shown that greater effort requirements increase the positive impact of (or sensitivity to) larger (sure) rewards. This finding is consistent with the conjunction of Assumptions 1 and 2 (due to higher effort), because the concavity of the gain function implies that increasing the reference point will enhance the perceived difference between (sure) rewards of varying magnitudes. It is noteworthy, however, that consumers should (normatively) care less about the magnitude of the reward when the required effort is high, because higher effort implies lower probability (and frequency) of completing the program and reaching the reward. Indeed, Kivetz (2003) demonstrates that when consumers are prompted to consider their likelihood of completing the program, higher required effort decreases the sensitivity toward the magnitude of the reward.

### **Practical Implications**

Beyond the theoretical significance of understanding the impact of effort on preferences toward the certainty and magnitude of rewards, this issue has important practical implications for frequency programs and other types of incentive systems. The advent of the Internet and other new technologies

(e.g., CRM software) has led to a proliferation of programs that reward consumers for the investment of various efforts, including reviewing products, completing surveys, shopping, exercising, gambling, and more. These myriad FPs offer different types and magnitudes of rewards, including uncertain ones. Nevertheless, as several FP experts have argued, many of these programs are structured with a limited understanding of consumer preference (e.g., Barlow 1999, O'Brien and Jones 1995). Although a complete understanding of the determinants of FP success requires a great deal of additional study, the present research provides insights regarding the matching of rewards with efforts and the design, promotion, and targeting of FPs.

With respect to the design of FPs, the findings imply that, as the level of program requirements increases, marketers should vary (in a nonlinear way) the relative share of sure-small versus large-uncertain rewards in their "reward mix." Marketers can also offer simultaneously two or more FPs, with either deterministic or stochastic reward systems and different levels of program requirements. Furthermore, a straightforward implication of the present research is that when the effort activity is not inherently motivating, marketers should refrain from relying solely on probabilistic reward systems. Indeed, even the Internet portal iWon, famous for its use of sweepstakes entries as an incentive for Web site browsing, has recently extended its program by also offering points that are redeemable for sure rewards.

The findings of this research provide some general guidelines regarding the manner in which FPs can be promoted and targeted. For example, by emphasizing the intrinsic value of the effort activity and the secondary role of the program rewards, and by targeting programs toward highly motivated individuals, marketers may be able to reduce the program's funding rate (the reward-to-effort ratio) without a significant drop in participation rates. Although existing FPs do not permit a rigorous test of this implication, there are indications that various programs were able to lower their funding rates by using related tactics—for instance, by stressing the pleasure of rating music (Moodlogic, Inc.) or the benefits of voicing one's opinions and learning how

they compare with others' opinions (HarrisPollOnline Rewards) over the extrinsic rewards of the program. Relatedly, FPs can increase the intrinsic motivation of participants (thus deemphasizing the need for costly rewards) by providing identity-related "soft" benefits (see, e.g., Lind and Tyler 1988) such as ranking and congratulating top members, fostering a sense of community, and treating members as unique, valuable individuals.

Finally, the present research may provide insights regarding other types of incentive systems, such as employment contracts, sales force compensation plans, and even academic tenure tracks. For example, salespeople can often earn cash bonuses or non-monetary rewards for reaching a specific sales quota. Understanding the relationship between efforts and preferred rewards may improve the design of such bonus plans. Further, interestingly, the compensation structure of workers in intrinsically motivating professions (e.g., athletes, artists, politicians) is often stochastic, whereas that of laborers in low intrinsic motivation occupations is invariably deterministic (e.g., sanitary workers, prison guards). The extension of the present research to labor market psychology and economics is an interesting avenue for future research.<sup>10</sup>

Let us conclude by noting the advice often given to junior professors—"just enjoy your research!" Indeed, given the uncertainty inherent in the outcome of the research process (e.g., publications and tenure), focusing on the intrinsic rewards of scholarship is a good way to reduce any possible perceptions of loss and disappointment due to insufficient extrinsic rewards.

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<sup>10</sup> The author is grateful to Eric Johnson and Drazen Prelec for related discussion.

### Appendix A: Formal Proof of the Conceptual Framework<sup>11</sup>

This appendix shows that the conjunction of two simple assumptions provides a unifying framework for the findings of the present paper regarding the impact of effort on reward preferences. The two assumptions are:

(1) effort requirements create an expectation for reward (i.e., a reference point for evaluating the actual FP rewards), with higher requirements leading to greater expectations; and

(2) the valuation of program rewards vis-à-vis the reward expectation (or reference point) follows the principles of prospect theory's value function (i.e., reference-dependence, loss aversion, and diminishing sensitivity).

Thus, in the subsequent analyses,  $v_E(x)$  is the subjective value of outcome  $x$  given a reference point  $r_E$ , where the reference point  $r_E$  (equivalent to the expected fair reward) increases with greater effort requirements  $E$ . Diminishing sensitivity implies that, for  $x > r_E$ ,  $v'_E(x) < 0$ , whereas for  $x < r_E$ ,  $v'_E(x) > 0$ . Further, following Tversky and Kahneman (1991), it is assumed that the value function exhibits constant loss aversion, captured by the loss-aversion coefficient,  $\lambda$ . Thus, the reference-dependent value function can be expressed as

$$v_E(x) = \begin{cases} g(x - r_E) & \text{if } x \geq r_E \\ (-\lambda)g(r_E - x) & \text{if } x < r_E, \end{cases}$$

where  $g(0) = 0$ ,  $g' > 0$ ,  $g'' < 0$ ,  $g''' \geq 0$ ,  $\lambda > 1$ , and  $r_E$  increases in effort.<sup>12</sup>

**PROPOSITION 1 (HYPOTHESIS 1).** *As long as the sure-small reward satisfies the reward expectation (i.e.,  $s \geq r_E$ ), and the probability of winning the large-uncertain reward is reasonably low (i.e.,  $p_l < \hat{p}_l$ ), the preference for sure-small rewards over large-uncertain rewards will increase when the rewards are contingent on effort ( $r_E > 0$ ) compared to when the rewards are effort free ( $r_E = 0$ ). When  $\lambda = 2$ ,  $\hat{p}_l = 0.5$ .*

Note that the sure-small reward (S) is a riskless prospect that offers  $s$  with probability 1. Conversely, the large-uncertain reward (LU) yields outcome  $l$  with probability  $p_l$  (where  $p_l < p_s = 1$  and  $l > s \geq r_E$ ) and outcome 0 with probability  $1 - p_l$ . Given a reference

<sup>11</sup> The author is indebted to Oleg Urminsky for his invaluable input and contribution to this proof.

<sup>12</sup> The assumption that  $g''' \geq 0$  (i.e., convexity of marginal utility) ensures nonincreasing risk aversion (see Pratt 1964) and is consistent with a power function formulation for the value function as proposed by Tversky and Kahneman (1992) and estimated in their and other studies (e.g., Camerer and Ho 1994, Donkers et al. 2001, Wu and Gonzalez 1996).

point  $r_E$ , we have the following reward valuations ( $V$ ):<sup>13</sup>

$$V(S | r_E) = g(s - r_E) \quad \text{versus}$$

$$V(LU | r_E) = p_l * g(l - r_E) - [\lambda * (1 - p_l) * g(r_E)].$$

For any pair of sure-small and large-uncertain rewards that satisfy the above conditions, we define the relative preference for (or advantage of) S over LU, given a reference point  $r_E$ , as  $A(S, LU | r_E)$ . Thus,

$$A(S, LU | r_E) = V(S | r_E) - V(LU | r_E)$$

$$= g(s - r_E) - p_l * g(l - r_E) + [\lambda * (1 - p_l) * g(r_E)].<sup>14</sup>$$

We wish to examine the impact on  $A(S, LU | r_E)$  of increasing the reference point from zero to  $r_E > 0$  (i.e., making the rewards contingent on effort  $E$  rather than no-effort). The change in the components of  $A(S, LU | r_E)$  as the reference point shifts from 0 to  $r_E$  (where  $s \geq r_E > 0$ ) can be written as

$$\Delta g(s) = g(s - r_E) - g(s - 0) = g(s - r_E) - g(s) < 0,$$

$$\Delta g(l) = g(l - r_E) - g(l - 0) = g(l - r_E) - g(l) < 0,$$

$$\Delta g(r_E) = g(r_E) - g(0) = g(r_E) > 0.$$

Thus, the change in  $A(S, LU | r_E)$  as the reference increases from zero to  $r_E$  can be expressed as

$$\Delta A(S, LU | r_E) = A(S, LU | r_E) - A(S, LU | 0)$$

$$= \Delta g(s) - p_l * \Delta g(l) + [\lambda * (1 - p_l) * g(r_E)].$$

It is proposed that there exists a  $\hat{p}_l$  such that  $\Delta A(S, LU | r_E) > 0$  for all  $p_l < \hat{p}_l$ . To identify  $\hat{p}_l$ , we search for the smallest  $p_l$  that satisfies the inequality:  $\Delta A(S, LU | r_E) > 0$ .

Solving for  $p_l$ , we get,

$$\Delta g(s) - p_l * \Delta g(l) + \lambda * g(r_E) - \lambda p_l * g(r_E) > 0,$$

$$p_l * [\Delta g(l) + \lambda * g(r_E)] < \Delta g(s) + \lambda * g(r_E).$$

Because  $g$  is strictly concave and  $g(0) = 0$ ,  $g(s - r_E) + g(r_E) > g(s)$  and  $g(l - r_E) + g(r_E) > g(l)$  (see Lemma 1). Therefore,  $\Delta g(s) + \lambda *$

<sup>13</sup> In this and the subsequent analyses, consumers are assumed to adopt the explicit probabilities (i.e.,  $p$ ) stated for the various rewards. Replacing these probabilities with prospect theory's decision weights (i.e.,  $\pi(p)$ ) does not alter the nature or conclusions of the analyses.

<sup>14</sup> The relative advantage of S over LU (i.e.,  $A$ ), which equals the difference in their utilities, can be used to compute the probability of choosing S over LU by employing a "single-agent stochastic choice model" (see Camerer and Ho 1994). Such a model assumes a single preference structure for all consumers (the deterministic component of utility), and an additional random utility component that leads to variations in consumers' choices (for further details see Camerer and Ho 1994).

$g(r_E) > 0$  and  $\Delta g(l) + \lambda * g(r_E) > 0$  whenever  $\lambda > 1$ . Because both terms are positive, the inequality can be rewritten as

$$p_l < [\Delta g(s) + \lambda * g(r_E)] / [\Delta g(l) + \lambda * g(r_E)].$$

Thus, we are searching for  $\hat{p}_l = \text{Min}\{[\Delta g(s) + \lambda * g(r_E)] / [\Delta g(l) + \lambda * g(r_E)]\}$ . This  $\hat{p}_l$  is minimized when  $\Delta g(s) < 0$  is at its minimum and  $\Delta g(l) < 0$  is at its maximum. By definition,  $\text{Min}\Delta g(s) = \text{Min}[g(s - r_E) - g(s)]$ . We have noted above that because  $g$  is strictly concave and  $g(0) = 0$ ,  $g(s - r_E) + g(r_E) > g(s)$ , and therefore,  $g(s - r_E) - g(s) > -g(r_E)$ . Thus,  $\text{Min}\Delta g(s) \rightarrow -g(r_E)$ . The maximum of  $\Delta g(l)$  is less than zero, because  $\Delta g(l) = g(l - r_E) - g(l) < 0$ . Therefore,

$$p_l < [-g(r_E) + \lambda * g(r_E)] / [0 + \lambda * g(r_E)] = (\lambda - 1) / \lambda.$$

Thus,  $\hat{p}_l = (\lambda - 1) / \lambda$ , and consequently, for all  $p_l < \hat{p}_l$ ,  $\Delta A > 0$ .

Moreover, based on empirical evidence (e.g., Heath et al. 1999; Kahneman et al. 1990; Tversky and Kahneman 1991, 1992), it is assumed that  $\lambda \geq 2$ . In the specific case,  $\lambda = 2$ , we have  $\hat{p}_l = 0.5$ .  $\square$

**PROPOSITION 2 (HYPOTHESIS 4).** Assuming  $\lambda \geq 2$  and  $p_l < 0.5$ , there exist  $r^* < r^{**}$  (where  $s/2 < r^* \leq s$ ), such that:

- When  $0 \leq r_E < r^*$ ,  $\partial A / \partial r_E > 0$ .
- When  $r^* < r_E$ ,  $\partial A / \partial r_E < 0$  (for all  $r_E < r^{**}$ ).

Equivalently, as long as  $r_E < r^{**}$ , the advantage  $A(S, LU | r_E)$  is a curvilinear (i.e., inverse-U shape) function of the required effort level (or reference point,  $r_E$ ), with a peak at  $r^*$  (where  $s/2 < r^* \leq s$ ).

**COROLLARY 1.** For any  $p_l$ ,  $r^{**} > (l + s) / 2 > s$ .

**COROLLARY 2.**  $r^{**}$  shifts to the right, toward  $l$ , as the probability  $p_l$  decreases (where  $0 < p_l < 1$ ). Further, when  $p_l \rightarrow 0$ ,  $r^{**} \rightarrow \infty$ .

Proposition 2 is demonstrated in three steps. First, it is shown:

**PROPOSITION 2A.** If  $p_l < \hat{p}_l$  (where  $\hat{p}_l = (\lambda - 1) / \lambda$ ), then  $r^* > s/2$ . When  $\lambda = 2$ ,  $\hat{p}_l = 0.5$ .

Consider  $0 \leq r_E \leq s/2$ . We want to show that in this range  $A$  increases in  $r_E$ . This can be expressed as the partial derivative  $A' = \partial A / \partial r_E > 0$ . Thus, we want to show that:

$$A' = -g'(s - r_E) + p_l * g'(l - r_E) + \lambda * (1 - p_l) * g'(r_E) > 0.$$

Because  $r_E \leq s/2$ ,  $s - r_E \geq r_E$  and  $g'(s - r_E) \leq g'(r_E)$ . Therefore, we can write  $g'(r_E) = b * g'(s - r_E)$  where  $b \geq 1$ . Thus:

$$A' = -g'(s - r_E) + p_l * g'(l - r_E) + \lambda * (1 - p_l) * b * g'(s - r_E)$$

$$= p_l * g'(l - r_E) + [\lambda * (1 - p_l) * b - 1] * g'(s - r_E).$$

Because  $g'(l - r_E) > 0$  and  $g'(s - r_E) > 0$ , we have  $A' > 0$  if  $\lambda * (1 - p_l) * b - 1 \geq 0$ , or equivalently, if  $\lambda * (1 - p_l) * b \geq 1$ . Given that  $b \geq 1$ , it suffices to show that  $\lambda * (1 - p_l) - 1 \geq 0$  to show that  $A' > 0$ . This is true when  $\lambda - \lambda * p_l \geq 1$ , or equivalently, when  $p_l \leq (\lambda - 1) / \lambda$ . Because we defined  $\hat{p}_l = (\lambda - 1) / \lambda$ , for all  $p_l < \hat{p}_l$ ,  $A' > 0$  (i.e.,  $A$  is strictly increasing) for any  $r_E \leq s/2$ . Thus,  $r^* > s/2$ .

Assuming  $\lambda = 2$  (e.g., Tversky and Kahneman 1991), we have  $\hat{p}_l = 0.5$ . Note that  $\hat{p}_l$  increases with higher  $\lambda$ .

Next, we show that:

**PROPOSITION 2B.** For any  $p_l$ ,  $r^* \leq s$ .

Consider  $s < r_E < (l + s)/2$ . By concavity,  $g'(r_E - s) > g'(r_E)$ . Because  $r_E < (l + s)/2$ , we can show  $r_E - s < l - r_E$ . Therefore,  $g'(r_E - s) > g'(l - r_E)$ .

We want to show that  $A' < 0$ . Because  $s < r_E$ , this can be rewritten as:  $A' = -\lambda * g'(r_E - s) + p_l * g'(l - r_E) + \lambda * (1 - p_l) * g'(r_E) < 0$ , or equivalently:

$$-\lambda * g'(r_E - s) < -p_l * g'(l - r_E) - \lambda * (1 - p_l) * g'(r_E),$$

$$g'(r_E - s) > (p_l / \lambda) * g'(l - r_E) + (1 - p_l) * g'(r_E).$$

Because  $\lambda > 1$ , it suffices to show:  $g'(r_E - s) > p_l * g'(l - r_E) + (1 - p_l) * g'(r_E)$ . This must be true for any  $p_l$ , because  $g'(r_E - s) > g'(r_E)$  and  $g'(r_E - s) > g'(l - r_E)$ .

Thus, as  $r_E$  increases past  $s$  (toward  $l$ ),  $A$  declines, and therefore,  $r^* \leq s$ .

Next, in order to complete the proof of Proposition 2, it remains to show that:

PROPOSITION 2c. For any  $p_l$ , if  $s/2 < r_E < s$ , then  $A' = 0$  holds at no more than one point  $r_E = r^*$ .

Because  $A' > 0$  for  $r_E < s/2$  and  $A' < 0$  for  $r_E > s$ , and  $A'$  is continuous in the range  $[s/2, s)$ , then either  $A' > 0$  for all  $r_E < s$ , or there must exist some point  $r^*$  at which  $A' = 0$ .

If  $A' > 0$  for all  $r_E < s$ , then  $r^* = s$  is the only local maximum in the range  $[0, r^{**}]$ .

If, on the other hand, there exists some point  $r^*$  at which  $A' = 0$ , then we will show that point  $r^*$  is unique. Consider any other point  $r^+ = r^* + \Delta r$ , where  $\Delta r > 0$  and  $s/2 < r^+ < s$ . At this point  $r^+$ , the slope is

$$A' = -g'(s - r^+) + p_l * g'(l - r^+) + \lambda * (1 - p_l) * g'(r^+).$$

We know that, by definition, at  $r^*$ :

$$A' = -g'(s - r^*) + p_l * g'(l - r^*) + \lambda * (1 - p_l) * g'(r^*) = 0.$$

So, we can subtract, and express the slope at  $r^+$  as

$$\begin{aligned} A' &= -g'(s - r^+) + p_l * g'(l - r^+) + \lambda * (1 - p_l) * g'(r^+) \\ &\quad - [-g'(s - r^*) + p_l * g'(l - r^*) + \lambda * (1 - p_l) * g'(r^*)], \\ A' &= -[g'(s - r^+) - g'(s - r^*)] + p_l * [g'(l - r^+) - g'(l - r^*)] \\ &\quad + \lambda * (1 - p_l) * [g'(r^+) - g'(r^*)]. \end{aligned}$$

Because  $\Delta r > 0$ ,  $r^+ > r^*$ . Therefore, the three terms of  $A'$  are

- (1)  $-[g'(s - r^+) - g'(s - r^*)] < 0$ ;
- (2)  $p_l * [g'(l - r^+) - g'(l - r^*)] > 0$ ; and
- (3)  $\lambda * (1 - p_l) * [g'(r^+) - g'(r^*)] < 0$ .

Because  $g''' \geq 0$ ,  $g'$  is convex, and the rate of change of  $g'$  is nonincreasing. Therefore, given  $s < l$ , the rate of change in  $g'$  at  $s - r^*$  is greater than or equal to the rate of change in  $g'$  at  $l - r^*$ . Thus,  $g'(s - r^+) - g'(s - r^*) \geq g'(l - r^+) - g'(l - r^*)$ . This implies that:

$-[g'(s - r^+) - g'(s - r^*)] + p_l * [g'(l - r^+) - g'(l - r^*)] \leq 0$ . Because  $\lambda * (1 - p_l) * [g'(r^+) - g'(r^*)] < 0$ , we have shown that  $A' < 0$  for  $r^+ > r^*$ .

Alternatively, consider  $\Delta r < 0$ . Then  $r^- = r^* + \Delta r < r^*$ , and the three terms of  $A'$  are

- (1)  $-[g'(s - r^-) - g'(s - r^*)] > 0$ ;
- (2)  $p_l * [g'(l - r^-) - g'(l - r^*)] < 0$ ; and
- (3)  $\lambda * (1 - p_l) * [g'(r^-) - g'(r^*)] > 0$ .

Because  $g''' \geq 0$ , and  $s < l$ , the rate of change in  $g'$  at  $s - r^*$  is greater than or equal to the rate at  $l - r^*$ . Thus,  $g'(s - r^-) - g'(s - r^*) \leq g'(l - r^-) - g'(l - r^*)$ . This implies that:  $-[g'(s - r^-) - g'(s - r^*)] + p_l * [g'(l - r^-) - g'(l - r^*)] \geq 0$ . Because  $\lambda * (1 - p_l) * [g'(r^-) - g'(r^*)] > 0$ , we have shown that  $A' > 0$  for  $r^- < r^*$ .

Thus, we have shown that  $r^*$  exists and is unique.  $\square$

COROLLARY 1. For any  $p_l$ ,  $r^{**} > (l + s)/2 > s$ .

This follows directly from the proof of Proposition 2b.

COROLLARY 2.  $r^{**}$  decreases in  $p_l$  (where  $0 < p_l < 1$  and  $r^{**} \leq l$ ).

Consider  $l \geq r^{**} > (l + s)/2$ . Let  $r_E = r^{**}$ . Because  $r_E > (l + s)/2$ , we know that  $r_E > r_E - s > l - r_E$ . Therefore,  $g'(r_E) < g'(r_E - s) < g'(l - r_E)$ . We also know that at  $r_E = r^{**}$ ,  $A' = 0$ . We can rewrite this as  $\lambda * g'(r_E - s) = p_l * g'(l - r_E) + \lambda * (1 - p_l) * g'(r_E)$ . Because  $p_l + (1 - p_l) = 1$  and  $\lambda * g'(r_E - s) > \lambda * g'(r_E)$ , this can only be true if  $g'(l - r_E) > \lambda * g'(r_E - s)$ , which implies that  $g'(l - r_E) > \lambda * g'(r_E)$ .

Let us now decrease  $p_l$  by some amount  $k$ , where  $0 < k < p_l$ . The new slope of  $A$  at  $r_E$  is expressed as

$$\begin{aligned} A' &= -\lambda * g'(r_E - s) + (p_l - k) * g'(l - r_E) + \lambda * (1 - p_l + k) * g'(r_E) \\ &= [-\lambda * g'(r_E - s) + p_l * g'(l - r_E) + \lambda * (1 - p_l) * g'(r_E)] \\ &\quad + k * [\lambda g'(r_E) - g'(l - r_E)]. \end{aligned}$$

We know that, given  $p_l$ ,  $[-\lambda * g'(r_E - s) + p_l * g'(l - r_E) + \lambda * (1 - p_l) * g'(r_E)] = A'(r_E = r^{**}) = 0$ . Therefore, if  $p_l$  is decreased by  $k$ , then  $A' = 0 + k * [\lambda * g'(r_E) - g'(l - r_E)]$ . Further, it was shown above that  $g'(l - r_E) > \lambda * g'(r_E)$  and we chose  $k > 0$ . Hence,  $A' < 0$ , and we have shown that  $r^{**}$  shifts to the right, toward  $l$ , as the probability  $p_l$  decreases.

Next, it is shown that when  $p_l \rightarrow 0$ ,  $r^{**} \rightarrow \infty$ . By Corollary 2, decreasing  $p_l$  increases  $r^{**}$ . In the limit,  $p_l \rightarrow 0$ , implies  $A' \rightarrow -\lambda * g'(r_E - s) + \lambda * g'(r_E)$ , which can be rewritten as  $A' \rightarrow \lambda * [g'(r_E) - g'(r_E - s)] < 0$ , and  $A$  declines continuously. Note that  $A$  is continuously differentiable in the interval  $(s, \infty)$ . Therefore, we can say that in the limit, as  $p_l$  approaches 0,  $r^{**}$  approaches infinity.  $\square$

LEMMA 1. Under strict concavity of function  $f$ , assuming  $f(0) = 0$ ,  $f(a + b) < f(a) + f(b)$ . Assume, without loss of generality, that  $0 < a < b$ . By strict concavity,  $f(a + b) < f(b) + a^* f'(b)$ . We will show that  $f(a) > a^* f'(b)$ .

Note that for any  $0 < a < b$ ,  $a^* f'(a) > a^* f'(b)$ . It now remains to be shown that  $f(a) \geq a^* f'(a)$ . For any  $0 < x \leq a$ ,  $f'(a) \leq f'(x) \Rightarrow a^* f'(a) \leq \int_0^a f'(x) dx = f(a) - f(0) = f(a)$ .

$\Rightarrow f(a) \geq a^* f'(a) > a^* f'(b)$ , and we have proved that  $f(a + b) < f(a) + f(b)$ .

**Appendix B: Additional Tests of Hypothesis 1**Grocery Store Scenario—Effort Condition:Grocery Store Rewards

Imagine that your grocery store offers its frequent customers the opportunity to earn one of the following two rewards:

**Reward A:** After you purchase groceries at the grocery store five times (each purchase must be over \$30), you will earn a 1/50 chance to win a \$1,000 grocery certificate good toward future grocery purchases (one out of every 50 participants wins).

**Reward B:** After you purchase groceries at the grocery store five times (each purchase must be over \$30), you will earn a \$15 grocery certificate good toward future grocery purchases.

Circle the reward you would prefer to earn:     A            B

Grocery Store Scenario—No-Effort Condition:Grocery Store Rewards

Imagine that as an appreciation gift your grocery store offers a choice between the following two rewards:

**Reward A:** A 1/50 chance to win a \$1,000 grocery certificate good toward future grocery purchases (one out of every 50 participants wins).

**Reward B:** A \$15 grocery certificate good toward future grocery purchases.

Circle the reward you would prefer to receive:     A            B

Hotel Scenario—Effort Condition:Hotel Frequency Program

Imagine that a luxury hotel chain offers guests the opportunity to earn one of the following two rewards:

**Reward A:** If you stay 10 nights (not necessarily on one occasion) at the chain's hotels, you will earn a \$100 cash award (the award distribution takes place one week after you accumulate 10 nights).

**Reward B:** If you stay 10 nights (not necessarily on one occasion) at the chain's hotels, you will earn an entry into a lottery with a 1/1,000 chance to win a \$100,000 cash award (one out of every 1,000 participants wins; the lottery and award distribution take place one week after you accumulate 10 nights).

Circle the reward you would prefer to earn:     A            B            Wouldn't join this program

Hotel Scenario—No-Effort Condition:Hotel Raffle

Imagine that a luxury hotel chain offers guests the opportunity to win one of the following two rewards in a free raffle:

**Reward A:** If you win the raffle, you will receive a \$100 cash award (the award distribution takes place one week after you win the raffle).

**Reward B:** If you win the raffle, you will receive an entry into a lottery with a 1/1,000 chance to win a \$100,000 cash award (one out of every 1,000 participants wins; the lottery and award distribution take place one week after you win the raffle).

Circle the reward you would prefer to receive:     A            B            Wouldn't want either reward

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