Journal of Personality and Social Psychology
2012, Vol. 102, No. 6, 1136–1147

0022-3514/12/$12.00 DOI: 10.1037/a0027855

Beyond Gains and Losses: The Effect of Need on Risky Choice in Framed Decisions

Sandeep Mishra
University of Guelph

Laurence Fiddick
Lakehead University, Orillia

Substantial evidence suggests people are risk-averse when making decisions described in terms of gains and risk-prone when making decisions described in terms of losses, a phenomenon known as the *framing effect*. Little research, however, has examined whether framing effects are a product of normative risk-sensitive cognitive processes. In 5 experiments, it is demonstrated that framing effects in the Asian disease problem can be explained by risk-sensitivity theory, which predicts that decision makers adjust risk acceptance on the basis of minimal acceptable thresholds, or need. Both explicit and self-determined need requirements eliminated framing effects and affected risk acceptance consistent with risk-sensitivity theory. Furthermore, negative language choice in loss frames conferred the perception of high need and led to the construction of higher minimal acceptable thresholds. The results of this study suggest that risk-sensitivity theory provides a normative rationale for framing effects based on sensitivity to minimal acceptable thresholds, or needs.

Keywords: framing effects, risk-sensitivity theory, prospect theory, need, decision making, minimal requirements, aspiration levels, Asian disease problem

Expected utility theory has been the dominant framework for understanding decision making in the behavioral sciences since the mid-20th century (Friedman & Savage, 1948, 1952; Von Neumann & Morgenstern, 1944). This theory is part of a broad category of normative (or functional) models of decision making, all of which are concerned with identifying the most optimal, or "rational," decision in a given situation. In these models, rationality is defined by decision making motivated to maximize a currency of interest. Expected utility theory, for example, posits that people seek to maximize utility in all decisions, where utility is broadly defined as a measure of happiness, gratification, or satisfaction derived from a behavior (Friedman & Savage, 1952).

This article was published Online First April 9, 2012.

Sandeep Mishra, Department of Psychology, University of Guelph, Ontario, Canada; Laurence Fiddick, Department of Psychology, Lakehead University, Orillia, Ontario, Canada.

The writing of this manuscript was partially supported by the Ontario Problem Gambling Research Centre and the Natural Sciences and Engineering Research Council of Canada (postdoctoral fellowships awarded to Sandeep Mishra). A portion of data for Experiments 1, 3, and 4 were collected while Laurence Fiddick was a postdoctoral researcher at the Center for Adaptive Behavior and Cognition, Max Planck Institute for Human Development, Berlin, who we thank for their support. The remainder of data for Experiments 1, 3, 4 and data for Experiments 2 and 5 were collected while Sandeep Mishra was at the University of Lethbridge. Laurence Fiddick presented portions of Experiments 1, 3, and 4 at the annual meeting of the Society of Judgment and Decision Making, Month 2000, New Orleans, LA. Thanks to Annabree Fairweather, T. Andrew Hurly, Martin Lalumière, Christine Michell, and Kelly Suschinsky for their comments on the manuscript.

Correspondence concerning this article should be addressed to Laurence Fiddick, Lakehead University, Orillia, 500 University Avenue, Orillia, Ontario L3V 0B9, Canada. E-mail: fiddick@gmail.com

A large body of evidence, however, suggests that people make "irrational" decisions under various predictable conditions (e.g., Allais, 1953; Ellsberg, 1961; Kahneman & Tversky, 1979; reviewed in Aktipis & Kurzban, 2004; Barrett & Fiddick, 1999; Mishra, 2012; Rode & Wang, 2000), the most famous of which is the framing effect (Tversky & Kahneman, 1981). Tversky and Kahneman demonstrated that people shift risk preference between options with equal expected outcomes in identical problems that are differentially framed in terms of losses or gains. Specifically, people are largely risk-prone when faced with a decision framed as a loss and risk-averse when faced with a decision framed as a gain. Consider the classic Asian disease problem (Tversky & Kahneman, 1981, p. 453):

> Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows.

In the standard version of the Asian disease problem, participants are provided with a decision scenario involving a choice between two options, presented in either a positive or a negative frame. The positive frame states:

> 1. If Program A is adopted, 200 people will be saved.
>
> 2. If Program B is adopted, there is a one third probability that 600 people will be saved and a two thirds probability that no people will be saved.

In this positive frame, both options are phrased in terms of the possibility of saving people, and thus in terms of gains. When presented with this positively framed scenario, Tversky and Kahneman (1981) found that 72% of participants preferred the certain option (Program A), and 28% preferred the risky option (Program

B). Program B is the riskier of the two options because it involves higher outcome variance. The negative frame states:

> 1. If Program C is adopted, 400 people will die.
>
> 2. If Program D is adopted, there is a one third probability that nobody will die and a two thirds probability that 600 people will die.

Here, both options are negatively framed in terms of the number of possible deaths, and thus in terms of losses. Tversky and Kahneman (1981) found that when presented with this loss scenario, participants' risk preferences reversed: 22% of participants preferred the certain option (Program C), and 78% preferred the risky option (Program D). This finding of risk reversal in mathematically identical decisions made in loss and gain frames has received substantial empirical support (reviewed in Levin, Schneider, & Gaeth, 1998; Levin, Gaeth, Schreiber, & Lauriola, 2002; for a meta-analysis, see Kühberger, 1998).

Prospect Theory

Why do people exhibit vastly different levels of risk acceptance in mathematically identical problems? Prospect theory was developed in part to account for framing effects in decision making (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). Prospect theory suggests that people exhibit framing effects because the rate of increase in utility derived from gains is steeply diminishing: For example, gaining $100 is subjectively more valuable if one starts with $0 than if one starts with $10,000. In the domain of losses, however, utility diminishes more rapidly, and so risky behavior may be engaged in to prevent any further experience of loss. Gains and losses are determined around a reference point, where outcomes below the reference point represent losses and outcomes above the reference point represent gains. Prospect theory is a descriptive theory of decision making, however, and does not offer a normative rationale of why reference points are privileged in decision making. Although prospect theory states that reference points are derived from an individual's present state—and can change on the basis of expectations or biases of decision makers (Tversky & Kahneman, 1981)—it does not offer an explanation of why reference points are constructed.

Risk-Sensitivity Theory

Risk-sensitivity theory provides a normative account of why minimal acceptable requirements, or need, should contribute to the construction of reference points, and thus influence risky choice (Stephens, 1981; Stephens & Krebs, 1986). Risk-sensitivity theory was developed by behavioral ecologists to explain food acquisition decisions in animals (e.g., Caraco, Martindale, & Whittam, 1980, reviewed in Kacelnik & Bateson, 1996, 1997). Instead of focusing on the goal of maximizing utility, risk-sensitivity theory was originally conceived to explain risky decisions in the context of foraging. Specifically, decision making was characterized as responses of organisms designed to maximize foraging returns in stochastic environments, with the ultimate goal of maximizing biological reproductive success or fitness (Mishra, 2012; Mishra & Lalumière, 2008; Stephens, 1981; Stephens & Krebs, 1986; Weber, Shafir, & Blais, 2004).

According to risk-sensitivity theory, decision makers should prefer high-risk options in situations of high need, when low-risk options are unlikely to meet those needs. Here, *need* refers to disparity between an individual's present state and a goal or desired state (Mishra & Lalumière, 2010). For example, someone with a pressing $5,000 debt should prefer a 10% chance of winning $5,000 (or an even lower probabilistic chance of earnings; Thaler & Johnson, 1990) over receiving $500 with certainty. In this scenario, even though both options have the same expected value, only the risky option offers the decision maker a chance to meet his or her needs. More generally, risk-sensitivity theory posits that decision makers do not seek to maximize certain outcomes (e.g., maximizing dollars of income), but rather seek to minimize the probability of experiencing outcomes that fail to meet his or her needs (Mishra & Lalumière, 2010; Rode, Cosmides, Hell, & Tooby, 1999; Stephens, 1981).

Although most evidence in support of risk-sensitivity theory has been quantified in the animal behavior literature, a small but growing body of evidence suggests that people make decisions conforming to the predictions of risk-sensitivity theory. It is difficult to directly manipulate energy needs in human participants, but other currencies, including money, offer analogues through which risk-sensitive decision making can be investigated in a laboratory setting. Some studies of humans have demonstrated shifts from risk-aversion to risk-proneness under conditions of need using monetary rewards. These studies used arbitrary requirements for creating situations of low need and high need, such as point totals that had to be met before any money was earned (Deditius-Island, Szalda-Petree, & Kucera, 2007; Ermer, Cosmides, & Tooby, 2008; Pietras & Hackenberg, 2001; Pietras, Locey, & Hackenberg, 2003; Rode et al., 1999; Searcy & Pietras, 2011). Other studies have manipulated perceived need in other domains, such as social status (Ermer et al., 2008), hypothetical survival decisions (Mishra, Gregson, & Lalumière, 2012; Mishra & Lalumière, 2010; Wang, 2002), hypothetical financial portfolio scenarios (Mishra et al., 2012), or drug access (Bickel, Giordano, & Badger, 2004) with similar results.

Mishra and Lalumière (2010), for example, showed in an experimental study that people made significantly more risky, high-variance choices under induced conditions of high need. Under induced conditions of low need, participants did not expose themselves to the unnecessary possibility of not meeting their needs. Rather, they preferred low-risk options with low variance in payoff. These results were obtained both when people were explicitly aware of the parameters of decision options (i.e., mean and variance in a *decision-making-from-description* task) and when they implicitly learned the parameters of decision options through experience (using a *decision-making-from-experience* task; Mishra & Lalumière, 2010). These results were also obtained both with and without controlling for individual differences in personality relevant to risk taking (impulsivity, sensation seeking, and self-control), suggesting that this pattern of decision making conforming to risk-sensitivity theory represents a robust, adaptive pattern of behavior for most individuals. Together, these studies add to a growing body of evidence indicating that risk-sensitivity theory can effectively account for patterns of risk taking under conditions of need.

Language Pragmatics

Risk-sensitivity theory suggests that participants make decisions around minimal requirements, or needs, which should contribute to the construction of reference points in prospect theory. The Asian disease problem, for example, is relatively novel as a decision-making scenario, however, in that it does not offer any explicit indication of the base rate of potential outcomes or acceptable minimal requirements. Furthermore, participants have little background knowledge or expertise about the problem. In unfamiliar problems with little base rate information, reference points may be derived from a speaker's choice of frame. Word choice in decision scenarios may provide implicit cues about expected outcomes, and thus contribute to the definition of a reference point. For example, a full glass of water that subsequently has half its volume poured out is more likely to be described as half empty rather than half full, because the reference point is a full glass (Sher & McKenzie, 2006). Consistent with this hypothesis, McKenzie and Nelson (2003) demonstrated that perceptions of certain decisions vary on the basis of the valence of word use. Similarly, Levin, Schnittjer, and Thee (1988) demonstrated that the base-rate perception of the incidence of cheating among hypothetical college students was higher among participants who received the statement "65% of the students had cheated during their college career," compared with the statement "35% of the students had never cheated." These results suggest that base-rate outcomes may be inferred from word choice in framed scenarios.

Framed scenarios involving the Asian disease problem provide people with information about the number of lives that can be possibly saved or lost with different options, and the probabilities associated with each choice, but no explicit information is provided about what constitutes a satisfactory outcome. In the Asian disease problem, participants may implicitly infer what constitutes a satisfactory outcome from the valence and the wording of decision options. Wang (2002) found that when asked to provide a minimum acceptable number of people to save, people indicated a significantly higher acceptable minimum after making a decision in a negatively framed scenario compared with a positively framed scenario. This finding suggests that the wording of decision outcomes plays an important role in determining the perceived reference point of a decision. Specifically, negatively framed scenarios may motivate people to set higher minimal acceptable thresholds, or need levels, and thus adjust their reference points.

Overview

Risk-sensitivity theory may be used to augment prospect theory by providing a normative rationale for why people exhibit framing effects in decision scenarios. Specifically, risk-sensitivity theory provides an explanation for how reference points in prospect theory are constructed. In the Asian disease problem, people appear to use wording and valence cues to determine a minimal acceptable threshold, or need, in the absence of more explicit cues. These minimal thresholds, or needs, should in turn facilitate the development of an analogous reference point, as in prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). In negatively framed situations, people appear to set a higher need requirement (Wang, 2002). This higher need requirement motivates risky choice: Risk-sensitivity theory predicts that both human and nonhuman animals prefer risky options in situations of high need. Thus, the classic finding that people are risk-averse in the face of gains and risk-prone in the face of losses in the Asian disease problem may be a by-product of people trying to minimize the possibility of experiencing a negative outcome that does not meet their needs.

A few previous studies have investigated the effect of need on risky choice in framed decision-making tasks (e.g., Mishra et al., 2012; Wang, 1996a, 1996b, 2002; Xie & Wang, 2003). These studies have shown that people will sometimes violate the expectations of prospect theory in certain conditions. For example, Wang (2002) showed that self-reported minimum requirements were shown to be associated with risky choice in framed decision scenarios involving hypothetical family members. However, this study suffered from several problems. First, minimum requirements were determined by self-report after participants had already made a decision and, as a result, may have been subject to consistency effects. Second, a nonstandard survival scenario was used involving the possibility of saving immediate family members. Third, the study did not examine whether externally imposed minimum requirements, or needs, affected decision making in framed scenarios. Similarly, Mishra et al. (2012) demonstrated that imposed minimal requirements, or needs, motivated risky choice in framed decision scenarios (involving both behavioral tasks and theoretical financial scenarios). However, this study did not examine decision making in the canonical Asian disease problem, making results difficult to compare with much of the existing body of research on framing effects. Furthermore, this study did not examine whether negative frames confer the perception of high need or higher perceived minimal requirements.

The present investigation consists of five experiments in which we examined whether risk-sensitivity theory can be used to complement prospect theory to better explain decision making in framed scenarios involving the Asian disease problem. Specifically, we suggest that risk-sensitivity theory provides a normative rationale for the construction of reference points. A substantial body of research on framing effects has focused on examining decision making in the Asian disease problem; as a consequence, we chose to use the same problem as the basis for our experiments so as to allow clearer comparisons across the existing literature. In Experiments 1 and 2, we determined whether the imposition of an external need affected risk preferences in decision making. In Experiments 3 and 4, we investigated whether self-generated need requirements predicted risky decision making. Finally, in Experiment 5, we determined whether negatively framed scenarios confer the perception of high need.

Experiment 1

People exhibit risk acceptance when faced with a need or a minimal requirement that cannot be met with a low-risk option (Deditius-Island et al., 2007; Mishra et al., 2012; Mishra & Lalumière, 2010; Pietras & Hackenberg, 2001; Pietras et al., 2003; Rode et al., 1999; Wang 2002). Wang (2002) demonstrated that participants indicated a higher minimal requirement of lives saved and were more risk-prone following exposure to a negative frame of the Asian disease problem. These results may be relevant to framing effects in the Asian disease problem: Shifts in risk preference may result from people using language cues to infer base-

line requirements (and potential base-rate outcomes) and then choosing behavioral options that meet or exceed these requirements. Consequently, if an inferred need—perhaps derived from scenario wording—is supplanted with an explicitly stated need, framing effects should not be observed. In this experiment, we presented participants with the Asian disease problem, but stipulated an explicit need requirement. We predicted that participants would choose options that were most likely to meet their needs, regardless of positive or negative framing. More specifically, we predicted that participants would prefer the risky option in situations of high need and the certain option in situations of low need.

Method

Participants. Ninety-four students and staff at a university participated in this study. Two participants were eliminated for failing to properly complete the task, leaving 33 men and 59 women (age: $M = 22.5$, $SD = 2.9$, range = 19–33). Participants received a chocolate bar for their participation.

Measures and procedure. Each participant received one of four versions of the Asian disease problem. Two involved positive framing, and two involved negative framing. Within each type of framing, one version specified a need that exceeded the expected value of the two options (a high-need condition), and the other specified a need that did not exceed the expected value of the two options (a low-need condition): Positive frame/high need ($n = 24$), positive frame/low need ($n = 24$), negative frame/high need ($n = 24$), and negative frame/low need ($n = 20$). The expected value of lives saved was equivalent over all conditions and choices.

The Asian disease problem was modified from Tversky and Kahneman's (1981) version to remove reference to the United States (to accommodate non-American participants) and to eliminate any potential effects of familiarity, background knowledge, or bias that may have arisen from calling the health crisis an "Asian disease." The scenario presented was as follows:

> Imagine that you are the health minister in a small country. As part of your job, you need to decide how to respond to health crises. Suppose that 600 people are infected by a fatal disease. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows.

The two options in the positive framing conditions were:

> 1. If Plan A is adopted, 200 people will be saved.
>
> 2. If Plan B is adopted, there is a one third probability that all the people will be saved and a two thirds probability that none of them will be saved.

The two options in the negative framing conditions were:

> 1. If Plan A is adopted, 400 people will die.
>
> 2. If Plan B is adopted, there is a one third probability that none of them will die and a two thirds probability that all the people will die.

Participants in the positive frame/high-need condition were asked: "Assuming that you must save at least 300 people, which of the two plans would you choose?" In the positive frame/low-need condition, participants were asked: "Assuming that you must save at least 100 people, which of the two plans would you choose?" Participants in the negative frame/high-need condition were asked: "Assuming that you must prevent more than 300 people from dying, which of the two plans would you choose?" Finally, in the negative frame/low-need condition, participants were asked: "Assuming that you must prevent more than 100 people from dying, which of the two plans would you choose?"

Results and Discussion

The imposition of need significantly affected participants' preference for the risky option. Collapsed across framing, participants chose the risky option more frequently under conditions of high need compared with conditions of low need, $\chi^2(1, N = 92) = 17.27$, $p < .001$; proportion choosing risky option: high need = .77; low need = .34. Within each framing condition, the same pattern of results was observed. In the negative frame condition, participants chose the risky option significantly more when under a condition of high need, $\chi^2(1, N = 44) = 5.53$, $p = .03$; proportion choosing risky option: high need = .75, low need = .40. Similarly, in the positive frame condition, participants chose the risky option more frequently under a condition of high need, $\chi^2(1, N = 48) = 12.08$, $p = .001$; proportion choosing risky option: high need = .79, low need = .29. These results are summarized in Figure 1.

These results support the prediction that an externally imposed need would influence risky choice in the Asian disease problem. Participants preferred the risky option when under a condition of high need, where the certain option fell below the required number of lives saved (and therefore did not offer a chance of meeting participants' needs). These results were obtained both across and within the positive and negative framing conditions, suggesting that need is an important motivator of risky choice.

As predicted, no framing effects were observed. Collapsed over need condition, participants did not vary in their choice of the risky option, $\chi^2(1, N = 92) = 0.23$, $p = .68$; proportion choosing risky

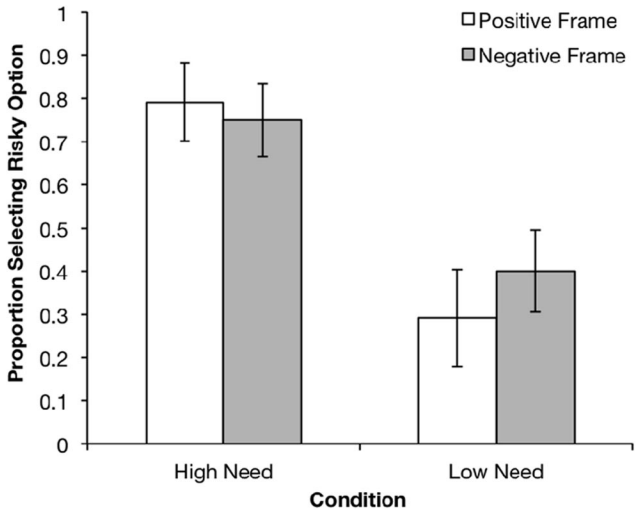

Figure 1. Proportion of participants choosing the risky option (*M*, *SE*) based on explicit imposition of high- or low-need requirements (Experiment 1).

option: negative frame = .59, positive frame = .54. Framing effects were not observed within either need condition (both χ^2s < .57, ps > .53). In the standard version of the Asian disease problem, participants may make decisions on the basis of the wording of decision options (Wang, 2002). The elimination of framing effects through the imposition of explicit need requirements suggests that these requirements may supplant any implicit cues of baseline requirements derived from wording valence in the Asian disease problem.

This experiment demonstrated that participants make risk-sensitive decisions that are motivated by externally imposed baseline requirements, or need. This result is particularly important in light of research suggesting that people often make "irrational" automatic or implicit decisions (as opposed to "rational" deliberative or probabilistic decisions) in many different circumstances (cf. Ariely, 2008). That participants made mathematically "rational" decisions in this experiment indicates that participants are sensitive to explicit need constraints on decision making and do not exhibit unqualified loss aversion or framing effects in the Asian disease problem.

Still, an important limitation in this experiment constrains the scope of our conclusions. It is possible that framing effects were eliminated in this experiment because participants were acutely sensitive to the mathematics of the scenario, and not because of any psychological effects. Specifically, in the high-need condition, only the risky option allowed participants a chance to meet their needs. As a result, the observed elimination of the framing effect may have simply been a consequence of strong demand characteristics. We address this shortcoming in Experiment 2.

Experiment 2

Experiment 1 provided some evidence suggesting that participants are sensitive to externally imposed need. However, Experiment 1 suffered from an important limitation: In the high-need condition, the only option that allowed participants to meet their need was the risky option, setting up a potential demand characteristic. In Experiment 2, we sought to examine whether externally imposed situations of need facilitate risk preference consistent with risk-sensitivity theory, but in a way that did not facilitate significant demand characteristics. In this experiment, the need requirements and decision options were constructed such that both decision options offered some chance of meeting one's needs in the high-need and low-need conditions. We predicted that participants would exhibit a preference for options that were most statistically likely to meet their needs (e.g., Mishra et al., 2012; Mishra & Lalumière, 2010). More specifically, we predicted that participants would prefer the high-risk option in situations of high need and the low-risk option in situations of low need.

Method

Participants. Seventy-two students (30 men, 42 women) at a university participated in this study (age: M = 19.1, SD = 1.1, range = 18–22). Participants received course credit for their participation.

Materials and procedure. Each participant was randomly assigned to either a positive frame condition or a negative frame condition. Within each condition, participants received three decision scenarios similar to the Asian disease problem. The first scenario specified a need that exceeded the expected value of the two options (a high-need condition), the second specified a need that did not exceed the expected value of the two options (a low-need condition), and the third did not specify a need condition at all (the control condition). The order of presentation of the three decision scenarios was randomly determined for each participant. The decision scenario presented was as follows:

> Imagine that you are the health minister of a small country. As part of your job, you need to decide how to respond to health crises. Suppose that 1,500 people are infected by a fatal disease. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows.

The two options in the positive framing conditions were:

> 1. If Plan A is adopted, there is an 8/10 chance that 500 people will be saved and a 2/10 chance that 1,000 people will be saved.
>
> 2. If Plan B is adopted, there is a 4/10 chance that all the people will be saved and a 6/10 chance that none of them will be saved.

The two options in the negative framing conditions were:

> 1. If Plan A is adopted, there is a 2/10 chance that 500 people will die and an 8/10 chance that 1,000 people will die.
>
> 2. If Plan B is adopted, there is a 6/10 chance that all of the people will die and a 4/10 chance that none of the people will die.

Participants in the positive frame/high-need condition were asked: "Assuming that you must save at least 900 people, which of the two plans would you choose?" In the positive frame/low-need condition, participants were asked: "Assuming that you must save at least 300 people, which of the two plans would you choose?" Participants in the negative frame/high-need condition were asked: "Assuming that you must prevent more than 900 people from dying, which of the two plans would you choose?" Finally, in the negative frame/low-need condition, participants were asked: "Assuming that you must prevent more than 300 people from dying, which of the two plans would you choose?"Participants in the control condition were asked: "Which of the two plans would you choose?" The high-need and low-need conditions imposed minimum requirements of 300 above and 300 below the expected value of lives saved across all decision options (600), respectively.

Results and Discussion

Collapsed across framing, participants exhibited a significantly higher preference for the risky option in the high-need condition compared with both the low-need condition (Wilcoxon Z = 3.71, p < .001) and the control condition (Z = 3.46, p = .001); proportion choosing risky option: high need = .64, low need = .40, control = .47. The same pattern of results was obtained both within the positive frame and the negative frame. Within the positive frame, participants exhibited higher risk preference in the high-need condition compared with the low-need condition (Z = 2.31, p = .02) and the control condition (Z = 2.65, p = .008); proportion choosing risky option: high need = .56, low need = .33, control = .36. Within the negative frame, participants exhib-

ited higher risk preference in the high-need condition compared with the low-need condition ($Z = 3.00$, $p = .003$) and the control condition ($Z = 2.24$, $p = .03$); proportion choosing risky option: high need = .72, low need = .47, control = .58. These results are summarized in Figure 2.

Collapsed across need conditions, an overall framing effect was observed, $\chi^2(1, N = 216) = 6.69$, $p = .01$; proportion choosing risky option: negative frame = .59, positive frame = .42. A significant framing effect was observed in the control condition, $\chi^2(1, N = 72) = 3.57$, $p = .05$ (one-tailed); proportion choosing risky option: negative frame = .58, positive frame = .36. However, significant framing effects were not observed within either the high-need condition, $\chi^2(1, N = 72) = 2.17$, $p = .11$, or the low-need condition, $\chi^2(1, N = 72) = 1.44$, $p = .17$.

The results of Experiment 2 replicate those of Experiment 1 without the problems of potential demand characteristics, given that both the risky and nonrisky options offered participants a chance to meet their minimum requirement of lives saved in either need condition. Furthermore, Experiment 2 addresses the possibility that the imposition of external minimum requirements simply uncovered an anchoring and adjustment effect. In Experiment 1, the anchor in the positive framing was 200, and the anchor in the negative framing was 400. As a consequence, it is possible that these asymmetrical anchors affected risky choice. In Experiment 2, however, identical anchors were used in both the positive frame and the negative frame (i.e., 500 and 1000), and the anchor numbers were presented in the same order in both frames. As a consequence, anchoring effects cannot explain differential risk preference among the high-need, low-need, and control conditions in Experiment 2.

The results of Experiment 2 provide further evidence indicating that externally imposed conditions of need influence risky choice consistent with risk-sensitivity theory. As in Experiment 1, participants preferred the risky option when under a condition of high need, where the certain option fell below the required number of lives saved (and therefore did not offer a chance of meeting participants' needs). Framing effects were observed for decisions collapsed across all conditions, as well as within the control condition. However, within conditions of high need and low need, framing effects were not observed. Imposing explicit need requirements may have eliminated any effects of language valence on risky choice that normally contribute to framing effects (e.g., McKenzie, 2003; McKenzie & Nelson, 2003).

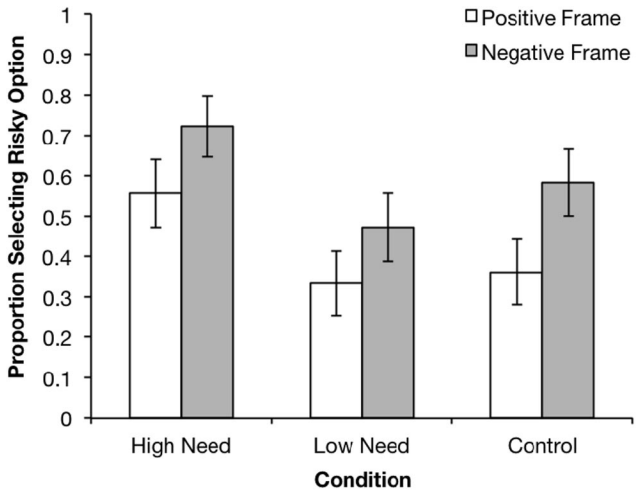

Figure 2. Proportion of participants choosing the risky option (*M*, *SE*) in Experiment 2.

Experiment 3

Experiments 1 and 2 demonstrated that participants shift risk preference as a function of an externally imposed need. The standard version of the Asian disease problem contains no explicit mention of any baseline requirements or any base-rate information. Therefore, if perceived need influences performance in standard versions of the task, it must be self-generated. To our knowledge, only one previous study has investigated the role of internally determined need on decision -making in the Asian disease problem.

Wang (2002) found that people's self-generated minimum requirements of number of lives saved predicted choices in the Asian disease problem: People who reported a minimum requirement above the expected value of the certain option showed increased risk acceptance, as predicted by risk-sensitivity theory. Framing of the task may have influenced people's minimal reported need requirements, and indeed, Wang (2002) found that people's minimal reported need requirements were higher in the negative framing condition compared with the positive framing condition. Wang's study involved asking participants about their minimal requirements after they had already made a decision, however, and so participants may have indicated minimal requirements that were consistent with the choices they made.

In this experiment, we investigated whether self-generated evaluations of need predicted subsequent decision making in the Asian disease problem. We predicted that people's self-generated need requirements would predict subsequent risky choice consistent with risk-sensitivity theory. Specifically, we predicted that individuals with high-need requirements would prefer risky options more than those with low-need requirements. Given the finding that people appear to perceive higher need requirements in negatively framed scenarios (Wang, 2002), we predicted that we would observe an overall framing effect across need groups. However, we also predicted that framing effects would not be observed within need groups, with the effect of need superseding that of framing.

Method

Participants. Seventy-nine students and staff at a university participated in this study. Three participants were removed from the study for failing to complete the task, leaving 76 participants (30 men, 46 women; age: $M = 22.6$, $SD = 3.5$, range = 18–36). Participants received a chocolate bar or course credit for their participation.

Materials and procedure. Each participant received the Asian disease problem described in Experiment 1, either positively ($n = 40$) or negatively ($n = 36$) framed. Before making a decision between the certain and risky options, participants were asked (a) how many people they would like to save and (b) what their minimum requirement was for number of people saved. These two questions were asked in order to distinguish between two potential

reference points: (a) participants' aspiration level and (b) their minimal requirements or need (or "survival point"; March & Shapira, 1992).

In the positive frame, the two questions were phrased as follows: (a) "Out of the 600 people infected with the disease, how many people would you like to save?" (b) "What is your bottom line: How many people out of 600 must live?" In the negative framing condition, the two questions were phrased as follows: (a) "Out of 600 people infected with the disease, how many people would you like to prevent from dying?" (b) "What is your bottom line: How many people out of 600 can die?" Following these two questions, participants indicated which of the two plans they would prefer to implement. Participants saw the full description of either the negatively framed or positively framed plan before answering the questions and making a decision between the plans. Questions were presented separately, although it was possible for participants to go back and change their answers for consistency. We note, however, that few participants appeared to have changed their responses, even though they were free to do so. [1]

Results and Discussion

Every participant reported that they would like to save (or prevent from dying) all 600 people, and so reported aspiration levels could not explain participants' choices, nor were they influenced by the framing of the options. To investigate the role of minimum requirements on decision making, we separated participants into two groups: those who reported minimal need requirements above ($n = 51$) and below ($n = 25$) the expected value of the certain option (saving 200 people/preventing 200 people from dying). These two groups represent a high-need group and a low-need group, respectively. Collapsed across framing, participants who reported a self-generated need requirement above the expected value of both options were significantly more likely to select the risky option, $\chi^2(1, N = 76) = 11.13$, $p = .001$; proportion choosing risky option: above expected value = .65, below expected value = .24.

The same directional pattern of risky choice was observed within each frame. In the positive frame, participants made significantly more risky choices if their minimal need requirement exceeded the expected value of the options, $\chi^2(1, N = 40) = 5.02$, $p = .05$; proportion choosing risky option: above expected value = .54, below expected value = .19. A similar pattern of results was obtained for the negative frame, $\chi^2(1, N = 36) = 4.86$, $p = .05$; proportion choosing risky option: above expected value = .74, below expected value = .33. These results are summarized in Figure 3.

Participants provided higher minimal need requirements for lives saved in the negative frame compared with the positive frame ($Z = -1.63$, $p = .05$, one-tailed); mean minimum need requirement: negative frame = 394.39, positive frame = 326.25. This finding replicates the results obtained by Wang (2002), demonstrating that participants indicated higher minimal need requirements when exposed to a negatively framed condition.

A significant framing effect was not observed in the high-need group, $\chi^2(1, N = 51) = 2.21$, $p = .16$; proportion choosing risky option: positive frame = .54, negative frame = .74. Similarly, no framing effect was observed in the low-need group, $\chi^2(1, N = 25) = 0.672$, $p = .63$; proportion choosing risky option: positive frame = .19, negative frame = .33. That framing effects were not observed within need condition conforms to our predictions; any effect of perceived need derived from framing should have been superseded by self-report of a minimal requirement. This result provides support for the prediction that framing effects would be eliminated under conditions of self-generated need, with participants choosing options that were likely to meet their need requirements.

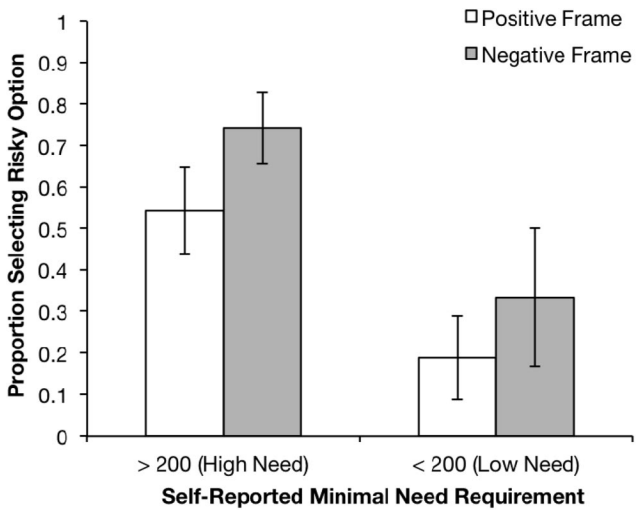

Figure 3. Proportion of participants choosing the risky option (*M*, *SE*) based on self-reported minimal acceptable need requirements (Experiment 3).

Across all participants, however, a significant framing effect was observed, $\chi^2(1, N = 76) = 4.33$, $p = .04$; proportion choosing risky option: positive frame = .40, negative frame = .64. This result was as predicted; according to Wang (2002), negative frames should facilitate a perception of high need, and positive frames a perception of low need. This effect is further investigated in Experiment 5. Together, the results of Experiments 1, 2, and 3 indicate that people make risky decisions contingent on need, regardless of whether that need is determined externally (Experiments 1 and 2) or internally (Experiment 3).

Experiment 4

Experiments 1, 2, and 3 demonstrated that people exhibit elevated risk acceptance in situations of high need, regardless of whether that need was determined either externally, through an imposed requirement of number of lives saved, or internally, through self-report of a minimum acceptable number of lives saved. These experiments, however, assumed that needs are discrete targets. Minimal requirements need not display a step–function relation, with all values below a threshold value being equally important and all values in excess of the threshold being equally unimportant. Experiment 4 allowed participants to express

[1] Six of the 53 participants appeared to have changed their answers. Analyses conducted with these participants eliminated provide the same pattern of results.

their needs over a range of values rather than specifying a single minimal requirement.

We investigated whether participants' risk preferences predicted the self-rated importance they attached to saving different numbers of people. If participants' goals are discrete, then one would expect to see a threshold in reported importance of saving a certain number of people. For example, if an individual places high value on saving no fewer than all 600 lives, then they may always prefer the risky option regardless of the expected value of the certain outcome. We predicted that ratings of the importance of saving a certain number of lives across the distribution of all possible outcomes (ranging from 100 to 600 lives saved) would be associated with variation in risk preference across the distribution, with risk-averse participants displaying a different pattern of importance ratings than risk-prone participants.

Method

Participants. Fifty-three students participated in this study. Four participants were removed from the study for failing to complete the task, leaving 49 participants (19 men, 30 women; age: $M = 24.4$, $SD = 3.6$, range = 19–35). Participants received a chocolate bar as compensation.

Materials and procedure. The same Asian disease problem decision scenario as in Experiment 1 was used. Each participant received a single scenario framed either positively ($n = 24$) or negatively ($n = 25$). Participants then answered six questions to assess how important they felt it was to save the lives of various numbers of people. In the positive framing condition, the question read as follows: "Assuming that these are the only options available, how important is it that at least 100 [200, 300, 400, 500, 600] people live?" In the negative framing condition, the question read as follows: "Assuming that these are the only options available, how important is it that at least 100 [200, 300, 400, 500, 600] people are prevented from dying?" Participants answered on a 5-point Likert scale (1 = *not important*, 5 = *very important*). The order of the questions was randomized. Participants were asked which of the two plans they would implement after all other questions.

Results and Discussion

Participants were split into two groups on the basis of whether they chose the certain option ($n = 16$) or the risky option ($n = 33$). We conducted a repeated measures analysis of variance (ANOVA) on participants' importance judgments, with the number of lives saved (100, 200, 300, 400, 500, 600) as the within-subjects factor and option choice (certain, risky) and frame (positive, negative) as the between-subjects factors.

A main effect of the importance judgments was observed, indicating that saving a smaller minimum number of lives was rated as more important than saving a larger minimum number of lives, $F(5, 205) = 16.36$, $p < .001$, $\eta^2 = .29$; adjusted mean importance rating: $M_{100} = 4.54$, $M_{200} = 4.41$, $M_{300} = 3.77$, $M_{400} = 3.59$, $M_{500} = 3.52$, $M_{600} = 3.56$. A main effect of risky choice was also obtained, $F(1, 41) = 9.69$, $p = .003$, $\eta^2 = .19$, indicating that participants who chose the risky option rated saving lives as more important (collapsed over all six decisions); mean importance rating: risky choice = 4.38, certain choice = 3.42. No main effect of frame on importance judgments was obtained, $F(1, 41) = 0.001$, $p = .98$, $\eta^2 < .01$; mean importance rating: positive frame = 3.90, negative frame = 3.89. These results are summarized in Figure 4.

As predicted, we obtained a significant number of lives saved by option choice interaction for participants' importance judgments, $F(5, 205) = 22.03$, $p < .001$, $\eta^2 = .35$. Participants who chose the certain option judged saving fewer people (100, 200) to be more important than saving a larger number of people (>300) (see Figure 4). Follow-up planned simple effects comparisons support this claim. Among participants who chose the certain option, importance judgments of saving 100 and 200 people were significantly higher than all other possible numbers of lives saved (all ps $< .007$), suggesting that people who chose the certain option show a threshold of importance at the expected value of the available options. Compared with participants who chose the certain option, participants who chose the risky option indicated that saving a number of people greater than the expected value of the certain option (greater than 200) was more important (all ps $< .006$). There was no significant difference in the reported importance of saving 100 or 200 people among participants who chose the risky and certain options (both ps $> .17$). Participants who chose the risky option did not exhibit variation in importance judgments across the range of possible lives saved (all ps $> .09$), suggesting that such participants exhibited no threshold of importance.

No framing effect was observed, $\chi^2(1, N = 49) = 0.01$, $p > .99$; proportion choosing risky option: positive frame = .67, negative frame = .68. By rating how important it is to save different numbers of people, participants may have created an internal minimum acceptable threshold of need even though they were not explicitly instructed to do so. That participants who chose the certain option exhibited a steep drop in the rated importance of saving more than the expected value of 200 people supports this hypothesis. An alternative explanation for the lack of a framing effect in this study, however, may be that asking participants to provide minimal requirements across the range of options may have changed the decision scenario significantly and thus affected

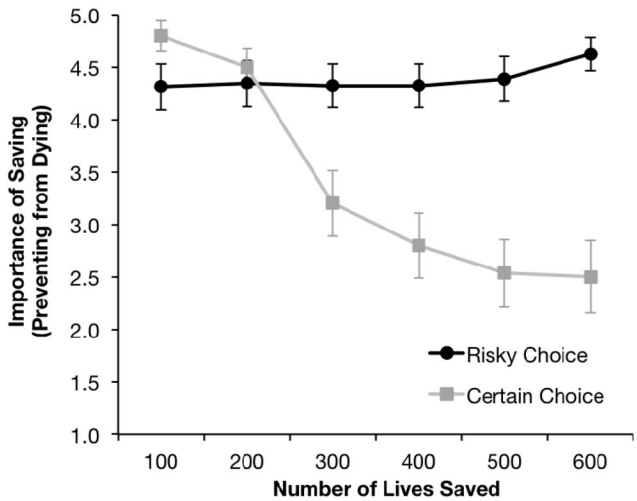

Figure 4. Importance ratings for saving at least 100, 200, 300, 400, 500, or 600 people (*M*, *SE*) as a function of risky choice (Experiment 4).

participants' risky choice. As a consequence, these results must be interpreted with some caution. We do note, however, that the results of both Experiments 3 and 4 provide convergent evidence indicating that self-reported minimal requirements (although measured in different ways) facilitate risky choice consistent with risk-sensitivity theory.

The results of Experiment 4 suggest that people who choose the certain option and people who choose the risky option in the Asian disease problem have different valuations of the importance of saving a large number of lives. Participants who chose the certain option tended to devalue the importance of saving a number of lives greater than the expected value of available options. Participants who chose the risky option emphasized the importance of saving a number of lives greater than the expected value of the available options. These results are consistent with results obtained from Experiment 3, in that people appear to make decisions on the basis of self-constructed minimal requirements.

Experiment 5

Experiments 3 and 4 were predicated on the assumption that negatively framed decision scenarios confer the perception of higher need. This assumption was supported in Experiment 3: Participants making decisions in negative frames indicated significantly higher minimal requirements for lives saved compared with those making decisions in positive frames. These results replicate Wang's (2002) findings, indicating the same pattern of higher reported minimal requirements in negative frames. However, these findings may be the product of artificial consistency effects. In Experiment 3, participants indicated a minimal requirement of lives saved and then made a decision. Similarly, in Experiment 4, participants provided importance ratings prior to making a decision. It is possible that participants' decisions in Experiments 3 and 4 were made to appear to be consistent with their reported minimal requirement of lives saved. In Wang (2002), participants indicated a minimal requirement after they had already made a decision, and so participants may have indicated a minimal requirement that was consistent with the choice they had made. In Experiment 5, we examined whether negative frames confer the perception of high need.

Method

Participants. Fifty-one students (21 men, 30 women) at a university participated in this study (age: $M = 20.6$, $SD = 3.6$, range = 18–28). Participants received course credit for their participation.

Materials and procedure. Each participant was randomly assigned to receive a single Asian disease scenario (as in Experiment 1) framed either positively ($n = 22$) or negatively ($n = 29$). Following the decision scenario, participants answered two questions. In the positive frame, the two questions were phrased as follows: (a) "out of the 600 people infected with the disease, how many people would you like to save?" (b) "What is your bottom line: How many people out of 600 must live?" In the negative framing condition, the two questions were phrased as follows: (a) "Out of 600 people infected with the disease, how many people would you like to prevent from dying?" (b) "What is your bottom line: How many people out of 600 can die?" Participants did not choose a plan after answering these questions.

Results and Discussion

As in Experiment 3, all participants indicated that they would like to save all 600 people. Participants in the negative frame condition indicated that their minimal requirement for number of lives saved was significantly higher than did participants in the positive frame condition (Mann–Whitney $U = 213.00$, $p = .02$, one-tailed); mean minimal requirement: positive frame = 292.50, negative frame = 410.17. That participants in the negative frame indicated a significantly higher minimal requirement of lives saved independent of any decision suggests that negatively framed scenarios confer the perception of high need and that this perception is not a by-product of any consistency effects.

Why do negative frames confer the perception of higher need? It is possible that participants do not explicitly construct a single threshold that describes the number of lives they feel is a minimal requirement to save, but rather a range of acceptable outcomes. Positive and negative frames may therefore lead to estimates that are, respectively, at the lower and higher bounds of an acceptable range of casualties (e.g., Yaniv & Schul, 1997, 2000). The results of Experiment 4 provide some indirect evidence for this hypothesis: Gain and loss framing did not facilitate significantly different mean ratings of the importance of saving lives across a possible distribution (although a significant threshold effect was observed among participants who chose the certain option).

An alternative explanation for different perceived minimal requirements in gain and loss frames involves the differential use and perception of language. In the absence of background knowledge or any explicit information about minimal acceptable thresholds (e.g., as in Experiments 1 and 2), decision makers may rely on implicit cues (such as language valence; Druckman, 2001) to infer how well they are performing relative to perceived expectations. These inferences may subsequently inform people's decisions. Negatively framed options might signal that one is farther away from a desired goal or need (facilitating risk preference), whereas positively framed options might signal that one is closer to a desired goal or need than expected (facilitating risk aversion; McKenzie, 2003; McKenzie & Nelson, 2003).

Further research is necessary to examine the proximate mechanisms underlying the construction of lower minimal requirements in gain frames compared with loss frames. Regardless of the underlying mechanism, however, elevated risk acceptance in response to higher reported minimal thresholds in negative frames in Experiments 3 and 5 may be interpreted as the product of the perception of high need facilitating increased risky choice, consistent with risk-sensitivity theory.

General Discussion

The results of five experiments indicated that people make decisions that conform to the predictions of risk-sensitivity theory in the Asian disease problem. People preferred risky options in situations in which their need requirements were unlikely to have been met by low-risk alternatives. These results were obtained regardless of whether need requirements were determined externally, through the imposition of a "target" number of lives to save (Experiments 1 and 2), or internally, through self-report of a discrete minimum acceptable threshold of lives to save (Experiment 3). People who opted for the certain option in the Asian

disease problem placed less value on achieving outcomes in excess of the expected value of the available options (i.e., self-reporting themselves as being in a condition of low need), whereas people opting for the risky option placed more of a value on achieving outcomes in excess of the expected value (i.e., self-reporting a condition of high need; see Experiment 4). Importantly, need was in part determined by framing, with negative frames conferring the perception of high need; participants indicated a higher minimal acceptable threshold of lives saved in negative frames (Experiments 3 and 5).

The results of this study suggest that risk-sensitivity theory can explicate mechanisms of choice that facilitate framing effects by providing a normative rationale for risky choice based around minimum requirements, or need. Kahneman and Tversky (1979) suggested that framing effects arise on the basis of decisions made around a reference point, where outcomes below a reference point represent losses and outcomes above a reference point represent gains. The results of this study suggest that minimum requirements, or needs, may determine the construction of reference points around which decisions are made. Participants whose minimal acceptable outcome threshold fell below the expected value of the decision options tended to prefer the certain option. For these participants, their minimum acceptable outcome thresholds (and thus reference point) was likely defined by the expected value of the certain option. Participants who chose the risky option did so in situations in which their need requirement was higher, and so, for these participants, reference points were likely higher.

Reference Points and Needs

Risk-sensitivity theory posits that decision makers seek to minimize the probability of experiencing outcomes that fail to meet their needs (Stephens, 1981). Risk-sensitivity theory further posits that minimum requirements, or need, are importantly privileged in decision making and serve as a normative motivator of risky choice (Mishra & Lalumière, 2010; Rode et al., 1999; Stephens & Krebs, 1986). The predictions of risk-sensitivity theory are similar to those of prospect theory, where decision makers engage in risk taking to maximize gain, but not at the cost of loss (Tversky & Kahneman, 1981). Tversky and Kahneman suggested that reference points (around which gains and losses are defined) are derived from an individual's present state, but can change on the basis of expectations or biases of decision makers. As a consequence, the reference point in prospect theory may be determined from need thresholds. Below the reference point, people may perceive themselves to be in a situation of high need (i.e., far from a desired state), and above the reference point, people may perceive themselves to be in a situation of low need (i.e., close to a desired state, or having exceeded the threshold of a desired state).

The results of Experiments 3 and 5 suggest that people have two potential reference points: aspiration levels (or goals; Heath, Larrick, & Wu, 1999) or minimal acceptable thresholds, or needs (or survival points; March & Shapira, 1992). In Experiments 3 and 5, all participants reported an aspiration to save all 600 people. If participants considered their reference point to be 600 people, then any decision involving saving fewer than 600 people would have constituted a loss, and thus prospect theory would predict that participants should have been risk-prone under these circumstances. Contrary to this prediction, participants did not make decisions on the basis of their reported aspiration level, but rather made decisions on the basis of their reported minimum acceptable thresholds (Experiment 3). The results of Experiments 3 and 5 indicated that negative frames confer higher minimum acceptable requirements compared with positive frames and that these minimum requirements motivate risky choice. This finding suggests that minimal requirements, or needs, either induce the creation of a reference point or significantly contribute to the determination of a reference point. Because minimal requirements appear to primarily motivate risky choice, minimal requirements may be privileged in decision making. Together, our findings support the predictions of risk-sensitivity theory, which posits that minimal requirements are key motivators of decision making under risk.

Language Pragmatics and Affect

The results of previous studies have shown that language use in framed decision scenarios may implicitly provide base rate information, and thus subtly influence choice (Levin et al., 1998; McKenzie & Nelson, 2003; Sher & McKenzie, 2006). The results of our experiments provide further evidence for this effect and suggest a potential mechanism that may in part explain shifts in base-rate perception. Experiments 3 and 5 demonstrated that negative frames conferred the perception of high need, in that participants set higher minimal acceptable requirements for themselves, and Experiment 3 demonstrated that this perception of high need leads to increased risky choice.

The use of loss-oriented language may serve as a subtle prime of risk-accepting attitudes, leading to shifts in risk-accepting behavior (e.g., Erb, Bioy, & Hilton, 2002). Other research has shown that loss framing leads to negative affect (Nygren, 1998), which in turn has been associated with increased risk-accepting behavior, especially in negative frames (Leith & Baumeister, 1996; Mittal & Ross, 1998). Loewenstein, Weber, Hsee, and Welch (2001) proposed the "risk as feelings" hypothesis, which posited that emotions sometimes affect cognitive evaluation of choice options, such that the perception of decision options changes based on mood state. People exposed to negative frames may engage in reasoning that is implicitly motivated by sensitivity to affect (i.e., people may "feel" that risky decisions are a better option if they are in a negative mood). Thus, it is possible that negative affect may mediate the link between loss-framed language, the perception of high need, and subsequent risk acceptance. Our results provide evidence suggesting that negative frames lead to the perception of high need, but further research is required to examine whether the construction of higher minimal requirements in negative frames is in part facilitated by negative affect.

Individual Differences

Although previous research has indicated that individual differences cannot explain variation in risky choice under conditions of explicitly defined need (Mishra & Lalumière, 2010), little research has been conducted on whether individual differences contribute to the construction of different acceptable minimal requirements, or needs. The results of Experiment 1, for example, suggest that people set different minimal requirements even when explicit minimal requirements are stated: 34% of participants selected the

risky option, even though they were told that they only needed to save 100 people (an outcome guaranteed by the certain option).

Some participants might have erred in their reasoning, but it is also possible that many of these participants set higher minimal thresholds for themselves. In support of this hypothesis, the results of Experiments 3 and 5 demonstrated that people reported highly variable minimal acceptable need requirements and that these need requirements motivated different patterns of risky choice. This result suggests that there are significant individual differences in the construction of minimal need requirements and that these variable need requirements motivate different patterns of risk acceptance. Further research is necessary to examine the influence of individual differences on minimal need requirement perceptions.

Limitations

Despite this study's results, some limitations must be noted. The Asian disease problem or some modification of the Asian disease problem was used in all experiments in the present study. Although the Asian disease problem has been studied extensively, it has been argued to be an outlier in that it is more likely to produce framing effects compared with other decision scenarios (Sickar & Highhouse, 1998). The generalizability of our results is therefore an open question. We do note, however, that some other recent evidence suggests that risk-sensitivity theory can explain risky choice in frame scenarios beyond the Asian disease problem. Mishra et al. (2012), for example, showed that the predictions of risk-sensitivity theory hold in framed scenarios involving behavioral risk-taking tasks in both ecological and financial domains. Although it appears that a growing body of evidence suggests that risk-sensitivity theory can explain risk-sensitive choice in framed scenarios, further research examining the generalizability of these findings is required.

In this study, we did not exhaustively address the process through which minimal requirements or need thresholds are constructed. Some others have suggested possible models for the generation of reference points or minimal thresholds for decision making. Koszegi and Rabin (2006), for example, suggest that reference points are determined endogenously from expectations about past outcomes. Lopes and Oden (1999) propose that security potential/aspiration theory can explain risky choice by accounting for security potential (which accounts for outcomes and probabilities) and aspiration (the probability of obtaining a previously specified outcome). These models offer possible proximate mechanisms that may account for risky choice under conditions of need in framed scenarios, and both share some important components of risk-sensitivity theory. It would be informative to compare the predictive ability of risk-sensitivity theory with these other models.

Other mechanisms may also play an important proximate role in facilitating risk-sensitive decision making in framed scenarios. In particular, little is known about what proximate cues are used to construct need requirements, or acceptable thresholds, in everyday decision making. In the present article, we suggest a few possibilities, including language choice (e.g., Levin et al., 1998; McKenzie, 2003; McKenzie & Nelson, 2003), negative emotional states (e.g., Loewenstein et al., 2001), and individual differences. Other research suggests that perceptions of one's own accountability in a given decision scenario affect aspects of risk sensitivity, including ambiguity aversion and loss aversion (Lerner & Tetlock, 1999). The Asian disease problem in particular involves hypothetical decisions about the well-being of others, and thus decision making in this scenario may be in part influenced by perceptions of accountability. Further research is necessary to shed light on proximate mechanisms involved in risk-sensitive decision making in framed scenarios, and risk-sensitive decision making more generally.

Conclusions

The results of this study suggest that risk-sensitivity theory elucidates a normative mechanism of choice that facilitates framing effects on the basis of minimal acceptable thresholds, or need. Framing effects are often described as an "irrational" violation of expected utility theory. However, framing effects may actually be by-products of adaptive cognitive mechanisms that infer the efficacy of outcomes through determination of a need, facilitating decisions that minimize the possibility of loss (i.e., experiencing an outcome that does not meet one's needs; Barrett & Fiddick, 1999; Rode & Wang, 2000). Most decisions are made under some consideration of need. As a consequence, risk-sensitivity theory is useful in being able to explain risky choice under such conditions. Further consideration of such cognitive phenomena as framing effects in light of ecologically relevant theorizing, such as risk-sensitivity theory, may lead to a better understanding of human cognitive biases and how they manifest in situations that better approximate everyday decision making.

References

Aktipis, C. A., & Kurzban, R. (2004). Is Homo economicus extinct? Vernon Smith, Daniel Kahneman and the evolutionary perspective. In R. Koppl (Ed.), *Advances in Austrian economics* (Vol. 7, pp. 135–153). Amsterdam, the Netherlands: Elsevier.

Allais, M. (1953). Le comportement de l'homme rationnel devant le risque: Critique des postulats et axiomes de l'école Américaine [The so-called Allais paradox and rational decisions under uncertainty]. *Econometrica, 21,* 503–546.

Allais, M., & Hagen, O. (1979). The so-called Allais paradox and rational decisions under uncertainty. In O. H. M. Allais (Ed.), *Expected utility hypothesis and the Allais paradox* (pp. 437–681). Dordrecht, the Netherlands: Reidel.

Ariely, D. (2008). *Predictably irrational: The hidden forces that shape our decisions.* New York, NY: HarperCollins.

Barrett, H. C., & Fiddick, L. (1999). Evolution and risky decisions. *Trends in Cognitive Sciences, 4,* 251–252.

Bickel, W. K., Giordano, L. A., & Badger, G. J. (2004). Risk-sensitive foraging theory elucidates risky choices made by heroin addicts. *Addiction, 99,* 855–861.

Caraco, T., Martindale, S., & Whittam, T. S. (1980). An empirical demonstration of risk-sensitive foraging preferences. *Animal Behavior, 28,* 820–830.

Deditius-Island, H. K., Szalda-Petree, A. D., & Kucera, S. C. (2007). Sex differences in risk sensitivity under positive and negative budgets and predictors of choice. *The Journal of General Psychology, 134,* 435–452.

Druckman, J. N. (2001). Using credible advice to overcome framing effects. *The Journal of Law, Economics, and Organization, 17,* 62–82.

Ellsberg, D. (1961). Risk, ambiguity, and the Savage axioms. *Quarterly Journal of Economics, 75,* 643–669.

Erb, H., Bioy, A., & Hilton, D. J. (2002). Choice preferences without

inferences: Subconscious priming of risk attitudes. *Journal of Behavioral Decision Making, 15,* 251–262.

Ermer, E., Cosmides, L., & Tooby, J. (2008). Relative status regulates risky decision-making about resources in men: Evidence for the co-evolution of motivation and cognition. *Evolution and Human Behavior, 29,* 106–118.

Friedman, M., & Savage, L. J. (1948). The utility analysis of choice involving risk. *Journal of Political Economy, 56,* 279–304.

Friedman, M., & Savage, L. J. (1952). The expected-utility hypothesis and the measurability of utility. *Journal of Political Economy, 60,* 463–474.

Heath, C., Larrick, R. P., & Wu, G. (1999). Goals as reference points. *Cognitive Psychology, 38,* 79–109.

Kacelnik, A., & Bateson, M. (1996). Risky theories—The effects of variance on foraging decisions. *American Zoologist, 36,* 402–434.

Kacelnik, A., & Bateson, M. (1997). Risk-sensitivity: Crossroads for theories of decision-making. *Trends in Cognitive Sciences, 1,* 304–309.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47,* 263–292.

Koszegi, B., & Rabin, M. (2006). A model of reference-dependent preferences. *Quarterly Journal of Economics, 121,* 1133–1166.

Kühberger, A. (1998). The influence of framing on risky decisions: A meta-analysis. *Organizational Behavior and Human Decision Processes, 75,* 23–55.

Leith, K. P., & Baumeister, R. F. (1996). Why do bad moods increase self-defeating behavior? Emotion, risk-taking, and self-regulation. *Journal of Personality and Social Psychology, 71,* 1250–1267.

Lerner, J. S., & Tetlock, P. E. (1999). Accounting for the effects of accountability. *Psychological Bulletin, 125,* 255–275.

Levin, I. P., Gaeth, G. J., Schreiber, J., & Lauriola, M. (2002). A new look at framing effects: Distribution of effect sizes, individual differences, and independence of types of events. *Organizational Behavior and Human Decision Processes, 88,* 411–429.

Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All frames are not created equal: A typology and critical analysis of framing effects. *Organizational Behavior and Human Decision Processes, 76,* 149–188.

Levin, I. P., Schnittjer, S. K., & Thee, S. L. (1988). Information framing effects in social and personal decisions. *Journal of Experimental Social Psychology, 24,* 520–529.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127,* 267–286.

Lopes, L. L., & Oden, G. C. (1999). The role of aspiration level in risky choice: A comparison of cumulative prospect theory and SP/A theory. *Journal of Mathematical Psychology, 43,* 286–313.

March, J. G., & Shapira, Z. (1992). Variable risk preferences and the focus of attention. *Psychological Review, 99,* 172–183.

McKenzie, C. R. M. (2003). Rational models as theories–not standards–of behavior. *Trends in Cognitive Sciences, 7,* 403–406.

McKenzie, C. R. M., & Nelson, J. D. (2003). What a speaker's choice of frame reveals: Reference points, frame selection, and framing effects. *Psychonomic Bulletin & Review, 10,* 596–602.

Mishra, S. (2012). *Towards a general theory of decision-making under risk: Integrating interdisciplinary perspectives*. Manuscript submitted for publication.

Mishra, S., Gregson, M., & Lalumière, M. L. (2012). Framing effects and risk-sensitive decision-making. *British Journal of Psychology, 103,* 83–97.

Mishra, S., & Lalumière, M. L. (2008). Risk taking, antisocial behavior, and life histories. In J. Duntley & T. K. Shackelford (Eds.), *Evolutionary forensic psychology: Darwinian foundations of crime and law* (pp. 139–159). New York, NY: Oxford University Press.

Mishra, S., & Lalumière, M. L. (2010). You can't always get what you want: The motivational effect of need on risk-sensitive decision-making. *Journal of Experimental Social Psychology, 46,* 605–611.

Mittal, V., & Ross, W. T. (1998). The impact of positive and negative affect and issue framing on issue interpretation and risk taking. *Organizational Behavior and Human Decision Processes, 76,* 298–324.

Nygren, T. E. (1998). Reacting to perceived high- and low-risk win-lose opportunities in a risky decision-making task: Is it framing or affect or both? *Motivation and Emotion, 22,* 73–98.

Pietras, C. J., & Hackenberg, T. D. (2001). Risk-sensitive choice in humans as a function of an earnings budget. *Journal of the Experimental Analysis of Behavior, 76,* 1–19.

Pietras, C. J., Locey, M. L., & Hackenberg, T. D. (2003). Human risky choice under temporal constraints: Tests of an energy-budget model. *Journal of the Experimental Analysis of Behavior, 80,* 59–75.

Rode, C., Cosmides, L., Hell, W., & Tooby, J. (1999). When and why do people avoid unknown probabilities in decisions under uncertainty? Testing some predictions from optimal foraging theory. *Cognition, 72,* 269–304.

Rode, C., & Wang, X. T. (2000). Risk-sensitive decision-making examined within an evolutionary framework. *American Behavioral Scientist, 43,* 926–939.

Searcy, G. D., & Pietras, C. J. (2011). Optimal risky choice in humans: Effects of amount of variability. *Behavioral Processes, 87,* 88–99.

Sher, S., & McKenzie, C. R. M. (2006). Information leakage from logically equivalent frames. *Cognition, 101,* 467–494.

Sickar, M. J., & Highhouse, S. (1998). Looking closer at the effects of framing on risky choice: An item response theory analysis. *Organizational Behavior and Human Decision Processes, 75,* 75–91.

Stephens, D. W. (1981). The logic of risk-sensitive foraging preferences. *Animal Behavior, 29,* 628–629.

Stephens, D. W., & Krebs, J. R. (1986). *Foraging theory.* Princeton, NJ: Princeton University Press.

Thaler, R. H., & Johnson, E. J. (1990). Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management Science, 36,* 643–660.

Tversky, A., & Kahneman, D. (1981, January 30). The framing of decisions and the psychology of choice. *Science, 211,* 453–458.

Von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior.* Princeton, NJ: Princeton University Press.

Wang, X. T. (1996a). Domain-specific rationality in human choices: Violations of utility axioms and social contexts. *Cognition, 60,* 31–63.

Wang, X. T. (1996b). Framing effects: Dynamics and task domains. *Organizational Behavior and Human Decision Processes, 68,* 145–157.

Wang, X. T. (2001). Bounded rationality of economic man: New frontiers in evolutionary psychology and bioeconomics. *Journal of Bioeconomics, 3,* 83–89.

Wang, X. T. (2002). Risk as reproductive variance. *Evolution and Human Behavior, 23,* 35–57.

Weber, E. U., Shafir, S., & Blais, A. (2004). Predicting risk sensitivity in humans and lower animals: Risk as variance or coefficient of variation. *Psychological Review, 111,* 430–445.

Xie, X., & Wang, X. T. (2003). Risk perception and risky choice: Situational, informational and dispositional effects. *Asian Journal of Social Psychology, 6,* 117–132.

Yaniv, I., & Schul, Y. (1997). Elimination and inclusion procedures in judgment. *Journal of Behavioral Decision Making, 10,* 211–220.

Yaniv, I., & Schul, Y. (2000). Acceptance and elimination procedures in choice: Noncomplementarity and the role of implied status quo. *Organizational Behavior and Human Decision Processes, 82,* 293–313.

Received November 7, 2011
Revision received January 31, 2012
Accepted February 2, 2012 ■