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Abstract:

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Loving the Longshot: Risk Taking with Skewed Gambles

1. Introduction

Until very recently, the most popular means of measuring risk attitudes has been a variation on the two-stage preference-revelation mechanism developed by Becker, DeGroot and Marschak (1964). This mechanism asks subjects to choose a selling price for a lottery. A randomly drawn value then determines whether the subject sells the lottery (if the drawn price exceeds the subject's price) or plays the lottery.

Recently, several additional measures have received attention. Eckel and Grossman (2002, 2008) developed a simple task for measuring risk preferences. Subjects are shown five gambles and asked to choose which of the five they wish to play. The gambles include one sure thing with the four remaining gambles increasing (linearly) in expected payoff and risk (measured by the standard deviation of expected payoff).[1] Grossman and Lugovskyy (2008) and Grossman (2009) added a sixth gamble with the same expected payoff as the fifth gamble but with higher risk. Its inclusion was to distinguish between those subjects who might be only slightly risk averse, and therefore inclined to select lottery five, and those subjects who are risk seekers, and therefore inclined to select lottery six. All gambles were 50/50 gambles. The instrument was designed to keep the task as simple as possible and the use of only 50/50 gambles is easy for subjects to understand; expected payoffs are easy to calculate. The increase in variance associated with an increase in expected value is high enough to get subjects' attention.

Holt and Laury (2002) also use a lottery-choice task. In their mechanism subjects make

[1] This measure is similar to that developed by Binswanger (1980, 1981) for use in rural India. He asked subjects to make binary choices between pairs of 50/50 gambles. As with the Eckel and Grossman measure, gains in expected value can be had only with an increase in risk (standard deviation). His choice set was somewhat more extensive, and included two dominated lotteries. Within the undominated gambles, expected payment has a nonlinear (convex) relationship to risk.

multiple choices between pairs of lotteries that vary in risk and return. This mechanism imposes a finer grid on the subjects' decisions, and so produces a more refined estimate of the relevant utility function parameters. However, this comes at a cost of increased complexity, which may lead to nosier behavior.[2]

The advantage of these measures of risk preferences is their relative simplicity, focusing on expected returns and variance. Opting for simplicity, though, means forgoing the ability to address some of the broader aspects of risk addressed in financial economics (see, for example, Alderfer and Bierman, 1970; Harvey and Siddique, 2000; Kraus and Litzenberger, 1976; and Moskowitz and Vissing-Jørgensen, 2002). For example, none of the risk measures currently in use are able to address preferences over positive skewness, which various studies have shown to be favored by gamblers and investors (see, respectively, Garrett and Sobel, 1999, and Åstebro, 2003).[3]

A preference for skewness is suggested by the popularity of state lotteries. Both the number of states with lotteries and the revenues generated by lotteries have been increasing. State lotteries began in 1964 with New Hampshire. Currently 42 states and the District of Columbia have some form(s) of a state lottery. Revenues have increased from $12 billion in 1986 to $48 billion in 2004. The popularity of state lotteries is difficult to understand; the payout rates are low and the odds of winning are slim. With lotteries paying out $0.50 for every $1 played, a gambler's expected earnings are negative.[4]

For this paper we have adapted the Eckel and Grossman (2002, 2008) risk measure (with

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[2] Dave et al. (2008) find that while more complex elicitation methods have superior predictive accuracy, this accuracy comes at the cost of nosier behavior.

[3] Througout this paper our concern is with positive skewness. Unless otherwise indicated, skewness should be taken to mean positive skewness.

[4] However, as Thaler and Ziemba (1988) note, $0.50 is a small price to pay for a fantasy.

six gamble choices) to incorporate skewness. The Eckel and Grossman measure is the simplest possible task that gives sufficient heterogeneity in choices and at the same time minimize errors. Its simplicity also makes it easy to adapt. The adapted gamble choices are designed to have the same expected payoffs and risk as the original gamble choices, but to exhibit increasing degrees of right skewness. The adapted instrument is used to address three questions:

1) Do people prefer skewness? When given a choice between a symmetrical gamble (i.e., skewness = 0) and a positively skewed gamble (i.e. skewness > 0) with equal expected earnings and risk, which will they choose?

2) Does skewness encourage greater risk taking? Does the possibility of winning a high-earnings, long shot entice people into greater overall risk taking? The existence of positive skewness may encourage people to take greater risks than they would in the absence of skewness; and

3) Do men and women differ in their preferences regarding skewness? Considerable evidence exists suggesting that women are more risk averse than men (for a review see Eckel and Grossman, 2008). To our knowledge no study has addressed the issue of skewness and whether or not this differentially affects the risk attitudes of men and women.

2. Literature Review

That risk-averse individuals play unfair gambles is a conundrum that a number of authors have attempted to explain. Freidman and Savage (1948) suggested that the prospect of significantly improving one's standard of living could induce risk-averse individuals to play unfair gambles. Kahneman and Tversky (1979) argued that in placing decision weights on the probability of each

possible outcome, people tended to overweight low probabilities and underweight high probabilities. Overweighting low probability makes unfair gambles attractive. Quiggin (1991) employs a rank-dependent utility function to explain why risk-averse people might play unfair gambles such as lotteries. If the lottery is comprised of a large number of smaller prizes and a few large prizes, risk-averse individuals could find it worthwhile playing.

Analysis of actual gambling behavior has been undertaking by a number of researchers. Ali (1977) examined betting on horse races and concluded that high probability horses were underweighted and low probability horses were over weighted. Applying a utility function defined over mean and variance, and assuming bettors are sophisticated, Ali concluded that bettors at horse tracks were risk lovers.

Golec and Tamarkin (1998) offer a different interpretation of Ali's findings. They suggest a utility function defined over mean, variance, and skewness with bettors having a preference for positive skewness; bettors are willing to forgo a higher mean in return for a high positive skewness. Like Ali (1977), Golec and Tamarkin examine betting on horse races. They conclude that bettors are skewness lovers not risk lovers trading off expected return for positive skewness.[5]

Garrett and Sobel (1999) offer further evidence that bettors favor positive skewness. They examine data for all lottery games played in the United States. They argue that, since many more people play state lotteries than bet on horse races and that the prize structure of lottery games is much more skewed than payoffs in horse races, lotteries offer a better test of individuals' risk preferences. Their analysis suggests "… that lotteries players, like horse race bettors, are risk averse but favor positive skewness (p.88)."

[5] Cain et al. (2002) argue that Golec and Tamarkin's (1998) argument is not general. They propose an alternative utility function (one proposed by Markowitz, 1952) and find expected utility decreasing in positive skewness.

Haisley et al. (2008) use two experiments to consider whether or not the preference for skewness differs with income. In their first experiment they manipulate feelings of relative income to test the hypothesis that people who feel relatively poor are more likely to purchase lottery tickets. The tickets "… may be seen as a means to correct for low-income status (p. 285)." For their second experiment, Haisley et al. hypothesize that members of the lower classes, feeling that their lower status prevents them from having the same opportunities as higher class individuals, more frequently purchase lottery tickets. A lottery, where everyone has an equal chance of winning serves as a "social equalizer". It gives the lower class member a chance to correct for his low standing. Haisley et al. find that subjects who were made to feel they had relatively high income purchased significantly fewer lottery tickets than did subjects who were made they had relatively low income. Individuals in the experimental group, who were primed to consider the advantages of the nonpoor bought significantly more lottery tickets than individuals in the control group.

The most relevant paper for our study is Brünner et al. (2007). In their study Brünner et al. modified the Holt and Laury (2002) lottery choice task. Subjects were presented with 20 lottery pairs that, with the exception of two, have the same means and standard deviations, but different degrees of skewness. Subjects selected, for each of the 20 pairs, which of the paired lotteries they wanted to play. One of the 20 pairs was selected at random and that lottery was played to determine a subject's earnings. Brünner et al. report that approximately 39 percent of their 99 subjects selected the lottery with the higher skewness in 15 or more of the 20 rounds and only 10 percent of the subjects selected the lottery with the higher skewness in less than six rounds. Brünner et al. conclude that "…this is clear evidence that for many participants skewness is a positive factor in their decision-making process (p. 9)."

The Brünner et al. study differs from this study in a number of ways. First, the lotteries choices in Brünner et al. do not include any "extreme" long shots; the smallest probability is 10 percent. In this study, the long shot has only a 1 percent chance of occurring. Second, Brünner et al. have both lotteries with positive skewness and lotteries with negative skewness. Although it is not stated explicitly, it appears that when they refer to "greater skewness" they mean higher positive skewness. Third, the Brünner et al. study is unable to tell if skewness encourages people to take on more or less risk. Finally, Brünner et al. do not address gender differences in the preference for skewness.

3. Experimental Design and Procedures

All sessions were conducted in the SCSU Department of Economics Research and Teaching Laboratory. Subjects were recruited by email and posters to participate in a three-part experiment and participation was on a first-come, first-served basis. Subjects were randomly assigned to a computer station and 5-digit identification number. The subjects signed a consent form and the proctor read aloud a statement welcoming the subjects, providing general instructions regarding logging on to the experiment website, and prohibiting the use of calculators for the mathematical literacy questions. Subjects then proceeded through the various tasks at their own pace. Ten sessions were conducted with between three and twelve subjects.

Part 1 of the experiment consisted of the Weber et al (2002) 50 statement, domain-specific risk-attitude scale (DSRAS). The DSRAS assesses risk attitudes in five domains: financial (gambling and investing), health/safety, recreational, ethical, and social decisions. Subjects indicated on a five-point Likert scale their likelihood of engaging in each activity (1 = extremely unlikely; 5 = extremely likely). Sample statements include:

Arguing with a friend, who has a very different opinion on an issue (Social).

Investing 10% of your annual income in a very speculative stock (Financial).

Buying an illegal drug for your own use (Health).

Chasing a tornado by car to take photos that you can sell to the press (Recreational).

Cheating on an exam (Ethical).

Subjects are told that they will earn $12 for completing the survey, but that this money may be at risk in a later part of the experiment.

For Part 2, Task 1 of the experiment, subjects are first presented with the six-gamble Eckel and Grossman (2002, 2008) lottery experiment (the first four columns of Table 3). Probabilities were presented visually as pie charts (see Figure 1). Note that each gamble had a 50 percent chance of a low payoff and a 50 percent chance of a high payoff. Subjects selected their preferred lotteries. This provided a baseline measure of the subjects' risk attitudes in the absence of skewness.

For Task 2, subjects were presented with six additional gambles having the same expected earnings and risk as the corresponding Task 1 gambles but now with a positive level of skewness (see Table 2 and Figure 2 for the gamble details and the visual presentation, respectively). Each gamble had a 50 percent chance of a low payoff, a 49 percent chance of a "moderate" payoff, and a 1 percent chance of a large payoff (the long shot). Subjects could choose to: 1) keep their original Task 1 choices, 2) move directly down to the gambles with the same expected payoff and risk but with positive skewness, 3) move down and to the left trading risk for skewness, or 4) move down and to the right accepting both skewness and more risk.
For Task 3, subjects were presented with six additional gambles having the same expected earnings and risk as the corresponding Tasks 1 and 2 gambles but now with an even higher level

of positive skewness (see Table 3 and Figure 3 for the gamble details and the visual presentation, respectively). Again, subjects could choose to: 1) keep their Task 2 choices, 2) move directly down to the gambles with the same expected payoff and risk but with a higher level of skewness, 3) move down and to the left trading risk for skewness, or 4) move down and to the right accepting both skewness and more risk. The gambles selected in Task 3 were the gambles the subjects played to determine their earnings.

In Part 3 of the experiment, subjects completed a survey collecting subjects' socio-economic information, risk assessments regarding natural disasters, math competency, and time consistency (see Appendix for survey questions). Once all subjects had completed all tasks, subjects were called one at a time to the proctor's station. The subject spun a bingo ball cage containing balls numbered from 1 – 100. Drawing a ball numbered from 1-50 earned the subject the low payoff; a ball numbered from 51-99 earned the subject the moderate payoff, and a ball numbered 100 earned the subject the high payoff. The subjects completed a receipt form, were paid, and were free to go.

4. Results

4.1. Subject Characteristics

A total of 93 subjects participated in 10 sessions. A summary of the subjects' characteristics is reported in Table 4. The average age of the subjects was 21.7 years. Approximately 60 percent are males, 55 percent work at least part-time, and 95 percent listed themselves as full-time students.[6] Over 90 percent of the subjects were undergraduates; 42 percent were White with the

[6] We attempted to recruit a more gender balanced sample (by holding female only sessions, etc.) but women did not volunteer as frequently as did men. When we attempted to conduct gender even sessions (i.e. the first 5 men and the first 5 women were seated) more men than women tended to show up. After waiting a reasonable length of time for more women to appear, the session was filled with the surplus men.

next largest group Asian Non-Indian. Eighty seven percent of the subjects do not live with their parents, 85 percent consider their family's relative income (with other SCSU students' families being their reference) to be between somewhat below average and somewhat above average but 68 percent considered their own personal finances to be poor or not so good. As part of the session, subjects were asked to answer six mathematics questions (see Figure 4). The average number correct was 3.52.[7] Consistent with the St. Cloud, Minnesota region, where SCSU is situated, Catholics comprised the largest religious group. Non-religious and Hindu were the next two largest groups.[8] While many subjects indentify with a religion, less than half attend religious services regularly (i.e. once or more a month). Finally, approximately 25% of the subjects practice a religion that prohibits gambling and 45 percent have never played the lottery. The religious prohibition on gambling may influence the subjects' choices in the gambling exercise.

4.2. Task 1 Choices

Table 5 reports Task 1 (skewness = 0) gamble choices by gender. Consistent with the findings of Eckel and Grossman (2002) we find that women are significantly more risk averse than men. Men's mean gamble choice was 3.60 approximately one gamble choice higher than women's mean gamble choice of 2.56. Both a means test and a χ^2 contingency table test reject the null that gamble choice is independent of gender.

To control for other factors that may influence a subjects' gamble choice we estimated an ordered Probit model. In addition to the gender variable (Female), we controlled for age (AGE), race (Caucasian); Relative Family Income, Personal Finances, Religion Prohibits Gambling, Play

[7] Subjects were not permitted to use calculators. Seven math questions were asked but the answers of one were inadvertently not recorded.
[8] SCSU has a large contingent of Nepalese students which helps to explain the high percentages of Buddhist and Hindu subjects.

the Lottery, if the subject has either a full- or part-time job (Employed), Lives with Parents, their college (Science and Engineering is the control group), and their number of correct answers on the six mathematical questions (Math). Results are reported in Table 6. We estimate the model for all subjects and for men and women separately.

The regression results for the complete sample confirm the gender difference in gamble choices. Women are significantly (1 percent level or better) more likely to choose the less risky gambles. Specifically, women are 16 percent more likely to choose gamble 1, the sure thing, and 10 percent more likely to choose gamble 2 than their male counterparts (Table 7 reports the marginal effects for the significant variables).[9] Regarding the riskier gambles, women are 5 percent less likely to choose gamble 6 and 13 percent less likely to choose gamble 5 than the men. Subjects who live with their parents are significantly (10 percent level or better) more risk averse than those who do not live with their parents; they are 17 percent more likely to choose the risk free gamble 1 and 11 percent less likely to choose gamble 5. Even after controlling for subjects' math abilities, students in the Colleges of Education and Fine Arts and Humanities are more risk averse than students from the Science and Engineering College; they are 36 percent and 22 percent more likely to select gamble 1 and 15 and 12 percent less likely to choose gamble 5. While the remaining variables have insignificant coefficients, in some cases the sign are consistent with what might be expected. For example, since playing the lottery reveals a preference for risky gambles, the positive sign for the variable Plays The Lottery is to be expected. Likewise, for subjects whose religion prohibits gambling, the negative coefficient is expected. Finally, students whose relative family income is above average, whose personal finances are good, and who have a job are more likely (insignificantly) to choose riskier gambles.

[9] Complete results available upon request.

Comparing the regression results for women and men separately some interesting differences emerge. For men, the only significant variable is Lives With Parents. Men who live with their parents are significantly more risk averse (20 and 15 percent more likely to choose either gambles 1 or 2, respectively, and 21 percent less likely to choose gamble 5) than men who do not live with their parents. Women studying in the disciplines of social sciences, education, and fine arts and humanities are more risk averse (47, 67, and 49 percent more likely to choose gamble 1, respectively) than their business and science and engineering counterparts. Women who assessed their family income to be relatively high are less risk adverse (23 percent less likely to select gamble 1 than those women who assessed their family income to be relatively low.

4.3. Task 2 Gamble Choices

Task 2 gamble choices show a strong preference for positive skewness. Of the 93 subjects, 78 (83.9 percent) moved from a no skewness gamble choice to a gamble choice with skewness (see Table 8).[10] Men showed a stronger preference for skewness than did women. Fifty two (91 percent) of the men moved from a no skewness choice to a choice with skewness while only 27 (75 percent) of the women made such a move. A χ^2 contingency table test reject the null that the choice of a skewed gamble is independent of gender ($p = 0.027$).

Ignoring the skewness factor for a moment and just comparing the riskiness of the gamble choice (defined by standard deviation), the introduction of skewness did not significantly increase risk taking; the mean gamble choice increased from 3.19 in Task 1 to 3.34 in Task 2 but the difference is not significant (paired two-sample means test t-statistic = 1.64, $p = 0.104$; Wilcoxon Matched-Pairs Signed Rank (WMP) test $p = 0.140$). The mean gamble choices of men and women both increased: from 3.60 to 3.72 and from 2.56 to 2.75, respectively. The increases

[10] We include as a no skewness gamble choice gamble 1 choice.

in risk taking were both insignificant (the paired two-sample means tests t-statistics = 0.98 and 1.48, p = 0.331 and 0.147; WMP p = 0.326 and 0.175, respectively). The difference between men and women in risk taking is still significant: both a means test and a χ^2 contingency table test reject the null hypothesis that the Task 2 gamble choice is independent of gender ($p < 0.001$ and $p = 0.042$, respectively).

Looking at the data a bit more carefully does reveal some interesting gender differences in the responses to skewness. The majority of women (66.7 percent) did not alter their level of risk taking in response to the introduction of skewness (see Table 9). Twenty two percent increased their level of risk taking and 8.3 percent reduced their level of risk taking.[11] Over half of the male subjects changed their risk exposure with the introduction of skewness. Men's responses were more varied than women's: 22.8 percent reduced their risk exposure, 42.1 percent did not change their risk exposure, and 35.1 percent increased their risk exposure.[12] A χ^2 contingency table test rejects the null that the change in risk taking in response to skewness is independent of gender ($p = 0.089$).

4.4. Task 3 Gamble Choices

Task 3 gamble choices show preference for even greater positive skewness. Of the 93 subjects, 73 (78.5 percent) moved from a either a no skewness gamble choice or a gamble choice with skewness = 1 to a gamble choice with skewness = 2 (see Table 10).[13] Men and women did not differ significantly in their preference for the more skewed gamble choices: 46 (81 percent) of the men and 27 (75 percent) of the women moved from either a no skewness choice or a choice with skewness = 1 to a choice with skewness =2. A χ^2 contingency table test cannot reject the

[11] Five moved up one gamble choice, three moved up two gamble choices; one moved down two gamble choices, two moved down one gamble choice.
[12] Three moved down two gamble choices, ten moved down one gamble choice; 17 moved up one gamble choice, three moved up two gamble choices.
[13] We include as a no skewness gamble choice gamble 1 choice.

null hypothesis that the choice of a gamble with skewness = 2 is independent of gender (p = 0.163).

Again, if we ignore the skewness factor and just comparing the riskiness of the gamble choice (defined by standard deviation), the increase in skewness significantly increased risk taking with the mean gamble choice by all subjects increasing from 3.34 to 3.58 (paired two-sample means test t-statistic = 3.27, p = 0.002; WMP p = 0.004). While both men's and women's risk taking increased, only risk taking by men increased significantly. Men's mean gamble choice increased from 3.72 to 3.98 (paired two-sample means test t-statistic = 3.24, p = 0.002; WMP p = 0.008). Women's mean gamble choice increased from 2.75 to 2.94 (paired two-sample means test t-statistic = 1.42, p = 0.165; WMP p = 0.206).[14] The difference between men and women in risk taking is still significant: both a means test and a χ^2 contingency table test reject the null hypothesis that the Task 3 gamble choice is independent of gender (p < 0.001 and p = 0.013, respectively).

The majority of men and women (61.4 and 69.4 percent, respectively) did not alter their level of risk taking when skewness increased from 1 to 2. Of those who did change their risk exposure, men were more likely to take on more risk (31.6 of the men and 22.2 percent of the women increased their risk exposure). Men and women were equally likely to reduce their risk exposure (7 percent of the men and 8.3 percent of the women reduced their level of risk exposure).[15] A χ^2 contingency table test rejects the null that the change in risk taking in response to skewness is independent of gender (p = 0.089).

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[14] The increase in mean gamble choice between Task 1 and Task 3 was significant for the complete sample and for both men and women (paired two-sample means tests t-statistics = 3.91, 2.98 and 2.50, p = 0.0001, 0.004 and 0.017, respectively.

[15] Six women moved up one gamble choice, one moved up two gamble choices and 1 moved up two gamble choices; one moved down two gamble choices, one moved down one gamble choice. Seventeen men moved up one gamble choice, one moved up two gamble choices; none moved down two gamble choices, four moved down one gamble choice.

We again estimate an ordered Probit model of all three task's decisions to control for other factors besides gender that may influence a subjects' gamble choice (the model is estimated for all subjects and for men and women separately). The interdependency of predictions from each predictor is controlled for by clustering the standard errors on the individual level of predictors. In addition to the gender variable (Female), we controlled the task (TASK), for the degree of skewness, for age (AGE), race (Caucasian); Relative Family Income, Personal Finances, Religion Prohibits Gambling, Play the Lottery, if the subject has either a full- or part-time job (Employed), Lives with Parents, the subject's college (Science and Engineering is the control group), and the number of correct answers on the six mathematical questions (Math). Results are reported in Table 12.

The results for the complete sample indicate that, after controlling for other factors, subjects neither significantly increase nor decrease their risk taking when presented with gambles with skewness. The results also again confirm the significantly greater risk aversion of women relative to men. Women are 12 and 14 percent more likely to select gambles 1 and 2, respectively, and 15 percent less likely to select gamble 5 than men (marginal values, for significant variables only, are reported in Table 13).[16] Subjects who live with their parents are also significantly more risk adverse (16 and 13 percent more likely to select gambles 1 and 2, respectively, and 14 percent less likely to select gamble 5). Education majors are significantly more risk adverse than other students (32 and 13 percent more likely to select gambles 1 and 2, respectively and 17 percent less likely to select either gamble 4 or 5).

Comparing the regression results for men and women separately we again find some interesting differences. Women in the social sciences and education are more risk averse than other college women. Social science majors are 20 percent more likely to select gamble 1 and 10

[16] Complete results available upon request.

percent more likely to select gamble 2 than other women. They are also, 16 percent less likely to select gamble 4. Female education majors are 55 percent more likely to select gamble 1 and approximately 20 percent less likely to select gambles 3 or 4. Women who assessed their family income to be relatively high are less risk adverse (14 percent less likely to select gamble 1 and 11 percent less likely to select gamble 2 than those women who assessed their family income to be relatively low. They are also 14 percent more likely to select gamble 4. Men who live with their parents are significantly more risk averse (17 and 20 percent more likely to choose either gambles 1 or 2, respectively, and 24 percent less likely to choose gamble 5) than men who do not live with their parents. Men majoring in the fine arts and humanities are more risk averse (22 and 20 percent more likely to choose either gambles 1 or 2, respectively, and 24 percent less likely to choose gamble 5) than men majoring in other disciplines. Men with poor math skills are also significantly more risk adverse though the magnitude of the difference is small (3 percent more likely to choose gamble 2 and 4 percent less likely to choose gamble 5).

5. Conclusion

This paper provides a controlled laboratory experiment to test if subjects have a preference for positive skewness and how the presence of skewness affects subjects' rsik taking. We have adapted the Eckel and Grossman (2002, 2008) risk measure (with six gamble choices) to incorporate skewness, while holding expected earnings and risk constant, and use the adapted instrument is used to address three questions: 1) Do people prefer positive skewness? 2) Does skewness encourage greater risk taking? And 3) Do men and women differ in their preferences regarding skewness?

Our results offer strong evidence that people prefer skewness in their gamble

choices (i.e. the long shot outcome makes a gamble more attractive than a gamble lacking such an option). Approximately 80 percent of our subjects selected a gamble with skewness over a gamble, with equal expected earnings and risk, with skewness = 0 and 80 percent also preferred a gamble with skewness = 2 over a gamble, with equal expected earnings and risk, with skewness = 0 or 1.

While subjects showed a significant preference for skewness, the existence of skewness did not result in subjects systematically taking on more risk. After controlling for other subject characteristics, skewness was not significantly correlated with risk taking.

Finally, we find that men are significantly more likely to opt for a skewed gamble (with skewness = 1) over an unskewed gamble but when skewness increased from 1 to 2, this difference went away. Our results, while limited, suggest that while men will go for the longshot, women are a bit more reticent. The longshot must be sufficiently enticing (i.e. the degree of skewness must be sufficiently high) for women to go for it.

(to be completed)

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Figure 1: Presentation of Task 1 Gamble Choices

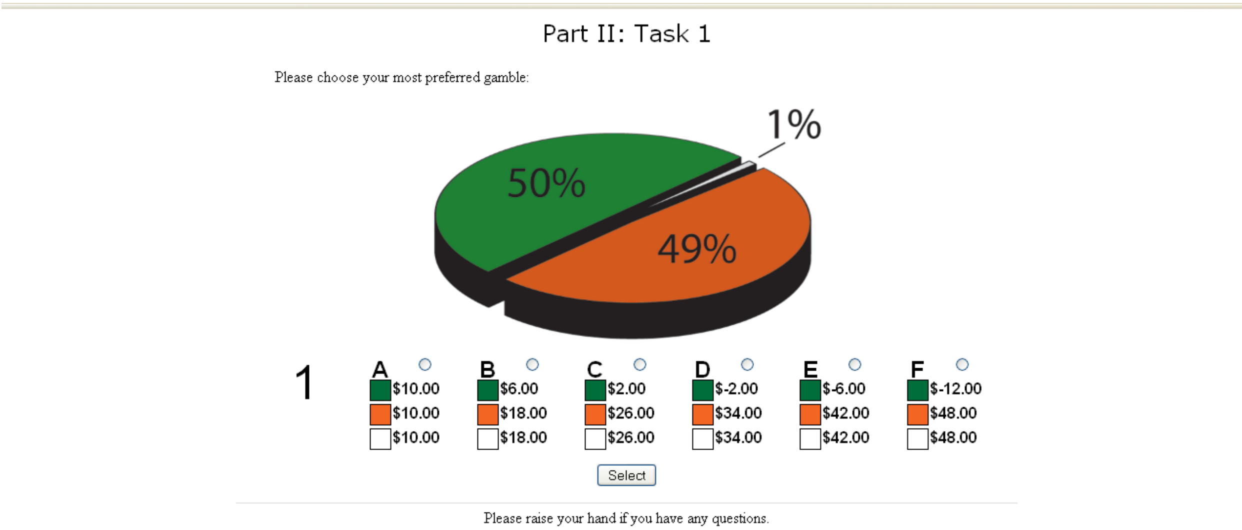

Figure 2: Presentation of Task 2 Gamble Choices with Skewness

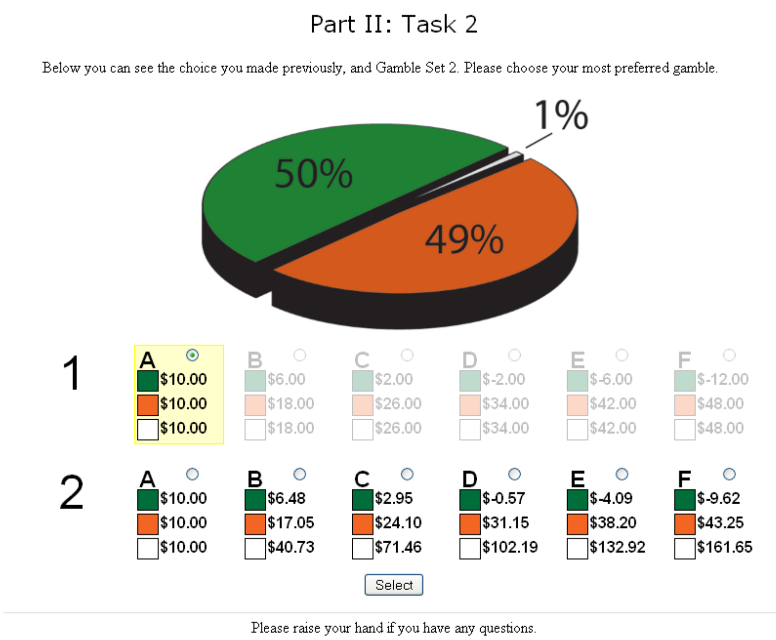

Figure 3: Presentation of Task 3 Gamble Choices with Skewness

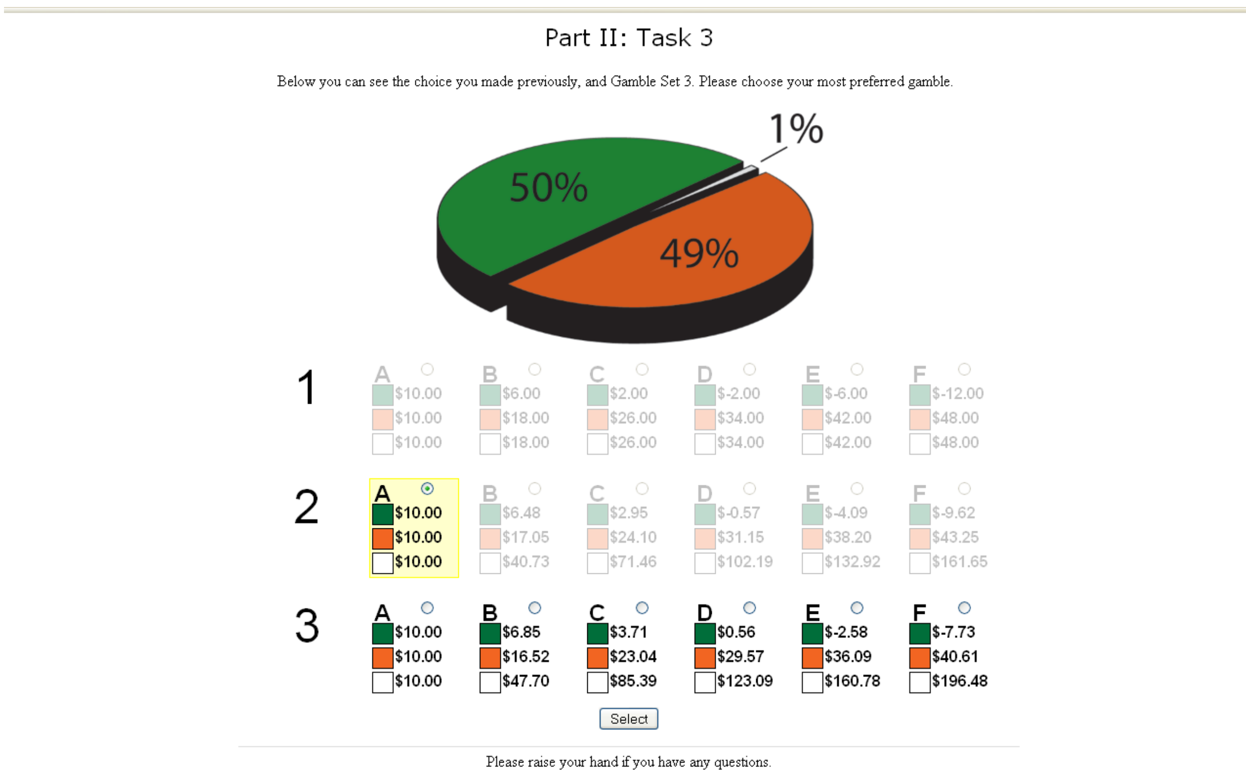

Table 1: Task 1 Gamble Choices

Lottery	Event	Probability	Payoff	Expected	Risk*	Skewness
1	A	50%	$10	$10	0.00	0
	B	49%	$10			
	C	1%	$10			
2	A	50%	$6	$12	6.00	0
	B	49%	$18			
	C	1%	$18			
3	A	50%	$2	$14	12.00	0
	B	49%	$26			
	C	1%	$26			
4	A	50%	-$2	$16	18.00	0
	B	49%	$34			
	C	1%	$34			
5	A	50%	-$6	$18	24.00	0
	B	49%	$42			
	C	1%	$42			
6	A	50%	-$12	$18	30.00	0
	B	49%	$48			
	C	1%	$48			

* - Measured as standard deviation of expected payoff.

Table 2: Task 2 Gamble Choices

Lottery	Event	Probability	Payoff	Expected	Risk*	Skewness
1	A	50%	$10	$10	0.00	0
	B	49%	$10			
	C	1%	$10			
2	A	50%	$6.48	$12	6.00	1.0
	B	49%	$17.05			
	C	1%	$40.73			
3	A	50%	$2.95	$14	12.00	1.0
	B	49%	$24.10			
	C	1%	$71.46			
4	A	50%	-$0.57	$16	18.00	1.0
	B	49%	$31.15			
	C	1%	$102.19			
5	A	50%	-$4.09	$18	24.00	1.0
	B	49%	$38.20			
	C	1%	$132.92			
6	A	50%	-$9.62	$18	30.00	1.0
	B	49%	$43.25			
	C	1%	$161.65			

* - Measured as standard deviation of expected payoff.

Table 3: Task 3 Gamble Choices

Lottery	Event	Probability	Payoff	Expected	Risk*	Skewness
1	A	50%	$10	$10	0.00	0
	B	49%	$10			
	C	1%	$10			
2	A	50%	$6.85	$12	6.00	2.0
	B	49%	$16.52			
	C	1%	$47.70			
3	A	50%	$3.71	$14	12.00	2.0
	B	49%	$23.04			
	C	1%	$85.39			
4	A	50%	-$0.56	$16	18.00	2.0
	B	49%	$29.57			
	C	1%	$123.09			
5	A	50%	-$2.58	$18	24.00	2.0
	B	49%	$36.09			
	C	1%	$160.78			
6	A	50%	-$7.73	$18	30.00	2.0
	B	49%	$40.61			
	C	1%	$196.48			

* - Measured as standard deviation of expected payoff

Table 4: Subject Characteristics

Variable	Percent of Total (n = 93)	Variable	Percent of Total (n = 93)
Age			
18-19	15.1%	**Student Status**	
20-21	43.0%	Full-time	94.6%
22-23	23.7%	Part-time	3.2%
24-25	9.7%	Not a student	2.2%
26-27	5.4%		
>27	2.2%		
Male	61.3%	**Live with parents**	12.9%
Class		**College**	
Freshman	10.8%	Business	23.7%
Sophomore	35.5%	Social Sciences	22.6%
Junior	25.8%	Education	4.3%
Senior	21.5%	Fine Arts and Humanities	10.8%
Graduate	5.4%	Science and Engineering	38.7%
Not a Student	1.1%		
Race		**Religion**	
White	41.9%	Catholic	23.7%
Hispanic	1.1%	Protestant	5.4%
African-American	5.4%	Other Christian	12.9%
Asian Non-Indian	29.0%	Buddhist	10.8%
Asian Indian	9.7%	Muslim	4.3%
American Indian or Native Alaskan	1.1%	Hindu	19.4%
Middle Eastern	2.2%	Other Non-Christian	1.1%
Other	9.7%	Non-religious	19.4%
		Other	3.2%
Relative Income		**Attendance at Religious Services**	
Much below average	14.0%	More than once a week	11.8%
Somewhat below average	20.4%	Once a week	19.4%
About average	43.0%	At least once a month	11.8%
Somewhat above average	21.5%	Less than once a month	38.7%
Much above average	1.1%	Never	18.3%
Personal Finances		**Religion Prohibits Gambling**	25.8%
Poor	23.7%		
Not so good	44.1%		
Good	31.2%		
Excellent	1.1%		
Plays the Lottery		**Employment Status**	
Never	45.2%	No Job	46.3%
Sometimes	54.8%	Part-time	50.5%
Often	0.0%	Full-time	3.2%
Math Score (number correct)			
0	2.2%		
1	11.8%		
2	14.0%		
3	17.2%		
4	25.8%		
5	17.2%		
6	11.8%		

Table 5: Task 1 (No Skewness) Gamble Choices

Gamble	1	2	3	4	5	6	Mean Gamble Choice (Std. Dev.)	Means Test **t-statistic** *p-value*	χ^2 Contingency Table p-value
Number Choosing Male	5	10	12	11	14	5	3.60 (1.47)	**3.48** *<0.001*	0.042
Female	10	9	8	6	2	1	2.56 (1.36)		
All	15	19	20	17	16	6	3.19 (1.51)		

Table 6: No Skewness Gamble Choice Ordered Probit Results

	Coefficient (t-stat.)		
Variable	All	Women	Men
Female	-0.685+ (2.79)	…	…
Age	-0.012 (0.30)	-0.064 (0.90)	-0.008 (0.12)
Caucasian	0.175 (0.72)	-0.367 (0.71)	-0.085 (0.25)
Relative Family Income	0.137 (1.05)	0.781 (3.00)*	-0.167 (0.94)
Personal Finances	0.041 (0.26)	-0.507 (1.35)	0.081 (0.43)
Religion Prohibits Gambling	-0.123 (0.47)	0.053 (0.11)	0.100 (0.26)
Plays the Lottery	0.336 (1.33)	0.509 (0.93)	0.209 (0.64)
Employed	0.005 (0.02)	0.512 (1.08)	-0.144 (0.46)
Lives With Parents	-0.629+++ (1.81)	0.117 (0.14)	-0.991* (2.39)
Business	0.304 (0.99)	-0.405 (0.66)	0.623 (1.54)
Social Sciences	-0.046 (0.14)	-1.407** (2.15)	0.416 (0.92)
Education	-1.142+++ (1.72)	-1.962** (2.11)	…[a]
Fine Arts and Humanities	-0.775+++ (1.79)	-1.415** (2.01)	-0.698 (0.96)
Math	-0.029 (0.35)	0.038 (0.25)	-0.081 (0.71)
Constant	1.420 (1.56)	1.709 (1.08)	2.107 (1.47)
LLF	-148.82	-48.13	-91.28
N	93	36	57

+ $p < 0.01$; ++ $p < 0.05$; +++ $p < 0.10$

a – There was only one observation in this cell. It was merged with the control group. This did not significantly alter any of the other coefficients.

Table 7: Probit Model Marginal Effects (Significant Variables Only)

Variable	Sample	Marginal Effects					
		Y=0	Y=1	Y=2	Y=3	Y=4	Y=5
Female	All	0.155	0.100	0.001	-0.077	-0.127	-0.052
Relative Family Income	All	-0.028	-0.022	-0.003	0.015	0.027	0.011
	Female	-0.227	-0.083	0.106	0.150	0.040	0.014
	Male	0.022	0.030	0.015	-0.006	-0.041	-0.019
Lives With Parents	All	0.165	0.078	-0.022	-0.080	-0.106	-0.036
	Female	-0.033	-0.014	0.015	0.023	0.006	0.002
	Male	0.204	0.151	0.016	-0.087	-0.214	-0.070
Social Sciences	All	0.010	0.007	0.001	-0.005	-0.009	-0.004
	Female	0.470	0.011	-0.210	-0.204	-0.049	-0.018
	Male	-0.045	-0.070	-0.045	0.004	0.098	0.058
Education	All	0.363	0.066	-0.096	-0.146	-0.147	-0.041
	Female	0.673	-0.180	-0.273	-0.177	-0.033	-0.010
Fine Arts and Humanities	All	0.215	0.085	-0.038	-0.100	-0.123	-0.039
	Female	0.493	-0.033	-0.221	-0.185	-0.040	-0.013
	Male	0.139	0.113	0.016	-0.062	-0.156	-0.049

Table 8: Task 2 Gamble Choices

Gamble	1	2	3	4	5	6	Mean Gamble Choice (Std. Dev.)	Means Test **t-statistic** *p-value*	χ^2 Contingency Table p-value
Male							3.72 (1.31)	**3.50** *<0.001*	0.008
Skewness = 0	0	1	0	1	2	0			
Skewness = 1	1	12	9	15	12	4			
Female							2.75 (1.30)		
Skewness = 0	2	1	1	0	0	0			
Skewness = 1	5	8	9	7	2	1			
All							3.34 (1.38)		
Skewness = 0	2	2	1	1	2	0			
Skewness = 1	6	20	18	22	14	5			

Table 9: Changes in Gamble Choices with the Introduction of Skewness

	Change in Gamble Choice				
	-2	-1	0	1	2
Males	3	10	24	17	3
Females	1	2	24	5	3

Table 10: Task 3 Gamble Choices

Gamble	1	2	3	4	5	6	Mean Gamble Choice (Std. Dev.)	Means Test **t-statistic** *p-value*	χ^2 Contingency Table p-value
Male									
Skewness = 0	0	0	0	0	2	0	3.98 (1.47)	**3.58** *<0.001*	0.013
Skewness = 1	0	2	0	1	1	1			
Skewness = 2	4	5	9	9	17	6			
Female									
Skewness = 0	1	0	0	0	0	0	2.94 (1.29)		
Skewness = 1	1	2	1	0	1	0			
Skewness = 2	3	9	6	9	2	1			
All									
Skewness = 0	1	0	0	0	2	0	3.58 (1.48)		
Skewness = 1	1	4	1	1	2	1			
Skewness = 2	7	14	15	18	19	7			

Table 11: Changes in Gamble Choices with the Increase in Skewness

	Change in Gamble Choice					
	-2	-1	0	1	2	3
Males	0	4	35	17	1	0
Females	1	2	25	6	1	1

Table 12: Gamble Choice with Skewness, Ordered Probit Results with Clustered Standard Errors[a]

	Coefficient (t-stat.)		
Variable	All	Women	Men
Task	0.087 (0.46)	-0.112 (0.40)	0.267 (1.02)
Skewness	0.085 (0.42)	0.360 (1.21)	-0.116 (0.42)
Female	-0.730+ (3.08)	…	…
Age	-0.023 (0.71)	-0.044 (0.92)	-0.009 (0.17)
Caucasian	0.045 (0.18)	-0.288 (0.59)	-0.202 (0.57)
Relative Family Income	0.180 (1.46)	0.613* (2.53)	-0.034 (0.17)
Personal Finances	0.157 (1.02)	-0.183 (0.59)	0.184 (1.09)
Religion Prohibits Gambling	-0.142 (0.52)	-0.096 (0.17)	0.158 (0.45)
Plays the Lottery	0.278 (1.21)	0.172 (0.36)	0.239 (0.77)
Employed	-0.033 (0.15)	0.158 (0.36)	-0.205 (0.74)
Lives With Parents	-0.754++ (2.39)	-0.097 (0.19)	-1.052* (2.74)
Business	0.180 (0.58)	-0.077 (0.11)	0.291 (0.82)
Social Sciences	-0.101 (0.33)	-0.767*** (1.69)	0.151 (0.37)
Education	-1.203+ (2.81)	-1.630* (2.56)	…[b]
Fine Arts and Humanities	-0.567 (1.53)	-0.518 (0.94)	-1.142** (2.01)
Math	-0.056 (0.82)	0.054 (0.38)	-0.172*** (1.81)
Constant	1.641++ (2.53)	0.977 (1.00)	2.289** (2.02)
LLF	-440.83	-152.16	-267.17
N	279	108	171
Number of Individuals	93	36	57

a - Standard errors are clustered on the individual predictor.

+ p < 0.01; ++ p < 0.05; +++ p < 0.10

b – There was only one observation in this cell. It was merged with the control group. This did not significantly alter any of the other coefficients.

Table 13: Probit Model Marginal Effects (Significant Variables Only)

Variable	Sample	Marginal Effects					
		Y=0	Y=1	Y=2	Y=3	Y=4	Y=5
Female	All	0.120	0.137	0.025	-0.077	-0.149	-0.057
Relative Family Income	All	-0.026	-0.036	-0.010	0.017	0.039	0.016
	Female	-0.136	-0.108	0.049	0.136	0.044	0.014
	Male	0.003	0.007	0.004	0.000	-0.009	-0.004
Lives With Parents	All	0.157	0.127	-0.007	-0.100	-0.137	-0.041
	Female	0.023	0.016	-0.009	-0.021	-0.007	-0.002
	Male	0.165	0.195	0.040	-0.081	-0.241	-0.078
Social Sciences	All	0.015	0.020	0.005	-0.010	-0.022	-0.008
	Female	0.201	0.098	-0.086	-0.155	-0.044	-0.014
	Male	-0.012	-0.029	-0.017	-0.001	0.038	0.020
Education	All	0.323	0.130	-0.069	-0.168	-0.173	-0.043
	Female	0.548	-0.035	-0.233	-0.220	-0.047	-0.012
Fine Arts and Humanities	All	0.111	0.102	0.002	-0.073	-0.108	-0.033
	Female	0.134	0.070	-0.059	-0.107	-0.030	-0.009
	Male	0.216	0.195	0.012	-0.112	-0.244	-0.066
Math	All	0.008	0.011	0.003	-0.005	-0.012	-0.005
	Female	-0.012	-0.010	0.004	0.012	0.004	0.001
	Male	0.015	0.033	0.018	-0.001	-0.043	-0.021