USING LOSS AVERSION AND FRAMING TO NUDGE STUDENTS' CLASSROOM PERFORMANCE

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Abstract

Behavioral economics suggests that people do not always decide rationally but are even predictably irrational. This gives rise to the concept of nudge, which creates an architecture of choices that encourages people to behave as they wish. Loss aversion is one of the best-known phenomena in behavioral economics and a central notion of the prospect theory. The main idea behind this phenomenon is that losses hurt more than gains feel good. The framing effect is a bias where people choose some options differently, depending on whether they are presented as a gain or a loss. In this quasi-experimental study, the authors examine the role of loss aversion and framing effects on students' engagement and academic success. This study aims to test the hypothesis that students will have a stronger reaction to the reduction of awarded points, as opposed to an increase of awarded points, as they progress through the course. This will motivate them to work harder and achieve better academic success. The results show significant differences between the two groups in favor of the group being graded using the point reduction grading scheme. This suggests that the power of loss aversion can be exploited to increase students' engagement and academic success. The existence of framing effect in this case has been demonstrated, which shows it might be possible to use the choice architecture to improve the student results.

Keywords*: loss aversion, nudge effect, prospect theory, education, student achievement*

1. INTRODUCTION

Loss aversion is one of the basic principles of the prospect theory developed by Tversky and Kahneman (1979). The prospect theory has brought a new and different perspective to decision-making under risk. Initially, it was presented as a critique of the expected utility theory that had dominated the field at the time. The underlying assumption of the expected utility theory is that people will behave in a rational and logically consistent manner when faced with choices that have uncertain outcomes. Rational behavior means

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assigning probability values to likely outcomes, calculating expected utility (by adding the utility values of the outcomes multiplied by their respective probabilities), and comparing the expected utility values of the different outcomes to choose the option that maximizes total utility (Friedman & Savage, 1948). In their seminal paper about prospect theory, Tversky & Kahneman (1979) demonstrated several phenomena that violated the central tenets of this normative rational choice model and proposed an alternative theory of choice under risk.

The prospect theory presupposes that individuals have a propensity to evaluate outcomes concerning deviations from a reference point they have set. Every outcome lesser than the identified reference point is regarded as a loss, while every outcome better than the reference point is considered a gain. Furthermore, people tend to give more weight to losses than comparable gains. Finally, the prospect theory assumes that people are generally risk-averse concerning gains, emphasizing framing and setting the reference point. Many scholars have found the notion of loss aversion and framing to be a promising avenue for experimental research and, through a series of robust and controlled studies, have built and expanded the field of behavioral decision theory (Barberis, 2013; Schmidt & Zank, 2005; Thaler, 2016).

The central idea of loss aversion is that individuals experience losses with a more significant psychological force than gains of similar magnitude. More precisely, Thaler (2000) stated that "losses hurt about twice as much as gains make us feel good" (p. 137). Therefore, an individual will prefer avoiding losses to acquiring gains.

This paper aims to test the loss aversion and framing effect in classroom settings. According to the prospect theory, it is assumed that students exposed to the loss of points will try harder to avoid the losses (in this way, they will accomplish better results related to top students who get points in a usual way). There is an intention to explore whether it is possible to encourage students to change their behavior predictably through the choice architecture (grading system). Previous studies have demonstrated inconclusive results. Specifically, two studies have conducted a similar experimental design to test the effect of loss aversion on the students' classroom performance. A field experiment pursued by Apostolova-Mihaylova et al. (2015) did not find a statistically significant difference in students' final grades but did find a specific gender effect. Male students in the treatment group earned higher grades than male students in the control group, and the opposite was true for female students whose grades were higher in the control group.

Another study (McEvoy, 2016) incorporated a similar experimental design and showed that students in the loss treatment earned statistically higher grades than those in the gain treatment. Smith et al. (2019) obtained similar results and pointed out that both genders benefit from the model with the loss of points while male students have more benefits. In their work, Gillanders et al. (2020) aimed to find a solution for students' engagement and academic integrity using the loss aversion principle. Students were faced with the possibility of losing previously collected points while doing a task in which they had to grade their peers' work precisely. The results showed that students, even though they did not like this grading strategy, were more engaged and considered their critical thinking skills

improved because of this approach. Coffey et al. (2020) surveyed the students' attitudes towards GPA concerning the time spent on different activities. Surveyed students had no preferences for losing points concerning the average number of points: they would exchange approximately 4.6 more free time to avoid a loss of one point concerning the time they would exchange to get a bonus point.

2. THEORETICAL FRAMEWORK

Tversky & Kahneman (1979) laid the foundation of the prospect theory, while the extended version of the theory, known as "cumulative prospect theory," was published in 1992. According to Tversky & Kahneman (1992), the prospect theory incorporates four critical elements.

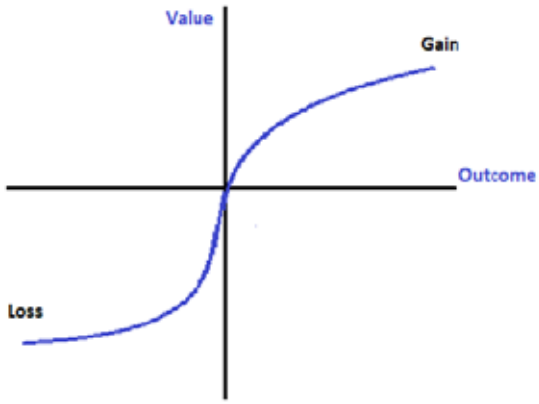

Figure 1. The prospect theory value function

Source: Authors, according to Tversky & Kahneman (1981)

An individual faced with a risky choice tends to measure the utility of an outcome (perceived as gain or loss) relative to some reference point. The asymmetric, S-shaped value function (concave in the area of gains or above the reference point and convex and much steeper in the area of losses or below the reference point) reflects the risk-averse and risk-seeking behavior associated with the potential gains and losses, respectively (Figure 1). The value function incorporates the logic of diminishing sensitivity, that the marginal impact of a change in value diminishes with the distance from a relevant point of reference. The last element refers to probability weighting, leading the individual to overweight unlikely extreme outcomes.

Loss aversion works powerfully in the process of making human decisions. It shows over two phenomena: framing and endowment. As individuals treat gains and losses differently, identifying the reference point or the choice framing becomes critical (Levy, 1996). Rational choice implies that preferences do not change with the change of frame. However, since human decision-making and perception are imperfect, the change of perspective might change the relative desirability of options. The preferences are changed by framing acts, contingencies, or results (Tversky & Kahneman, 1981). The framing effect is best illustrated by the disease problem, in which participants indicated two types of behavior: risk-averse preference for saving people's lives

over a gamble with the same expected value and risk-acceptance preference for a gamble in the hope of preventing people from certain death (Tversky & Kahneman, 1986). More recently, scholars have confirmed the framing effect in various environments. Hossain & List (2012) conducted a natural field experiment to test the framing manipulation of incentive systems to influence employees' productivity in the high-tech manufacturing facility. Their study resulted in two critical insights. First, framing bonuses as losses enhances team productivity. Second, neither the framing nor the incentive effect loses importance over time. The framing effect has been confirmed in classroom settings as well.

Fryer et al. (2012) tested the effect of framing in the presence of loss aversion in a field experiment on teacher incentives. In their study, teachers were paid in advance and asked to return the money if students did not improve as expected. The observed effects were comparable to an increase in teacher quality of more than one standard deviation. Their results imply the potential for applying loss aversion in boosting the effectiveness of public policies related to education. Finally, Levitt et al. (2016) examined the extent to which behavioral economic factors can influence students' levels of effort in a low-demand testing environment. They found that students are susceptible to the timing of rewards – payments made immediately positively impacted test scores. In contrast, no impact was recorded when rewards were delivered with a one-month delay. Besides, the authors suggest that framing the rewards as losses may be connected to better test results.

The power of framing is closely related to another behavioral anomaly known as the endowment effect. While prospect theory was originally developed as a theoretical framework for studying decisions under risk, Thaler (1980) points out that some aspects also apply to risk-free decisions. The endowment effect means that people value things they own more than things they do not own. Several well-known experimental studies examined the endowment effect using wine trade (Van Dijk & Knippenberg, 1998), coffee mugs, ballpoint pens (Kahneman et al., 1990), Swiss chocolate bars, and coffee mugs (Kentsch, 1989).

Over the years, many scholars have applied and tested the effect of loss aversion in various business settings. Building upon behavioral pricing literature, Hardie et al. (1993) designed a correlational study to explore consumers' reference-dependent choices in the context of brand preferences. A multinomial logit model showed a superior fit to a non-reference dependent model in both estimation and prediction but also demonstrated consistency with the notion of loss aversion (losses relative to a reference brand had more impact on consumer's decision than gains). Moreover, Su (2009) provided empirical evidence for loss aversion bias to be one of the causes of consumers' inertia. Consumers show an increased propensity to wait when faced with a purchase decision that involves the possibility of loss. However, not only customers and consumers are prone to loss aversion bias. Studies showed that loss aversion determines seller behavior as well. When coupled with the anchoring bias, this effect is discernible in the context of trading in the real estate market, in which house sellers are reluctant to sell at a loss relative to their former buying price (Buisson, 2016; Anenberg, 2011; Genesove & Mayer, 2001). Additionally, Thaler & Sunstein (2008) confirmed the causal relationship between loss aversion and inertia.

The choice of architecture represents the design of the surroundings and the context in which people make decisions. Previously mentioned studies in behavioral economics show that people do not usually make rational decisions, which means they do not maximize their welfare. Ariely (2008) states that human behavior is systematic and predictable, which means that humans are predictable. Thaler & Sustein (2008) introduce the term *nudge,* which denotes the possibility of designing the choice architecture that can influence people to change their behavior in a positive, predictable way. This choice of architecture relies on the perceived predictability of human behavior.

3. EXPERIMENT DESIGN AND PROCEDURE

The experiment aimed to detect whether a change in the grading system will affect students' approach toward their student assignments and ultimately lead to a better overall performance in the class. The experimental and control groups were exposed to the same instructional activities and tasks, but the grading system was different for each group. Students within the control group were assessed in a standard and familiar way: they started the class with zero points. They received points for completing assignments (the maximum number of points at the end of the class was 100). On the other hand, the experimental group of students received the opposite treatment. They started with the maximum number of points at the beginning of the class (100 points), and the points were deducted for every assignment that was not submitted or did not meet the teacher's expectations. The detailed structure of the student scoring system is presented in Table 1.

Students from the experimental and control group were informed about their performance via email weekly throughout the 15-week period. Every Monday, they received information about the number of points added (control group) or deducted (experimental group) that week and about the updated total number of points they had at the end of that week. Overall, students from both groups could calculate their expected grade based on their performance at any point in time.

Table 1. Class grade components

Task	Points	Grade percentage
Week Assignments	20	20%
Exam I	15	15%
Exam II	15	15%
Final Exam	50	50%
Total	100	100%

Source: Authors

Data used in this study came from various sources. Information about students' demographic and educational backgrounds was collected via a short survey administered at the end of the course and from the registrar's office. Data on students' performance (number of submitted assignments, points per assignment, and final grade) were collected during the course.

The experimental design was intended to hold constant any differences in

student achievement that might arise from peer effects or direct effects of class size. Therefore, the parts related to the test group associated with the loss of points are called *treatment,* and the parts related to the standard method of assessment of the control group are referred to as the *control*.

An experiment was conducted at the business and informatics school during a required course in electronic business. Participants were second-year undergraduate students majoring in either Information Technology or Contemporary Business. Sixty students participated in the study in exchange for course credit (average age was 22.86 years and 21.66 years for the experimental and control groups, respectively). During the first week of classes, the research study was presented to students, who gave their informed consent to participate. Using a numerated list of students and the Excel RAND function to ensure a random selection of participants, students were divided into an experimental and a control group. Sample characteristics are presented in Table 2.

Table 2. Sample characteristics

	Obs.	Information Technology (%)	Contemporary Business (%)	Academic success	Age	Male (%)
Treatment	30	86.7	13.3	7.68	22.86	76.7
Control	30	93.3	6.7	7.55	21.66	76.7

Source: Authors

In terms of academic success, the experimental and control group average grades (on a scale from 5 to 10) were 7.68 and 7.55, respectively. Furthermore, based on the results of the t-test analysis, no statistically significant difference was found between the experimental and the control group in terms of academic success, academic major, and gender. These results indicate the homogeneity between groups.

4. RESULTS

Throughout the 15 weeks, students gained points through week assignments, tests, final questions, and final exams. Table 3 shows the average results for the treatment and control groups for each activity. An overview of students' performance is shown in table 3.

Table 3. Students' average points following their activity (weekly)

	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	Exam 1	Exam 2	Final exam
Treatment group	1.2	1.2	1.27	1.4	1.07	0.93	0.93	0.8	0.6	0.87	6.27	6.5	33.8
Control group	1	0.93	0.93	1	0.93	0.87	0.67	0.53	0.4	0.53	6.83	6.87	11.55

Source: Authors

Students from the treatment group had higher points on average in weekly assignments and the final exam. In contrast, the students in the control group achieved better results on two midterm exams. The students in the treatment group were more regular in submitting their weekly assignments throughout the period. To complete

the course, the students had to collect 54 points. Table 4 shows data on the number of students who failed the course. The pass rate is far higher for the treatment group (70%) than for the control group (30%).

Table 4. Course completion rate

Group	Outcome	Frequencies	Percentage
Treatment	Pass the course	21	70%
	Fail the course	9	30%
Control	Pass the exam	9	30%
	Fail the exam	21	70%

Source: Authors

Table 5 demonstrates the average final score according to gender. Treatment group students, who started with 100 points and were exposed to the point deduction, gained 57.03 points on average, significantly higher than the control group, who gained 33.05 on the final exam.

Table 5. Means of the final score by section and gender

	N	Male Final Score	Female Final Score	Final Score
Treatment	30	56.43	59.14	57.03
Control	30	28.80	51.21	33.05

Source: Authors

In both groups, female students had higher final score (the difference in the treatment group is 4.8%, and in the control group, 77.81%). A t-test was used to test the significance of the differences for realized total average points between the treatment and the control group. Table 6 shows the test results and confirms the presence of the statistically significant difference in means of observed marks (number of points) between the treatment and the control group (p=0.001).

Table 6. Independent sample test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Final Score	Equal variances assumed	0.22	0.882	3.389	58	0.001

Source: Authors

The analysis of the final exam attempts shows that in the treatment group, only 13.3% of students did not take the final exam, while in the control group, this percentage accounts for 53,3%. The Chi-Square test results (Table 7) show a statistically significant difference between proportions of students from the treatment group and students from the control group, considering whether they were taking the final exam (p=0.003).

Table 7. Chi-Square test

	Value	df	Asymptotic significance (2-sided)
Pearson Chi-Square	10.800[a]	1	.001
Continuity Correction[b]	9.075	1	.003

a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 10.00.

b. Computed only for a 2x2 table

Source: Authors

The linear regression model was used to further test the hypothesis that the model for grading in which students lose points is superior to the standard grading. Obtained regression results are provided in Table 8. Students' *final score* is the dependent variable in the model. The influence of the loss treatment variable on the outcome is the most important in this model. That is a *dummy* variable; its value for the treatment group is one and for the control group is 0. The control variables were selected according to similar experimental research (Apostolova-Mihaylova et al., 2015; McEvoy, 2016; Smith et al., 2019).

Table 8. Regression results

	Pooled 1	Pooled 2	Treatment	Control
Loss treatment	16.697** (5.680)	21.273** (4.232)		
Weekly assignments	*6.058*** *(0.834)*	0.344 (1.045)	0.010 (1.649)	1.423 (1.443)
Male	- 3.634 (5.854)	0.831 (4.363)	5.851 (7.976)	8.452 (6.944)
Age	- 0.067 (0.647)	0.202 (0.478)	0.092 (0.569)	- 1.735 (1.875)
Information Technology	9.632 (8.110)	0.914 (6.112)	- 7.603 (9.760)	- 3.229 (9.591)
GPA	- 1.244 (4.190)	- 0.301 (3.089)	1.556 (5.140)	- 5.694 (4.782)
Points before final		1.725** (0.255)	1.704** (0.414)	1.515** (0.357)
Observations	60	60	30	30
Adjusted R-square	0.624	0.805	0.741	0.760

Note: Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors

The first column (Pooled 1) includes standardized coefficients for the observed independent variable of the model. The coefficient value with the dummy variable is significant (Sig.=0.01) and contributes significantly to the prediction of students' final grade as the dependent variable. The influence of other variables in the model on the dependent variable is insignificant. That shows the rise of the final score as a direct

consequence of the deduction of points, compared to awarding additional points. The second column (Pooled 2) provides regression results upon including variable *Points before the final exam* in the initial regression model. In this case, the influence of variable treatment on the dependent variable is also significant, which is partly opposite to the results of McEvoy (2016). Moreover, this was the only significant variable, just like in case two new regression models were introduced, with students divided into the treatment and control groups. The same independent variable was used in the second column without a treatment variable.

Table 9. Hierarchical regression

	Model 1	**Model 2**
Gender	4.435 (9.031)	6.724 (8.365)
Age	0.732 (0.933)	0.169 (0.933)
Study program	0.371 (12.311)	- 4.945 (11.479)
GPA	17.288** (5.276)	15.614** (4.896)
Loss treatment		22.126** (6.805)
Observations	60	60
Adjusted R-square	0.131	0.260
R Square change	0.190	0.133

Note: Standard errors are in parentheses. ** p<0.01, * p<0.05.
Source: Authors

The hierarchical regression was used to examine whether the *Loss treatment* variable explains the statistically significant amount of the variance of the dependent variable after accounting for influence of other variables. The first model included socio-demographic variables plus GPA. In the second model is inserted the *Loss treatment* variable. Obtained regression results are provided in Table 9. In Model 2, the *R Square change* is 0.13, meaning that the *Loss treatment* variable explains the additional 13% of the variance of the dependent variable. S*ig. F change* of 0.002 points to a statistically significant contribution. In Model 2, statistically variables *GPA* and *Loss treatment* (Sig.=0.01) are significant.

5. DISCUSSION AND CONCLUSION

The experiment results follow the defined theoretical framework, i.e., prospect theory and framing effect. Students in the experimental group who were graded using the point system performed significantly better than students in the control group who were graded using the standard grading system. The theoretical assumption that the fear of loss is more motivating than the joy of a gain was confirmed. Study results strongly confirm prospect theory's primary notion, which states that a fear of losing is stronger than a joy of receiving the same reward. Treatment group students exposed to the point deduction showed statistically significantly better final results than control

group students who were graded in a traditional way.

Interestingly, the treatment group students took more final exams, influencing the final score. Moreover, they completed more assignments that were given weekly. This can be explained by using the grading system that allowed the treatment group to start the course with the maximum number of points while the students in the control group had to collect these points. It is possible that the control group students decided to skip the final exam, as they had an opportunity to turn in the assignments in the following two weeks and re-take the final test. Psychology often recognizes this effect of postponing obligations, particularly in the cultural environment where the experiment had been conducted. In this environment, professors rarely penalize the students for their inactivity.

The loss aversion effect was evenly present among the male and female students. In both cases, the final score of the treatment group was higher than the control group. Unlike some previous studies, which showed that male students benefited more from this type of grading (Apostolova-Mihaylova et al., 2015), female students in the treatment group had 4.8% better final score than male students and 15.48% better final score, compared to male students in the control group. Moreover, for male students in the treatment group, points deduction had a decisive outcome compared to the control group since their final score was 95.93% higher than the final score of male students in the control group.

These results are encouraging and suggest that applying loss aversion can improve students' academic achievements. As demonstrated in this study, teachers can design the choice architecture to achieve the nudge effect so that students become more regular in completing their weekly assignments and feel motivated to take the final tests, which seems to be crucial for the final grade excluding strict rules and penalties.

The question that should be answered is whether this grading system applies to all levels of education, different study programs, and educational surroundings. Our research included small groups of students for which this effect was substantial. Moreover, student motivation might have been based on their feeling of being offered something new and essential. Furthermore, based on the results presented in this paper, it is reasonable to hypothesize that loss aversion and framing effect can be used in business settings to boost an organization's learning capacity. Framing incentives as losses is positively related to increased productivity, better focus, and willingness to work harder. If appropriately incorporated into the incentive system, loss aversion and framing can be used to modify employees' behavior and improve performance. Experimental studies in this regard are strongly encouraged.

The study's limitations and the opportunities to use the described grading approach can be addressed by future research, which might focus on applying a similar research design with more extensive and diverse student samples, at different educational levels and in various environments. Furthermore, it will be interesting to find out whether positive effects will disappear if the described approach is applied to entire student groups within extended periods. Finally, since previous studies have resulted in mixed conclusions, the effect of cultural and educational context should be considered when developing the research design.

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UPORABA ODBOJNOSTI PREMA GUBITKU I EFEKTA OBLIKOVANJA U POTICANJU STUDENTSKOG UČINKA

Sažetak

Bihevioralna ekonomija sugerira da ljudi uvijek ne odlučuju racionalno, već su predvidivo iracionalni. Na ovaj se na način otvara prostor za koncept poticanja, koji stvara arhitekturu izbora za usmjeravanje ljudskog ponašanja. Odbojnost prema gubitku je jedan od najpoznatijih fenomena u bihevioralnoj ekonomiji i centralni koncept teorije očekivanja, a na osnovu temeljne ideje da gubici više bole od dobrog osjećaja, kojeg donose dobici. Efekt oblikovanja je pristranost u procjeni, prilikom koje ljudi različito biraju između opcija, ovisno o tome prezentiraju li im se one kao dobitak ili gubitak. U ovoj kvazi-eksperimentalnoj studiji, autori analiziraju ulogu odbojnosti prema gubitku i efekta oblikovanja u angažmanu studenata i njihovom akademskom uspjehu. U radu se testira hipoteza da će studenti snažnije reagirati na smanjenje dodijeljenih bodova, negoli na dodjelu bodova, kako napreduju kroz kolegij. Pretpostavlja da će ih opisani pristup bodovanju motivirati da više rade i postignu bolji akademski uspjeh. Rezultati istraživanja pokazuju značajne razlike između dviju grupa, u korist grupe, bodovane putem smanjenja broja dodijeljenih bodova. Navedeni rezultat ukazuje da se snaga odbojnosti prema gubitku može koristiti za povećanje studentskog angažmana i akademskog uspjeha. Na ovaj je način dokazano djelovanje efekta oblikovanja, čime se otvara mogućnost za korištenje arhitekture izbora u unapređenju studentskih rezultata.

Ključne riječi: *odbojnost prema gubitku, efekt poticanja, teorija budućih izgleda, obrazovanje, studentska postignuća*