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Feedback and winning-losing probability effects on economic behavior in risky choices decision-making.

Efectos de retroalimentación y de probabilidad de ganar o perder sobre el comportamiento económico en la toma de decisiones con elecciones arriesgadas.

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ABSTRACT
Myopic Loss Aversion (MLA) is one of the study objects of behavioral economics. It corresponds to the fact that participants, when facing choice situations, cannot rationally evaluate the risks and profits of available options, leading them to choose investments more likely to occur but less profitable. This behavior shows that they cannot evaluate the options satisfactorily, so they have sub-optimal decisions. There may be conditions for MLA more favorable for it to occur, as the frequency one shows the participant the outcomes of their choices (feedback) and the probability of winning or losing. In this way, this study aims to evaluate how feedback influences participants' choices and the influence and interaction of the winning and losing probability. This study had the participation of 80 people, ages 18 to 30 years, all university students, 29 women and 51 men, without either relation to business degree courses or familiarity with the research area on economic behavior. The experiment consisted in making nine repeated choices in a lottery game. Participants started the experiment with R$1000 (a thousand) fictitious reais (Brazilian currency); each lottery game had a cost of 150 reais, and the profits returned this invested value with an addition of more 150 reais. The results indicate that the presence of feedback induces participants to bet more. However, the winning and losing probability do not influence the invested amount, and there was no interaction between these two factors.

RESUMEN
La Aversión Miope a la Pérdida (AMP) es uno de los objetos de estudio de la economía del comportamiento. Corresponde al hecho de que los participantes, frente a situaciones de elección, no pueden evaluar racionalmente los riesgos y beneficios de las opciones disponibles, llevándolos a elegir inversiones con mayor probabilidad de ocurrencia pero menos rentables. Este comportamiento muestra que no pueden evaluar las opciones satisfactoriamente, por lo que toman decisiones subóptimas. Puede haber condiciones para que AMP ocurra más favorablemente, ya que la frecuencia muestra al participante los resultados de sus elecciones (retroalimentación) y la probabilidad de ganar o perder. De esta manera, este estudio tiene como objetivo evaluar cómo la retroalimentación influye en las elecciones de los participantes y la influencia e interacción de la probabilidad de ganar y perder. Este estudio contó con la participación de 80 personas, con edades entre 18 y 30 años, todos estudiantes universitarios, 29 mujeres y 51 hombres, sin vinculación a carreras de negocios ni familiaridad con el área de investigación sobre comportamiento económico. El experimento consistió en hacer nueve elecciones repetidas en un juego de lotería. Los participantes iniciaron el experimento con R$1000 (mil) reais ficticios (moneda brasileña); cada juego de lotería tenía un costo de R$150, y las ganancias devolvían este valor invertido con una adición de más R$150. Los resultados indican que la presencia de feedback induce a los participantes a apostar más. Sin embargo, la probabilidad de ganar y perder no influye en el monto invertido y no hubo interacción entre estos dos factores.

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1. Introduction

In concurrent decisions under risks, information about the consequences of a course of action is an essential input for subsequent decisions. When there is feedback from past results, the current decision is usually made in a context that follows a previous action, i.e., information from past results conditions decision-making in the present. However, sometimes the previous consequences are not known, i.e., there is no feedback. Therefore, a decision is made with only information about the alternatives and the probability of occurrence of events available in the present.

A typical problem of concurrent decisions is faced by an investor who must decide whether to sell his shares or keep them. The decision will depend on the evaluation period of investment performance. In conjunction with his loss aversion, the decision to sell the shares is more attractive than keeping them, even though it is known that keeping them is a better alternative in the long term. This behavior is called Myopic Loss Aversion. According to Benartzi & Thaler (1995), the Myopic Loss Aversion (MLA) is a combination of loss aversion and a short evaluation period of an investment. These factors would make an investor not feel confident to take risks associated with an investment. The MLA also takes in two other behavior principles, myopic loss aversion itself (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992) and mental accounting (Kahneman & Tversky, 1984; R. H. Thaler, 1985). According to other research, myopic loss aversion is an individual tendency that makes a participant more susceptible to losing other than winning, inducing them to avoid investing or gambling on lotteries with high risk and high profit. At the same time, mental accounting refers to individuals' implicit methods for evaluating their profits and losses. Therefore, when many decisions have to be taken sequentially with short time horizons, these two behavioral components simultaneously generate myopic decisions.

Some previous research shows that people tend to prefer riskier gambles when they are losing, a phenomenon is known as escalation of commitment (Staw, 1976). On the other hand, evidence was also found the opposite: as people gain, they tend to take more risk, a phenomenon called the house-money effect (Thaler and Johnson, 1990). One possible explanation for these contradictory phenomena is the format in which the decision problem is presented (Weber and Zuchel, 2005) in Weber and Zuchel's (2005) study. This study shows hor to manipulate the presentation format of the same problem successfully induces an escalation effect or a house-money one. In the first case, the decision was made as a portfolio similar to what an investor does to invest in stocks: money can be held in cash or invested in a risky asset whose price differences fluctuates randomly. In the second case, the decision problem was posed as a sequential lottery problem in which the subject is confronted with a sequence of two identical betting games. Thus, in this case, different levels of risk aversion were observed in the presence of the same previous feedback.

Bellemare et al. (2005) researched to analyze the effects of feedback and investment flexibility (commitment) on MLA. These researchers found that MLA effect could be entirely assigned to the amount of feedback participants receive, and that commitment would have no effect. Furthermore, researchers claim that it is possible to influence the investment level by only varying the level of feedback that subjects receive from lottery results. The higher the level of feedback, the MLA takes action, preventing participants from taking more risks. These results were also found by Gneezy & Potters (1997) and Wang; Huang & Hsu (2013).

Langer & Weber (2008) also analyzed the interaction of feedback and commitment to MLA. The results suggest that the decrease in risky gambles' appetite due to loss aversion and continuous feedback is not generalized. The periodic presence of information induces the decision-maker to narrow bracketing of the decision problem, making a sequence of decisions made in short periods unattractive compared to when the problem is seen in the long term. However, by incorporating other features like diminishing sensitivity and probability weighting (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), MLA no longer operates. Instead, the opposite effect arises; myopia increases the desire to invest. For example, Langer & Weber (2008) find that in investment opportunities with a low probability of high losses, myopia does not decrease but increases the attractiveness of continuing to invest.

Besides, Fellner & Sutter (2009) did another research comparable to the ones of Bellemare et al. (2005) and Langer & Weber (2008), which results indicate that both feedback and flexibility (commitment) factors are important and affect MLA almost equally. So, they argue that investments are higher when subjects have lower flexibility or lower feedback frequency. These authors still found results indicating that subjects have a slight preference for a higher flexibility rate and a high preference for more frequent feedback. However, these preferable conditions are the ones in which subjects invest less and have less profit. The authors further show that determining an initial pattern, such as low flexibility or less frequent feedback, with an option for subjects to change either one condition or the other, is an efficient behavioral intervention that can diminish or even cure MLA effects.

Haffke & Hübner (2015), on the other hand, tested how different feedback types (outcome feedback and error feedback) influence subjects' choices compared to situations with no feedback. Their first experiment, which had no feedback, found that participants based their options only on partial information, even neglecting their earnings and preferably gambling on lotteries with a higher probability of winning. Researchers also showed that faster responses are attached to more uncomplicated game strategies that use only part of the information. At the same time, slower decisions are based on a higher amount of information.

Other researchers also studied the effects of experience and feedback on gamblers' decisions. (Jessup, Bishara, & Busemeyer, 2008; Tomás Lejarraga, 2010; Tomás Lejarraga & Gonzalez, 2011). Jessup, Bishara & Busemeyer (2008) found that feedback made decisions to deviate from the Prospect Theory (Kahneman & Tversky, 1979); that is, participants under the condition with feedback presentation subestimate small probabilities and so could invest less. Results from Lejarraga (2010) and Lejarraga & Gonzalez (2011) suggest that participants prefer to base on experience rather than on the games' descriptions (Tomás Lejarraga, 2010), but also that the descriptive information showed to participants is even neglected by them when feedback is presented, making subjects to be more based on the game experience, even when there is accurate descriptive information available (Tomás Lejarraga & Gonzalez, 2011).

As noted in previous paragraphs, the MLA has been an intense subject of study, particularly about the effects of frequency and type of information offered to participants after a decision is made. On the other hand, normative theory indicates that any alternative that offers a positive expected value should have a higher preference over another alternative that offers a negative expectation value. In other words, the subjects are rational because they make decisions that maximize the expected value. However, it is a stylized fact that decision-makers do not follow this maximizing behavior and often make decisions markedly from rational behavior.

According to the Prospect Theory, individuals judge the outcomes of decisions with a value function with the following characteristics:

1. It is defined in gains and loss and not over total wealth.
2. It is concave in the gain domain and convex in the loss domain.
3. It is considerably more pronounced in losses than gains (see Kahneman, & Tversky, 2013, for details).

These characteristics make lotteries, even with the positive expected value, evaluated by a decision-maker as an inconvenient alternative because they have been processed internally with a negative expected value.

The research on concurrent decision-making with MLA and feedback described above has been evaluated with prospects or lotteries with positive expected value (e.g., in Langer & Weber, 2008; Zeisberger, et al., 2011; Gneezy, et al., 2003). In this paper, we are interested in observing what happens with the feedback effect in concurrent decisions when decision-makers must evaluate alternatives under risk, not only with prospects with positive but also negative expected value.

The present study proposes a simple experimental design to observe how feedback influences a consecutive series of lottery bets. The expected values of lotteries are manipulated, but keeping constant their risks. In this way, it is possible to observe if the feedback effects observed in previous studies remain valid in situations of lotteries with different expected values. Our main hypothesis was that the willingness to take bets is moderated by the effect of the amount of feedback. By following the above, it is possible to conjecture that a higher feedback frequency decreases bet levels (lower risk). This is fulfilled as long as the gambler considers that the gamble has a positive expected value. However, in the case of a gamble with a negative expected value, the gambler could exacerbate risk aversion and, as a result, considerably decrease the appetite for playing lotteries. If our hypothesis is correct, the risk aversion with loss-averse preferences exacerbated by the feedback effect would be robust to both positive and negative expected value games.

2. Method.

2.1. Participants

This study counted on the participation of 80 people, with ages varying from 18 to 30 years, a total of 29 women and 51 men, all undergraduate students with neither relation to business courses nor familiarity with the research field of economic behavior. Participants were contacted by e-mail, text messages, or chatting on campus. As long as they accepted to be part of this research, they were taken to a waiting hall next to the experimental room, where they could read the Free and Informed Consent (FIC) and sign their data. After gathering the signed FIC, participants were taken to the experimental room. There was no refund or payment for participation in this study, including not paying for the final results of the gambling.

2.2. Equipment and Materials

The experiment was realized using the PsychoPy software (Peirce, 2007) version 1.81.02. The data was collected in an Acer® portable computer model Aspire E1-572-6 BR442, with a 15,6 inches screen, and an Intel® Core™ i3-4010U (1.7 GHz) processor with 2GB of RAM running Windows® 7 Ultimate.

The statistical analyses and the graphical modeling were done using the free software RStudio® version 1.0.136, which is an integrated environment for developing R (R Development Core Team, 2011) version 3.2.3. The data analyses and graphic modeling were done under a Lenovo™ portable computer, model Flex 2-14D, which processor is an AMD A8-6410 Quad Core with an AMD Radeon™ R5 (2.0 GHz) video card, 4GB RAM and running a 64 bits version of Windows® 10.

2.3. Procedure

The experiment asses the bet choices for nine consecutive and identical gambles. Participants started it with R$: 1000.00 (a thousand) fictitious reais in cash, with each gamble costing R$: 150.00, while in case of winning, this invested value was returned to them with an increase of R$ 150.00, totaling R$ 300.00 reais per winning (Note: US$1 is approximate to R$3,900 at the time of the experiment). The family income of the students enrolled at the university campus from which the participants were selected concentrated in the lower range of 3 to 5 mini-mum wages (49%) and the middle range of 6 to 10 minimum wages (50%) (Bueno, Tavares and Toneto Junior, 2021).

We carried out a complete 2X2 factorial experiment. Participants were randomly separated into four experimental groups, resulting from the combination of conditions WITH feedback or WITHOUT feedback, and the conditions of GREATER or LOWER probability of winning the lottery. In the first case, the lottery had a probability of winning of 70%, so the expected value of the lottery is positive equal to 0.6X (150) - 0.6X (150) = 30. In the second case, the lottery had a probability of winning of 30%, so the expected value of the lottery was negative equal to 0.3X (150) - 0.7 (150) = -60.

Under the "without feedback" condition, the result of gains and losses were informed to participants only at the end of the experiment, and at the end of the training period. Under the "with feedback" condition, the results of subjects' gambling were shown to them after each choice was taken.

Thus, the combination of these conditions results in four experimental groups, as written before, and the groups are the following:

- Group 1: Lower probability of winning without feedback.
- Group 2: Lower probability of winning with feedback.
- Group 3: Greater probability of winning without feedback.
- Group 4: Greater probability of winning with feedback.

Data gathering was taken in batches. That is, the first five sequential participants belonged to Group 1, the following 5 participants to Group 2, etc., while after gathering data from Group 4 participants, the next 5 belonged to Group 1 again, a cycle that was realized until the number of 80 participants was reached.

The room where data was collected is located in the Associative Processes, Temporal Control and Memory Laboratory at the University of Sao Paulo, campus Ribeirao Preto. Participants were invited to enter a soundproof experimental cubicle, where they sat in front of the computer during the experiment length. At the same time, the researcher stayed in a chair next to the participant.

Participants did not receive any previous verbal information about the experiment or how to perform it; instead, they read the information on the screen themselves. These instructions consisted of seven slides with a black background, explanatory texts about the experiment, a brief introduction to the test and risky decision making, some about probabilities of winnings/losings, and the experiment per se. During this reading phase, they could ask a question about the experiment. After finishing this presentation, they could no longer ask questions.

After this instruction reading session, the participants began the training phase, which consisted of 3 repeated choices according to the experimental group to which they belonged. After the training, participants of all experimental conditions saw feedback on the screen about the gains and losses they obtained in those three bets. After this training feedback slide, participants would start the experimental phase of making nine repeated choices.

The procedure of these two phases, training and experimental, was the same, and consisted of pressing the S key if they chose to play in that lottery or the N key if they didn't want to bet on the game, while the slides containing the feedback of each bet, in the case of groups with this presentation, could not be passed by pressing any keys.

On slides where participants should choose whether or not to bet on the lottery, there was information about the risks and probabilities of the game, i.e. the participants knew with that slide what was the chance of winning or losing in percentage, so they knew they had 40% to win and 60% to lose, in the case of the greater probability condition.

After the final (ninth) choice, for all groups, participants were presented with the final result of all their bets of the experimental phase, containing the total profits or losses and the number of games bets in that phase. On this last slide, there was also a greeting of thanks to the participants.

3. Results

The total sample was 80 participants who completed the experiment in a 2X2 arrangement (with and without feedback vs. greater or lower probability of gains). The response variable is the total amount of bets, calculated as the sum of the bets of the nine repeated choices from the experimental phase, while data of the three bets from the training phase were not analyzed; therefore, there is a total of 20 participants in each experimental treatment. Table 1 below shows the mean values and standard deviations of the total bets in each of the four experimental conditions.

Table 1: Means and standard deviations of the sum of the total bets in each of the four experimental conditions.

	Condition	Mean	Standard Deviation
Feedback	Without	592.50	258.58
	With	791.25	339.66
Winning Probability	Greater	757.50	323.94
	Lower	626.25	297.85

The data collected in this work will be presented using a boxplot representation, representing the values indicating their distribution within the sample. The boxplot boxes are represented in blue and visually indicate the distribution of 50% of the data collected. We have the lower limit of the box being the first quartile of data. In contrast, the upper limit is the third quartile.

Thus, figure 1, on the next page, shows a boxplot of the experimental groups mentioned in item 2.3. Interestingly, Group 3 contains a narrower box, indicating that the collected data are more concentrated in a specific range of values. It is also in Group 3 that there is an outlier point outside the curve, which corresponds to subjects 33 and 75, who bet R $ 1350.00 reais each.

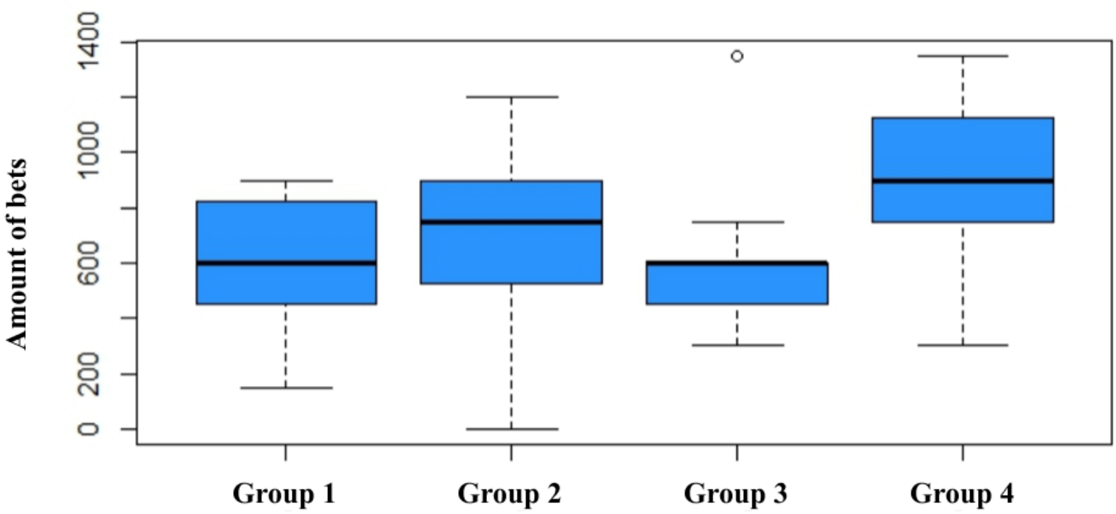

Figure 1: Boxplot of the bet amount in each of the experimental groups analyzed. Group 1: Lower probability of winning without feedback. Group 2: Lower probability of winning with feedback. Group

3: Greater probability of winning without feedback. Group 4: Greater probability of winning with feedback. The point represented in Group 3 represents an outlier point.

Overall, the results indicate that, at a univariate level, feedback and winning probability have significant effects on the total money invested. Thus, a two-way ANOVA demonstrated that effects from feedback (F = 9.2481, p = 0.003234) and winning probability (F = 4.0331, p = 0.048169) were both significant. Although the interaction of feedback and winning probability was not significant, F = 3.1639, p = 0.079281

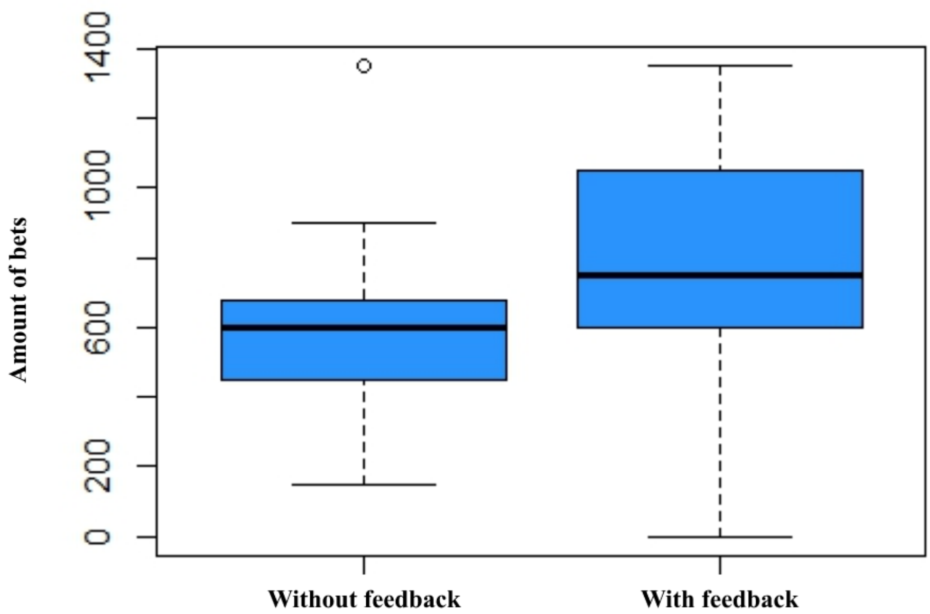

Figure 2: Boxplot of the bet amount in conditions with and without feedback. Note that the group with feedback shows a larger amount of bets. Differences were significant (p <0.05).

Figure 2 shows a boxplot of the bet amount according to the feedback condition. The total betting average of participants who received feedback (Mfeed = 791.25, SD = 339.66) was higher than that of participants who did not receive any feedback (Mnofeed = = 592.50, SD = 258.58), and according to an ANOVA, this difference is significant (F = 9.2481, p = 0.003234). The outlier point of the group without feedback is represented by participants 33 and 75, who bet R$: 1350.00 reais each.

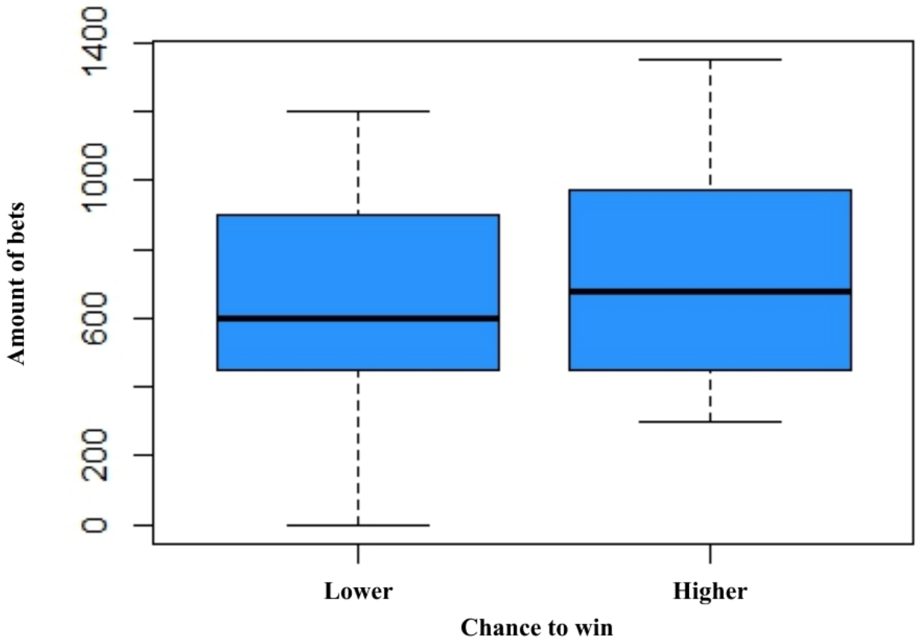

Figure 3: Boxplot of the amount bet on the conditions of greater and lower probability of winning. Note that the group with the highest probability of winning shows a higher amount of bets. Differences were significant (p <0.05).

Figure 3 shows a boxplot of the bet amount according to the probability of winning the lottery (high or low). The average of the total bets of participants under the condition with lower probability (M = 626.25, SD = 297.85) was lower than that of those whose bets were made under the condition with a greater probability of winning (M = 757.50, SD = 323.95), thus, according to an ANOVA, this difference is significant (F = 4.0331, p = 0.048169).

4. Discussion

The results in this work align with the hypothesis that with lotteries of negative expected value, there is a lower willingness to take risks than when dealing with bets with a positive expected value. In any case, the behavior is irrational from the economic point of view if the participants are inclined to bet on a lottery with a negative expected value.

On the other hand, the results indicated that the participants are inclined to take more risks in frequent feedback than in the low feedback condition. This is not in line with the original hypothesis. In other words, the effect of aversion does not operate in stopping or diminishing risk appetite.

These results coincide with those found by Haisley, Mostafa & Loewenstein (2008), in which participants who received feedback after their decisions bet more on lotteries, especially when they received feedback indicating a loss. In this case, the authors argue that this behavior can arise from a personal desire to recover what has been lost, which relates to the Prospect Theory (Kahneman & Tversky, 1979), whose main idea would be that participants would rather accept the risks when they are in a loss domain, but avoid risky decisions if they are already in a profit domain. Future studies could also consider the RPE function and analyze the difference of the RE on the participants, indicating if they modify their bets if they are winning or losing.

Interestingly, both this work and the one from Haisley, Mostafa & Loewenstein (2008) obtained almost the same proportion of men and women in their research. Therefore, the results found by Iturbe- Ormaetxe, Ponti & Tomás (2016) show that men would be more susceptible to MLA. These two studies may have found similar results because of their methodological similarity, experimental procedure, and the proportion of participating men and women.

However, studies from Bellemare et al. (2005), Gneezy & Potters (1997), and Wang, Huang & Hsu (2013) also found an effect of feedback, although this ended up causing participants to reduce their bets, contrary to what was found in this study. This is also the case for the results of Fellner & Sutter (2009), in which the authors still found that the participants prefer the conditions with the highest feedback frequency. However, in the studies cited above, the methods employed were slightly different from Bellemare et al. (2005), Gneezy & Potters (1997), and Fellner & Sutter (2009). Participants should make their bets based on lotteries worth pennies. In this experiment, the lottery value was R$150.00, and this higher bet value could be considerable for participants' decisions. In the work of Wang, Huang & Hsu (2013), participants should spend a non-fixed amount of money on a bet to hit the number of balls of different colors, while in this work, the lottery values were permanent.

It is also essential to highlight the results of Hopfensitz & Wranik (2008), which refer to experience, personality, and contextual parameters about the MLA, which can then influence the amount invested by the participants. These parameters have not been historically analyzed in this area of study. They also claim that a less frequent presentation of more aggregate feedback would reduce negative emotions, increase positive emotions, and thus increase participants' overall number of bets. Nevertheless, in this case, it would be interesting to assess the intensity of the interference of negative and positive emotions on MLA.

In addition, it is interesting to note that in this study, participants under the condition without feedback were still informed about how much money they had lost or won after the training phase, which can already be considered as an experience about the overall game. According to Lejarraga (2010), some participants rely more on experience than the betting description. Still, according to Leon & Lopes (1988), participants could change their risk aversion or willingness to take risks after receiving feedback, which is an important fact to consider about the participants in the condition with feedback.

However, the results of this article are still relevant, since the effect of the feedback on the participant's decisions has been verified, as well as the effect of the context, whether they are more or less likely to win. Thus, the feedback may have increased the participants' betting rate because, in this way, they could better evaluate their gains and losses, thus reducing the general effects of MLA. Regarding the probability of winning or losing, participants prefer to bet in lotteries with a positive expected value because profit is essential. Two main limitations of this study should be considered: first, the fact that participants bet with fictitious money, and second, the betting amounts are low, and eventually, higher betting amounts could change the results. In the first case, the study of Bickel et al. (2002), which found results supporting the idea that hypothetical or real rewards have the same effect, participants in this study must have shown actual behaviors for the hypothetical rewards as if they were actual rewards of lottery games. In the second case, larger amounts could be seen as unrealistic, considering the profile of participants in this study. However, this is a point that could be considered for future research.

Finally, new studies are needed to consider and analyze the possible interaction of feedback even in the training phases, the context of the bets at different levels of expected values, and the relation and influence of bets and profits magnitudes, and also try to include the analysis of participants' own experiences and personalities, as well as the gender. Thus, it is expected that future studies in this area will be able to control and assess the different variables that influence the decision-making process under a concomitant risk, as well as elucidate their mechanisms of action.

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