Buying and Selling Prices under Risk, Ambiguity and Conflict

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Abstract

This paper reports an empirical study of buying and selling prices for three kinds of gambles: Risky (with known probabilities), ambiguous (with lower and upper probabilities), and conflictive (with disagreeing probability assessments). The latter two types of gambles were constructed so that the variances in their probabilities were approximately equal, thereby ensuring that uncertainty type was not confounded with variance. Participants devaluated both ambiguous and conflictive gambles relative to risky gambles with equivalent expected utilities, but the ambiguous and conflictive valuation means did not significantly differ. Moreover, the endowment effect (the gap between buying and selling prices) was exaggerated for these two kinds of gambles in comparison with risky gambles. Conflictive gambles also were found to be devalued less than ambiguous gambles, relative to their risky counterparts. Several self-report measures of attitudes towards uncertainty and risk were included as potential predictors of pricing. The most effective predictors were a measure of instrumental risk orientation and a functional impulsivity scale. Instrumental risk positively predicted valuation of ambiguous and conflictive gambles but not of risky gambles. Functional impulsivity positively predicted valuation of risky gambles but neither of the other two kinds. No individual differences measures predicted relative devaluation.

Keywords. Ambiguity, conflict, prices, risk aversion, buying, selling.

1 Introduction

1.1 Preferences for Risk, Ambiguity and Conflict

The subject of this paper is the valuation of uncertain prospects when the uncertainty is not limited to known probabilities. We investigate two kinds of imprecise probabilities. Numerous studies since Ellsberg's [1] classic paper have demonstrated a general tendency for people to prefer *risky* gambles, i.e., with precise probabilities to *ambiguous* gambles, i.e., whose probabilities are imprecise in the sense of having a lower and upper bound. There have been only a few studies examining the effect of conflicting information [2], [3], and these have indicated that people prefer agreeing but ambiguous sources of information to conflictive but precise sources. To our awareness only one study has investigated *conflictive* gambles, i.e., gambles in which there are conflicting assessments of outcome probabilities [3].

Smithson [2] has argued that people treat ambiguity and conflict as distinct kinds of uncertainty in the sense that attitudes towards one may not correlate with attitudes toward the other, and his experiments and their replication by Cabantous [3] suggest that people prefer ambiguity to conflict. Several researchers also have investigated whether attitudes towards risk and ambiguity are correlated. An early study by Curley et al. [4] found no significant correlation, but later more nuanced investigations by Lauiola and his colleagues did find a positive correlation [5],[6]. Only one study to our knowledge has investigated the correlation between ambiguity and conflict attitudes [7], and found no significant correlation.

Nearly all of the studies in this vein have been based on choice tasks. However, a few have examined pricing, mainly regarding insurance premiums. There is a well-known reluctance for insurers to offer insurance on risks whose probabilities are unknown. When subjective probabilities are used by insurers such as Lloyds of London to estimate such risks, they regard those probabilities as ambiguous and charge higher premiums than they would if the probabilities were based on relative frequency data. The earliest empirical studies to test this effect found that insurers demand higher premiums under ambiguity than under risk [8], and clients are willing to pay more for insurance under ambiguity than under risk [9]. The only study to include conflict [3] found that insurers demand higher premiums under conflict than under ambiguity. These findings suggest that ambiguous and conflictive gambles are devalued relative to expected-utility equivalent risky gambles, and conflictive gambles may be viewed as having less value than ambiguous ones.

There are two ways preferences among gambles may be inferred from buying and selling prices. The first is simply through the prices themselves, i.e., valuation. The second is by comparing the price assigned to a gamble against an appropriate subjective benchmark, i.e., relative valuation. Such comparisons operationalize uncertainty aversion or seeking in terms of prices. The benchmark in this study was the individual's price for a risky gamble with an expected utility equal to that of the ambiguous or conflictive gamble under comparison. In turn, the comparison was operationalized by the log of the ratio of the two prices.

On the basis of the literature reviewed thus far, we propose the following hypotheses.
Hypothesis 1: For mid-range probabilities, both valuation and relative valuation will be lowest for conflictive gambles, second lowest for ambiguous gambles, and highest for risky gambles.
Hypothesis 2: Valuation and relative valuation of risky and ambiguous gambles will be positively correlated, but neither will be correlated with valuation of conflictive gambles.

To our knowledge, none of the aforementioned studies investigated the effect of ambiguity or conflict on the difference between buying and selling prices. In a well-known violation of subjective expected utility known as the *endowment effect* [10], people tend to offer higher selling than buying prices for risky gambles. The standard betting interpretation of lower and upper probabilities also stipulates a higher selling than buying price for ambiguous gambles, but there appears to be no similar standard interpretation for conflictive gambles. Moreover, although it is psychologically plausible that an endowment effect should be greater for ambiguous than for risky gambles, it is not clear how that effect for conflictive gambles would compare. Thus, we posit
Hypothesis 3: For mid-range probabilities, the difference between buying and selling prices will be higher for ambiguous and conflictive gambles than for risky gambles.

1.2 Individual Differences

Research on risk and ambiguity attitudes has paid only limited attention to individual differences, despite obvious variability among individual responses to risk or ambiguity. By far the most widely documented individual difference is due to gender: Men are more risk-seeking than women [11]. Nevertheless, several psychological traits have emerged in the literature as potential predictors of attitudes toward risk and ambiguity.

Research into dispositional components of risk attitudes and risky behaviour has revealed several key relationships. Dispositional traits such as Impulsivity, Locus of Control, and Sensation Seeking have been linked as predictors of risk preferences and risky behaviour in activities ranging from simple games of chance to financial risks, stimulatory hobbies such as rock climbing [12]. In the Big Five personality framework, openness has most commonly been linked with risk-seeking. Our study has included the ten-item-personality inventory (TIPI), a short version of the five-factor model [13]. Finally, Zaleskiewicz [14] developed a two-factor model of risk-taking disposition, with *stimulating risk* correlating with risk-taking in domains such as recreation, and *instrumental risk* correlating with risk-taking in the financial domain. We have included his scales in our study.

We propose the following hypothesis involving the measures described above.
Hypothesis 4: Openness and the stimulating risk scales will be positively correlated with valuation and relative valuation for risky gambles. We leave as exploratory matters the question of whether openness, stimulating risk, or instrumental risk will be correlated with valuation or relative valuation for the ambiguous and conflictive gambles.

Likewise, a few researchers have posited individual difference predictors of attitudes towards ambiguity. In Lauriola and Levin's first paper [5], interviews with participants showing marked ambiguity seeking suggested that they preferred the ambiguous to the risky gamble because they were curious. Huettel et al. [15] found that a measure of impulsivity predicted ambiguity seeking in their fMRI study. These findings suggest including measures of analogs to curiosity and impulsivity. For the first, we have incorporated two recently developed measures based on the theory of uncertainty orientation [16], namely need for discovery and need for certainty [17]. *Need for discovery* measures the extent to which people actively seek novel information, and *need for certainty* measures the disposition to bolster and maintain current beliefs. For the second, we have included Dickman's [18] measures of functional and dysfunctional impulsivity.

Finally, we propose the following hypothesis.
Hypothesis 5: Instrumental risk, need for discovery and functional impulsivity will be positively correlated and need for certainty negatively correlated with valuation and relative valuation for ambiguous and conflictive gambles.

2 Method

2.1 Participants, Design and Procedures

There were 88 participants with valid responses (58 females and 30 males), ranging in age from 18 to 57 ($M = 26.9$, $SD = 7.5$). A majority (78) of participants were friends and colleagues of the second author and were recruited via email. All participants had little background in probability or mathematics generally. The remaining participants were first year Australian National University psychology students participating for partial course credit. Participants gave informed consent, and were notified prior to commencement that their participation was voluntary and were given online feedback on the study's aims upon completion of the survey.

The study was administered via an online survey with two components, the second of which contained experimental stimuli. In the experimental component described below, participants were presented with 11 Card Game gambles. They were randomly assigned to one of two conditions: Vendor, where they were asked for a minimum selling price for each gamble, or Purchaser, where they were asked for a maximum buying price for each gamble.

2.2 Materials and Tasks

The first section of the study consisted of the individual differences measures. These included the need for discovery and need for certainty scales, the stimulating and instrumental risk inventories, functional and dysfunctional impulsivity scales, and the TIPI.

The second major component of the study consisted of three different tasks, designed to elicit uncertainty preferences. These tasks were extensively pilot-tested before the experiment was launched online. We restrict attention in this paper to the first task, the Card Game. The Card Game is comparable to Ellsberg's (1961) original two-colour task. It required participants to consider a gambling game in which players select a single card from a deck of 100. The deck consists of Old Maid and Go Fish cards in varying proportions. A player wins 10 dollars if they select a Go Fish card, and nothing if they select an Old Maid card. Participants were asked to consider 11 such games, and rate their preferences for each by either specifying the most they would be willing to pay to play the game (Pay to Play endowment condition) or the lowest price for which they would sell a free ticket to play (Selling Price endowment condition).

In the first five scenarios, the full contents of the deck were specified, and risk was manipulated by varying the number of Go Fish (winning) cards in the deck. The proportions of winning cards in the deck for these scenarios were .25, .4, .5, .6, and .75. The proportions were varied to enable estimation of the effect of probability on each participant's valuations of the gambles.

The next three scenarios contained ambiguous information about the deck. The probability intervals were $[.3, .7]$, $[.15, .85]$, and $[0, 1]$. Because the midpoint for each interval was .5, the expected value of each gamble was 5 dollars.

In the final three scenarios, participants were presented with conflicting pieces of information about the contents of the deck from two previous players, and were told that in each case one of the players was approximately correct. The expected value was again maintained at 5 dollars (probability 1/2 of winning 10 dollars), and the conflicting proportions of winning cards claimed by the two sources were $\{.4, .6\}$, $\{.3, .7\}$, and $\{.2, .8\}$. Because the average of each conflictive pair of probabilities was .5, the expected value of each gamble was 5 dollars.

The conflictive probabilities in each scenario were set such that the variance of the probabilities associated with each gamble was approximately equal to the variance in a corresponding ambiguous gamble. Sensitivity to variance has been posited as an explanation for ambiguity aversion, and this eliminates variance as a potential differentiating factor between ambiguous and conflictive gambles. Assuming a uniform distribution, the variance of the probability for an ambiguous gamble with winning probability $[p, 1-p]$ is

$$\sigma_a^2 = (1-2p)^2/12.$$

Likewise, the variance of the probability for a conflictive gamble with winning probability $\{p, 1-p\}$ is

$$\sigma_c^2 = ((1-2p)/2)^2.$$

Thus, the variances for the three ambiguous gambles are 0.083, 0.041, and 0.013 respectively; and the variances for the conflictive gambles are 0.09, 0.04, and 0.01 respectively.

3 Results

3.1 Uncertainty and Endowment Effects

The raw dependent variable was valuation, the buying or selling price (in Australian dollars) elicited from respondents. As described earlier, a relative valuation measure also was analyzed. We begin by analyzing valuation.

A minority of participants' valuations were equivalent to the expected utilities (EU's) of the gambles (e.g., valuing at 5 dollars a gamble with probability of .5 of gaining 10 dollars). In the Purchaser condition there were 13 EU responses for risky gambles, 13 for ambiguous gambles and 14 for conflictive gambles. In the Vendor condition, however, these dropped to 5, 3, and 9 EU responses respectively. A two-level logistic regression model found that the difference between the Vendor and Purchaser conditions was significant ($p = .031$), but found no difference among the three types of gambles.

All of the valuations were analyzed with a 2-level GLMM to test Hypotheses 1 and 3 on the valuation data. The GLMM is a choice model without a weighting parameter for probabilities, to ensure model identifiability. The final version of the choice model has the form

$$y_{ij} \approx N\left(\mu_{ij}, \sigma^2\right).$$

The μ_{ij} are defined as subjective expected utilities:

$$\mu_{ij} = U_{ij}\,\pi_i,$$

where U_{ij} is the subjective utility and π_i is the expected probability for the i^{th} gamble and j^{th} subject. In turn, the U_{ij} comprise a 2-level model:

$$U_{ij} = \beta_{0j} + \beta_{1j}\,x_{1i} + \left(\beta_{2j} + \beta_{22j}\,x_{1i}\right) z_{1i} + \left(\beta_{3j} + \beta_{33j}\,x_{1i}\right) z_{2i} + \left(\beta_{4j} + \beta_{44j}\,z_{1i}\right) x_{2i},$$

where
$x_{1i} = 0$ for the purchaser condition and 1 for the vendor condition,
x_{2i} is the variance of the probability in the i^{th} gamble,
$z_{1i} = 0$ for a precise or conflictive probability and 1 an ambiguous probability, and
$z_{2i} = 0$ for a precise or ambiguous probability and 1 a conflictive probability.
The random-effects coefficients are defined as follows: $\beta_{kj} = \nu_k + u_{kj}$, with $u_{kj} \approx N\left(0, \sigma^2_{kj}\right)$.
The model was estimated via Bayesian MCMC using WinBUGs1.4, in a 2-chain model with a burn-in length of 5,000 iterations and estimations based on a subsequent 10,000 iterations. Convergence diagnostics were favorable for all parameters.

The fixed-effects parameter ν_1 establishes the classic effect of devaluation in the vendor condition if it is negative. The ν_2 and ν_3 parameters compare valuation of ambiguous and conflictive gambles with risky gambles under the purchaser condition, whereas ν_{22} and ν_{33} do so under the vendor condition. All four of these parameters are engaged for testing Hypothesis 1 and the latter two for testing Hypothesis 3. Finally, the ν_4 parameter tests the effect of variance in the probabilites for conflictive gambles and $\nu_4 + \nu_{44}$ does so for ambiguous gambles.

The parameter estimates are displayed in Table 1, along with their standard errors and 95% credible intervals. For risky gambles, the ν_0 estimate suggests a tendency to devalue the $10 monetary amount slightly in the purchaser condition and the negative ν_1 estimate reproduces the classic further devaluation under the vendor condition.

parameter	estimate	se	lower credib.	upper credib.
ν_0	9.298	0.177	8.954	9.651
ν_1	-0.772	0.290	-1.341	-0.205
ν_2	-1.462	0.201	-1.856	-1.071
ν_{22}	-0.782	0.290	-1.347	-0.208
ν_3	-1.317	0.200	-1.709	-0.924
ν_{33}	-0.520	0.296	-1.100	0.063
ν_4	0.092	0.024	0.044	0.139
ν_{44}	-0.088	0.033	-0.153	-0.022

Table 1: Fixed-Effect Parameter Estimates

Although it is not immediately clear from Table 1, Hypothesis 1 receives only partial support from the findings. The risky gambles are valued more highly ($M = 4.320$) than the ambiguous ($M = 3.166$) and conflictive ($M = 3.568$) gambles, but the ambiguous and conflictive valuation means do not significantly differ. Hypothesis 3, on the other hand, is well-supported. Both ν_{22} and ν_{33} are negative and not significantly different from each other, reflecting greater differences between buying and selling prices for the ambiguous and conflictive gambles than for risky gambles.

Additionally, the effect of variance in the probabilities on valuation was positive for conflictive gambles ($\nu_4 = 0.092$). However, this effect did not emerge for ambiguous gambles because $\nu_4 + \nu_{44} = 0.004$ which did not differ significantly from 0.

We now turn to relative valuation. Recall that the relative valuation measure was the log-ratio of the valuation of the benchmark risky gamble v_r and an alternative gamble v_a:

$$c_r = \ln\left(v_r \,/\, v_a\right)$$

The measure is defined so that higher scores indicate greater relative devaluation of the alternative gamble, so it behaves much like an uncertainty aversion measure.

A mixed ANOVA yielded significant main effects for variance and endowment, and type of gamble. The variance and endowment effects were in the expected directions, so that greater variance resulted in greater relative devaluation ($F(2, 59) = 5.695, p = .005$) and purchasers gave greater relative devaluations than vendors ($F(1, 60) = 9.327, p = .003$). Likewise, there was a significant tendency for conflictive gambles to be relatively devalued less than ambiguous ones ($F(1, 60) = 4.557, p = .037$). There were no interaction effects.

Finally, Hypothesis 2 was tested initially by examining correlations among the valuation and relative valuation measures. These revealed that although valuations and relative valuations of risky and ambiguous gambles were indeed positively correlated, so were they with their counterparts in the conflictive gambles. There were no discernible differences in the strength of correlations between the different types of gambles. The correlations of valuations among gambles were relatively high, ranging from .625 to .950, with RMS $r = .786$. The corresponding findings were similar for both measures of relative valuation (difference and log-ratio), although the correlations were not as strong.

A major limitation of simply correlating valuations across gambles is its inability to address correlations between specific effects. This limitation can be overcome by examining correlations between random-effects parameter estimates in the choice model developed earlier. Table 2 displays these correlations.

β_{0j}							
0.67	β_{1j}						
-0.21	-0.10	β_{2j}					
0.18	0.23	0.41	β_{22j}				
-0.24	-0.12	0.63	-0.05	β_{3j}			
0.27	0.39	0.11	0.52	0.27	β_{33j}		
-0.01	0.01	-0.14	0.02	-0.31	-0.18	β_{4j}	
0.04	0.02	-0.38	-0.42	0.09	0.08	-0.50	β_{44j}

Table 2: Random-Effect Parameter Correlations

The parameters relevant to risky gambles alone (β_{0j} and β_{1j}) are more strongly correlated with each other than with any of the other parameters. Likewise, the parameters measuring effects relevant to the ambiguous and conflictive gambles are more strongly correlated among each other than they are with β_{0j}, β_{1j} or β_{4j}. These findings contradict Hypothesis 2 and suggest a moderately strong link between ambiguous and conflictive gambles in terms of the effects that endowment and variance have on them.

3.2 Individual Differences

Hypotheses 4 and 5 were assessed by excluding the responses that conformed to expected utility theory, because those cases would not be predicted by anything other than the value of the gamble and its probability. To enhance statistical power, the variance in the probabilities was ignored in these analyses, so that only endowment and gamble type were taken into account. Individual differences variables were entered one at a time on their own and a final model was built up by forward addition and likelihood-ratio tests.

Hypothesis 4 was not supported by the prediction of valuation, relative devaluation, or random-effects coefficients. Neither the Openness nor stimulating risk scales predicted any of these dependent variables. Only functional impulsivity predicted valuation of risky gambles, with a positive coefficient ($z = 0.540, p = .005$). However, functional impulsivity did not predict relative devaluation of risky gambles. The relevant random-effects coefficients, β_{0j} and β_{1j}, were weakly positively correlated with scores on the instrumental risk scale ($r = .22$ and .23 respectively).

Hypothesis 5 received some support only for the prediction of valuation and random-effects coefficients. No individual differences measures predicted relative devaluation. For valuation data, there were significant two-way interaction terms between gamble type and instrumental risk and functional impulsivity. The functional impulsivity interaction term was significantly negative for ambiguous gambles ($z = -0.452, p = .005$) and nearly so for conflictive gambles ($z = -0.358, p = .063$). The instrumental risk interaction term, on the other hand, was significantly positive for ambiguous gambles ($z = 0.426, p = .012$) and nearly so for conflictive gambles ($z = 0.337, p = .058$). As for random-effects coefficients, two of the relevant coefficients, β_{2j} and β_{3j}, were positively correlated with scores on the instrumental risk scale (r = .27 for both).

4 Discussion

Our data reproduced the classic endowment effect, the routine violation of expected utility theory whereby people nominate higher selling prices than buying prices for gambles with precise probabilities. The fact that this effect emerged clearly in this study suggests that the experimental manipulation of endowment condition was effective, despite the fact that the gambles did not yield actual monetary rewards.

Hypotheses 1 and 2 received partial support, but there were some unexpected findings. Conflictive and ambiguous gambles were valued less than expected-utility-equivalent risky gambles. This finding is in line with the aforementioned insurance literature regarding ambiguous gambles, and establishes a similar result for conflictive gambles. However, valuations of ambiguous and conflictive gambles with equivalent variances in the probabilities did not differ. The finding that the random-effects coefficients for ambiguous and conflictive gambles were correlated with each other but not with risky gambles adds weight to the impression that people may evaluate these two kinds of nonprobabilistic uncertainty in similar ways.

However, relative devaluation behaved differently: A significant tendency for conflictive gambles to be relatively devalued less than ambiguous ones and no interaction with endowment or variance. The main effect is unexpected and directly counterindicative of hypothesis 1. It is possible that respondents are more willing to bet on a gamble where the probability of winning is either very high or very low, and this suggests investigating this effect for much higher stakes and also for loss frames.

These findings appear contrary to the preference for ambiguity over conflict established in [2] and replicated in [3]. Moreover, in a recent study of choices among gambles quite similar to those used in this study [7], conflictive gambles were selected less often than ambiguous ones. However, it certainly is possible for people to show preferences in their choices that do not emerge in their valuations (and vice-versa). Preference reversals, after all, are one of the most thoroughly studied violations of expected utility theory. More specifically, response mode (direct comparison versus rating or pricing) has been shown to affect the strength of ambiguity aversion ([19], [20]), with stronger effects found in forced-choice tasks.

A worthwhile extension of the current study would include appropriate choice tasks along with valuation. However, Bowen et al. [21] have observed that when forced to choose, individuals would choose the less ambiguous option and their choice in turn motivates them to overly value the unambiguous option precisely because they need to justify having chosen it. An obvious way around this problem would be to randomize the order of response mode (i.e., half choosing first and half valuing first).

Hypothesis 3 received fairly strong support. The endowment effect was decidedly stronger for conflictive and ambiguous gambles than for risky ones. The random-effects coefficients for these endowment effects were moderately correlated ($r = .52$) but they also were weakly but positively correlated with the endowment effect for risky gambles ($r = .23$ and $.39$).

Could the extra endowment effect for ambiguous and conflictive gambles be explained by the standard betting interpretation of lower and upper probabilities, and therefore by a function of the variance in probabilities? Our findings indicate otherwise, and in fact when variance is taken into account by introducing the appropriate variance*endowment and variance*endowment*gamble-type interaction terms into the choice model, these terms do not significantly improve model fit. Therefore, the betting interpretation of lower and upper probabilities does not explain the extra devaluation of ambiguous and conflictive probabilities, so the cause probably is an alternative psychological response to those types of gambles.

Almost all evidence for candidate explanations comes from studies of ambiguous gambles [22]. However, there is also direct evidence that people simply regard options with missing information as inferior to those with complete information [23], and that this view holds even when the outcomes are losses instead of gains [24]. There appears to be no difference between ambiguous and conflictive gambles; the endowment effect is enhanced equally for both. Respondents appear to devalue both types of gamble as if they perceive a solitary feature that makes both of them inferior to gambles with known probabilities. These findings are compatible with the missing-information explanation.

The absence of correlations between the stimulating risk scale, openness, need for discovery or need for certainty and the valuation of risky gambles (Hypothesis 4) is somewhat surprising, although not very unusual for research in this area. Self-report measures of risk-taking dispositions, tolerance of uncertainty, and the like often do not correlate strongly and can vary considerably across different domains [25]. The study of attitudes towards and responses to nonprobabilistic uncertainty is beset with difficult issues in terminology and measurement [26].

Functional impulsivity and the instrumental risk scale, on the other hand, predicted valuation and random-effects coefficients, albeit in some ways not anticipated in Hypothesis 5. Instrumental risk positively predicted valuation in the ambiguous and conflictive gambles but not in the risky gambles, in line with Hypothesis 5. Likewise, instrumental risk was positively associated with the random-effects coefficients that differentiate the valuation of the ambiguous and conflictive gambles from risky gambles. In other words, higher instrumental risk scores predicted greater valuation of conflictive and ambiguous gambles relative to risky ones. Functional impulsivity, on the other hand, positively predicted valuation only in risky gambles. That effect was reduced to insignificance in the ambiguous and conflictive gambles, in contrast to the Huettel et al. [15] finding that related functional impulsivity to ambiguity seeking.

The instrumental risk scale measures the extent to which people are willing to bear risks in the pursuit of goals or achievements, in contrast to enjoying risks for thrill or excitement. One consequence of this effect is that people scoring high on functional impulsivity value ambiguous and conflictive gambles more like a subjective expected utility agent. A goal-oriented attitude towards risk-taking may lessen the deleterious impact of missing information on the valuation of uncertain prospects, perhaps by motivating people to seek additional information about such prospects. This explanation is compatible with Lauriola and Levin's [5] surmise about the role of curiosity in ambiguity-seeking.

We have already suggested extending this study by comparing preferences as revealed in choice and pricing tasks. We conclude with three additional suggestions for future experimental research on this topic. The most severe limitation on our study is the restriction of the expected probability in the ambiguous and conflictive gambles to a single value (.5) and the prize to $10. Those restrictions make it impossible to ascertain whether devaluation of ambiguous and conflictive gambles is due to decreasing subjective utility, pessimistic down-weighting of probabilities, or both. Systematically varying the monetary amounts and expected values of the imprecise probabilities would enable separate estimation of probability weighting and subjective utility functions. Second, loss frames need to be studied as well as gain frames. Although Einhorn and Hogarth [24] found ambiguity aversion for loss frames, Smithson [2] found a reflection effect for conflictive scenarios in line with prospect theory's claim that people become risk-seeking under the prospect of loss. Third, the effects of ambiguous versus conflicting utility assessments have yet to be investigated. Taken together, these four suggestions offer a research program that should enrich our understanding of judgment and choice under imprecise probabilities.

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