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# Are there gender differences in delay discounting of monetary losses?

**Summary:** We investigate gender differences in delay discounting of monetary losses. 203 participants solved a discounting task based on the titration algorithm. The individual rates of delay discounting of losses were calculated with the use of AUC (Area Under the Curve) method. The results show that there is no statistically significant impact of gender on delay discounting of monetary losses. We briefly discuss possible biological and social explanations of the above finding.

**Keywords:** delay discounting, monetary losses, gender differences

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## Czy istnieją różnice płciowe w czasowym dyskontowaniu strat pieniężnych?

**Streszczenie:** Przedmiotem badania są różnice płciowe w czasowym dyskontowaniu strat pieniężnych. Zadanie dyskontowe skonstruowane na podstawie algorytmu miareczkowania rozwiązało 203 uczestników eksperymentu ekonomicznego. Indywidualne stopy dyskontowania w czasie zostały obliczone z użyciem metody AUC. Wyniki badania wskazują na brak istotnego statystycznie efektu płci na dyskontowanie strat pieniężnych w czasie. Autorzy zwięźle dyskutują możliwe biologiczne i społeczne wyjaśnienia uzyskanego wyniku.

**Słowa kluczowe:** dyskontowanie w czasie, straty pieniężne, różnice płciowe

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**JEL:** D6, D8, D9

Delay discounting is a process that allows assessing the degree of self-control of a decision maker. In the economics literature, self-control constitutes one of the three pillars of the modern concept of man (Hendrikse, 2003; Karbowski, 2016). According to this concept, human economic behavior can be described with the use of three dimensions

– **degree of rationality (full or limited, cf., Hendrikse, 2003; Rabin, 2013, for a detailed discussion), behavioral motivation (e.g., altruistic, cooperative, competitive, egoistic, cf., Simon, 1993; Zamagni, 1995; Karbowski and Ramsza, 2017, for a wider discussion), and degree of self-control (level of impulsiveness in making decisions on monetary payoffs, cf., Thaler and Shefrin, 1981; Laibson, 1997; Frederick et al., 2002; Myerson et al., 2017; Vosgerau et al., 2020, for details).**

In behavioral economics setting, delay (or temporal) discounting procedures (see, e.g., Ashby and Gonzalez, 2017) allow decision makers to choose between monetary amounts (positive – gains or negative – losses) available at different points in time (this is so called ‘inter-temporal choice’; Hoch and Loewenstein, 1991; Hill et al., 2017; see also Karbowski, 2018, for a wider review). The individual rate of delay discounting can be measured by determining one’s preferences in choices between (1) a smaller and less delayed monetary amount and (2) a larger but more delayed monetary amount (Frederick et al., 2002).

In experiments on monetary gains, decision makers usually choose the less delayed amounts, but moving both amounts (1 and 2) by the same period promotes self-control, i.e., choosing a more delayed monetary amount. This effect was observed by many researchers and passed the replicability test (cf., e.g., Ainslie and Herrnstein, 1981; Loomes and Sugden, 1983; Loomes et al., 1989; Loewenstein and Prelec, 1992; Hyten et al., 1994; Cubitt et al., 2004).

In experiments on both monetary gains and losses, the latter are discounted in time at lower rates than gains (the gain-loss asymmetry; Murphy et al., 2001; Estle et al., 2006; Mitchell and Wilson, 2010; Appelt et al., 2011). Neuro-economists identified different neural mechanisms behind delay discounting of monetary gains and losses (cf., Karbowski, 2018). Xu and colleagues (2009) found that discounting of future monetary losses and future monetary gains proceed asymmetrically in the brain. In the behavioral economics and psychology literature, there is still no consensus on the differences between the discounting of monetary gains and monetary losses. Some authors report a positive correlation between the discounting of monetary gains and discounting of monetary losses (Chapman, 1996; Mitchell and Wilson, 2010), others do not find enough evidence supporting the latter claim (Hardisty and Weber, 2009; Harris, 2012; cf., Myerson et al., 2017).

In this paper, we point to another possibly important difference between delay discounting of monetary gains and losses. The literature on delay discounting of gains reports significant gender differences – e.g., Kirby and Marakovic (1996) show that men discount probabilistic gains at higher rates than women (see also, Koff and Lucas, 2011; Lawyer and Schoepflin, 2013). Interestingly enough, there is a deficit of studies that test gender differences in delay discounting of monetary losses. Thus, we set out to address this research gap and present the results of a study on gender differences in delay discounting of monetary losses.

Based on the cited literature (see, the passage above) on delay discounting of monetary gains, we decided to test the hypothesis that men discount monetary losses at higher rates than women. We limit our attention to students of the leading Polish university of economics – SGH.

The paper is organized as follows. In the next section, we comment on used materials and methods. The subsequent section is devoted to the presentation of obtained results. Discussion follows and concludes the paper.

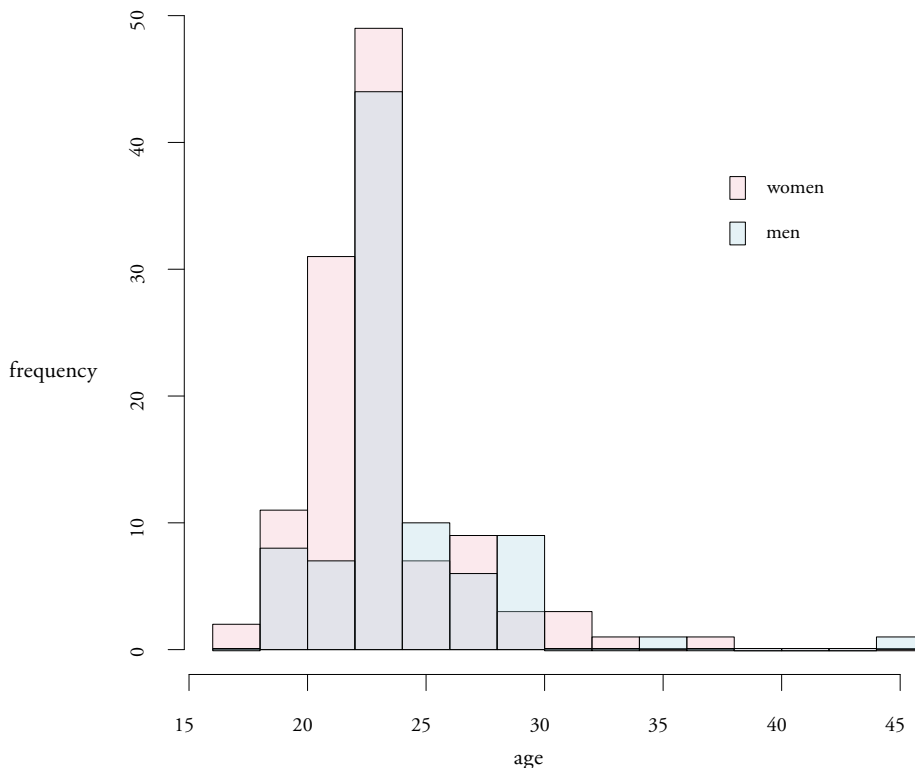
## Materials and methods

The online experiment on delay discounting of monetary losses has been conducted in October-December 2020 among students of SGH Warsaw School of Economics, Poland. The participants were graduate students representing various fields of studies (students volunteered to take part in the experiment; the raw data are available online – DOI: 10.13140/RG.2.2.35480.21760; the raw data include information on students' majors, among others). The study was conducted through a designed web-page on a university server with a link sent to the participants. A total of 207 people participated in the study. All methods were carried out in accordance with SGH guidelines/regulations. All experimental protocols were submitted to the Research Project Center at SGH Warsaw School of Economics and approved by the university official. Informed consents from participants were obtained with the help of computer application.

To qualify for the sample, each participant had to answer all the questions. Apart from the research questions concerning different monetary loss choices, we collected data about the participants' gender, age, and major. No further personal information was collected, making the study anonymous.

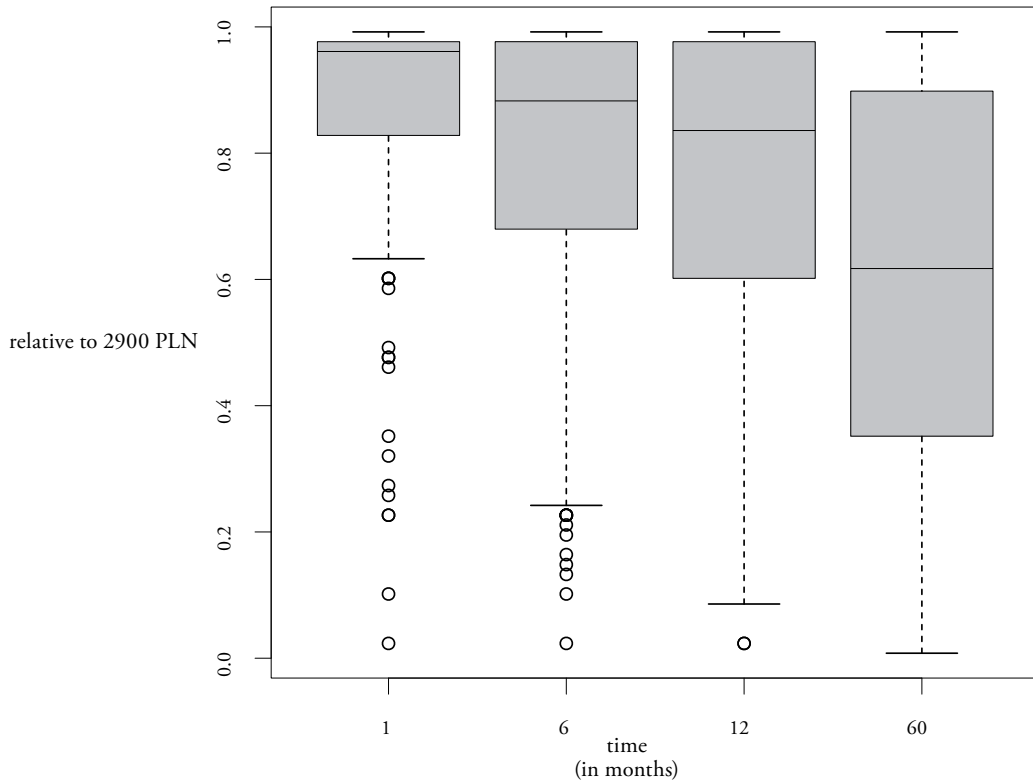
Also, the time of completing the discounting task was recorded. Due to some very rapid responses in that task (less than three standard derivations from mean), we excluded four observations from the analysis, limiting the sample to 203 participants, which makes it a representative and large enough sample to draw conclusions from.

Figure 1. Age distribution of participants



Source: own study.

**Figure 2. Distributions of relative money equivalents of immediate monetary loss for 2900 PLN loss incurred in a time period depicted on the horizontal axis**



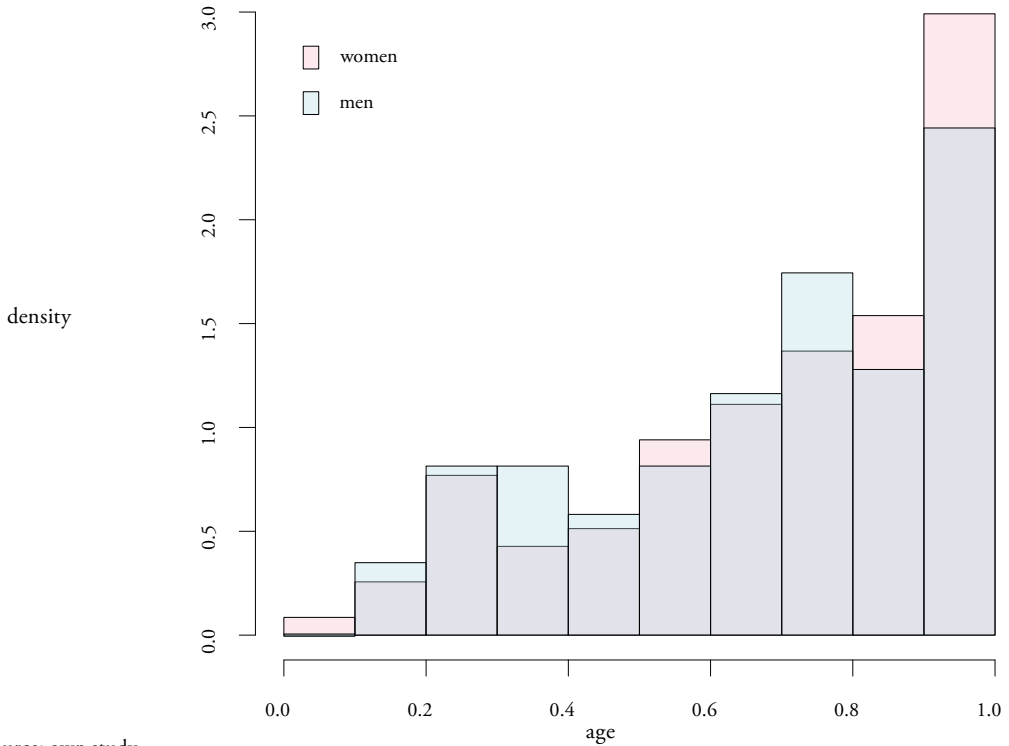
Source: own study.

The gender division of the data sample is as follows: 86 participants identified themselves as men, while 117 as women, which gives us a 42:58 men-women ratio. As the study was conducted among students, the participants were most commonly 20-25 years old. Figure 1 shows the distribution of age for male and female participants.

We observe a slightly higher average age for men (24.5 compared to 23.4 for women) and moderately different age distributions among the two genders. This difference is statistically significant ( $t$ -test statistic is 2.211) as well as the distributions are statistically distinct ( $D = 0.254$  for discrete Kolmogorov-Smirnov test).

In the discounting task, the participants were asked to evaluate their preferences towards losing different amounts of money at different time periods. Participants were initially asked to choose between incurring a monetary loss of 1450 PLN (about 320 EUR) now (1st option) or 2900 PLN (640 EUR) in some fixed time period (2nd option). Then, as the participant chose the preferred option, the immediate amount of loss changed to capture the indifference between the two amounts. This procedure is in line with the algorithm proposed by Holt, Green, and Myerson (2003) – in the first choice, 1st option was half the amount in 2nd option, in subsequent choices, 1st option increased or decreased depending on the previous decisions made by participants. The amount in 1st option following the sixth choice was treated as the equivalent of the amount in 2nd option. With the same initial monetary amounts, this procedure was run for losses of 2900 PLN in 1, 6, 12, and 60 months.

Figure 3. Distribution of AUC divided into gender



Source: own study.

To obtain individual discounting rates of losses, we use the Area Under the Curve (AUC) method, cf. Myerson et al. (2001). Thus, we calculate the value of AUC, representing the area that lies under the curve, joining the relative time delay points of losses with the relative equivalent. Therefore, AUC can take values between 0 and 1 with higher values indicating more patient individuals. As we can see in figure 2, the average money equivalent for the 1-month delay is about 90% of the loss. The equivalent drops sharply to less than 80% for the 3-month delay. It gradually decreases and is about 60% for a 5-year delay, which corresponds to an approximately long term 10% annual discount rate.

It is worth noting that AUC is a theoretically neutral measure of the discounting process since the AUC method does not assume any particular type of discounting – exponential, hyperbolic, nor q-exponential (see, e.g., Takahashi, 2013).

## Results

The procedure mentioned above allows to find the discounting rates of losses for different time periods. The distribution of these discounting rates is depicted in figure 2 using box plots. As we can see, the immediate loss equivalent decreases with time. For a one-month delay, participants would incur a similar loss as immediately, whereas increasing the delay lowers the immediate money equivalent. Moreover, as time progresses, the distribution of money equivalents becomes more variant. It shall be noted that there are some outliers in the data, especially concerning the short-term relation between monetary losses. Some participants do not wish to incur losses now and want to delay it even for a high loss in a short time.

We find that pattern believable as the survey participants were mostly students who may be in a currently troublesome financial situation.

The distribution of the Area Under the Curve values is depicted in the histogram in figure 3. As we can see, the distribution is negatively skewed, with the average observed value of AUC being 0.686. The dominant level of AUC is greater than 0.9, with over 25% of participants being highly patient.

The central question in this paper is the relationship between the delay discounting of monetary losses (measured with the use of AUC) and the gender of the decision makers. As we can see from figure 3, women are more represented in the high extreme of the AUC distribution. Thus, it may imply a higher value of this indicator for women than men, hence signaling higher patience. On the other hand, the distribution of AUC is more diversified as there are women with AUC lower than 0.1. Thus, the question remains whether the observed difference in the sample is significant enough to justify indicating it in the population.

In order to find the differences between gender and delay discounting of losses, we use statistical methods. The t-test statistic of sample means is equal to 1.0894 and hence shows no indication of the means being different. On the other hand, according to the Kolmogorov-Smirnov test ( $D=0.1284$ ) the distributions of AUC among men and women may differ with a significance level of 10%.

Therefore, to quantitatively determine the relationship between gender and delay discounting of losses, we use the following regression model:

$$AUC_i = \beta_0 + \beta_1 SEX_i + \beta_2 AGE_i,$$

where  $AUC_i$  denotes the value of the Area Under the Curve of participant  $i$  (multiplied by 100),  $AGE_i$  is the participant's age measured in years and  $SEX_i$  is the declared gender of participant ( $SEX_i = 1$  for male).

We estimate the model using Ordinary Least Squares. We use age as a control variable as the distribution of participants' age differs among genders. As a robust check, we include alternative model forms. We add squares of age as the participants' patience might not change monotonically with age. Moreover, we apply the interaction of participant's age and gender to provide flexibility in the estimates of sex and age relationships with the value of AUC. The following table summarizes our findings.

**Table 1. OLS regression of the Area Under the Curve (dependent variable). Values in brackets represent standard deviations of model parameters**

Variable	Model							
	1		2		3		4	
Intercept	56.8147	(12.5979)	51.9409	(17.8435)	25.8855	(47.4961)	-32.5921	(85.2683)
SEX	-4.5729	(3.6251)	5.2376	(25.6409)	-4.7292	(3.6374)	87.0708	(108.0916)
AGE	0.6091	(0.5285)	0.8172	(0.7551)	2.9422	(3.4943)	7.4882	(6.6227)
AGE • SEX			-0.4094	(1.0593)			-6.8860	(8.0958)
AGE <sup>2</sup>					-0.0425	(0.0629)	-0.1285	(0.1267)
AGE <sup>2</sup> • SEX							0.1251	(0.1496)

Source: own study.

As we can see from Table 1, gender was proven to be an insignificant factor describing an individual's attitude towards monetary losses for all the investigated models. In all the models, the only significant variable was the intercept. With any reasonable level of confidence, we cannot decline the hypothesis concerning the insignificance of sex and gender variables, including their derivatives.

Thus, the regression shows that there is no statistically significant difference or impact of gender on time discounting of losses. In addition, the participants' age also seems not to have any impact on the discounting of monetary losses. Hence, we claim that the simple demographic factors do not affect the preferences towards discounting losses by individuals.

## Discussion

Delay discounting of monetary amounts can be treated as a measure of the decision maker's impulsivity (self-control). Behavioral economics and psychological studies often report higher impulsivity of men – cf., e.g., Waldeck and Miller, 1997; Weinstein and Dannon, 2015. The latter authors attribute the indicated difference between males and females to neurobiological mechanisms, particularly the serotonin (5-HT) system, different for men and women.

Persons who can be characterized by lower delay discounting rates of monetary amounts are said to be more patient and exhibit a higher degree of self-control over immediate impulses. Since men are often described in the literature (see the sources cited above) as less patient, we expected the significant impact of gender on delay discounting of monetary losses. This expectation seemed natural since impulsive people prefer to solve problems quickly. In our discounting task, the last sentence means incurring losses sooner than postponing the loss or moving the financial problem to the future.

Surprisingly, in our study which is limited to SGH students, we did not observe significant differences in delay discounting of monetary losses between men and women. We see several explanations for that.

First, the delay discounting of monetary losses can be biologically much different than delay discounting of monetary gains, and no gender differences occur in the context of losses, while they do occur in the context of gains. Then still, the question on biological (and specifically neural) mechanisms behind those two types of discounting remains open.

Second, the negative results (no observed differences) can be explained by the relatively homogenous (in terms of age) group of tested people. It can be speculated that during studies, both men and women play similar social roles, spend much time in peer groups consisting of both men and women, and that possibly can form similar viewpoints or behaviors. Therefore, the natural next step would be to extend our study to non-student groups.

Third, the negative results can be explained by other possible limitations of our study, e.g., the amounts proposed in the discounting task are too small (thus, the students do not care about them; however, we do think they are large enough for students in Poland to make them choose seriously in the discounting task). Another reason for the negative results can be the fact that the amounts are only hypothetical (on the other hand, there are numerous studies which link choices of hypothetical amounts with real impulsive behavior, cf., e.g., Wilson et al., 2011).

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