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AN EXAMINATION OF AMBIGUITY AVERSION IN DECISIONS MADE BY DYADS

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Abstract

Ambiguity aversion has been widely observed in individuals' judgments. Using scenarios that are typical in decision analysis, we investigate ambiguity aversion for pairs of individuals. We examine risky and cautious shifts from individuals' original judgments to their judgments when they are paired up in dyads.

In our experiment the participants were first asked to specify individually their willingness-to-pay for six monetary gambles. They were then paired at random into dyads, and were asked to specify their willingness-to-pay amount for the same gambles. The dyad's willingness-to-pay amount was to be shared equally by the two individuals. Of the six gambles in our experiment, one involved no ambiguity and the remaining five involved ambiguity with different degrees of familiarity. We found that dyads exhibited both risk aversion as well as ambiguity aversion. Further, when facing ambiguity, dyads' willingness-to-pay amounts are sometimes more and sometimes less than the average paid by the individuals making up the dyad. The majority of the dyads exhibited a cautious shift in the face of ambiguity, stating a smaller willingness-to-pay than the two individuals' average. Our study thus confirms the persistence of ambiguity aversion in a group setting and the predominance of cautious shifts for dyads.

1. Introduction

A businessman recently asked one of us: “What can decision analysis research tell me about what price a team of executives in a competing firm would set for buying a business?” A number of firms were going to submit sealed bids for the business (the firm’s value could be represented as a lottery over monetary outcomes with ambiguous probabilities), and his firm was trying to decide upon their bid. A key feature of the real decision the businessman faced was the ambiguity of the probabilities, since they depended on future tax rulings. Further, their decision making process had each executive individually determine his/her bid price and then, through a group discussion, the group arrived at the firm’s bid price.

Much theoretical and experimental research in decision analysis has examined how *individuals* do and should make choices and set prices they are willing to pay for risky and ambiguous options. But, not as much focus has been placed by decision analysts on decisions made by *groups* of two or more, which is the common setting in business decision making. It would be helpful to understand the relationship between individuals’ decisions and group decisions by first examining the simplest setting of pricing a lottery. As a start in this direction, the primary question we address here via an experiment is “When decision makers make decisions in a group and are not provided with any decision aid, do they exhibit a cautious shift (a more risk averse price) when they face *ambiguous* probabilities?”

We envision that business executives (or their decision analysis consultants) might run a similar experiment (call it a business simulation) when they face an ambiguous price-setting task. Using the available, but ambiguous, information on the entity to be priced, groups of participants

could set their prices. The experiment results would then be input to a decision analysis model to aid the firm in setting its own price in the face of potential bids by others.

Ambiguity

In decisions under uncertainty the probabilities of the underlying events can often be imprecise, vague, or ambiguous. Ellsberg (1961) demonstrated that this can lead to *ambiguity aversion*, on top of any existing *risk aversion* of a decision maker. Camerer and Weber (1992) review the many studies that have examined how individuals react to probabilistic ambiguity. While much is now known about how an individual decision maker reacts to ambiguity, little is known about how groups of individuals react. Our primary aim in this paper is to examine whether ambiguity aversion persists in group decision making, and if it does, to quantify it.

Studies of people's decision behavior have shown that ambiguity affects choices in both simple-context tasks, such as choice between monetary gambles (Ellsberg, 1961; Slovic & Tversky, 1974; Curley, Yates & Abrams, 1986), and context-rich tasks, such as patient decision making (e.g., Curley, Eraker & Yates, 1984), use of accounting information to investigate cost variances (Ho, Keller, and Keltyka, 2001), managerial choices between options for allocating resources to earn returns (Ho, Keller, and Keltyka, 2002), other business decisions (e.g., Camerer & Weber, 1992; Einhorn & Hogarth, 1986; Hoch & Ha, 1986; Hogarth & Kunreuther, 1985; Taylor, 1995), and sports and politics (Heath & Tversky, 1991).

Group Risk Aversion

The literature on group risk aversion is large. Most articles focus on *risky and cautious shifts*, which refer to the shifts in the risk attitude as we go from individual decisions to group decisions. A risky shift means the group takes more risks than the average individual in the group, and a cautious shift means the opposite. Stoner (1968) presents a good account of these

shifts. Our experiment was designed to elicit individuals' and dyads' willingness-to-pay (WTP) for ambiguous gambles, to examine the effects of ambiguity directly.

An examination of ambiguity aversion necessitates an examination of risk aversion, to separate out the two effects. But the theory of risk sharing among individuals in a group is complex. An efficient risk sharing scheme may require further randomization beyond that of the underlying gamble (see for example, Pratt 2000). Furthermore, a group decision may be influenced in complex ways by *group dynamics*, especially if the size of the group is large (Shaw 1981). In an effort to limit such complexities, we chose to limit the group size to dyads (i.e., groups of two people). Many decisions are made by dyads, such as marriage partners, business partners, two-person teams with one marketing representative and one technical representative, etc. Further, we minimized the risk-sharing complexities by requiring the individuals to equally divide the cash inflows and outflows. Such equal sharing portrays a joint decision with the realization of the same outcome by all, and is common in organizational settings. Examples include joint decisions of a household, acquisition decisions by a team of managers, and committee decisions such as choice of a conference venue. These two restrictions helped us to better focus on ambiguity aversion.

Our Study

We test the following four hypotheses about risk aversion and ambiguity aversion, and risky and cautious shifts of dyads.

1. Dyads will display risk aversion while making decisions under risk.
2. Dyads will display ambiguity aversion while making decisions under ambiguity.

3. Dyads are more likely to make a cautious shift than a risky shift while making decisions under risk.
4. Dyads are more likely to make a cautious shift than a risky shift while making decisions under ambiguity.

The participants were a total of 70 MBA students who volunteered for our experiments at the University of California, Irvine and the University of Wisconsin-Parkside. At each campus the participants answered a questionnaire individually first and then were paired into dyads at random. The dyads filled in another questionnaire. The analysis of the responses affirmed all of the four hypotheses. Our experiments thus confirm the persistence of ambiguity aversion and the predominance of cautious shifts as we go from individuals to dyads.

This paper is organized as follows: A review of related literature is next, followed by the hypotheses. Then the method and the results are presented. The paper concludes with a detailed discussion of the observed shifts and the conclusion.

2. Research Background

Choice Shift Research

In the early 1960's, groups were found to exhibit so-called "risky shifts," being more risk-taking on the average than individuals on specific choice dilemma scenarios (Stoner 1961; Wallach, Kogan, & Bem, 1962). Rim (1967) and Swap and Miller (1969) examined risky shifts in dyads, and Bennett *et al.* (1973) examined the effects of group size on risky shifts. After this phenomenon had been named the "risky-shift phenomenon," groups facing different questions were seen to shift to greater caution, so-called "cautious shifts" (see, *e.g.*, Nordhoy, 1962). So the phenomenon was then called a "choice shift." Thus, there was "group exaggeration" or

“polarization” of risk-taking tendencies, rather than moderation. Davis *et al.* (1992) contains a discussion of group decision tasks and risk. BarNir (1998) also provided a review and meta-analysis and noted that larger groups are more likely to shift to risk. Houghton *et al.* (2000) examined cognitive biases of individuals and teams in judging risks and found that groups were more affected by the law of small numbers bias than were individuals. Such a result could lead to groups appearing more risk taking since they perceive the probability of failure to be lower than it really is.

In a related stream of research on two-person groups, DeDreu *et al.* (2000) review negotiation research involving dyads, see also Barry and Oliver (1996). Also, Allwood and Granhag (1996) compared confidence judgments by dyads versus individuals. Further, juries are groups facing ambiguity and risk. Studies of jury size (summarized in Davis 1992) calculated the probability of the jury verdict as a function of the probability of each individual’s verdict preference (among conviction, acquittal and hung jury).

The structure of the lottery can lead to different polarization results, even when there is no added social context. Davis, Kerr, Sussmann and Rissman (1974) conducted an experiment to gather individual and group decisions about the attractiveness ratings of duplex bets. Group shifts depended on the expected value of bets. Individual preference distributions were positively skewed for bets with negative expected values and negatively skewed for bets with positive expected values. Group distributions were exaggerations of the individuals. Bets with near zero expected value yielded no shifts. But then the group decisions clustered more closely (symmetrically) around the modal choice category. The social decision scheme model (Davis, 1973, 1982; Stasser, Kerr & Davis, 1980) was used to predict this data. Assuming a simple majority can essentially mandate the choice or else (lacking a majority) pluralities of subgroups

can get the group to choose their own preference with a probability equal to their proportion in the group, predicted group ratings match well the observed data. Zajonc *et al.* (1968) conducted a similar experiment with trial-by-trial choices among events.

Probabilistic Ambiguity Research

Ellsberg (1961) demonstrated the paradox that two options, which should be indifferent according to expected utility, will often not be indifferent if one has unambiguous probabilities and the other has ambiguous probabilities. Ellsberg's original example created ambiguity by not knowing how many balls of each color there were in an urn. In practical decisions, a probability can be ambiguous due to vagueness, imprecision, conflicting information, lack of knowledge, *etc.* Following Ellsberg, a number of studies have been conducted to investigate the effects of such ambiguity on individuals, see *e.g.*, Kahn and Sarin (1988). Hogarth and Kunreuther (1989), Kunreuther (1989), and Kunreuther *et al.* (1995) examine ambiguity in insurance decisions.

Little has been done to extend ambiguity research results to groups. Sarin and M. Weber (1993) discuss whether ambiguity effects found with a single person making a one-time choice or judgment persist in market settings with multiple people, acting individually, setting prices over multiple time periods. They found that the market setting did not generally eliminate ambiguity aversion. Zur Shapira (1993) discussed ambiguity in organizations. Carnes *et al.* (1996) compared individual and group tax accounting judgments in the face of ambiguous tax scenarios. Here ambiguity lies in the uncertainty of how the Internal Revenue Service would react to an accountant's judgment. When there was a high probability of taking a position favorable to a client, groups made a higher (risky) tax judgment (more favorable to the client). When there was a low probability, group decisions were lower (more conservative, less

favorable to the client) than were individual judgments. This is consistent with group polarization from choice shift research.

3. The Hypotheses

We test the following four hypotheses using the data gathered about individuals' and dyads' willingness-to-pay amounts (WTP) for specially designed risky and ambiguous gambles.

H₁. Dyads will display risk aversion while making decisions under risk.

Although this hypothesis has been addressed well in the literature, we repeat it here to examine the dyads' risk attitude for our specific unambiguous gamble question, since prior research has shown different results for different gambles.

H₂. Dyads will display ambiguity aversion while making decisions under ambiguity.

Although ambiguity aversion of *individuals* has been repeatedly shown in the literature, particularly for gambles involving monetary gains, it is unknown if this will persist in *groups*. In our experiment we compare prices for a gains-domain gamble involving ambiguous probabilities with an otherwise identical unambiguous gamble with precise probabilities.

H₃. Dyads are more likely to make a cautious shift than a risky shift while making decisions under risk.

A risky shift occurs when the amount a dyad is willing to pay for a gamble is more than the average willingness-to-pay amount of the two individuals. A cautious shift occurs in the opposite case. Stoner (1961) first reported risky shifts, and later (Stoner 1968) acknowledged that both risky and cautious shifts occur in group decision making. In the context of the unambiguous gamble we used in our experiment it is intuitive that the more risk-averse

individual in a dyad will find it easier to persuade the other individual to decrease his/her willingness-to-pay amount rather than the other way around. We therefore predict that a cautious shift will be more predominant.

H₄. Dyads are more likely to make a cautious shift than a risky shift while making decisions under ambiguity.

We next examine risky or cautious shifts in the context of pricing gambles with ambiguous probabilities. Based on the same intuitive reasoning as in the previous hypothesis, we predict that a cautious shift is more likely than a risky shift for ambiguous gambles.

4. Method

Participants

A total of 70 graduate business students volunteered for and completed the experiment at the University of Wisconsin-Parkside (in the Midwestern US) and the University of California, Irvine (in the Western US). The 26 students at Parkside and the 44 Irvine studentsⁱ were randomly paired into 13 and 22 dyads, respectively.

Procedures

In Part 1, each individual responded to three cases. Each case required a choice between two scenario options and a judgment of a willingness-to-pay (WTP) amount for each scenario. They also responded to questions on gender, graduate status, major, age, and familiarity with men's baseball and women's soccer. Upon turning in their part 1 responses, they were randomly paired with another participant to complete part 2 of the survey. In this part, they responded to the same cases as in part 1, except they had to decide together in a face-to-face meeting on a

choice and a WTP amount for each scenario option. Upon completing the three cases, the dyad wrote down the general approach they took in making their decision.

Survey

The appendix contains the texts for the three cases in part 1 (involving scenarios with known vs. unknown numbers of red vs. white balls, distances between cities in the U.S. vs. China and outcomes of a men's baseball game vs. a women's soccer match). The cases dealt with gambles that could pay off \$100 or \$0. They were assumedly similar gambles except that in each case one scenario option had presumably less ambiguous probabilities than the other. We designed the scenarios to vary in ambiguity so we could examine shifts in dyad's prices for the scenarios across varied levels of ambiguity. Following each case were the following questions:

1. Suppose you are to be given the choice of one game ticket.
Which ticket will you choose? (Ticket A, Ticket B, or Indifferent)
2. What is the most that you would pay for Ticket A?
3. What is the most that you would pay for Ticket B?

For example, in Case 1, we present Ellsberg's two-color problem: a participant could choose Ticket A, which allowed him/her to draw from Bag A with 50 white balls and 50 red balls. The participant would guess a color (white or red), then draw a ball out of the bag. If the ball matched the guessed color, the participant would win (hypothetically) \$100; if not, nothing was won.

With Ticket A the probability of winning \$100 is 0.5, so the expected value is \$50. Or, the participant could choose Ticket B, which allowed a draw from a 100-ball bag B with unknown numbers of red balls and white balls. Again, if the guessed color matches that drawn, \$100 is won; if not, nothing is won. With Ticket B, there is an ambiguous probability p of a white ball and $(1 - p)$ of a red ball. If a person thinks $p > 0.5$, then the white color should be

guessed and the expected value is $\$100p > \50 . If p is thought to be less than 0.5, the red color should be guessed and the $EV = \$100(1 - p) > \50 . If p is seen as 0.5, $EV = \$50$. Thus, with Ticket B, in all cases, $EV \geq \$50$. By construction, the probability in B is more ambiguous than the probability in A, and a “good guess” for each probability would be 0.5. Cases 2 and 3 are constructed similarly, except in each of the two scenarios in each case all probabilities are ambiguous. Case 2 dealt with distances in the US (assumed to be more familiar and less ambiguous because the subjects were in the US) and in China (conversely, assumed to be more ambiguous). By construction, a good guess for the probabilities would again be .5, since participants were to specify if a distance was less than or greater than 680 miles, when the true distances were within 10 miles of that number. Case 3 dealt with professional men’s baseball (assumed to be more familiar and less ambiguous) vs. women’s soccer.ⁱⁱ

For part 2, the texts were the same except the participants had to specify how much the team would be willing to pay for an option, when a correct prediction would yield each person \$100 and an incorrect prediction would yield each \$0. Each person had to pay exactly half of the total the team would pay. Thus, they faced the same monetary outcomes for each person as in part 1, except the pair had to decide together.ⁱⁱⁱ

5. Results

Table 1 contains the result we got for testing the first hypothesis:

H₁: Dyads will display risk aversion while making decisions under risk.

Table 1. WTP of Dyads under risk

| Scenario | <i>n</i> | Mean WTP/2 | Std. Err. | <i>p</i> -value |
|----------------------------|----------|------------|-----------|-----------------|
| Balls in bag - unambiguous | 35 | \$ 20.74 | \$ 2.87 | 0.0000 |

A dyad's WTP is divided by two to facilitate comparison with the individuals' WTP's. Since the mean WTP/2, namely, \$20.74, is less than the expected value of \$50, it confirms that dyads display risk aversion. The average risk premium is thus $\$50 - \$20.74 = \$29.26$. Since the standard error is only \$2.87, the hypothesis H_1 is confirmed with a p -value less than 0.0001.

The second hypothesis is:

H₂. Dyads will display ambiguity aversion while making decisions under ambiguity.

We used the unambiguous and ambiguous "balls in bag" gambles to test this hypothesis. We calculated a dyad's ambiguity premium as: willingness-to-pay for the unambiguous gamble minus the willingness-to-pay for the ambiguous gamble. The average ambiguity premium of \$9.96 and its standard error are in Table 2. The average ambiguity premium is significantly more than zero, confirming H_2 with a p -value less than 0.0001. Thus, on average, the dyads implicitly are willing to pay a risk premium of \$29.26 and an extra \$9.96 on top of that as an ambiguity premium.

Table 2. Ambiguity Premium of Dyads

| Scenario | n | Ambiguity Premium | Std. Error | p -value |
|---------------|-----|-------------------|------------|------------|
| Balls in bags | 35 | \$ 9.96 | \$ 2.26 | 0.0000 |

The third hypothesis is:

H₃. Dyads are more likely to make a cautious shift than a risky shift while making decisions under risk.

We used the unambiguous “balls in bag” gamble to test this hypothesis. The frequencies of risky and safety shifts in this scenario are shown in Table 3. As seen in the table, H_3 is confirmed with a p -value less than 0.0001.

Table 3. Risky and Cautious Shifts under Risk

| Scenario | n | #Cautious shift | #Risky shift | p -value |
|----------------------------|-----|-----------------|--------------|------------|
| Balls in bag - unambiguous | 35 | 23 | 4 | 0.0000 |

Note that the #cautious shifts and #risky shifts need not (and does not) equal $n=35$ since some dyads’ willingness to pay could equal the average of their individual WTP amount.

Our fourth hypothesis is:

H₄. Dyads are more likely to make a cautious shift than a risky shift while making decisions under ambiguity.

The relevant results are tabulated in Table 4.

Table 4. Risky and Cautious Shifts under Ambiguity

| Scenario | n | #Cautious shift | #Risky shift | p -value |
|---------------------------------|-----|-----------------|--------------|------------|
| Balls in bag - ambiguous | 35 | 18 | 11 | 0.0447 |
| Distance between US cities | 35 | 23 | 5 | 0.0000 |
| Distance between Chinese cities | 35 | 25 | 5 | 0.0000 |
| Men's Baseball outcome | 35 | 18 | 12 | 0.0736 |
| Women's Soccer outcome | 35 | 18 | 15 | 0.2363 |
| Aggregate | 175 | 102 | 48 | 0.0000 |

In the aggregate, H_4 is confirmed with a p -value less than 0.0001. Table 4, however, reveals that in some specific scenarios (women’s soccer in our study), it is possible that cautious and risky shifts are equally likely to be observed.

6. Detailed Discussion of Observed Shifts

In each lottery in the experiment one can win a prize of $\$x$ (written simply as x) with probability p where p may be unambiguous or ambiguous. Let us denote the two individuals in a

dyad by subscripts 1 and 2. For the points we wish to make in this discussion a simplified expected utility approach will suffice, and that is the approach we shall take here. More technical discussions of optimal risk and ambiguity sharing using a non-expected utility approach can be found, for example, in Epstein (2001) and Chateauneuf *et al.* (2000). In a typical ambiguous scenario of our experiment, the two individuals could solve the equations (1) to find their individual WTP amounts y_1 and y_2 .

$$\begin{aligned}
 p_1[u_1(w_1 + x - y_1)] + (1 - p_1)[u_1(w_1 - y_2)] &= u_1(w_1) \\
 p_2[u_2(w_2 + x - y_2)] + (1 - p_2)[u_2(w_2 - y_2)] &= u_2(w_2)
 \end{aligned} \tag{1}$$

In the above equations, p_1 & p_2 are the ‘ambiguity-adjusted’ subjective probabilities of winning the prize, u_1 & u_2 are the utility functions and w_1 & w_2 are the initial wealths. When p is unambiguous, we have $p = p_1 = p_2$. The smaller the y , the more risk averse is the individual, at least as far as this experiment is concerned.

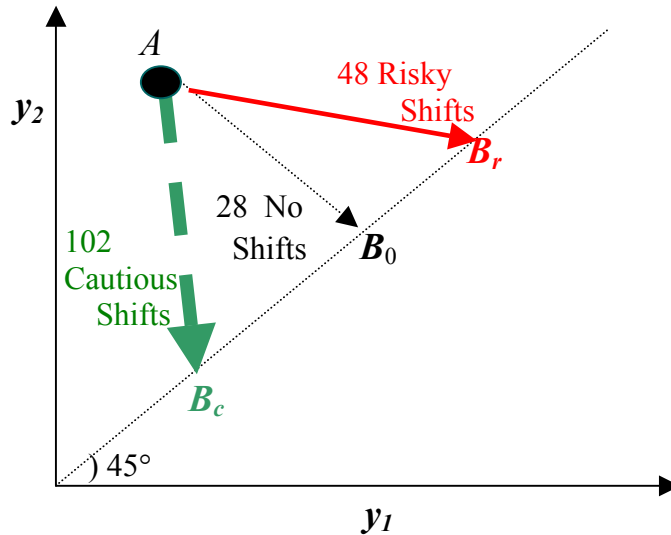
When the individuals are paired into dyads, the gamble is winning a prize of $2x$ with probability p , where p , once again, may be unambiguous or ambiguous. The dyad’s WTP of $2y$ is to be shared equally between the two individuals, as well as the prize money of $2x$. Thus the dyad had to solve (1) for each individual with the constraint that y must be the same for both. More explicitly, the individuals have to solve (2), where z_1 and z_2 denote how much utility each individual was willing to give up to arrive at a group decision. (A z value can be negative.) The process requires an implicit choice of z_1 and z_2 which requires discussion, negotiation and compromise between the two individuals.

$$\begin{aligned}
p_1[u_1(w_1 + x - y)] + (1 - p_1)[u_1(w_1 - y)] &= u_1(w_1) - z_1 \\
p_2[u_2(w_2 + x - y)] + (1 - p_2)[u_2(w_2 - y)] &= u_2(w_2) - z_2
\end{aligned}
\tag{2}$$

Once again, in the case of unambiguous p , we have $p = p_1 = p_2$. Further, if the individuals shared some information about the probability distribution of the underlying gamble and revised their beliefs about the distribution, then p_1 and p_2 in equations (2) can be different from those in equations (1).

When the value of y in (2) is less than the average of y_1 and y_2 in (1), the dyad is willing to pay less than what they paid individually, which implies a cautious shift. When y is more than the average, it is a risky shift. And, when y equals the average, we shall say there is no shift. Our experiments focused on the question of which shift is more likely. To visualize y , y_1 , and y_2 , as well as the shift, we use Figure 1.

Figure 1. Risky and Cautious Shifts under Ambiguity



In Figure 1, A represents the point corresponding to the two individual WTP positions and B represents the point corresponding to the dyad's position. B has to lie on the 45 degree line due to equal sharing. The point B_0 represents the dyad's position where y equals the average of y_1 and y_2 , and therefore no shift. B_c represents a cautious shift and B_r represents a risky shift. Across the 5 scenarios involving ambiguity, 102 pairs exhibited a cautious shift, 25 pairs exhibited no shift, and 48 pairs exhibited risky shifts.^{iv}

For $y_1 < y < y_2$, referring to equations (2), z_1 is positive and z_2 is negative, or, individual 1 loses some utility while 2 gains some. As y reduces, individual 1 loses less and 2 gains more. We can therefore reasonably expect the individuals to be more willing to reduce y below the average of y_1 and y_2 than to increase y above the average. We therefore hypothesized that a cautious shift is more likely than a risky shift. It is not impossible, especially in cases involving ambiguity, for y to go below y_1 or exceed y_2 . This could be due to some new knowledge the dyad may gain about the probability p or some other aspect of the situation.

7. Conclusion

We examined willingness to pay for gambles involving risk and ambiguity made by individuals and dyads. As the results showed, dyads did display risk aversion and ambiguity aversion, and they were more likely to display a cautious shift than a safety shift under both risk and ambiguity.

Our study was restricted in at least three important aspects. First, the group was limited to dyads. Many decisions are made by dyads, such as marriage partners, business partners, etc., though larger groups are common and might exhibit more complex attitudes toward risk and ambiguity. Second, a dyad's willingness-to-pay amount was required to be equally shared by the

two individuals, as was the group payoff. Showing the same decision outcome among the whole group is common in organizational settings. Examples include joint decisions of a household, acquisition decisions by a team of managers, and committee decisions such as choice of a conference venue. Differential sharing of the cash flows with side payments and further randomization is possible. Such sharing might affect risky and cautious shift patterns. Third, the underlying gamble was winning a prize with an ambiguous probability p . More complex gambles with many different outcomes can also affect the behavior of groups. Future research may take up the case of larger group sizes, unrestricted risk/ambiguity sharing among individuals and other types of underlying gambles.

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Author Notes

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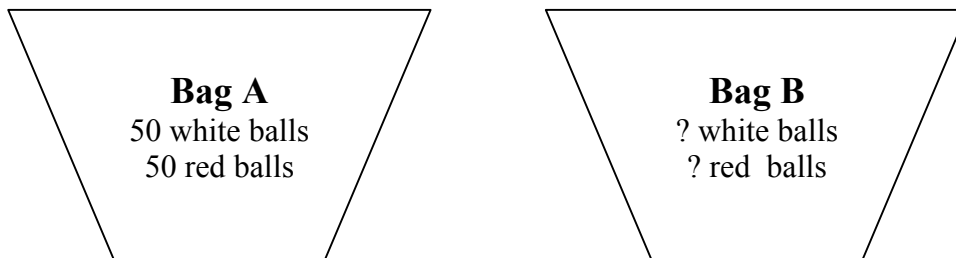
APPENDIX

Texts for Three Cases

Case 1

Imagine that there is a bag on the table (**Bag A**) filled with exactly 50 white balls and 50 red balls, and a second bag (**Bag B**) filled with 100 balls with some that are white and some that are red, but you do not know their relative proportion.

Suppose that you are offered a ticket to a game that is to be played as follows: First, you are to guess a color (white or red). Next, without looking, you are told to draw a ball out of one of the bags. If you draw the ball matching the color you predicted, then you will win \$100; otherwise you win nothing.



Ticket A: You will draw from Bag A with 100 total balls
(with 50 red and 50 white balls.)

Ticket B: You will draw from Bag B with 100 total balls
(with an unknown number of white and red balls.)

Case 2

Imagine that there are two game tickets.

Ticket A: You guess whether the air distance between San Francisco and Seattle is less than 680 miles (1094 km) or more than 680 miles (1094 km.). If you are right, you win \$100.

Ticket B: You guess whether the air distance between Shanghai and Beijing is less than 680 miles (1094 km) or more than 680 miles (1094 km.). If you are right, you win \$100.

Case 3

Imagine that there are two game tickets.

Ticket A: You guess the winner of the August 23, 1999 professional baseball game between the Los Angeles Dodgers and the Milwaukee Brewers. You have to make your guess now. If you are right, you win \$100. (If the other team wins or there is a tie, you get nothing.)

Ticket B: You guess the winner of the June 20, 1999 Women's World Cup soccer match between North Korea and Nigeria. If you are right, you win \$100. You have to make your guess now. (If the other team wins or there is a tie, you get nothing.)

Footnotes

ⁱ UC-Irvine students received \$5 each for participation in the experiment.

ⁱⁱ Based on participants' responses, women's soccer was more familiar than baseball for only 3 out of 70 subjects. Women's soccer was more familiar to none of the Wisconsin subjects (21 were more familiar with baseball and 5 were equally familiar with both) and to 3 of the California subjects (23 were more familiar with baseball and 18 were equally familiar).

ⁱⁱⁱ The experiments were conducted April 13, 1999 in Wisconsin and April 21, 1999 in California. Nigeria beat North Korea, 2-1, in the Rose Bowl in Pasadena, California on June 20, 1999. The USA Women eventually won the World Cup. The Los Angeles Dodgers professional men's baseball team beat the Milwaukee Brewers by 8 to 4 on August 23, 1999. The distance between San Francisco and Seattle is 679 miles (via United Air flight 2106) and between Beijing and Shanghai is 670 miles (via China Eastern Airline flight 5162). Chow and Sarin (2001) used scenario 1 in an experiment on ambiguity; they found an ambiguity premium for individuals (UCLA undergraduates) of \$15.07 when participants compared two gambles, as did our participants, and an implicit premium of \$9.45 when different people judged the two gambles.

^{iv} For figures with the data for each dyad, see "An Examination of Risk and Ambiguity Aversion in Decisions Made by Dyads," Keller, Sarin, & Souderpandian, Working Paper, UC Irvine, Institute for Math. Behavioral Sci., 2001.