Risk Aversion Behavior in a Mock Gambling Task

Evan Jonson *

B.A. Candidate, Department of Psychology, California State University Stanislaus, 1 University Circle, Turlock, CA 95382

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Abstract

Humans consistently face risky decisions. Previous research suggests that people tend to favor lower risk options and that framing influences an individual's choices. The present study set out to discover whether reordering the level of risk of a gamble and the payout of that gamble changes an individual's decision when faced with multiple gambling options. The participants in the study were recruited through, an online survey platform (n = 431). Participants were shown 15 questions, each containing 5 gambles of which they were instructed to choose one. These gambling options presented participants with complete information, i.e. the exact percentage chance of winning and payout of the win. Participants, on average, played conservatively overall, choosing options with lower levels of risk. The hypothesis was that those individuals who were shown the level of risk first would choose their gambles more conservatively because they would be focused on the levels of risk. The results did not support the hypothesis, indicating that there is no statistically significant difference between the individuals that were shown the level of risk first compared to the payoff of a particular gamble. This suggests that the experimental manipulation did not have a significant impact on the behavior of the participants. The present study demonstrates that this low level of manipulation is not enough to sway an individual's choice.

Keywords: risk aversion, framing effects, gambling

Introduction

Individuals consistently face risky decisions. When we encounter these situations, we have to weigh the costs and benefits, considering if the risk we are taking is worth the potential gain. A large body of research is built around discovering what impact risk has on our behavior. Most individuals display a general aversion to risk, called risk aversion, meaning that they are more likely to choose an option with lower levels of risk, even if it is not the most statistically valuable. When proposed with two options of similar expected value (percent level of risk multiplied by payout), most individuals choose the option with a lower level of risk. These effects have been heavily examined in recent years in many different circumstances (e.g. Buchak, 2014, He & Hong, 2018). Due to its prevalence, risk aversion has become one of the foundational assumptions of modern behavioral economics.

Some popular explanations as to why humans are economically risk averse come from Expected Utility (EU) Theory (Neumann & Morgenstern,1944) and later Prospect Theory (Kahneman & Tversky, 1977, 1990). EU Theory postulates that when a decision maker is faced with a risky situation, they will weigh the EU of each choice and make the decision best suited for their needs. This theory was first described by Bernoulli in 1738, who saw that individuals did not simply weigh the expected value (EV) of a scenario, they took many other variables into account. EV is a simple calculation of potential payout of a scenario multiplied by the likelihood of that scenario happening, most easily calculated in a gambling scenario (one ticket out of 20 in a raffle with a $100 prize is worth $100/20 = $5). Bernoulli noticed that individuals do not always value things in terms of their EV, even if they are purely financial endeavors, because they take into account the relative usefulness (utility) they would get from it. For example, an impoverished individual finds a lottery ticket on the ground with 50% chance of winning $100,000 and are offered $49,999 for it. The expected value method would recommend that the individual refuse the offer, since the ticket is worth $50,000. However, most people would gladly take the offer since the utility difference between $0 (their current net worth) and $49,999 is significantly more than the utility difference between $49,999 and $100,000.While the most obvious times that this sort of logic comes into play are decisions to gamble (e.g. play the lottery), but it also impacts our decisions on things such as potential career paths (e.g. weighing future pay vs. career satisfaction). This theory was further developed and brought into more modern economics by John von

* Corresponding author. Email: ejonson1@csustan.edu

Neumann and Oskar Morgenstern (1947), who added axioms of rational behavior to the theory.

However, even the updated theory came under criticism, as some researchers try to develop the theory and accompanying models to better adapt them to the real world. For example, Buchak (2014) argues that EU theory inadequately addresses how different people react to risky situations. She proposes a risk-weighted expected utility theory, which more broadly considers risk in its calculations, essentially adding a third variable on top of utility and probability: risk-attitudes. She further argues that when individuals are faced with a risky situation, their attitudes towards risk and their current situations have a significant impact on the decision they will make. Because of this, she makes risk more of a centerpiece to how individuals behave, rather than as a small, individual difference in behavior. This view of risk-taking behavior does a better job of taking individual and cultural perceptions of risk into account on a situational basis, providing a more holistic view of human risk-taking behavior.

Prospect theory adds significant psychological complications to traditional views on risk-taking behaviors (Tversky & Kahneman, 1981). The authors of Prospect Theory argue that the framing of a situation has significant effects on the decisions made by individuals. By framing something in a positive light (e.g. saving lives), individuals are more inclined to choose that option over something framed in a negative light (e.g. losing lives). Their research provides quantitative evidence that individuals typically display some risk averse behavior. For example, the researchers gave participants the option to choose between two treatment options for a fatal disease that 600 patients contracted. Treatment "A" results in 400 deaths, treatment "B" gives a 33% chance that no one dies, but a 66% chance that all 600 participants die. Treatment "A" was augmented in different surveys, sometimes stating rather than 400 people dying, 200 people will live. When framed as 200 lives saved, 72% of participants chose treatment "A", but when framed as 400 lives lost, the number dropped drastically to 22%, despite the exact same outcome. This shows that the way a question is presented to participants has a substantial effect on their choices. Beyond this, the researchers asked 77 individuals if they would prefer a sure win of $30 (78% of participants), or an 80% chance to win $45 (22% of participants). This is despite the expected value of the latter bet being higher ($36 compared to $30), illustrating an apparent irrationality in human behavior, that most individuals display some kind of risk aversion behavior (Tversky & Kahneman, 1985). This is also partially explained from taking into account EU theory, in that the utility difference between $0 and $30 is much more significant than the difference from $30 to $45, so many individuals would be inclined to take the sure bet. From this idea of risk aversion, we can assume that most individuals, on average, frame high levels of risk in a negative light. Thus, making the level of risk of a particular scenario more pronounced, individuals may have an aversion to it.

Risk aversion plays a large role in gambling decisions. The vast majority of researchers agree that some form of risk aversion takes place in gambling situations. While there are some individuals who are actively risk-loving (meaning they seek risky situations out for the potential rewards), most individuals are actively risk averse. Safra and Segal (2008), for example, argue that risk aversion is low when only small gambles are in questions, but when larger amounts of money come into play, the risk aversion displayed by individuals increases. This can help explain why individuals are willing to gamble small amounts of money in lotteries. Despite the incredibly small chance of winning, the small amount of money allows people to display substantially less risk averse behavior. The loss of that small amount of money may have no significant effect on the lifestyle of an individual, so there is no noticeable penalty through the loss.

With the existence of risk aversion behavior comes the need to measure how much risk taking an individual is likely to do. Numerous risk-taking questionnaires have been developed with the goal of predicting human risk-taking behavior. Established tests such as the Everyday Risk Inventory (Steketee & Frost, 1994) seek to gain insight into how much risk an individual is willing to take in specific areas such as finances. The Risk Propensity Scale is a newer scale, developed to be taken quickly which is advantageous in a brief, online study such as this (Meertens & Lion, 2008). The RPS has 7 questions, each of which use a Likert scale from 1 to 9. The Cronbach's alpha for the RPS was .77 and showed significant correlations with the longer Everyday Risk Inventory ($p = .01$, $r = .48$).

The present study examines the levels of risk individuals are willing to take depending on whether the participants are given the condition in which risk or reward is emphasized. The first hypothesis is that individuals will be more risk averse when level of risk is emphasized as opposed to an emphasis on the payout. The idea behind this is that individuals will pay more attention to the first thing that they see (the part of the gamble that is on top), which provides them with a foundation to compare and judge the proceeding gambles. Here, if an individual sees that there is a 90% chance at winning a small amount of money that may look significantly better to them than a 20% chance at winning a much larger amount of money, even if the expected value (EV) of the latter bet is greater.

The second hypothesis is that individuals will tend to choose gambles with a higher expected value, regardless of level of risk since the additional payout

will be enough to outweigh the additional risk. Essentially, this is a prediction that individuals will pay attention to the gambles. While they may show some risk aversion or risk loving behavior, individuals will pay attention to the EV of the gambles and take the bets that have a higher value. Individuals may make different decisions at this level, with some individuals that show extreme risk aversion choosing the safer bets consistently over more risky gambles, but on the whole participants should pick the bets with higher EV.

The final hypothesis is that individuals whose scores on the Risk Propensity Scale indicate that they will be more prone to take risk will take more risky gambles overall. This serves to show that the predictive value of the scale can be applied to this mock gambling task. Since the measure has been shown to have predictive value, a correlation here provides supporting evidence that people are taking the gambles seriously and playing in accordance to how they actually view risk taking.

Methods

Participants. Participants were recruited through Amazon Mechanical Turk (MTurk). Participants were paid $0.50 for their participation in the survey. A total of 431 participants were recruited, all of whom completed the study in its entirety. The median age of the sample was 33 years old, ranging from 19 to 80. The majority of the sample was white (75.4%), heterosexual (87.5%), and male (58.9%). Data were collected on the participant's level of education. All participants completed their high school education and 89.8% of the sample completed at least some college or trade school.

Materials and Procedure. Participants were directed from Mturk to a Qualtrics survey. Participants were first given an informed consent form followed by a basic demographics questionnaire. Participants were then directed to an instruction block, which described the task and ensured participants that none of their own money was at risk, nor would they win anymoney from the task. Then participants were randomly assigned to one of two groups, the risk emphasis (RE) group or the payout emphasis (PE) group (see Figure 1).

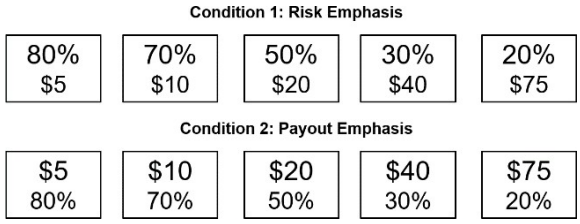

Figure 1. Example of Risk Emphasis and Payout Emphasis groups

The participants in these groups were given fifteen questions in total. In each question, the participants were able to choose one of five available options, depending on which gamble they would prefer. All of the gambles were entirely theoretical, meaning that there was no risk to participants. The RE group was shown the gamble with the level of risk on top and the payoff on bottom, and the PE group was shown the opposite. The gambles were separated into three separate groups, one group where expected value (EV) increases with increasing levels of risk, one where EV decreases with increasing levels of risk, and one where EV remains constant throughout levels of risk. The gambles were created somewhat arbitrarily so that it was not immediately obvious which bet had the highest EV, but preference was given to bets with numbers divisible by 5 for both the payout and level of risk. This was done mostly for easy processing of the bets by the participants, since the goal is not to "trick" them into picking the "wrong" bet. The bets with increasing EV with increasing levels of risk were chosen such that there was a consistent increase in EV. Similarly, the bets with decreasing EV with increasing levels of risk were chosen such that there was a consistent decrease in EV. The bets with constant EV were chosen so that there was very little (if any) variance between the EV of the different choices. Differences in EV were kept below 10 percent in this condition. Each of these gambles were rated on a scale of 1 to 5, 1 being the least risky option and 5 being the riskiest option. These were defined as such to determine how much participants were willing to take risks.

Safety first

totally disagree	1 …… 9	totally agree

I do not take risks with my health

totally disagree	1 …… 9	totally agree

I prefer to avoid risks

totally disagree	1 …… 9	totally agree

I take risks regularly

totally disagree	1 …… 9	totally agree

I really dislike not knowing what is going to happen

totally disagree	1 …… 9	totally agree

I usually view risks as a challenge

totally disagree	1 …… 9	totally agree

I see myself as a ...

risk avoider	1 …… 9	risk taker

Figure 2. The Risk Propensity Scale (Meertens & Lion, 2008)

Participants were then given the Risk Propensity Scale (RPS) in order to correlate their general risk-taking behaviors with the options they choose (see Figure 2). The RPS consists of 7 questions, each scored on a Likert scale from 1 to 9, several of which are reverse coded. A high score means an individual is more prone to risk taking behavior and a low score means an individual is less prone to risk taking behavior. Finally, participants were given a debriefing form and thanked for their participation in the study.

Results

The participant's choices on the gambling tasks were rated from 1 to 5, with 1 being the least risky gamble and 5 being the most risky. This weighting is regardless of the EV of the gamble. The first hypothesis, that individuals will be more risk averse when level of risk is emphasized as opposed to an emphasis on the payout, was not supported. An independent samples t-test was used to determine if there was a difference between the PE ($M = 2.15$, $SD = 1.01$) and RE ($M = 2.13$, $SD = 1.05$) groups based on RPS scores ($t(428)$, $p = .87$, $d = 0.02$), indicating no significant difference between the randomly assigned groups. In sum, this indicates that the order of the level of payoff and risk were not significant determinants of the participant's choices.

For the second hypothesis, the means of participants' choices between the three groups of gambles (increasing, decreasing, and constant EV with increasing risk) were compared. Since the increasing EV questions should have influenced participants to choose gambles with higher risks, the decreasing EV questions should have influenced participants to choose gambles with lower risks, and the constant EV should have been somewhere in the middle. The mean responses followed the prediction with participants taking the most risky gambles in the increasing EV group (M = 2.49, SD = 1.16) followed by the constant EV group (M = 2.08, SD = 1.12), and the decreasing EV group (M = 1.84, SD = 1.12). The PE and RE groups were compared based on their gambling choices with a Repeated Measures ANOVA ($F(1, 429) = 0.03$, $p = .871$) with increasing, decreasing, and constant EV as factors. This indicated there was no significant difference between the groups from the experimental manipulation across the gambling options. While there was no difference between the PE and RE groups, there were differences in the increasing, decreasing, and constant conditions. The difference between increasing and decreasing EV was the largest ($t(429) = 15.608$, $p < .001$, $d = 0.75$), then the difference between increasing and constant EV ($t(429) = 11.99$, $p < .001$, $d = 0.56$), followed by the difference between constant and decreasing EV ($t(429) = 8.08$, $p < .001$, $d = 0.39$). This suggests that the participants paid attention to the EV of each of the bet choices and chose, on average, bets with a higher EV. A bivariate correlational analysis was conducted to determine whether the individual's choices on the Risk Propensity Scale (RPS) correlated to their level of risk taking. The analysis showed that the individuals whose scores indicated that they were more prone to risk taking behavior correlated to more risky behavior in the gambling task; $r = -.13$, $p = .008$, $N = 431$. This supports the original hypothesis that those individuals that score higher on the RPS will take more riskygambles overall.

Discussion

The data did not support the first hypothesis. This suggests that the experimental manipulation may have not been significant enough. Past research has focused largely on framing the risk level as a potential for loss or in a significantly different way. The present study had a much subtler manipulation, which may have not been enough to sway the decisions of the participants. Future researchers should consider significantly increasing the font size of the group they wish to emphasize or find another way to further emphasize the group of interest. This study does, however, indicate more about what is necessary to manipulate the decisions of participants. The questions could also be phrased differently in two different groups which either emphasize the amount of money that will be lost if the gamble is not won or the amount of money that will be won if the gamble is won. This could be done in a similar way to Tversky and Kahneman (1981), who showed that participants will overwhelmingly choose an option framed as saving lives over an option framed as losing lives, even if the net outcome was identical. This addition could tell us more about individual differences and their interaction with risk. Alternatively, an example could have been given at the start that was framed in the opposite way of the participant's condition, or the framing could have been switched part way through the questionnaire for comparison purposes. This would have given a baseline for each individual, and a better indicator of the effect of the framing effects (Druckman, 2001).

Additionally, there may have been issues with the participants not taking the study seriously enough. The average participant completed the survey in just three minutes. While the survey itself was not particularly time intensive and actually could benefit from a "gut feeling" approach, 75 participants chose the first option for all of their gamble questions. While a risk averse individual may choose the most "sure thing", some of the gambles were quite obviously a better deal with the increased levels of risk. This suggests that these individuals may have simply chosen the option that completed the survey the quickest. Moreover, the gambles were presented to participants from lowest

level of risk to highest level of risk in every gambling option. Randomization of the options or randomly switching the order from increasing risk to decreasing risk would likely have made the phenomenon of individuals picking the left or right most options easy to identify. Given that the second hypothesis was supported, we can assume that participants, on average, gave some thought to their choices, by making a conscientious effort to change their decisions depending on the options available to them.

Even though there is, some indication that some of the participants may not have taken the study very seriously, the fact that the second hypothesis was supported indicates that the participants paid some attention, on average, to the gambles. Participants took significantly more risky gambles when the EV increased with increasing levels of risk compared to those gambles where EV decreased with increasing level of risk. This indicates that participants actually cared, to some extent, about how good of a "deal" they were getting with the gambles. They looked through their options and were more likely to choose those that had a higher EV. The fact that this hypothesis was supported may give an indication of how much reward is required for participants to take added levels of risk. It is interesting to note that the mean choice of the increasing EV group of questions (2.49) was still below the middle of the scale (2.5), indicating that individuals played conservatively overall. The final hypothesis aligns with previous research on the RPS, since individual differences in gambling choices were correlated with the test; this provides supporting evidence that it has predictive capabilities (Meertens & Lion, 2008). If future researchers are able to keep the attention of their participants for longer (perhaps through an in-person study), they should consider having longer-form risk taking questionnaires, perhaps including a financial risk-taking subtest, for a more sensitive measure. Alternatively, including multiple risk-taking tests would be beneficial so that the results of these tests could be correlated with one another.

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