Neuroeconomics Final Project Report

Team: Buy High Sell Low

Dayitva Goel
2019101005
IIIT Hyderabad
dayitva.goel@students.iiit.ac.in

Harshwardhan Prasad
2019102021
IIIT Hyderabad
harshwardhan.prasad@students.iiit.ac.in

Abstract

In this paper we aim to analyse the risk-taking behaviour of a person in response to a win or a loss after continuous losses or wins respectively using a task that simulates real-life non-strategic gambling and DOSPERT (Domain-specific Risk-taking Scale for Adult Populations). Even in circumstances when decisions are autonomous and consequences are unforeseen, human decision-making is often influenced by choices made earlier and their corresponding results. In our experiment, we use the coin toss game to achieve this which is rigged to show continuous wins or losses to different groups of participants and make note of features like playing time, final balances, bet amounts etc. We found that people who face losses play for a longer time and indulge in more risky behaviour mainly to recoup their initial losses.

Introduction

Decision making[3] is a goal-directed cognitive activity that involves selecting among possibilities that come with variable degrees of risk, uncertainty, and reward. Making decisions in risky circumstances is crucial for adaptive behaviour. How risky decision-making differs in relation to past results is a key question in decision neuroscience. Making risky decisions entails making decisions where the outcome is not entirely predictable but yet has the potential for reward or loss. Risk-taking is frequently modelled via lab exercises in two ways. One
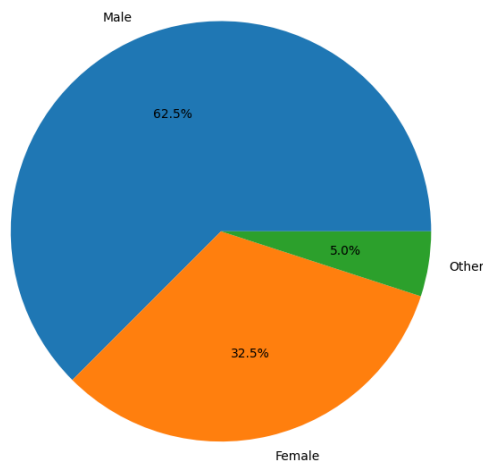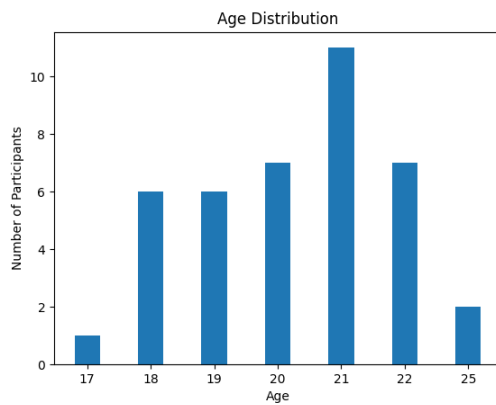
technique is that while the possible quantity of reward or loss stays constant, the risk level i.e., likelihood of reward vs loss changes. Other technique is that when the risk level is maintained while the outcomes of rewards and losses are random and trials are conducted independently with coin tosses where the likelihood of a win or loss is always 50 percent for each individual trial.

Some key occurrences, including the gambler's fallacy, are caused by a stronger propensity to take a risky decision after a loss than after a victory. The gambler's fallacy[4] is the tendency to see independent occurrences as negatively linked, leading to the expectation that the subsequent independent outcome would differ from the preceding ones. We have combined analysing this behaviour with the DOSPERT survey[1]. DOSPERT is a psychometric scale that assesses risk taking in five content domains: financial decisions (separately for investing versus gambling), health/safety, recreational, ethical, and social decisions. Respondents rate the likelihood that they would engage in domain-specific risky activities

Method

(A) Demographics

We had 40 people take part in our experiment who were mostly college students falling in the age range of 18-24. The following graphs show the age and gender distribution of our participants as seen below.

Age Distribution

PLAY THE FOLLOWING GAME

Your task in this game is to predict the outcome of a coin toss. If you predict correctly, you win twice the amount you bet. If you predict incorrectly, you lose the amount you bet. You have been given 100 tokens to start with and you can bet any amount upto 20 tokens. The game ends when you have lost all your tokens or you decide to cash out early and proceed. Press the Proceed button when you are done.

Results

Your balance: 100

(B) Design of the experiment

We designed a game in which people had to predict the outcome of a coin toss and bet a certain amount for it. The task was meant to generate gain or loss scenarios using a reality-simulated guessing exercise. It begins with the current balance displayed on the screen along with a graph which keeps track of the balance updates due to the results of the toss and a space to enter the amount the participant wants to bet. Any number between 1 to 20 can be used to bet on either heads or tails. After the bet is placed, the participant gets a prompt saying the coin is flipping and after clicking "okay", they get another prompt which shows the result thus ensuring a 3 second gap between consecutive bets. If the result is guessed correctly then the money on stake doubles else the bet money is lost and the graph and balance update accordingly.
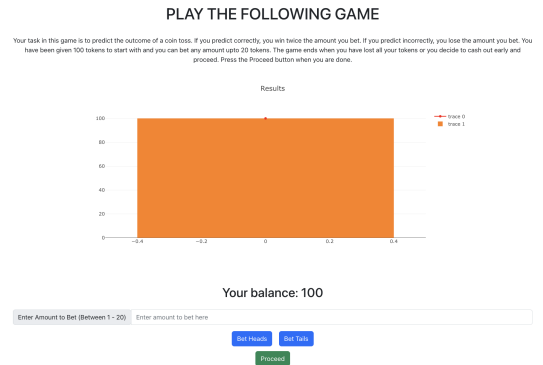
The participant can choose to play as many times as they want. The game ends when their balance becomes 0 or they choose to cash early and move to the next step. At the beginning of the game, each participant starts with a balance of 100 tokens. The participant is randomly assigned to one of these groups -

- WIN: People who experience continuous wins
- LOSS: People who experience continuous losses
- CONTROL: People who experience discontinuous (random) outcomes

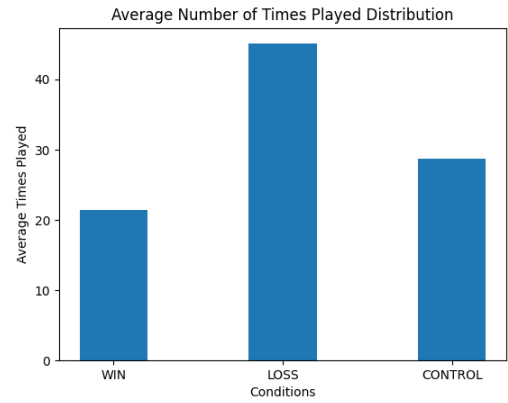The distribution of these three groups is as follows.
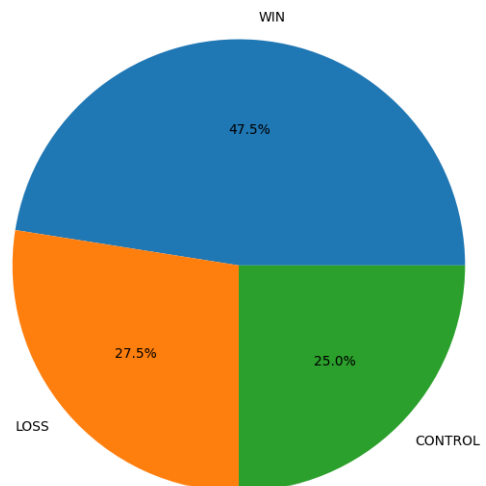
The LOSS group experienced a win after 3-5 continuous losses while the WIN group experienced a loss after 3-5 continuous wins. After the participant is done with the coin flips, they are given the DOSPERT survey to fill up to analyse behaviour in different types of risk taking activities.

(C) Questionnaire

The participants are a survey containing various risky activities belonging in different categories like ethical, health, recreational ranging from going skydiving, bungee jumping to investing a portion of your earnings into sporting events like horse racing.

Results

This segment this divided into 2 parts. We first analyse the results from the coin toss experiment. Then we analyse the responses on the DOSPERT form.

(A) Experiment Analysis

As we are trying to understand the subjective value of wins and losses, we looked at three main questions.

(a) How many times did people play this game?

(b) What was the final balance that people finished at?

(c) How did people change their bet amount after a win or a loss?

These questions are important as we want to look if the threat of losses makes people explore more than the promise of gains[6]. Here is the distribution for the first question,

Average Number of Times Played Distribution

People who are prone to gambling display long streaks of gambling[5] behaviour which makes the playing time an important attribute to study. We see that people in the LOSS condition played for an average of 45.09 times while people in the WIN condition played for average of 21.47 times. The CONTROL condition played for 28.7 times on average. This seems to suggest people who faced losses played for a much longer time to recoup their losses while people who faced wins were content with their winnings and cashed out early[2].

However, when we plot the playing time for each person in each condition, we see this.

Playing Time Distribution

3

Playing Time Distribution

Average Final Balance Distribution

Playing Time Distribution
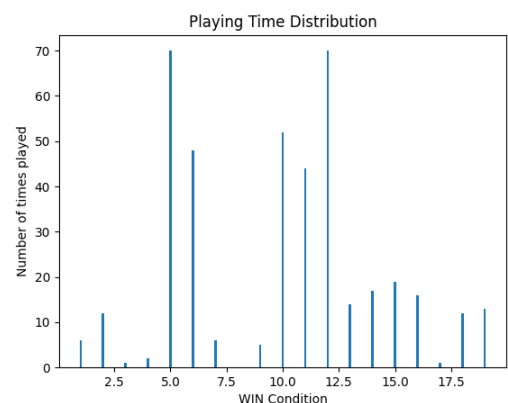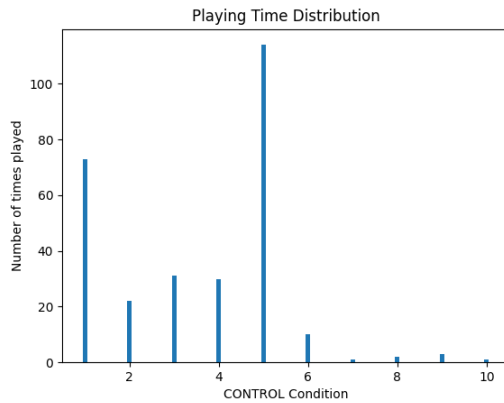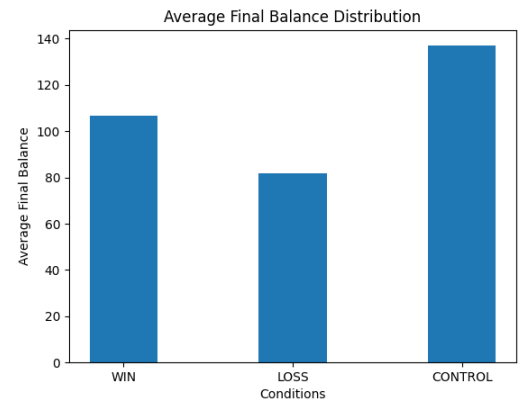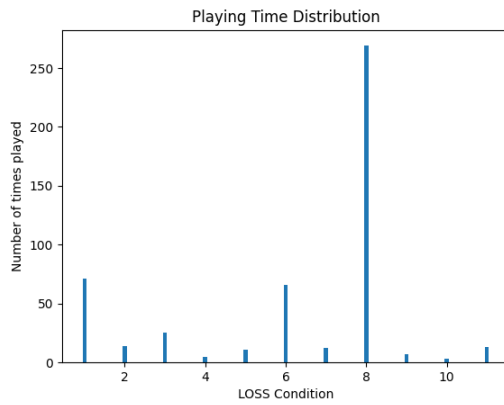
The LOSS condition ended at a lower balance than the WIN condition while CONTROL condition had the highest average balance at the end. The difference does not seem to be a lot. However, we do a similar analysis on individual balances and find the same outlier for the person.

While WIN and CONTROL are more or less uniform, there is an outlier in the LOSS condition. One person played for more than 250 times while the second highest player only played for 60 times. Accounting for this outlier, we have the new distribution of playing time as follows.

Average Number of Times Played Distribution

Final Balance Distribution
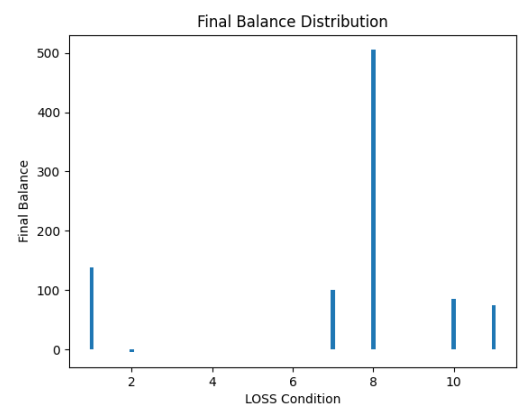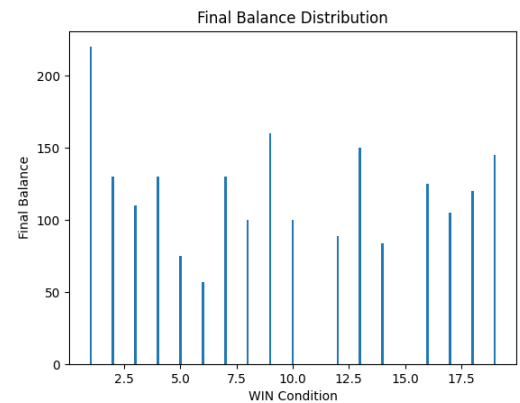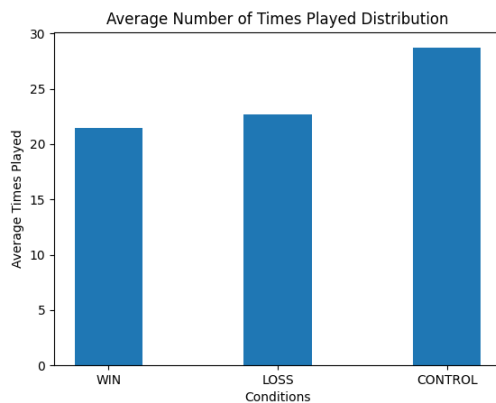
The LOSS condition still played for more time than the WIN condition but not significantly.

This leads us to the second question regarding their final balances. The distribution looks like

Final Balance Distribution

Final Balance Distribution
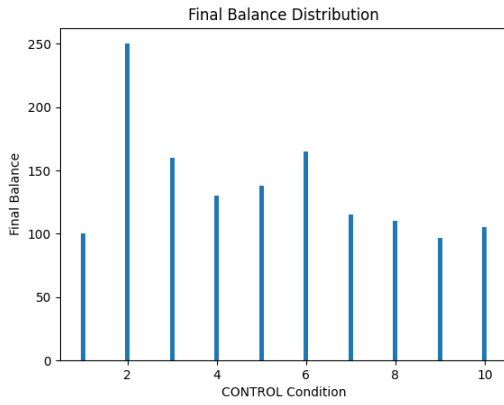
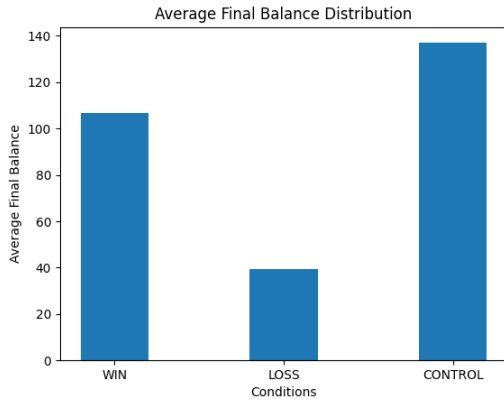We see that most people in LOSS condition ended at 0 points while the outlier ended at 505 points. Accounting for this outlier, we have the new distribution of playing time as follows.


Average Final Balance Distribution

Most people in LOSS condition ended at 0 as they kept playing to recoup losses while WIN condition cashed out early. The CONTROL condition has does not display any such effects.

This leads us to our last question regarding bet amounts. We found that most people did not change the bet amounts after a loss in the WIN condition. We attribute it to the fact that after having won 3 to 5 times, they had enough points to gamble with and did not care if they lost a part of it (as most people in WIN condition bet the maximum of 20 points at the start). However, we also found that the WIN group ended at a lower balance than the highest balance they had achieved over the course of the play.
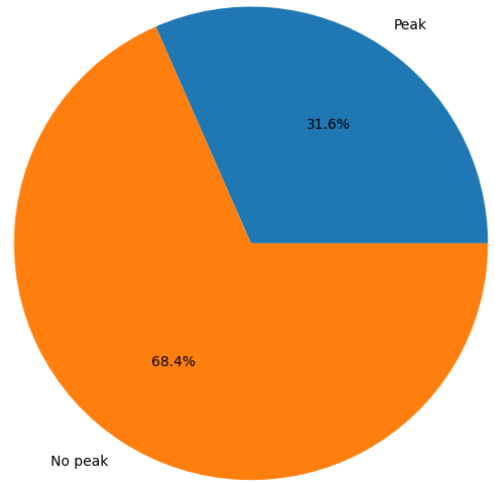
Peak

Only 30% of the WIN group ended at the peak of their balance graph. In the LOSS condition, the people lost quite a bit of points at the start and lowered their bets to not exhaust their points. Over time, if they won, they increased their bets taking a risky approach to recoup the lost points.

Uptrend
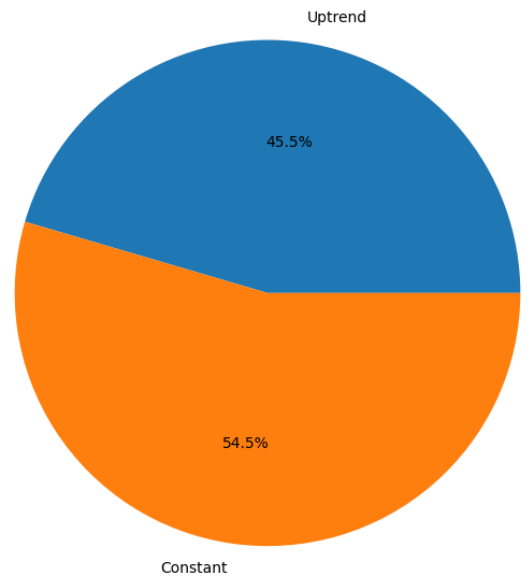
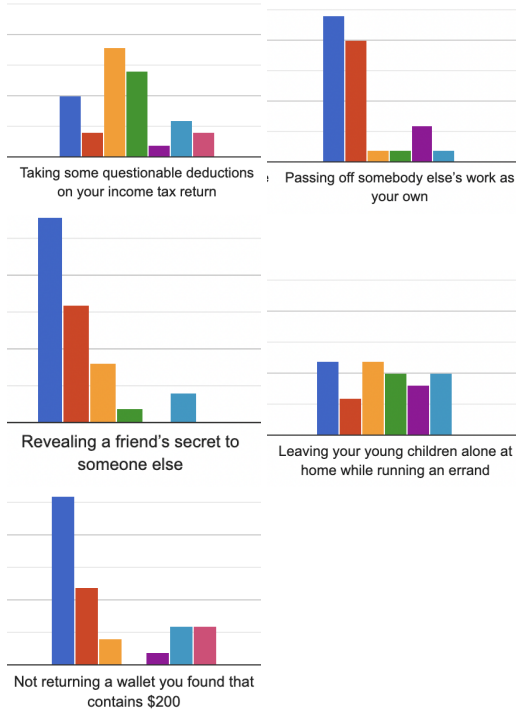We see that everyone in the LOSS condition either upped their bet amounts or remained constant after the continuous losses while no one showed a down trend. This seems to be consistent with this study[3] that showed that people do not change their strategy when they lose owing to gambler's fallacy. A similar trend was observed in the WIN condition who keep their bets and bet amounts the same due to the hot-hand fallacy.
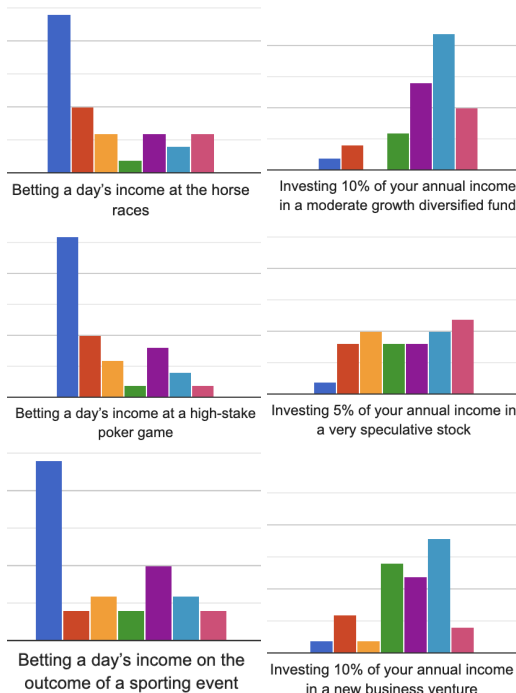
(B) DOSPERT Analysis

In the graphs belonging to this section, leftmost means highly disagree while the rightmost means highly agree.

(i) Ethical

Taking some questionable deductions on your income tax return

Passing off somebody else's work as your own

Revealing a friend's secret to someone else

Leaving your young children alone at home while running an errand

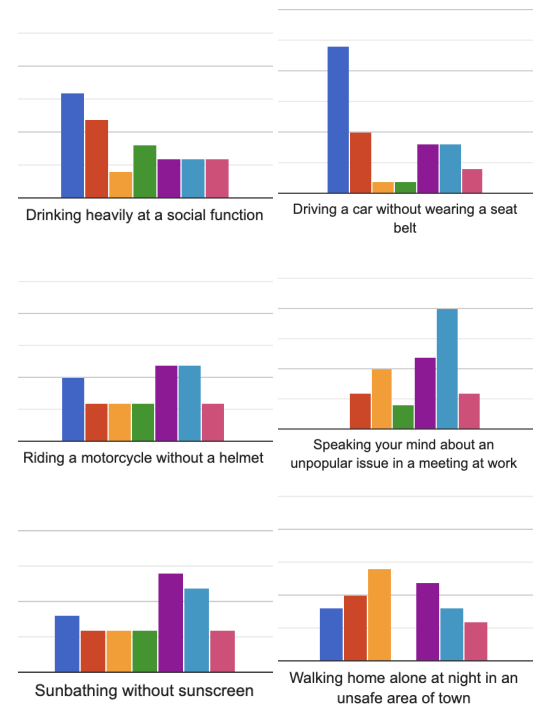Not returning a wallet you found that contains $200

For the ethical questions, a pattern inclining towards the participants being on the disagreeing side and not taking decisions which would be immoral.

(ii) Financial Investment/Gambling

Betting a day's income at the horse races

Investing 10% of your annual income in a moderate growth diversified fund

Betting a day's income at a high-stake poker game

Investing 5% of your annual income in a very speculative stock

Betting a day's income on the outcome of a sporting event

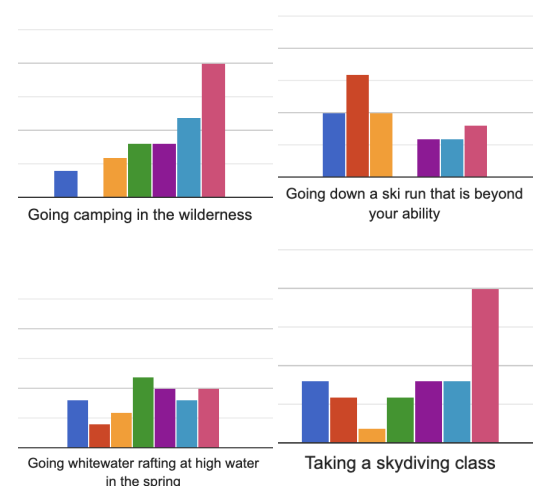Investing 10% of your annual income in a new business venture

A clear difference between betting and investment choices can be made with participants not wanting to engage in betting activities while saying yes to investments.

(iii) Health/Safety

Drinking heavily at a social function

Driving a car without wearing a seat belt

Riding a motorcycle without a helmet

Speaking your mind about an unpopular issue in a meeting at work

Sunbathing without sunscreen

Walking home alone at night in an unsafe area of town

Here, depending on the intensity of the health or safety hazard people choice shifts from being agreeing to strongly disagreeing. People are willing to go for sunbathing without sunscreen but strongly disagree with driving a car without a seat belt.
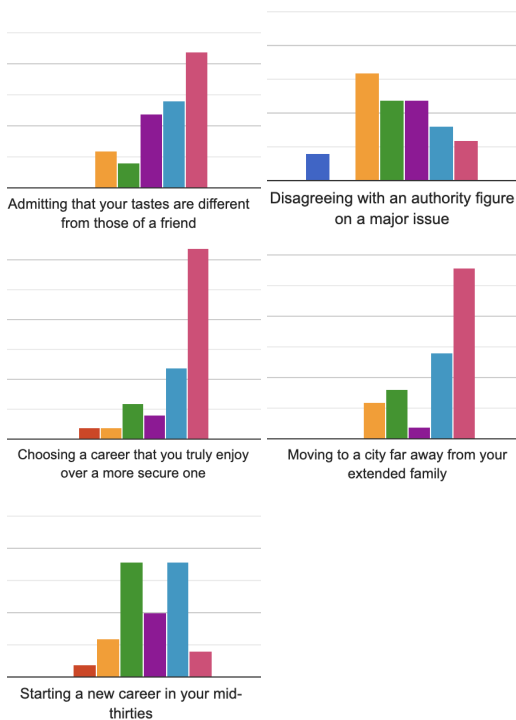
(iv) Recreational

Going camping in the wilderness

Going down a ski run that is beyond your ability

Going whitewater rafting at high water in the spring

Taking a skydiving class

Bungee jumping off a tall bridge   Piloting a small plane
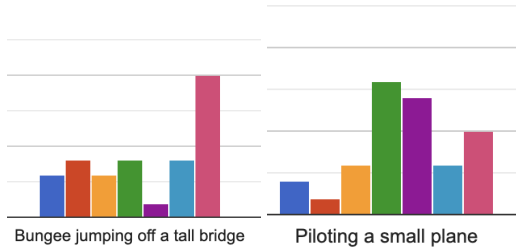
We observe that participants are willing to go for risky recreational activities. This is consistent with the fact that the Gen Z population really likes adrenaline pumping activities and are ready to take risks for that.

(v) Social

Admitting that your tastes are different from those of a friend   Disagreeing with an authority figure on a major issue

Choosing a career that you truly enjoy over a more secure one   Moving to a city far away from your extended family

Starting a new career in your mid-thirties

We observe that there is a trend where participants are ready to take social risks. This is mainly because the demographics of the survey are Gen Z people.

On computing the average risk taking decision on the scale of 1-7, with 1 being Extremely Unlikely and 7 being Extremely Likely, we found out the average as 3.71 for the LOSS condition, 4.20 for the WIN condition and 3.70 for the CONTROL. This seems to suggest that people in the LOSS group are less risk-taking than the ones in WIN condition, however, peo-

ple's own perception of risk in these activities has not been measured here. There could have been the effect of playing the game that changed the responses they gave in the form too.

Conclusion

Through the game playing behaviour of the participants, we conclude that people who faced losses displayed a greater risk-taking behaviour than people who faced wins. This can be seen from the fact that most people in LOSS condition ended at 0 points and had a slightly greater playing time than people in the WIN condition. This is due to the fact that LOSS condition wanted to recoup the losses they had in the initial trials. The DOSPERT survey seems to confirm some but not all of these predictions.

Limitations

The biggest limitation is the difficulty to imitate actual gambling environment and conditions because of the funds being completely virtual leading to people not taking the bets they placed as seriously as they would have in the actual conditions. The sample space is not skew and the age group is significantly influencing the study due to which the results would mostly apply to the age group of 18-24. The gender distribution is not equal too as the study has a majority of male participants.

References

[1] Weber Elke U., Blais Ann-Rene, and Betz Nancy E. "A domain-specific risk-attitude scale: measuring risk perceptions and risk behaviors". In: *Journal of Behavioral Decision Making* 15.4 (2002), pp. 263–290. DOI: 10.1002/bdm.414. URL: http://dx.doi.org/10.1002/bdm.414.

[2] Smith Gary, Levere Michael, and Kurtzman Robert. "Poker Player Behavior After Big Wins and Big Losses". In: *Management Science* 55.9 (Sept. 2009), pp. 1547–1555. DOI: 10.1287/mnsc.1090.1044. URL: http://dx.doi.org/10.1287/mnsc.1090.1044.

[3] Dong Guangheng et al. "Decision-making after continuous wins or losses in a randomized guessing task: implications for how the prior selection results affect subsequent decision-making". In: *Behavioral and Brain Functions* 10.1 (2014), p. 11. DOI: 10.1186/1744-9081-10-11. URL: http://dx.doi.org/10.1186/1744-9081-10-11.

[4] Xue Gui et al. "An fMRI study of risk-taking following wins and losses: Implications for the gambler's fallacy". In: *Human Brain Mapping* 32.2 (May 6, 2010), pp. 271–281. DOI: 10.1002/hbm.21015. URL: http://dx.doi.org/10.1002/hbm.21015.

[5] Rachlin Howard. "Why do People Gamble and Keep Gambling despite Heavy Losses?" In: *Psychological Science* 1.5 (Sept. 1990), pp. 294–297. DOI: 10.1111/j.1467-9280.1990.tb00220.x. URL: http://dx.doi.org/10.1111/j.1467-9280.1990.tb00220.x.

[6] Lejarraga Tomás and Hertwig Ralph. "How the threat of losses makes people explore more than the promise of gains". In: *Psychonomic Bulletin amp; Review* 24.3 (Sept. 12, 2016), pp. 708–720. DOI: 10.3758/s13423-016-1158-7. URL: http://dx.doi.org/10.3758/s13423-016-1158-7.