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Valuing Money and Things: Why a $20 Item Can Be Worth More and Less Than $20

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The study of risky decision making has long used monetary gambles to study choice, but many everyday decisions do not involve the prospect of winning or losing money. Monetary gambles, as it turns out, may be processed and evaluated differently than gambles with nonmonetary outcomes. Whereas monetary gambles involve numeric amounts that can be straightforwardly combined with probabilities to yield at least an approximate "expectation" of value, nonmonetary outcomes are typically not numeric and do not lend themselves to easy combination with the associated probabilities. Compared with monetary gambles, the evaluation of nonmonetary prospects typically proves less sensitive to changes in the probability range (inside the extremes of certainty and impossibility), which, among other things, can yield preference reversals. Generalizing on earlier work that attributed similar findings to the role of affect in the evaluation process (Rottenstreich, Y., C. K. Hsee. 2001. Money, kisses, and electric shocks: An affective psychology of risk. *Psych. Sci.* **12**(3) 185–190), we attribute the observed patterns to a fundamental difference in the evaluation of monetary versus nonmonetary outcomes. Potential pitfalls in the use of monetary gambles to study choice are highlighted, and implications and future directions are discussed.

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Introduction

Decision-making researchers have long relied on monetary gambles as the "fruit flies" in the study of choice. Such gambles offer monetary outcomes with known likelihoods, and much attention has been focused on the ways in which payoffs and probabilities are combined to yield a choice (Bernoulli 1954, Kahneman and Tversky 1979, Savage 1954, von Neumman and Morgenstern 1947, Kahneman and Tversky 2000 and references therein). Many decisions, however, are not monetary in nature. Simple information processing considerations suggest that monetary gambles may be evaluated differently from nonmonetary prospects. Monetary gambles present probability and outcome information that can be straightforwardly, even if approximately, combined. This is quite different from most everyday decisions, which do not provide comparable probability and monetary information. Even when probabilities are known, nonmonetary prospects (say, a day at the beach) are not naturally represented in a manner comparable to monetary outcomes. In particular, it is not clear how an outcome such as a day at the beach can be multiplied by its probabilities. To do so requires some mental conversion of the anticipated outcome into an estimated numeric value. Such conversion, we contend, rarely occurs naturally. As a result, what is learned about choices between monetary gambles may be limited in its applicability to other domains. In particular, apart from the extreme cases of certainty and impossibility, nonmonetary prospects are less likely to be straightforwardly weighted by their probabilities, or decision weights. As a result, choice is predicted to prove less sensitive to changes in probability information in the context of nonmonetary compared to monetary prospects. This differential sensitivity as probabilities change from low to high, we suggest, can explain preference reversals between monetary versus nonmonetary prospects. We also illustrate how the relative insensitivity to changes in probability in the context of nonmonetary prospects can be lessened in instances where probabilities are made particularly salient, or when a conversion of the prospects into their estimated monetary worth is first carried out. In what follows, we document these patterns and discuss their implications for the study and interpretation of monetary and nonmonetary gambles in judgment and choice.

Calculation, Feelings, and Preference Reversals

Contrary to the normative treatment of decision making, where likelihoods and outcomes are evaluated independently and then combined, there is mounting evidence that probability and outcome valuation may influence one another (e.g., Camerer and Weber 1992, Diecidue and Wakker 2001, Gneezy et al. 2006, Todorov et al. 2007, Weber 1994). A well-known example of the violation of the independence assumption is Rottenstreich and Hsee's (2001; henceforth R&H) documented preference reversals between risky monetary and nonmonetary gambles. R&H show, for example, that people are willing to pay more to avoid a 1% chance of electric shock than a 1% chance of a $20 loss, but that at 99% chance they are willing to pay more to avoid the monetary loss than the shock.

According to R&H, as probabilities change from low to high, the emotional response generated by affect-rich outcomes tends to overwhelm the nuanced effect of probabilities, leading to a relative overweighting of small probabilities and underweighting of large ones in a manner that accentuates prospect theory's S-shaped function. R&H characterize the dollar amounts of traditional monetary gambles as "low affect" and nonmonetary outcomes as "high affect." Affect-rich positive outcomes, according to R&H, overweight low probabilities because of the hope of receiving the outcome, and underweight high probabilities because of the fear of failing to obtain it. Conversely, affect-rich negative outcomes overweight low probabilities because of fear and underweight high probabilities because of hope. Because modest monetary outcomes are deemed affect poor whereas nonmonetary outcomes are deemed affect rich, reversals of preference of the variety shown by R&H are predicted.

The pattern of preference reversals demonstrated by R&H is attributable to the feelings that outcomes generate, rather than a precise measure of expected worth. Hsee and Rottenstreich (2004; see also Kahneman et al. 1999) advance a distinction between the assessment of value by "calculation" or by "feeling," and similarly document instances in which the evaluation of stimuli is purportedly influenced by whether people engage in affect-poor, and therefore, calculative, or affect-rich, and hence, noncalculative, processes. In one study, for example, respondents showed a willingness to work longer for $60 than for $30 cash. However, for presumably more affect-laden prizes, such as music books valued at those dollar amounts, price did not influence how long respondents were willing to work. According to Hsee and Rottenstreich (2004), respondents relied heavily on their affective reaction and were therefore insensitive to the price of the affect-rich books, whereas they were sensitive to the magnitude of cash rewards because these affect-poor outcomes led them to engage in calculation. It is noteworthy that because the books' valuation is relatively insensitive to price, it is also possible to find amounts that reverse the ordering of preferences. For example, reported willingness to work was greater for $60 cash than for a $60 book, but greater for a $30 book than for $30 cash.

The Current Inquiry: Money vs. Things

Reminiscent of R&H's findings, we demonstrate preference reversals between monetary versus nonmonetary outcomes as probabilities change from low to high, but we put forth an alternative explanation for the data. Although we generally endorse the notion that affect can influence valuation, we suggest that the options' affective value plays no role in the present analysis. Instead, we attribute the observed patterns to simple facts about information processing. Consider the insight in behavioral decision research that specific stimulus and task characteristics can play a pivotal role in preference construction (e.g., Payne et al. 1993). The principle of compatibility, for instance, states that the weight of a stimulus attribute is enhanced to the extent that it is compatible with the required response (see Proctor and Reeve 1990, Tversky et al. 1988 and references therein), so that setting the price of a gamble tends to emphasize payoffs more than probabilities because price and payoffs are both in monetary units. When a stimulus attribute and the response scale do not match, additional steps are required to map one into the other, which tends to lessen reliance on the "incompatible" attribute.

We suggest that sensitivity to probability information is greater when outcomes are strictly monetary, and thus more straightforwardly combined with probabilities, than when they are not. In the case of monetary outcomes, people process probability and outcome information much like is typically hypothesized: outcome value is assessed and weighted, even if approximately, by its probability (or decision weight; Kahneman and Tversky 1979). In the case of nonmonetary outcomes, on the other hand, there is reduced sensitivity to probability information because people do not readily consider the outcomes in strictly monetary terms to be combined with (nonnumeric) outcome valuation. In these cases, likelihoods of 0 and 1 remain straightforward, but acuity in the interior of the probability range is diminished, resulting in discounted valuation that is regressive and less responsive to the full probability range.

Nonmonetary (and nonnumeric) prospects, such as consumer items, elicit nonnumeric valuations that are not easy to combine with probability information. Such items' values need to be converted into a dollar (or some other numeric utility) amount before they can be straightforwardly combined with the relevant probabilities. Such conversion and subsequent combination rarely occurs naturally. Without it, the valuation of nonmonetary prospects proves insufficiently sensitive to changes in probability, thus failing to generate order-preserving expectations, and yielding potential preference reversals between monetary prospects (which are more responsive to the probability range) and nonmonetary prospects (which are less responsive). Specifically, monetary prospects will be priced low at low likelihoods and high at high likelihoods, whereas equally valuable nonmonetary counterparts are priced somewhere in between.

Supportive Research

Several other research strands support the present analysis. Slovic et al. (1990; see also Tversky et al. 1988) documented preference reversals among gambles, which were attributed to price–payoff compatibility: whereas high-probability gambles with smaller payoffs were preferred in choice, willingness-to-pay (WTP) elicitations yielded a greater preference for the larger-payoff, low-probability gambles. However, when those monetary payoffs (e.g., $16) were substituted with nonmonetary outcomes (e.g., a one-week pass to a movie theater), preference reversals were attenuated, with people no longer favoring the more valuable outcome options in the pricing task. Apparently, respondents did not convert the nonmonetary outcomes into their monetary worth, for that should have resulted in a replication of the original pattern.

Failure to simply weigh monetary worth can also be seen in the Gneezy et al. (2006) uncertainty effect, where people value a risky prospect less than its least valuable component. For example, the mean WTP for bookstore gift certificates valued at $100 and $50 was $66.15 and $38.00, respectively, whereas the mean WTP for a 50/50 gamble to win either the $100 or $50 gift certificate was only $28.00. As before, outcomes do not appear to be merely converted into their monetary worth and then weighted by the probabilities, for that simple summation would presumably not violate monotonicity (see also Wu and Markle 2008 for further illustration of differential sensitivity to probabilities as a function of mixed gambles).

Further support for the proposed account comes from research outside the domain of gambles. Alternative currencies, such as frequent flyer miles or prizes, tend not to be treated like money unless the conversion is extremely natural or people are highly motivated to do it (Drèze and Nunes 2004, Nunes and Park 2003). Nunes and Park's (2003) "incommensurate resources" effect is demonstrated in a study modeled after Kahneman and Tversky's (1984) calculator-jacket problem. In the standard version, people express greater willingness to travel 15 minutes to save $10 on a $25 item than to save $10 on a $125 item. In the incommensurate resource version, on the other hand, when the $10 discount is replaced by a gift umbrella valued at $10, the difference in propensity to travel is eliminated. Respondents apparently do not convert the umbrella's worth into its dollar value, for that would presumably recreate the original effect.

In sum, the simple combination of outcome and likelihood is relatively straightforward when the prospect is monetary, but less so when the prospect is nonmonetary, like a computer keyboard whose attractiveness cannot easily be multiplied by a probability measure. A prospect of a 1% chance to win $20 elicits a valuation of the payoff weighted by the probability; in contrast, the WTP for a 1% chance to win a desktop lamp does not readily elicit a valuation of the lamp's monetary worth weighted by the probability. Instead, the valuation of risky nonmonetary prospects such as keyboards and desk lamps produces a discounting due to the risk, but such discounting is relatively insensitive to the full range of the probability scale (apart from the extremes of impossibility and certainty).

Overview

In the studies that follow, we document preference reversals between monetary gambles and nonmonetary gambles as probabilities change from low to high. The nonmonetary gambles featured low affect outcomes, including mildly aversive events (e.g., washing dishes) and run-of-the-mill consumer products, like a keyboard or a desktop lamp. We replicate the findings in the context of choice, in addition to pricing, and obtain further support regarding decision makers' thought processes when they contemplate monetary versus nonmonetary gambles. Finally, motivated by the underlying theory, we investigate two ways to eliminate the reversals of preference. In the first, we explore whether raising the salience of probability information increases sensitivity to probabilities in the context of nonmonetary gambles (where it is otherwise neglected), but not in the case of monetary gambles (where it is typically incorporated). In the second, we examine whether probability sensitivity increases and preference reversals disappear when people are encouraged to assign a monetary value to nonmonetary outcomes and use it in their evaluation of the gamble. We conclude with a brief discussion of the findings and their implications.

Table 1 Monetary and Nonmonetary Outcomes in Order of Presentation, Experiment 1

Gamble outcome
A brief but painful electric shock as part of an experiment
Lose \$50
Spend a weekend painting someone's 3-bedroom apartment
Lose \$100
Clean three stalls in a dormitory bathroom after a weekend of use
Lose \$75
Wash the dishes of a 20-person four-course meal
Lose \$40
Spend four hours doing someone's computer data entry
Lose \$80

Experiment 1

We asked people to evaluate low- or high-probability negative outcome gambles. The outcomes were either monetary (e.g., lose \$75) or nonmonetary (e.g., a data entry task), and respondents provided their willingness to pay to eliminate having to play each gamble.

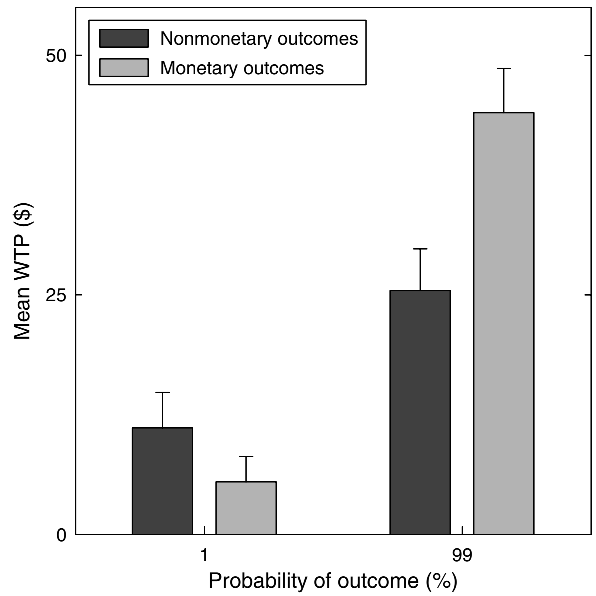
Method

Forty-seven undergraduate volunteers were paid for their participation. The study was embedded in a series of other, unrelated tasks. Participants were presented with a list of 10 hypothetical gambles offering a chance to lose money or to experience some undesirable nonmonetary outcomes, some intended to be affect rich (e.g., clean bathroom stalls) and others affect poor (e.g., wash dishes; see Table 1). We selected dollar amounts that, based on pilot surveys, would reasonably match in attractiveness the nonmonetary outcomes. Participants were randomly assigned to a low- or a high-probability condition, where the outcome's probability was either a 1% or a 99% chance. Participants determined their WTP to avoid each gamble.

Analysis

We began by examining the average WTP for monetary versus nonmonetary outcomes at low versus high probability. WTP for nonmonetary outcomes exceeded WTP for the monetary sum at 1% probability, but the reverse occurred at 99% probability. An analysis of variance predicting WTP averaged across outcomes, with outcome type (monetary and nonmonetary) as a within-subject predictor and probability (low or high) a between-subject predictor, showed that the interaction of outcome and probability was significant ($F(1,45) = 13.3$, $\eta^2 = 0.23$).[1] As shown in Figure 1, WTP for monetary outcomes was lower than WTP for nonmonetary outcomes at a 1% probability (\$5.50 versus \$11.13; $t(23) = 1.5$, $p < 0.14$, $d = 0.36$)[2] but higher at a 99% probability (\$44.05 versus \$25.46; $t(22) = 3.3$, $d = 0.87$). Although the difference in WTP values failed to reach significance at 1% probability, the analysis could be influenced by variance due to a positive skew in WTP judgments. We therefore subjected the data to a Wilcoxon rank-sum test, a nonparametric equivalent of a t-test that compares the ranks of differences between judgments for monetary and nonmonetary outcomes. The analysis revealed WTP values for nonmonetary outcomes that were ranked significantly higher than WTP values for monetary outcomes at low probability ($Z = 2.4$); however, the reverse was true at high probability ($Z = 3.6$).

Figure 1 Mean WTP in the 1% and 99% Probability Conditions in Experiment 1



Note. Error bars indicate one standard error above the mean.

We also compared the effect sizes of the probability manipulations. As shown in Table 2 (column 8), the average effect size, as measured by Cohen's d (Cohen 1977), was significantly greater in the context of monetary ($M = 2.11$) than of nonmonetary outcomes ($M = 0.50$, $t(8) = 10.3$). In fact, the smallest monetary effect was substantially larger than the largest nonmonetary effect, yielding nonoverlapping distributions. This clearly supports the notion of greater sensitivity to changes in probability in the context of monetary than of nonmonetary gambles.

On an individual item level, we can employ a post hoc test to examine which pairs of nonmonetary and monetary gambles imply a reversal of preference as

[1] All statistical tests are significant at the 0.05 level unless otherwise noted. The measure of effect size here, η^2, can be interpreted as proportion of variation accounted for by the treatment manipulation. The index can range from 0 to 1, with larger numbers representing a larger effect. Keppel (1991) offers the following guidelines: $\eta^2 = 0.01$ is a small effect, $\eta^2 = 0.06$ is medium, and $\eta^2 > 0.15$ is a large effect.

[2] Cohen's d (Cohen 1977) is the mean of the difference scores divided by the standard deviation of the difference scores.

Table 2 Descriptive Statistics, Cohen's *d* Effect Sizes for the Probability Manipulation for Monetary and Nonmonetary Outcomes, and Results of the Affect Check in Experiment 1

	Low probability ($n = 24$)			High probability ($n = 23$)				
Outcome	Mean ($)	Median ($)	SD	Mean ($)	Median ($)	SD	*d*	Affect check
Bathroom	19.07	5.00	33.0	37.65	25.00	46.6	0.46	7.43
Shock	10.14	2.50	22.0	13.07	5.00	16.1	0.15	5.96
Dishes	10.09	1.63	21.3	16.61	10.00	15.9	0.35	6.04
Data	9.14	1.50	21.2	18.74	10.00	19.0	0.48	5.88
Paint	7.19	3.50	10.8	41.22	20.00	44.2	1.07	4.96
$100	8.39	1.25	18.6	64.74	70.00	32.4	2.14	7.41
$75	6.27	1.08	14.3	48.92	60.00	24.3	2.15	6.93
$80	6.14	1.13	15.2	50.86	50.00	25.3	2.15	7.14
$50	3.90	0.50	10.2	31.57	40.00	16.6	2.02	6.42
$40	2.78	0.50	7.1	24.18	30.00	12.9	2.07	6.04
Avg. nonmon.	11.13	3.45	18.13	25.46	17.40	20.88	0.50	6.04
Avg. monetary	5.50	0.87	13.05	44.05	50.00	22.10	2.11	6.79

probability changes from low to high. For the electric shock, washing dishes, and data entry outcomes, mean WTP at low and high probability falls entirely between mean WTP at low and high probability for any of the five monetary outcomes. (In other words, for any monetary outcome investigated, mean WTP was lower for the monetary outcome than for, say, data entry, at low probability, but higher at high probability.) For cleaning bathroom stalls, this pattern held for three of the monetary outcomes ($75, $80, and $100) and for painting an apartment the pattern held for two ($75 and $80). In only 2 of 25 possible pairings did the interaction of outcome (monetary and nonmonetary) and probability (low or high) fail to reach statistical significance. For median WTP values (which are less influenced by extreme responses), the pattern holds for every possible pairing of nonmonetary and monetary outcomes.

Affect Check. As discussed above, Rottenstreich and Hsee (2001) documented similar preference reversals in the context of monetary versus nonmonetary gambles, which they attributed to the affect richness of the nonmonetary stimuli. The present findings, in contrast, cannot be explained by appeal to affect. Participants from the same population as Experiment 1 ($N = 59$) judged how emotionally unappealing each outcome was on a nine-point scale (from "not at all" to "extremely"). Overall, the sample of monetary outcomes was judged to be significantly more emotionally unappealing, i.e., higher affect ($M = 6.79$), than the nonmonetary outcomes ($M = 6.04$, $t(56) = 3.86$, $d = 0.48$; see column 9 of Table 2).

In sum, WTP to avoid an aversive gamble was less sensitive to probability variation among nonmonetary than among monetary prospects. The relative insensitivity in the case of nonmonetary prospects yields a regressive pattern, which produces apparent preference reversals: Nonmonetary prospects are judged more aversive than their monetary counterparts at low probability, but less aversive at high probability. This pattern is systematically observed among nonmonetary outcomes judged to be less affectively rich than their monetary counterparts, contrary to the standard affect-richness hypothesis.

Experiment 2

Experiment 2 replicates the above findings in a choice task. People were presented with a choice between a risky and a sure outcome, where the likelihood of the risky option was systematically manipulated. We expected people to show more sensitivity to probability information about monetary outcomes than about equally valued nonmonetary outcomes.

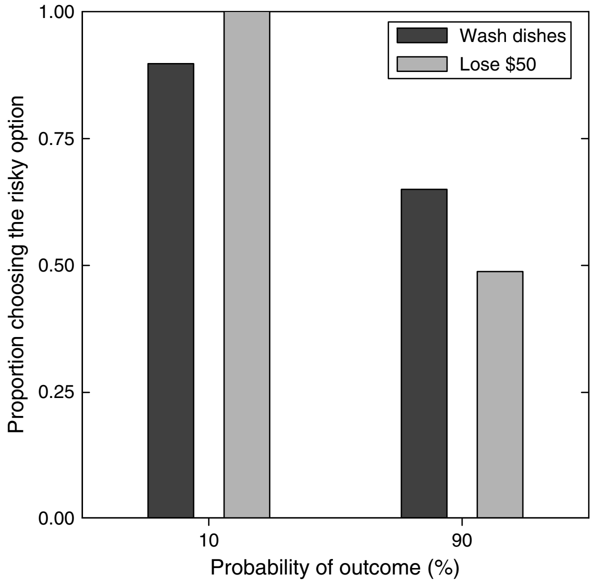
Method

One hundred and fifty-five undergraduate volunteers participated in a class survey. Participants were randomly assigned to a monetary or nonmonetary condition, as well as to one of two—low (10%) or high (90%)—probability conditions. All participants had the option of a sure $25 loss. Participants in the nonmonetary condition were offered a choice between the sure $25 loss and a 10% (90%) chance of having to wash the dishes of a 20-person four-course meal ($N_{10\%} = 38$; $N_{90\%} = 37$). Participants in the monetary risk condition were offered a choice between the sure $25 loss and a 10% (90%) chance to lose $50 instead ($N_{10\%} = 37$; $N_{90\%} = 43$). A pretest found that $50 was the median value that would render participants indifferent between losing the money and washing the dishes.

Analysis

As shown in Figure 2, the risky monetary option was more popular (100%) than the risky nonmonetary option (89%) at low probability, whereas at high

Figure 2 Choice Proportions for the Risky Gamble (Over a Sure \$25 Loss) for Monetary (Lose \$50) and Nonmonetary (Wash Dishes) Outcomes, Plotted Separately for 10% and 90% Probability Conditions in Experiment 2



Note. Nonmonetary outcomes are shown in black bars; monetary outcomes are shown in grey.

probability, the pattern was reversed: the risky monetary option was less popular (49%) than its risky nonmonetary counterpart (65%). In other words, at low probabilities, a potential \$50 loss appears less menacing than washing dishes, whereas at higher probabilities it appears more menacing. A binary logistic regression, predicting choices from outcome type and probability, found a significant interaction ($\chi^2(1, 151) = 4.5$). An instructive glimpse at the relative sensitivity to likelihoods is offered by a comparison of the difference in choice proportions between the high- and low-probability conditions, with a 51% difference in popularity for the monetary option, but only a 24% difference for the nonmonetary alternative ($\chi^2(1, 151) = 11.4$).

Although fully cognizant of the fact that self-reported cognitive processes ought to be interpreted with great caution (see, e.g., Nisbett and Wilson 1977), we nonetheless explored a distinction proposed by Hsee and Rottenstreich (2004): Upon completion of the above choice procedure, participants were asked, "Consider the thought process that you used to make your decision. Which of the following statements better describes the process that you used? (1) Calculation: I used math to help me arrive at my choice; (2) Feeling: I used emotion to help me arrive at my choice." Although there was no difference between the low- and high-probability conditions, there was a significant difference between gamble types: participants in the monetary gamble condition were twice as likely to report "calculation" than those in the nonmonetary gamble condition (51% versus 24%; $\chi^2(1, 151) = 10.9$).[3]

The relative insensitivity to probabilities observed in the pricing of nonmonetary gambles occurs also in choice. Consistent with our hypothesis, those contemplating monetary outcomes were more likely to report relying on calculative processing than those faced with nonmonetary outcomes. Finally, as in Experiment 1, the nonmonetary outcome (washing the dishes) was judged by a majority (66%) of a separate group of respondents to be less affectively rich than the monetary outcome (losing the money), contrary to the standard affect-richness hypothesis.

Experiment 3

Is the insensitivity observed in the context of nonmonetary outcomes mostly attributable to the fact that these outcomes are just hard to price? Or do such outcomes tend to be evaluated nonmonetarily even when their monetary values are technically available? Prior research suggests that the tendency to neglect magnitude information might persist even when monetary values are made available (Hsee and Rottenstreich 2004, Study 2). To see whether the above findings persist even in the face of price information, we presented people, as before, with descriptions of hypothetical low or high probability monetary and nonmonetary gambles and asked for their WTP. In the present study, however, the description of each nonmonetary item included its monetary value, in the form of an explicit dollar amount. The experiment compared WTP judgments for consumer items (with their prices) versus monetary gains.

Method

One hundred and eighty-two undergraduates participated in partial fulfillment of a course requirement. Participants were randomly assigned to a low- (1%) or high-probability (99%) condition. In each probability condition, they were asked for their WTP for each of 14 gambles offering consumer items, such as a down comforter or a trip to Miami, and for each of 22 gambles (14 stimuli items and eight fillers; Table 3) offering monetary gains ranging from \$5 to \$800. Each consumer item was presented in the form of a brief description, along with a picture and the item's dollar value (Figure 3). Corresponding to each consumer item, there was a matched gamble offering a monetary gain of equal value (Table 3).

[3] It is noteworthy that those who reported relying on "calculation" proved more sensitive to probability information than those who reported relying on "feelings," both for monetary and for nonmonetary outcomes. Collapsing across outcomes, the difference in the risky option's popularity when probability was high versus low was 69% among those reporting "calculation" but only 24% for those reporting feelings.

Table 3 Stimuli Used in Experiment 3 in the Order They Were Presented

Monetary prizes ($)	Nonmonetary prizes
80[a]	One dozen red roses in glass vase. Value: $30
20 120	Michael Jordan autographed official game NBA basketball, signed shortly after the 1997–1998 finals. Value: $350
800[a] 250[a]	A Massai mahogany wooden mask, completely hand carved in a Massai village in Kenya. Approximately 8″ tall. Value: $40
140 400[a]	Ferrari 360 Spyder car rental for one day. Silver convertible, 3.6 liter V8, 2-passenger, leather seats, CD player, comprehensive insurance included. Value: $700
30 200[a]	The painting "Green Dog" by Cuban painter Dania Sierra. Size 11″ by 15″. Acrylic paint. Value: $100
350 550	Cannondale F300 mountain bike with aluminum frame and Rockshock, Shimano derailleurs. Value: $500
15 300	LL Bean down box-stitch comforter. Made with premium white 600-fill goose down. Hypoallergenic. Value: $140
450[a] 750	Ionic Breeze Quadra air purifier. Low energy use and silent air cleaning. Traps airborne pollutants on stainless steel blades. Value: $300
10[a] 600[a]	A weekend trip for two to South Beach, Miami. Friday and Saturday night stay. Hotel is located on the beach. Value: $750
700	Walt Disney's *Finding Nemo* DVD. Value: $15
40	Tickets to see Green Day at the Boulder Theater in Boulder, CO. Value: $150.
500 150	Autographed copy of Joseph Heller's *Catch-22*. First edition, third impression, 1961, in very good condition. Value: $550
100 650[a]	An all expense dinner for two at Brasserie 1010 restaurant on Walnut Street in Boulder. Value: $120
5[a]	Goldtouch ergonomic keyboard. Adjustable horizontally and vertically. Eases repetitive stress on hands, wrists, and arms. Value: $20

[a] Indicates a filler item.

Analysis

The predicted ordinal preference reversal was evident in every mean pairing and in 9 of 14 median pairings (Table 4). For example, at low probability, participants' WTP was higher for the keyboard ($M = \$1.37$) than for the \$20 ($M = \$0.81$) but the reverse was true at high probability ($M_{\text{Keyboard}} = \$4.67$ versus $M_{\$20} = \$6.71$, respectively).

As summarized in Figure 4, the interaction of probability and outcome was once again significant ($F(1, 180) = 21.5$, $\eta^2 = 0.11$). WTP for monetary outcomes was lower than WTP for nonmonetary outcomes at the low, 1% probability (\$4.44 versus \$8.10; $t(92) = 3.1$, $d = 0.36$) but higher at the high, 99% probability (\$88.96 versus \$59.47; $t(89) = 4.1$, $d = 0.20$).[4] A Wilcoxon rank-sum test also revealed significant effects at low ($Z = 5.1$) and high probabilities ($Z = 3.7$).

Affect Check. Participants ($N = 119$) from the same undergraduate population were shown the paired outcomes with no probability information, and were asked to judge which outcome in each pair (the consumer item or the corresponding payoff) they would find more emotionally appealing (a random one-half of the respondents) or more emotionally arousing (the other half). There were no differences between the appeal and arousal judgments. In 7 of the 14 pairs, a majority judged the consumer item as less affect rich than the corresponding monetary payoff. All prior analyses remain statistically significant when confined to only those pairs in which the nonmonetary item was less affect rich than the corresponding monetary payoff. Figure 5 illustrates the persistence of the implied preference reversal across these pairs. Furthermore, average effect size for the probability manipulation was smaller (i.e., showed less sensitivity) for affect-poor consumer items than for affect-rich

Figure 3 Example of Nonmonetary Outcome in Experiment 3: "Goldtouch Ergonomic Keyboard Adjustable Horizontally and Vertically; Eases Repetitive Stress on Hands, Wrists, and Arms. Value: $20"

[4] A similar pattern was later replicated in an experiment that employed less extreme probabilities, namely, 5% and 95%.

Table 4 Descriptive Statistics and Cohen's *d* Effect Sizes for the Probability Manipulation for Monetary and Nonmonetary Outcomes in Experiment 3

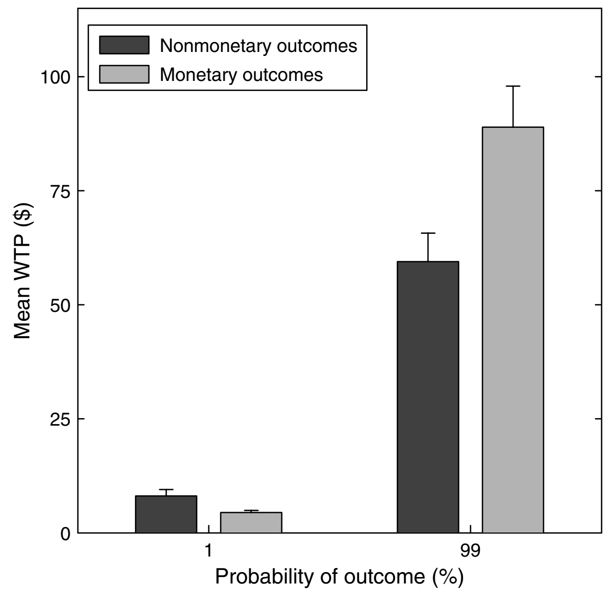
	Low probability (*N* = 93)			High probability (*N* = 89)			
Outcome	Mean ($)	Median ($)	SD	Mean ($)	Median ($)	SD	*d*
DVD ($15)	0.94	1.00	1.37	3.74	2.00	4.22	0.90[a]
$15	0.60	0.25	1.18	4.12	3.00	3.88	1.24
Keyboard ($20)	1.37	1.00	2.63	4.67	3.00	4.86	0.85[a]
$20	0.81	0.50	1.20	6.71	5.00	5.89	1.40
Roses ($30)	1.69	1.00	3.49	7.27	5.00	7.45	0.96
$30	1.30	0.50	3.06	9.76	5.00	8.57	1.33
Mask ($40)	3.04	1.00	5.83	9.55	5.00	10.17	0.79
$40	1.07	1.00	1.15	13.38	10.00	12.00	1.46
Painting ($100)	3.40	1.00	6.00	15.00	10.00	19.09	0.83
$100	2.29	1.00	3.36	32.07	20.00	30.32	1.40
Restaurant ($120)	7.58	3.00	15.25	35.65	25.00	29.85	1.19
$120	3.09	2.00	3.66	46.75	35.00	38.19	1.63
Comforter ($140)	6.02	2.00	10.33	38.04	29.00	36.32	1.21
$140	4.93	1.50	15.13	49.72	35.00	42.28	1.42
Concert ($150)	6.17	2.00	16.79	30.48	10.00	40.63	0.79[a]
$150	2.91	1.50	4.13	46.96	25.00	43.42	1.44
Air purifier ($300)	6.31	3.00	15.12	48.87	20.00	61.55	0.96[a]
$300	5.41	3.00	7.34	100.44	50.00	114.90	1.18
Basketball ($350)	10.76	5.00	18.11	75.93	30.00	92.31	0.99[a]
$350	5.37	3.50	6.18	116.16	70.00	114.43	1.38
Bike ($500)	9.62	5.00	14.78	98.69	50.00	127.59	0.99[a]
$500	6.96	5.00	7.96	168.19	100.00	161.13	1.43
Book ($550)	10.26	5.00	32.29	84.13	20.00	147.16	0.70[a]
$550	7.69	5.00	7.95	183.75	100.00	184.88	1.36
Ferrari ($700)	22.80	7.00	46.16	169.43	70.00	221.58	0.92
$700	10.35	7.00	18.86	229.87	100.00	230.37	1.36
Miami trip ($750)	22.06	10.00	43.94	211.12	100.00	216.52	1.22
$750	9.51	7.00	9.75	237.53	100.00	243.90	1.34
Overall nonmon.	8.10	3.50	13.77	59.47	38.71	58.96	0.95
Overal monetary	4.45	2.77	4.51	88.96	47.21	84.85	1.38
Low affect nonmon.	9.19	4.09	15.49	71.24	46.27	71.90	0.88
Low affect monetary	5.23	3.33	5.44	107.38	55.09	103.46	1.35

[a]The nonmonetary outcome was judged by a majority of respondents to be affect poor relative to the paired monetary outcome.

payoff outcomes ($M_{d's} = 0.88$ and 1.35, respectively), further arguing against the attribution of probability insensitivity to items' affect richness.

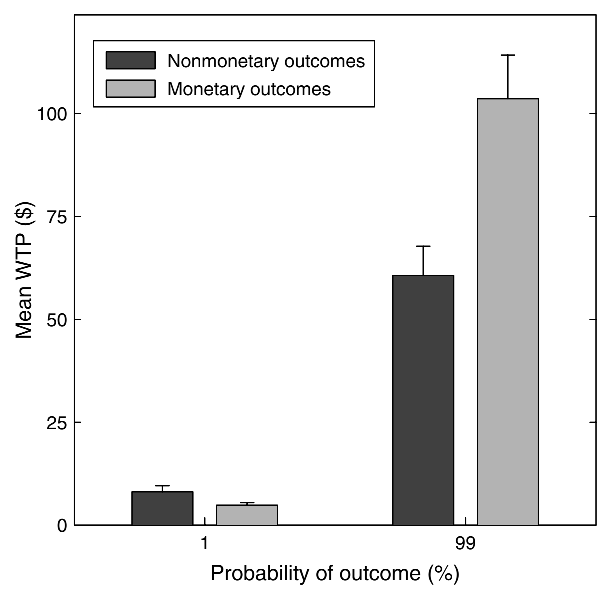
To summarize, the recurring pattern of insensitivity to probability information was shown to persist even when price information was provided alongside the nonmonetary items. Apparently, when nonmonetary items are evaluated, their monetary worth, even if available, is not immediately relied upon and weighted by the probabilities. The observed pattern persisted even when analysis was confined to the nonmonetary items judged to be affectively poor (i.e., emotionally less appealing or arousing) relative to their monetary counterparts.

Figure 4 Mean WTP Plotted Separately for the 1% and 99% Probability Conditions in Experiment 3



Note. Error bars indicate one standard error above the mean.

Figure 5 Mean WTP for the Seven "Affect-Poor" Nonmonetary Outcomes and for Matched Monetary Outcomes Judged more Affect Rich, Plotted Separately for the 1% and 99% Probability Conditions in Experiment 3



Note. Error bars indicate one standard error above the mean.

Experiment 4

To further explore the presumption that the influence of probabilities is muted when outcomes are nonmonetary, we test the persistence of preference reversals when likelihood information is made particularly salient. We do this by manipulating likelihoods in a more salient fashion: whereas in earlier studies we gauged the influence of probability information in a between-subject design, here we present low and high probability information within subjects. Our goal is to see if we can eliminate preference reversals by calling greater attention to probability information.

Systematic differences in sensitivity to numeric stimuli have been observed between separate evaluation, where options are presented in isolation, often between subjects, and joint evaluation, where options are evaluated simultaneously, within subjects (e.g., Hsee 1996, Hsee et al. 1999). "Transparent," within-subject presentation often triggers greater sensitivity to magnitude information than is observed in separate evaluation (LeBoeuf and Shafir 2003, Birnbaum 1999). Consequently, joint evaluation, encompassing both high and low probabilities, was expected to induce greater sensitivity to probability information, and, consequently, to lower the incidence of preference reversals.

Method

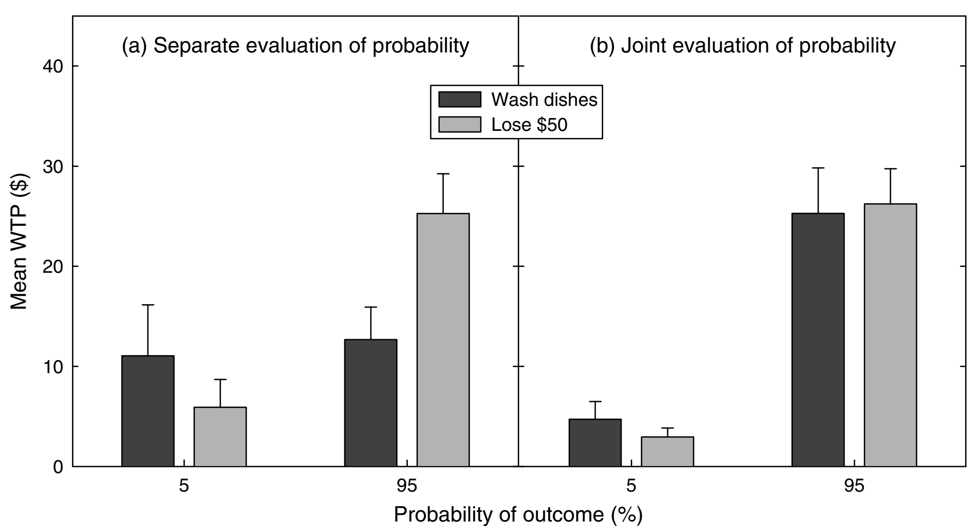
Forty-eight undergraduate volunteers were paid for their participation. The study was embedded in a series of other, unrelated tasks. Participants were randomly assigned to either a separate-evaluation condition, where (low or high) probability was a between-subject factor ($N = 15$ in each), or to a joint-evaluation condition, with probability (low and high) a within-subject factor ($N = 18$). Half of those in the separate-evaluation condition first estimated their WTP to avoid a 5% chance of having to wash the dishes of a 20-person four-course meal, and then estimated their WTP to avoid a 5% chance to lose $50. (Recall that $50 was participants' reported median value that would render them indifferent between losing the money and washing the dishes.) The other half in the separate-evaluation condition estimated their WTP to avoid those same outcomes at a 95% chance. Participants in the joint-evaluation condition estimated their WTP for those same outcomes at both 5% and 95% probability. Whereas the first two groups considered only one likelihood level (5% or 95%), the latter group made judgments for both levels, which was expected to raise the salience of probability information.

Analysis

The hypothesized probability insensitivity and resulting preference reversals were replicated in the standard, separate-evaluation condition. As shown in Figure 6 (panel (a)), the monetary outcome evaluation was sensitive to probability information, whereas the dishwashing task was substantially less so. The interaction of probability and outcome was significant: $F(1, 28) = 9.4$, $\eta^2 = 0.25$ (see Table 5 for descriptive statistics). WTP was lower for the monetary than the nonmonetary outcome at 5% probability ($5.92 versus $11.07; $t(14) = 1.3$, $p < 0.23$, $d = 0.31$), but substantially higher at 95% probability ($25.27 versus $12.66; $t(14) = 6.1$, $d = 0.94$). A Wilcoxon rank-sum test revealed a significant difference at 95% probability ($Z = 2.5$), although it failed to reach significance at 5% probability ($Z = 0.18$).

In contrast to the pattern observed in the separate evaluation condition, the interaction of probability and outcome proved nonsignificant in the joint-evaluation condition ($F(1, 17) = 0.33$, $\eta^2 = 0.02$; panel (b) of Figure 6). Also, in the joint evaluation

Figure 6 Mean WTP to Avoid Losing $50 (Monetary Outcome; Grey Bars) or Washing Dishes (Nonmonetary Outcome; Black Bars) in the 5% and 95% Probability Conditions of Experiment 4



Notes. A separate evaluation is shown in panel (a), and a joint evaluation is shown in panel (b). Error bars indicate one standard error above the mean.

Table 5 Descriptive Statistics and Cohen's *d* Effect Sizes of the Probability Manipulation for Monetary and Nonmonetary Outcomes in Experiment 4

	Low probability			High Probability			
Outcome (evaluation)	Mean ($)	Median ($)	SD	Mean ($)	Median ($)	SD	*d*
Wash dishes (SE)	11.07	1.00	19.7	12.67	10.00	10.8	0.10
Lose $50 (SE)	5.92	2.00	12.6	25.27	25.00	15.1	1.39
Wash dishes (JE)	4.72	1.00	7.3	25.28	20.00	18.8	1.44
Lose $50 (JE)	2.94	1.00	3.7	26.22	23.50	15.5	2.10

Note. SE denotes separate, between-subjects presentation of probabilities, and JE denotes joint, within-subjects presentation of probabilities.

condition the difference between monetary and nonmonetary outcomes was not significant at either high or low probability levels, according to a paired sample t-test or Wilcoxon rank-sum test.

As predicted, sensitivity to probabilities was greater in the joint-evaluation than the separate-evaluation condition. Also, consistent with the suggestion that (in separate evaluation) probability insensitivity is particularly characteristic of nonmonetary outcomes, the difference in effect sizes between separate- and joint-evaluation modes was greater for the nonmonetary gambles ($d = 1.44$ versus 0.10, respectively) than the monetary gambles ($d = 2.10$ versus 1.39, respectively; see Table 5).

Whereas preference reversals between monetary and nonmonetary outcomes are frequent under separate evaluation, joint evaluation attenuates the effect by raising sensitivity to likelihood information in the context of nonmonetary prospects. The observed difference between separate- and joint-evaluation conditions can help explain results reported elsewhere in the literature, which have found sensitivity to probability for nonmonetary outcomes. For example, Berns et al. (2007) observed similar S-shaped probability functions for the likelihood of shocks as typically observed for monetary gambles. Tversky and Fox (1995; see also Fox and Tversky 1998), using nonmonetary stimuli, such as the outcomes of sporting events, similarly found that people appear sensitive to probabilities. In all of these studies, however, probability was manipulated entirely in a within-subjects design, as above. Providing a moving range of probabilities within respondent lends a semblance of coherence to the relative evaluation of nonmonetary outcomes that in a between-subject presentation tends to be lost because of the underuse of the probability information (Ariely et al. 2003, Gneezy et al. 2006, MacCrimmon and Larsson 1979).

Experiment 5

In the opening studies, we found persistent insensitivity to changes in probability for nonmonetary prospects. Experiment 4 documented greater probability sensitivity in a transparent, within-subject presentation. The present study tried to raise sensitivity to probability information in the context of nonmonetary prospects by inducing participants to first gauge the monetary valuation of the outcomes, thereby yielding a more natural incorporation of, and, therefore, sensitivity to, probability information. Whereas in Experiment 4, the mere availability of monetary worth was found to have little influence on the valuation of nonmonetary outcomes, in this final experiment we first induced participants explicitly to convert nonmonetary outcomes to their monetary worth before gauging their WTP for the prospect. We hypothesized that we could recapture the probability sensitivity observed in the context of monetary outcomes by first having people estimate their willingness to pay for a consumer item before gauging their willingness to pay for a probabilistic chance to win the item (cf. Nunes and Park 2003).

Because the process requires people to first convert the nonmonetary item into a dollar amount, we expect people to show greater probability sensitivity for converted than for nonconverted items. Comparing the valuation of nonmonetary and of converted nonmonetary prospects, we expect to find preference reversals similar to those of our previous studies, where, like standard monetary outcomes, items converted into their monetary worth are preferred less at low probabilities and more at high ones.

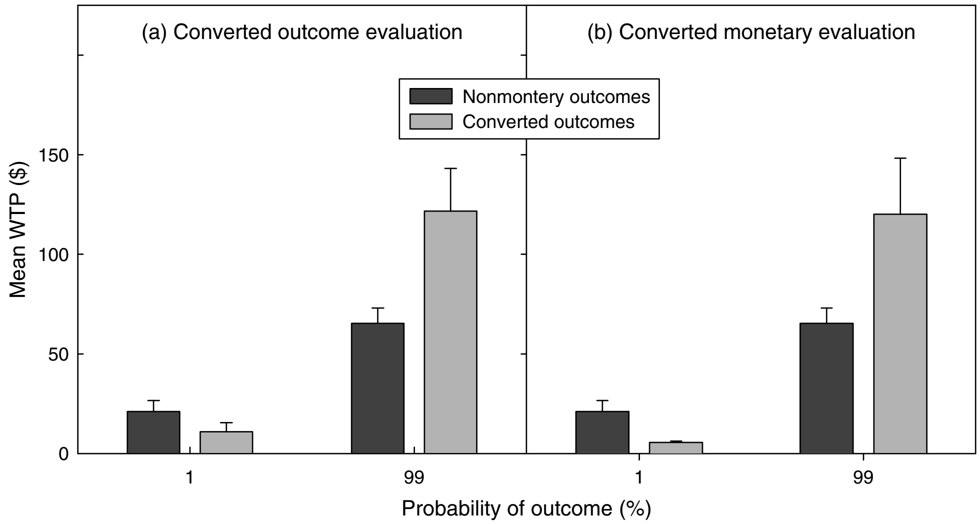
Method

One hundred and fifty-nine undergraduates participated in the experiment in partial fulfillment of a course requirement or for payment.[5] Their task was to estimate their WTP for nine consumer items used in Experiment 3 (five were removed to reduce survey length; see Table 6) at either low (1%) or high (99%) probability, based on random assignment. Each item appeared along with a brief description and a picture; no monetary value information was included.

Participants were also randomly assigned to a nonmonetary outcome condition, where they estimated their WTP as in previous studies, or to one of two conversion conditions. Prior to judging their WTP for a gamble to win the consumer item, participants in both conversion conditions were first asked, "How much would you be willing to pay to receive this

[5] Three participants were removed from the analysis because their average response was three or more standard deviations above the mean; in each case they provided extreme values for one of the options (Michael Jordan autographed basketball; WTP values > $10,000). Removing the respondents does not substantially change the statistical analyses herein but it does reduce variance due to skewed data.

Figure 7 Mean WTP Plotted Separately for the 1% and 99% Probability Conditions in Experiment 5



Notes. Panel (a) shows the WTP for a gamble involving the converted outcome evaluation. Panel (b) shows the WTP for a gamble involving the converted monetary evaluation. Error bars indicate one standard error above the mean.

prize for sure (i.e., with 100% certainty)?" In one conversion condition, which we call the converted outcome evaluation condition, respondents were asked, "Now, considering the amount you just stated, how much would you be willing to pay for a [1%/99%] chance to win the prize?" In the second conversion condition, labeled the converted monetary evaluation condition, which we created to serve as a point of comparison, participants were asked, "Now, considering the amount you just stated, how much would you be willing to pay for a [1%/99%] chance to win that amount of money?" We expected WTP in the two conversion conditions to be similar, but more importantly, we expected respondents who have carried out the conversion to show greater probability sensitivity. In that case, we would expect preference reversals between converted and nonconverted items, similar to that observed between monetary and nonmonetary prospects.

Analysis

Willingness-to-pay judgments were strikingly similar regardless of the type of conversion we encouraged; no significant differences were found between mean judged WTP for the two conversion conditions (p values > 0.8 for main effect and interaction with probability; see Figure 7), so we collapsed across conversion condition.[6] As expected, WTP for converted outcomes was lower than WTP for nonconverted outcomes at the low, 1% probability ($8.18 versus $21.01; $t(83) = 2.5$, $d = 0.52$) but higher at the high, 99% probability ($120.96 versus $65.31; $t(72) = 2.3$, $d = 0.63$).[7] A Wilcoxon rank-sum test found a similar effect: WTP for nonconverted outcomes was higher than WTP for converted outcomes at low probability ($Z = 2.2$), whereas the reverse occurred at high probability ($Z = 1.6$, $p < 0.11$). The predicted ordinal preference reversal was evident in seven of the nine mean pairings and in three median pairings (see Table 6 for means and median values at low and high probability). The interaction of probability (low versus high) and conversion (nonmonetary outcome converted or not) was significant ($F(1, 155) = 8.8$, $\eta^2 = 0.05$). Greater sensitivity to probability information was observed among converted than among nonconverted outcomes, with effect sizes for the converted outcomes consistently larger (seven of nine pairs) than for the paired nonconverted outcomes (see Table 6; $M = 1.03$ versus $M = 0.65$, respectively; $t(16) = 3.1$).

Whereas the preceding studies documented patterns of preference reversal in pairs of monetary versus nonmonetary prospects, our final study was able to recreate these patterns in pairs of only nonmonetary prospects. We did this by first inducing participants explicitly to consider the monetary worth of one item in each pair. Once they had determined an item's monetary worth, participants proceeded to treat that item more like they treated a monetary amount, showing the standard sensitivity to probabilities characteristic of monetary outcomes. Although

[6] The conversion of items to dollar amounts was not affected by probabilities; there was no significant probability difference across items. Two of nine items showed a significant difference at the individual level: the mask and the book were assigned higher monetary values in the high- than the low-probability condition.

[7] A similar pattern was found if the analysis was conducted separately for conversion condition.

Table 6 Means, Medians, Standard Deviations, and Cohen's *d* Effect Sizes for Stimuli in Experiment 5

	Low probability ($N = 56$)			High probability ($N = 48$)				
Outcome	Mean	Median	SD	Mean	Median	SD	*d*	WTP value at 100%
Roses	2.35	1.00	4.45	18.73	9.00	38.80	0.61	
Converted	1.12	1.00	1.70	10.63	9.50	8.94	1.53	17.39
Mask	15.48	2.00	30.48	41.52	32.50	48.79	0.65	
Converted	7.94	1.00	40.28	67.99	20.00	115.07	0.72	79.54
Painting	21.76	10.00	33.86	42.38	20.00	61.64	0.42	
Converted	5.08	2.00	8.43	109.10	35.00	200.93	0.77	126.87
Comforter	14.36	5.00	26.83	81.35	42.50	108.74	0.87	
Converted	6.52	2.50	14.68	68.17	50.00	64.17	1.37	110.74
Concert	17.59	5.00	38.29	29.19	20.00	23.63	0.36	
Converted	2.75	1.00	3.37	33.29	20.00	40.91	1.10	43.45
Air purifier	11.22	2.00	28.23	35.65	20.00	48.74	0.62	
Converted	3.78	1.13	7.72	37.64	20.00	39.80	1.23	54.78
Basketball	27.57	10.00	46.63	129.21	100.00	161.72	0.95	
Converted	9.71	5.00	10.69	335.65	82.50	531.23	0.91	408.19
Book	19.45	4.00	55.85	38.81	23.50	42.16	0.39	
Converted	3.64	1.00	7.49	47.76	19.00	72.28	0.89	61.19
Miami trip	59.34	20.00	100.61	192.96	100.00	168.52	0.99	
Converted	33.05	10.00	133.78	382.54	240.00	637.16	0.79	461.98
Overall nonmon.	21.01	6.44	29.89	65.31	62.53	39.17	0.65	
Overall converted	8.18	4.39	17.58	120.96	79.72	118.66	1.03	146.2

Note. The data are collapsed across conversion condition.

nonmonetary outcomes are not spontaneously converted into their monetary worth (even when price is available, as was shown in Experiment 3), once a monetary valuation is implemented and attended to, probability weighting then follows the calculative logic applied to monetary outcomes.

Concluding Remarks

In line with related research on information processing during decision making, the psychological valuation of monetary and of nonmonetary gambles appears to be quite distinct. When prospects are monetary, probabilities tend to be fairly naturally incorporated with payoffs to yield an approximate measure of expected worth; on the other hand, when outcomes are not monetary, conversion to monetary value is not immediate, and the weighting of anticipated value by the probabilities is less forthcoming. As a result, the valuation of nonmonetary outcomes proves less sensitive to adjustments in likelihood. This, in turn, can lead to apparent preference reversals, where people prefer the nonmonetary over the monetary outcome at low probability (where valuation of the monetary payoff is more responsive to the low likelihood), but then prefer the monetary over the nonmonetary outcome when probabilities are high (and valuation of the monetary payoff is more responsive to the now greater likelihood). Such reversals were observed independently of whether nonmonetary prospects were more or less affect rich than the corresponding monetary prospects. The pattern was observed in a pricing task in Experiment 1, and was then replicated in a choice task in Experiment 2. A greater tendency to rely on simple calculation in the context of monetary prospects was further supported by participants' self-reports.

The observed preference reversals persisted even when the monetary values of consumer goods were made available (Experiment 3), but diminished when participants were presented with problems in a within-subject design, where changes in likelihood were made particularly salient (Experiment 4). Finally (in Experiment 5), when participants were explicitly prompted to convert several nonmonetary items into their corresponding monetary worth, those prospects were then weighted by the probabilities much as they would have had they been monetary from the start, thereby undoing the persistent reversals of preference. This is consistent with a pattern described by Gneezy et al. (2006), whose uncertainty effect was observed to occur only when prices and prospects were in different currencies.

Apparently, people are capable of converting nonmonetary stimuli into their monetary worth and calculating expectation, although they do not readily do so. Reminiscent of Kahneman and Tversky's (1979) notion of "acceptance," which refers to people's tendency to accept the frame provided by a problem and not to explore alternative formulations, when presented with nonmonetary stimuli, people tend to evaluate them nonnumerically, even when their monetary worth could be computed, or, in some cases, is even explicitly provided.

Our results are not inconsistent with the suggestion that probability insensitivity is exacerbated in the context of affect-rich outcomes; nonetheless, our findings call into question the notion that affect richness is the main contributing factor to the observed patterns of probability insensitivity (Rottenstreich and Hsee 2001). People do rely on emotionally salient information as a proxy, and this can lead to nonnormative judgment (Slovic et al. 2002, Loewenstein et al. 2001). In fact, in Experiment 3, "feelings" reportedly played a prominent role in some participants' evaluation of monetary gambles (see Bateman et al. 2007, Mellers and McGraw 2001). In Hsee and Rottenstreich's (2004) terminology, processing based on feelings can lead to a systematic underappreciation of "scope" (see also Desvousges et al. 1993, Hsee et al. 2005, Kahneman et al. 1999). All this notwithstanding, our results appear largely independent of the affective strength of items, and more directly attributable to how readily the probabilistic information can be combined with monetary outcomes, as contrasted with outcomes that are nonmonetary.

In the experiments reported above we find less sensitivity to probability information in the context of nonmonetary as opposed to monetary outcomes. Although we have kept the methods of probability presentation and valuation (WTP and choice) constant, a change in these may further influence the type of processing decision makers engage in. Probability information conveyed in nonnumeric terms (via adjectives such as "probable" or "unlikely," for example) has been shown to encourage noncalculative or intuitive information processing, whereas numeric probability information leads to more rule-based processing (Windschitl and Wells 1996). Similarly, more qualitative evaluation methods (e.g., attractiveness ratings as opposed to WTP judgments) can encourage noncalculative processing and generate the kind of insensitivity that yields emergent preference reversals of the kind documented here (Mellers et al. 1992).

Situations where probability is systematically underappreciated may require alternative choice theoretic formulations, as proposed by Rottenstreich and Kivetz (2006), who distinguish between probabilistic and nonprobabilistic mindsets. Preferences in the latter are derived via noncalculative considerations, including social norms (e.g., McGraw et al. 2003), role-based decision making (e.g., March and Heath 1994), reason-based choice (Shafir et al. 1993), or story-construction (e.g., Pennington and Hastie 1988). There are also likely to be individual differences in the tendency to incorporate numeric and nonnumeric information, for example, as a function of ability or motivation, numeracy (Peters et al. 2006), intelligence (Frederick 2005), or need for cognition (Cacioppo and Petty 1982).

Classical accounts of decision making have assumed independent valuation and multiplicative combination of prospects' worth and their likelihood. A paradigm case is the monetary gamble, which has long served as the "fruit fly" in the study of choice (Kahneman and Tversky 2000). Monetary gambles offer monetary outcomes with known likelihoods, and their value is assumed to be the weighted sum of the potential payoffs, with probabilities treated linearly and independently (Bernoulli 1954, Von Neumann and Morgenstern 1947, Savage 1954). It has long been noted, however, that this simple and intuitively compelling view of the making of decisions is rife with assumptions that appear not to be borne empirically. Among other things, probabilities tend to be evaluated nonlinearly, with changes at the endpoints having greater impact than comparable changes in the middle of the probability scale (Kahneman and Tversky 1979), and reactions to losses tend to be stronger than to comparable gains, allowing framing effects (Tversky and Kahneman 1986, 1991) and generally questioning the notion of a well-defined preference order (see Lichtenstein and Slovic 2006 and references therein). It is noteworthy that these and other critiques and amendments (e.g., Allais 1953, Edwards 1954, Ellsberg 1961, Kahneman and Tversky 1979, Luce 1991, Tversky and Kahneman 1992), including ones that incorporate emotions like disappointment and regret (e.g., Mellers 2000), have altered how we think about the processing of outcomes and probabilities, but have structurally retained the gamble metaphor, wherein outcomes and likelihoods, however assessed, are assumed eventually to be systematically (usually multiplicatively) combined.

The present studies suggest that what is learned about choices between monetary gambles may be limited in its applicability to other domains. This notwithstanding, our intention is not to indict the use of gambles in decision research. Monetary gambles are clear and objective, and well suited for the development of tractable models of choice. Research driven by the gamble metaphor has uncovered important psychological phenomena, which have since been successfully extended to other domains (Kahneman and Tversky 2000 and references therein). Nonetheless, it seems warranted to conclude with a cautionary note. Decision research has uncovered important principles, one of which is that decision behavior is heavily context dependent. In this vein, it may be worth thinking of gambles as providing a special context, in which the relationship between probability and money is unlike the relationship between probability and things.

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