Decision Making And The Framing of Zero

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***Abstract*—This paper aims to analyse the importance of framing of zero and how decision making is affected when a certain problem is framed in a different way. The framing of zero has a significant impact on judgement and decision-making, although many authors frequently overlook or fail to realise this. We show how affect heuristics and risk aversive nature play role for both the genders and how often we fail to overlook the expected value of a problem and are often tricked by framing subliminally in this world.**

I. Introduction

The ability to categorise people based on consistent personality features that have predictable managerial implications is crucial for personnel placement and training. One such characteristic is risk preference, which can range from seeking risk to avoiding it. An experimental study of commuter preferences for trains with risky arrival times, designed to take advantage of Kahneman and Tversky's (1979) [1] reflection effect, i.e., the tendency of choices to appear risk-averse in the gain domain and risk-seeking in the loss domain. The current research replicates and extends the research done by wardely [2]. First, we replicate problem 3 and problem 4 from Tversky and Kahneman (1986) [3] and study 1 from Bateman, Dent, Peters, Slovic, and Starmer (2007) [4] and vary the framing of zero. Then we show how losing nothing is better than gaining nothing and extend their study by framing the questions according to the Indian audience. Fortunately, we were able to get a 50% representation from both the genders so we also anlyse and compare the risk aversive/seeking nature of both the genders and how affect heuristics play a major role in their life.

II. Literature Review

There has been a lot of work done in this field previously but none of them actually highlighted the importance of framing of zero untill the work done by wardely [2].

- In the study [5] it was shown how prospect Theory is used to quantify risk and loss aversion, and the effects of emotions were investigated. Information on rising drug-related mortality in Mexico and youth unemployment was used to alter students' emotions, and Tanaka et al. (2010) methodology was used to extract PT parameters. They discovered that whereas loss aversion is adversely affected by anger, risk aversion increases with melancholy. Anger reduces loss aversion by 50% on average.
- Another study [6]demonstrated the "framing effect," which occurs when options are described in terms of profits (positive frame) as opposed to losses (negative frame), which results in systematically different decisions. The cognitive effort needed to choose a definite benefit was, according to their findings, significantly less than the cognitive effort needed to select a hazardous gain. In contrast, the mental effort required to select a certain loss was equivalent to the mental effort required to select a risky loss. Working memory and imagery may have been involved in the decision-making process, according to fMRI results that showed the cognitive processes engaged by the decision makers in their study were concentrated in the prefrontal and parietal cortices of the brain.
- Human decisions are extremely vulnerable to how options are presented, according to a study from 2006 [7]. Even if the underlying neurobiology was unknown, they marked a remarkable defiance of accepted economic theories of human reason. They discovered that the framing effect was uniquely linked to **amygdala** activity, pointing to the importance of an emotional system in mediating biases in judgement. Additionally, medial and orbital prefrontal cortex activity indicated a decreased vulnerability to the framing effect among individuals. Their discovery emphasises the significance of including emotional processes in human choice models and offers some theories about how the brain can adjust the impact of these biassing factors to approach rationality.
- A 2019 research [8] that looked at the zero effect in life-saving decisions discovered that people strongly preferred options that increased the likelihood that no one would perish, even when the estimated loss was rather significant. One theory put forth was the prominence effect, which holds that the choice with potentially zero fatalities is simple to defend and justify. Additionally, they discovered that only loss framing, not gain framing, results in the zero effect in these life-saving decisions. The connections between the zero effect, framing, and evaluation mode in lifesaving and other.
- According to a 2003 study, people who engage in a decision-making activity using a holistic or heuristic processing style are particularly hypersensitive to the impact of framing effects. They also demonstrated that people who were either induced or predisposed to adopt a largely analytical/systematic vs holistic/heuristic processing style

should be affected relatively little by the way a decision is phrased.

III. Methodology

A. Participants

We collected the information from 66 participants.They all were college students within the age range of 17-23 years.The following figure denotes the age and sex distribution of the sampled crowd.

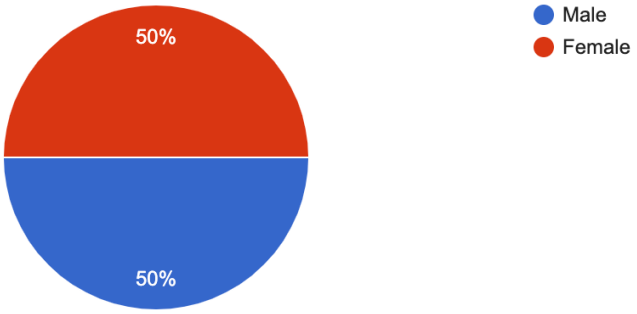

Fig. 1. Gender Distribution

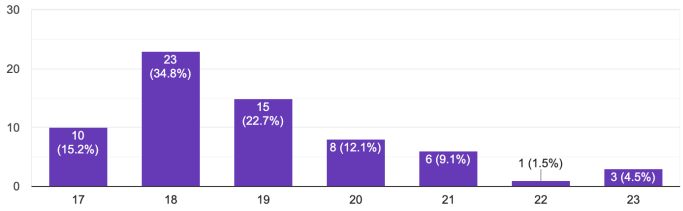

Fig. 2. Age-wise Distribution

B. Design of the experiment

We designed various questions that created different decision-making situations for participants. Participants were asked to imagine gambling and various other hypothetical situations in these questions and respond to a choice which evaluated their decision-making process. Questions were designed to evaluate following:

- Framing of zero in various decision-making scenarios.

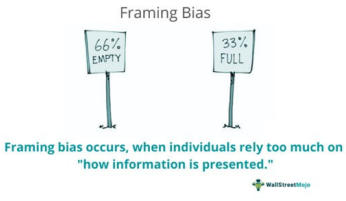

Fig. 3. Framing effect

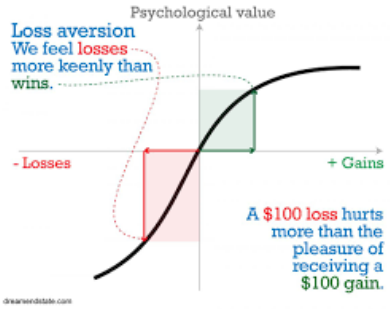

Fig. 4. Loss Aversion

- Loss Aversion Ratio.
- Risk seeking tendency of people in certain situations.

Our questionnaire can be divided into four parts. The first part includes questions that give participants a situation in which their initial wealth levels are changed, and then they are asked to make a choice in a gamble. This part tests our hypothesis that people perceive in terms of losses and gains rather than final wealth levels, thus solidifying the concept of reference points in decision making.

The second part of our questionnaire tests the framing effect of zero in decision making. Two gambling situations are given to participants, and the majority choice in both situations is recorded. Later, modified versions of these situations are given by changing the way zero is presented to test whether framing zero influences the decisions of participants, or maybe changing the majority option.

The third section includes a comparison between three choices given to user which are loss nothing, gain nothing and lose small amount along with a choice of earning profit. This section will also solidify our hypothesis of framing of zero's effect in decision making and along with that we can test how affect heuristics comes in picture when gain nothing and small loss choices are involved, hence validating its influence in decision making processes.

The fourth part of our questionnaire tests the risk aversive nature of participants, and we will be calculating the loss aversion ratio for that.

C. Data Analysis Methods

1) Part1: In this part, we analyze choices of same group of people in two differently framed choices where framing is done based on reference points. We will analyze number of people who made inconsistent choices and made decisions based on affect heuristics and thus get a graph. We will also look at percentage of people selecting different choices in both the situations. If a significant shift or variance of choices is observed, then we can validate our hypothesis of reference points.

2) Part2: In this part, we analyze the choices made by people in different scenarios with different ways in which zero is framed. We plot percentages of people in all the four situations in a graph which would clearly depict whether we

will see a shift in percentage of people in problem 3 and problem 4 from problem 1 and problem 2 respectively due to influence of framing of zero.

3) Part3: In this part, we will analyze whether there is a significant difference in preference order of bets which involves gain nothing, lose nothing and lose small amount. We will test our hypothesis by applying one way analysis of variance (ANOVA test) on responses we get from participants.

4) Part4: In this part, we wanted to evaluate risk aversive nature of two genders and loss aversion ratio would be calculated for evaluation purpose. We would analyze the loss aversion tendency for both the genders with one way analysis of variance (ANOVA). ANOVA compares the means for loss aversion value of two independent groups which is genders in our case in order to determine whether there is statistical evidence that the associated population means are significantly different. Significant difference in loss aversion values for both the groups will confirm the risk seeking nature of one group and risk aversive nature of other group.

IV. Results

A. Part1

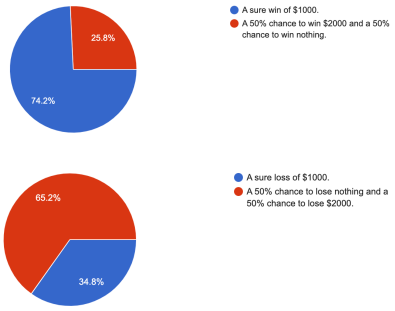

Fig. 5. Question set 1

The results achieved in this part are in accordance with the original study conducted by Tversky and Kahneman [3]. We changed the price to 10 times in both the options of both the questions and we also changed the word 'gain' to 'win' but inspite of that the results achieved are according to our hypothesis. We also **observed** a **slight increase** in percentage towards the sure win option in question 1 and **less inclination** towards the sure loss option in question 2 as compared to the original study. The Fig. 5 represents the percentage of different choices made by participants in two gamble situations given to them.

The Fig. 6 bar graph represents number of participants who were consistent with their choices and those who were not.

B. Part2

Fig 7. represents percentage of different choices made by participants for part 2 problem set. In first 2 problems, there was no change in initial wealth levels as compared to situations given in part 1 problem set.

Problem 3 and Problem 4 of this part are modified versions of

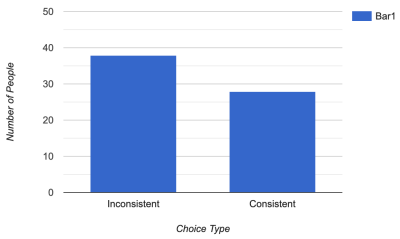

Fig. 6. Invariance of choice

Problem 1 and Problem 2 in which zero is framed differently from original problems. Problem 3 changes lose nothing to gain nothing, whereas Problem 4 changes gain nothing to lose nothing. Problem 3 and Problem 4 of this part are the replication of the study done by wardely [2]. In contrast to this study we observed an equal inclination towards the options in problem 3 and a decrease in the incline towards option 1 when going to problem 4.

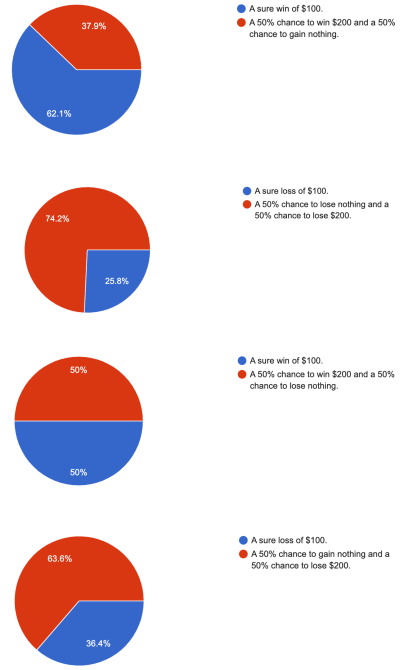

Fig. 7. Question set 2

C. Part3

We replicated and extended the study done by Bateman et al., [4] and study done by wardley [2] by changing the attractiveness of the bet scale to 10 from 21. We observed through the mean of the 3 options that the results were according to our hypothesis. A slight change that was observed after changing the scale was that the difference between the mean of the three options decreased as compared to the original study.

Fig 8. represents ratings collected through participants for win nothing option.

Fig 9. represents ratings collected through participants for lose nothing option.

Fig 10. represents ratings collected through participants for lose $0.05 option.

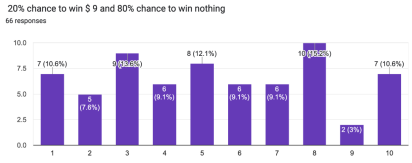

Fig. 8. Win nothing

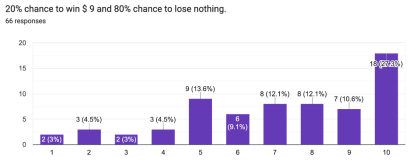

Fig. 9. Lose nothing

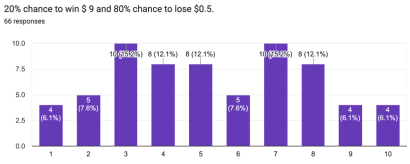

Fig. 10. Lose $0.05

D. Part4

In this part of questionnaire,we obtained a significant mean difference between the minimum amount proposed by males and females. As we changed the gamble money from $10 to $500 (i.e 50 times) we observed the jump of combined mean of proposed money from $24 to $1800 (i.e approx 75 times). Fig 11. represents mean values of loss aversion value chosen by male and female in gamble of 10 dollar.
Fig 12. represents mean values of loss aversion value chosen by male and female in gamble of 500 dollar.

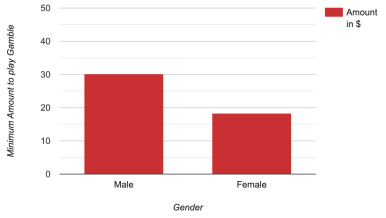

Fig. 11. Mean for Gamble amount = $10

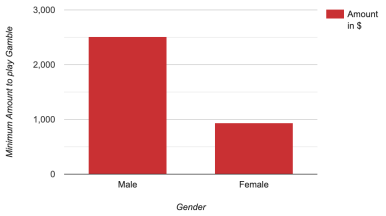

Fig. 12. Mean for Gamble amount = $500

V. Conclusions

A. Part 1

From part 1 we can conclude that:

- Participants are risk averse in positive realm and risk seeking in negative realm.
- The framing of problems lead to different choices due to the concept of reference point.
- Different initial wealth levels had little to no impact on decision, showing that outcomes are evaluated in terms of gains or losses rather than overall wealth.

In a nutshell, information is encoded as positive or negative depending on how the choices are framed. And this encoding affects the value of different choices present. These findings form the main pillars of prospect theory.

B. Part 2

From the results it can be conclude that a greater percentage of participants choose the risk-seeking option in the experiment's extension when the framing of zero is altered to "lose nothing," whereas in problem 4, when the framing of zero is modified to "gain nothing," a bigger percentage of participants choose the risk-averse alternative.
In modified problem 3, when the word gain was changed to lose a significant shift was observed towards option B because zero was framed as "lose nothing", hence, making people more risk taking.
Similarly in modified problem 4,when the word lose was changed to gain,a significant shift was observed away from option B because zero was framed as "gain nothing" which made people more risk averse. Hence, showing the importance of framing of zero.

C. Part 3

Fig. 13. Bet Attractiveness by condition

We applied one way analysis of variance (ANOVA) to study if there is a significant difference in preference order of the three choices given to participants. Fig. 14 shows the ANOVA analysis of these three choices and results are also displayed through bar graph in Fig 13 which shows significant difference in preference order for these choices. Results indicate a significant difference between conditions on bet attractiveness ($p < 0.05$). See Fig. 13 for means. Results of planned simple contrasts revealed attractiveness was significantly higher in the lose $.05 condition in comparison with the gain nothing condition ($p < 0.05$), and significantly higher in the lose nothing condition in comparison with the lose $.05 condition (p = 0.05).

This study explains that the difference between lose nothing, gain nothing, and a small loss is due to a combination of affect heuristic and reference point. It can be concluded that lose nothing , gain nothing and a small loss carries a certain affective attractiveness and acts as a reference point affecting the attractiveness of other parts of the bet. When zero is framed as gain nothing , this makes the other parts of the bet seem more negative due to the increased focus on not winning. But , when zero is framed as lose nothing , this induces positive affect and draws attention to the potential upside of the bet. In summary, focus on gain nothing or lose nothing causes different part of bet to be weighed differently in terms of overall attractiveness.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
20% chance	33	196	5.93939394	8.49621212
20% chance	33	249	7.54545455	6.19318182

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	42.5606061	1	42.5606061	5.79473956	0.01896889	3.99092377
Within Groups	470.060606	64	7.34469697			
Total	512.621212	65				

Fig. 14. Anova Analysis on Attractiveness of bet

D. Part 4

We applied one way analysis of variance (ANOVA)($p < 0.05$) to study if there is a significant difference in loss aversive nature of two gender groups. Fig 15. And Fig 16. Shows our ANOVA test results which clearly shows that female are more risk seeking and there is a significant difference in risk seeking tendency of both these gender groups.

Anova: Single Factor(GAMBLE AMOUNT = $10)

SUMMARY

Groups	Count	Sum	Average	Variance
Male	33	999	30.2727273	693.579545
Female	33	625	18.9393939	295.121212

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2119.33333	1	2119.33333	4.28710774	0.04244151	3.99092377
Within Groups	31638.4242	64	494.350379			
Total	33757.7576	65				

Fig. 15. Anova Analysis For Gamble amount = $10

Anova: Single Factor(GAMBLE AMOUNT = $500)

SUMMARY

Groups	Count	Sum	Average	Variance
Male	33	83000	2515.15152	13541794.5
Female	33	30846	934.727273	1426052.2

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	41212723	1	41212723	5.50683392	0.02204965	3.99092377
Within Groups	478971095	64	7483923.36			
Total	520183818	65				

Fig. 16. Anova Analysis For Gamble amount = $500

- The loss Aversion ration for male in the gamble with $10 came out to be 3 while that for female came out to be 1.89.
- The loss Aversion ration for male in the gamble with $500 came out to be 5.03 and for male it came out to be 1.06 .

In a summary we can say that as the price of the gamble increase the **Loss Aversion** also **increases**.

VI. Limitations

The sample space is not skew, age group is majorly affecting the study and thus, the results would primarily apply to this age group. Money is mostly used in dollars so the value of money will not be same for all. Questions could be biased because of experimenter's expectancy effect when trying to fit questions to the Indian scenario. Most of the time these kind of experiments are done with real money to get concrete results. Some participants might not have taken the experiment seriously owing to the outliers in the data as real money is not involved.

VII. Future Work

We wanted to know whether the participants were risk-averse or risk-seeking because "None of the Above" was not an option on the questionnaire. So the current study can be extended by giving NONE option or NOTA option to the participants to frame the study in a different direction and to study new parameters involved. Another extension to this experiment can be to see results after making gain nothing a better choice heuristically. No part of the questionnaire covered scenarios where a gain nothing option was rationally or heuristically better than the lose nothing option. So this form of study can be added to the current experiment and accordingly the expectancy value of the options can be framed in such a way that the participants are more inclined towards the gain nothing option. Another possible extension to this paper can be to conduct real-life gambles with actual money rather than hypothetical situations with participants, and to conduct an analysis on a larger population from which proper concrete conclusions can be drawn using artificial intelligence and machine learning.

Acknowledgment

This report has been based upon the paper titled [2]"Framing Zero: Why losing nothin is better than gaining nothing".

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