Studia Psychologica, Vol. 64, No. 3, 2022, 313-328
https://doi.org/10.31577/sp.2022.03.856

In Search of Determinants of Time-Discounting in Monetary Choices: Personal Characteristics Matter Only a Little

Lenka Vargová[1], Matúš Adamkovič[1,2,3]
[1]Institute of Psychology, Faculty of Arts, University of Prešov, Slovak Republic
[2]Institute of Social Sciences, CSPS Slovak Academy of Sciences, Košice, Slovak Republic
[3]Faculty of Humanities and Social Sciences, University of Jyväskylä, Jyväskylä, Finland

Time-discounting in monetary choices is determined by aspects related to the reward, contextual factors and characteristics of a person. In the present study, we used three datasets (N_{data1} = 419; N_{data2} = 485; N_{data3} = 240) to examine how well personal characteristics (sociodemographic, financial situation, self-control, cognitive abilities, negative experiencing, and trustfulness) predict time-discounting in both hypothetical and real reward scenarios. The results of the regression analyses indicate that the characteristics of a person only explain a small proportion of the variance in time-discounting (R^2 ranged from .10 to .19). The only substantive predictors of time-discounting in monetary choices were financial literacy and the general tendency to delay gratification. We conclude that there remains much work to be done in explaining what determines time-discounting. However, shifting the focus from personal characteristics to the characteristics of reward and contextual factors could be of interest.

Key words: time-discounting, delay discounting, monetary choices, predictors of time-discounting, personal characteristics

Introduction

In a range of situations, people choose between an immediate benefit or a future advantage. For instance, a few days before an important exam, a student could either go to a party and have a good time or study for the exam ensuring a better score. One of the phenomena related to this present-future trade-off is delay discounting in monetary choices. This has been widely studied in both economic and psychological literature (Madden et al., 2003; Ruggeri et al., 2021). Delay discounting (otherwise known as time-discounting, intertemporal discounting or inter-

Correspondence concerning this article should be addressed to Lenka Vargová, Institute of Psychology, Faculty of Arts, University of Prešov, Slovak Republic. E-mail: lmaskalova@gmail.com

The data and analytic code are freely available at https://osf.io/yp85k/

Received August 20, 2021

temporal choice) can be described as a person's preference for a smaller-sooner reward relative to a reward that is larger but more distal in time (e.g., Pepper & Nettle, 2017). A substantial body of literature has focused on the consequences of this (e.g., health issues, stress, various types of addiction, risky behavior; Amlung et al., 2016; Daugherty & Brase, 2010; Fields et al., 2014; Mishra & Lalumière, 2016) as well as on the antecedents/determinants (e.g., cognitive factors, personality traits, sociodemographic differences or contextual characteristics; Adamkovič, 2020; Hirsh et al., 2008; Hirsh et al., 2010; Huffman et al., 2019; Steinberg et al., 2009). In a recent paper, Bačová and Šrol (2021) found that cognitive predictors accounted for a relatively low percentage (about 12%) of the variance in delay discounting in monetary choices. The authors have concluded that there may be more important factors determining one's time-discounting and have called for further research on the topic. In an attempt to expand on their research, we have used the available data and computed several regression models combining potential sociodemographic, cognitive and personality-related predictors of time-discounting in monetary choices. The current study thus aims to explore the proportion of variance in delay discounting in monetary choices that can be explained by a set of these predictors as well as how much the results differ when different delay discounting tasks are used as the dependent variable.

On the (Non)Cognitive Predictors of Time-Discounting in Monetary Choices

Bačová and Šrol (2021) have provided a comprehensive overview of the most important cognitive determinants of time-discounting in monetary choices and discuss the issue from the perspective of rational thinking and decision-making in particular. The current paper extends their effort and lists the other main factors that could influence delay discounting in monetary choices. To summarize these factors systematically, we have divided them into three main categories: 1) characteristics of a person, 2) context of the situation, and 3) aspects related to the reward/task. The characteristics of a person include a) sociodemographic characteristics such as gender (Silverman, 2003), age (Read & Read, 2004), perspectives about the future (Hurwitz & Sade, 2020; Kim et al., 2020), b) objective socioeconomic status in terms of income/wealth and education (Brown et al., 2015) and subjective socioeconomic status (Liu et al., 2012); c) self-control in terms of willpower (Basile & Toplak, 2015; Waegeman et al., 2014), general delay of gratification tendency (Odum, 2011a), risk-seeking tendency (Epper & Fehr-Duda, 2012; Fields et al., 2015), frugality and spendthrift (Frederick et al., 2002; Prelec & Leowenstein, 1997), and neuroticism (Manning et al., 2014); d) cognitive factors such as susceptibility to bias (Stanovich et al., 2016), cognitive reflection (Białek et al., 2019; Frederick, 2005, Littrell et al., 2020), cognitive abilities (e.g., intelligence; Shamosh & Gray, 2008), working memory, information processing (Shamosh et al., 2008), abstract thinking (Malkoc et al., 2010); e) negative experiencing such as persistent negative affect (Lerner et al., 2013) or stress (Haushofer & Fehr, 2014); and f) trustfulness (Farah & Hook, 2017; Kidd et al., 2013). The contextual factors concern a) momentary scarcity (Hamilton et al., 2018; Griskevicius et al., 2011); b) perceived reliability of the environment (Kidd et al., 2013), c) acute stress (Malesza, 2019); d) acute emotional state (Liu et al., 2013), and e) stability of social relationships (Holmes et al., 2020). The factors related to the reward/task cover a) whether the reward is real or hypothetical (Hinvest & Anderson, 2010); b) size of the reward, time interval or lucrativeness of the re-

ward (Harman et al., 2020), and d) the nature of the time-discounting task (description-experience gap; Koritzky & Yechiam, 2010).

Differences between the Study by Bačová and Šrol (2021) and the Present Study

Even though the current study is an extension of the one done by Bačová and Šrol (2021) and not a replication, it is important to note the most significant differences and overlaps. The former study specifically focused on cognitive variables – cognitive ability, cognitive reflection, scientific reasoning, objective and subjective numeracy, analytic and intuitive thinking, and bias susceptibility. As such, they explored the effect of cognitive predictors on time-discounting in more depth. Besides cognitive variables (cognitive reflection, working memory and financial literacy), the current study also includes demographic characteristics, financial situation, self-control, negative experiencing and trustfulness as predictors of time-discounting. It is necessary to highlight that Bačová and Šrol (2021) modified the instruction for the time-discounting task to eliminate potential environmental sources that would justify the preference for smaller-immediate reward (e.g., doubting that the future reward would be delivered as promised; see Frederick et al., 2002) and thus their measure could be considered "a pure measure of rational delay discounting" (p. 132). No such modification has been done in this study. In order to make the results more robust, we used three different variations of the time-discounting measurement – Staircase module of time preferences (Falk et al., 2016), a 27-item monetary choice questionnaire (Kaplan et al., 2016), and a choice involving a real monetary reward (ranging from 6 euro immediately to 12 euro in a month). Furthermore, three samples (N_{total} = 1134) were used to cross-validate the results.

Data and Participants

The present data comes from three data collections that were conducted for the purposes of the research grant APVV-15-0404 "Psychological causes and consequences of poverty". As such, some parts of these data have already been published elsewhere. In the current study, three separate datasets

Table 1 *Descriptive characteristics of the sample*

	Data 1 (*N* = 419)	Data 2 (*N* = 485)	Data 3 (*N* = 240)	Total (*N* = 1144)
Gender (% female)	51.07	50.31	82.03	57.26
Age (SD)	40.23 (11.86)	39.62 (11.48)	34.41 (9.94)	38.75 (11.53)
Education (%)				
Without final exam	13.13	12.99	0.42	10.40
With final exam	52.74	52.78	47.5	51.66
University degree	34.13	34.23	52.08	37.94
Economic status (% employed)	63.96	62.68	66.67	63.99
Data collection procedure	Online (specialized agency)	Online (specialized agency)	In-person (experimental design)	-

were analyzed. In total, the sample consists of 1144 participants (N_1 = 419; N_2 = 485, N_3 = 240) of working age (mean age: 38.75 ± 11.53; age range: 18-62 years) with about 57% of the sample being female. About 10% of the sample had finished secondary school without the school-completion exam while about 53% had finished secondary school with it. About 38% of the sample had a university degree. At the time of the data collection, 64% of the sample was employed. The average equivalized net household income of the sample was 599 ± 327 euro per month. For a more detailed description of the sample see Table 1.

Measures

Given the main goal of the study, three distinct measures of time-discounting were modeled as the dependent variables. The list of predictors consisted of gender, age, education, economic status, health, household income, subjective SES, self-control, delay of gratification, risk preference, frugality, spendthrift, cognitive reflection, working memory, financial literacy, perceived stress, negative affect, shame, financial hassles, cognitive load, perceived reliability of the environment, and family functioning. Please note that 1) there were five time-discounting measures altogether across the three datasets (only the Staircase module of time preference was administered in each data collection and, therefore, only this module was used for the current analysis) and 2) that the list of predictors (slightly) varies across the datasets. For a comprehensive overview of all the measures (except for sociodemographic characteristics) see Table 2.

Statistical Analysis

The initial data handling (i.e., screening for improbable values, removal of careless participants, recoding of reverse-coded items, equivalization of household income and calculating the time-discounting scores) was done in the process of general data management for the purposes of project APVV-15-0404. For this study, the reliability of the measures was firstly estimated using the omega total coefficient. Then, the descriptive statistics and correlation matrices were calculated for all datasets. For the main analysis, we calculated several hierarchical regression models using the time-discounting measures as the dependent variables and the previously mentioned determinants as the predictors. The predictors were added in blocks (consisting of similar variables) to examine the increase in explained variance in time-discounting in several steps. The blocks were constructed as follows. The first block included the core demographic variables such as gender, age, education, employment, and subjective health. The second block contained factors related to the financial situation – household income and subjective SES. The third block covered the factors related to self-control; self-control, general delay of gratification tendency, risk preference, frugality, and spendthrift. The fourth block included cognitive factors such as cognitive reflection, working memory and financial literacy. The fifth block involved negative experiencing – perceived negative affect, stress, actual financial hassles, and cognitive load. The sixth block concerned trustfulness in the form of the perceived reliability of the environment. Both the standard OLS regressions as well as regressions with latent variables were estimated. The regressions with latent variables were calculated using lavaan (Rosseel, 2012) with the MLR estimator (initially, we aimed to treat the variables as ordinal and use the WLSMV estimator but due to several convergence issues, we stuck with the MLR estimator). Here the results obtained from the latent variables regressions are

Table 2 *Descriptive statistics of the measures*

Variable	*M*	*SD*	ω_{total}	Potential range	Higher value indicates	Reference	Notes
Time-discounting measures							
TD staircase	18.43	10.61	-	1 - 32	Higher patience (less discounting)	Staircase Time Preference (Falk et al., 2016)	E.g., "Would you rather receive 100 euros today or 150.1 euros in 12 months?"
	17.45	**10.91**					
	11.20	*7.76*					
IMCQ	**21.54**	**6.00**	-	-	Higher patience (less discounting)	27-item Monetary Choice Questionnaire (Kaplan et al., 2016)	The discount rate parameter (k) was obtained automatically using the spreadsheet by Kaplan et al. (2016). For an easier and more consistent (given the other two TD measures) interpretation, the scores were recoded so that a higher score represented higher patience. Due to problems with convergence when estimating the regression models, the original scores (k) were multiplied by 100.
Monetary reward	*2.41*	*1.45*	-	1 - 4	Higher patience (less discounting)	-	E.g., "Would you prefer 54€ today or 55€ in 117 days?" Real financial incentives. A participant was asked to choose between the alternatives: 1) 6 euro immediately 2) 8 euro in 10 days 3) 10 euro in 20 days 4) 12 euro in a month
Determinants of time-discounting							
Subjective health	2.41	0.89	-	1 - 5	Better health	-	Subjective evaluation of health (single item). E.g. "How would you evaluate your health generally ?"
Equivalized household income	561	295	-	-	-	-	Equivalization coefficients: 1 = head of the household; 0.5 = every other adult person; 0.3 = every person U18.
	606	**328**					
	647	*368*					
Subjective SES	5.03	1.69	-	1 - 10	Higher SES	MacArthur Scale of Subjective Social Status (Giatti et al., 2012)	Subjective assessment of SES on a visual scale.
	4.75	**1.60**					
	5.19	*1.61*					
Self-control	42.99	7.20	.82	13 - 65	Higher self-control	Self-Control Scale (Tangney et al., 2004)	E.g., "I never allow myself to lose control."
	43.28	**6.78**	**.79**				
	44.54	*7.65*	*.78*				

Table 2 continues

Table 2 continued

Table 2 *Descriptive statistics of the measures*

Variable	*M*	*SD*	ω_{total}	Potential range	Higher value indicates	Reference	Notes
Poor delay of gratification	19.71	5.17	.80	8 - 40	Poorer delay of gratification	Poor Behavioral Regulation Scale (Wills et al., 2013)	E.g., "I don't understand why people save their money when they could enjoy it right now."
	20.31	**5.38**	**.81**				
Risk preference	23.66	7.48	-	1 – 32	Higher risk-seeking behavior	Staircase Risk Preference (Falk et al., 2016)	E.g., "What would you prefer: a 50 percent chance of winning 300 euro when at the same time there is a 50 percent chance of winning nothing, or would you rather have 50 euro as a sure payment?"
	23.50	**7.26**					
Frugality	**30.38**	**6.15**	**.90**	8 - 40	Higher frugality	Frugality Scale (Lastovicka et al., 1999)	E.g., "If you can re-use an item you already have, there's no sense in buying something new."
	29.45	*7.48*	*.89*				
Spendthrift	**6.00**	**1.37**	-	1 - 11	Tendency to spendthrift	Tightwad - Spendthrift Scale (Rick et al., 2008)	E.g., "Which of the following descriptions fits you better? 1 – Tightwad (difficulty spending money); 6 – About the same or neither; 11 – Spendthrift (difficulty controlling spending)."
	6.17	1.44					
Cognitive reflection	2.25	1.66	.87	0 - 6	Lower intuitive thinking	3 items from Frederick (2005) and 3 items from Oldrati et al. (2016)	E.g., "A bat and ball cost 1.10€ in total. The bat costs 1.00€ more than the ball. How much does the ball cost ?", and "A farmer makes 4 piles of hay in one corner of a field and other 5 piles in another corner. If he merges them how many piles will he have?"
	2.55	**1.79**	**.88**				
	2.10	*1.40*	*.79*				
Working memory	8.75	1.57	.81	0 -10	Better working memory	Digit Span Test	A constant increase in the number of digits to reproduce. A simple mathematical equation to solve between the memorization and the reproduction phases.
	5.70	**2.07**	**.86**	0 - 9			
	3.36	*1.83*	*.81*	0 - 7			
Financial literacy	3.75	1.60	.81	0 - 6	Higher financial literacy	6/8 items from Lusardi (2008)	E.g., "Considering a long time period (for example 10 or 20 years), which asset normally gives the highest return: savings accounts, bonds or stocks ?"
	4.29	**1.88**	**.78**	0 - 8			
	4.03	*1.70*	*.69*				
Stress	18.33	5.39	.85	0 - 40	Higher perceived stress	Perceived Stress Scale (Cohen et al., 1983)	E.g., "In the last month, how often have you felt nervous and stressed ?"
	17.79	**5.81**	**.87**				
	24.65	*6.47*	*.83*				
Negative affect	27.11	6.57	.91	10 - 50	More frequent experience of negative affect	PANAS (Watson et al. 1988)	E.g., "Indicate the extent you generally feel distressed."
	25.90	**6.77**	**.91**				

Table 2 continues

Table 2 continued

Table 2 *Descriptive statistics of the measures*

Variable	*M*	*SD*	ω_{total}	Potential range	Higher value indicates	Reference	Notes
Financial hassles	2.40	2.43	.89	0 - 11	More financial hassles	The Daily Hassles Scale - Revised (Holm & Holroyd, 1992)	E.g., "Not enough money for basic necessities."
Cognitive load	23.10	6.45	.85	4 - 36	Higher perceived burden	-	Perceived burden on cognition caused by financial situation. E.g., "How much time do you spend thinking about your financial situation?"
	5.53	**2.05**	-	1 - 9			
Reliability of environment	**4.98**	**2.34**	-	1 - 9	Higher perceived reliability of the environment	-	"How much would you trust the scientist that your (delayed) reward will be rightly delivered?"
	5.52	*2.46*	-				

Note. Values obtained from Dataset 1 are written in normal font; values obtained from Dataset 2 are written in bold; values obtained from Dataset 3 are written in italics.

reported as this approach is superior to the standard OLS procedure (outputs of the OLS regressions can be obtained from the supplementary materials). For simplicity, we decided to only report the standardized regression coefficients, R^2 and its changes between the blocks. We set the smallest effect size of interest to *r* and $\beta = |.1|$, which means that effects (point estimates) smaller than .1 are not considered substantially meaningful. We intentionally do not report nor discuss the associated *p*-values. However, these as well as the confidence intervals (or SEs) of the estimates can be easily obtained from the supplementary materials. The data and analytic code are freely available at https://osf.io/yp85k/ and other researchers are invited to reproduce the results or use the data for their analyses. It is important to highlight the fact that the present research is of an exploratory nature and further (both close and conceptual) replications are very much needed.

Results

The binary correlations between time-discounting in monetary choices and its determinants indicated small effects, with the mean absolute value of *r* being .08 (*SD* = .07), ranging from .00 to .27. The estimates replicated fairly well across different time-discounting measures. For the exact correlation coefficients see Table 3.

The hierarchical regression analyses showed that all the studied predictors explained from 10% to 19% of the variance in time-discounting in monetary choices. The greatest increase in explained variance was observed after including the variables related to self-control and cognitive abilities. In particular, the biggest effect was observed for financial literacy with an average $\beta = .26$, followed by the general tendency to delay gratification ($\beta = -.18$) and financial hassles ($\beta = .18$; note that the

Table 3 *Binary relationships between time-discounting and its determinants in all three datasets*

Predictor	Data 1	Data 2		Data 3	
	Staircase module	Staircase module	IMCQ	Staircase module	Monetary reward
Gender	.00	-.07	.08	-.05	-.15
Age	-.01	-.03	-.16	.00	.06
Education	.19	.12	.11	.12	.08
Economic status	-.02	.01	-.04	.03	.01
Health	-.01	-	-	-	-
Household income	.16	.08	.02	.23	.06
Subjective SES	.09	.03	.03	.03	.02
Self-control	-.07	.01	-.08	-.04	-.11
Delay of gratification	-.13	-.21	-.13	-	-
Risk preference	.01	.00	.05	-	-
Frugality	-	.10	.02	.03	.02
Spendthrift	-	-.09	-.07	-.11	-.03
CRT	.15	.17	.17	.10	.06
Working memory	.01	-.09	-.05	-.08	-.10
Financial literacy	.27	.16	.16	.10	.19
Stress	-.09	-.13	-.03	-.05	.02
Negative affect	-.02	-.08	.02	-	-
Financial hassles	-.26	-	-	-	-
Cognitive load	-.19	-.15	-.11	-	-
Trustfulness	-	.00	-.01	.07	.09

financial hassles measure was only available in one dataset and thus the results should be interpreted with caution). The effects of all other variables were small, with an average βs ≤ .10. The summaries of the results can be found in Tables 4, 5, and 6.

Discussion

The present study aimed to explore how well a set of 1) sociodemographic variables, 2) financial situation, 3) self-control measures, 4) cognitive abilities, 5) negative experiencing, and 6) trustfulness predicts time-discounting in monetary choices. The results have revealed small correlations (average r = |.08| ± .06) between time-discounting in monetary choices and its potential determinants. The only substantively significant predictors (β > .10) of time-discounting appear to be financial literacy (average β = .26) followed by the general delay of gratification (average β = -.18).

The present study expands on the paper by Bačová and Šrol (2021) on three levels. 1) Bačová and Šrol (2021) specifically focused on the cognitive predictors of time-discounting in monetary choices and highlighted the importance of susceptibility to bias in this context. In fact, several other studies (e.g., Aranovich et al., 2016; Białek & Sawicki, 2018; Hirsh et al., 2008) have outlined the importance of cognitive abilities in delay discounting. In the current study, cognitive predictors played a somewhat minor role in explaining the variance of time-discounting (mean ΔR^2 = .06). The difference is likely to be caused by using diverse cognitive abilities (which were

Table 4 *Latent variables hierarchical regression analysis of predictors of time-discounting (N = 419; DV = Staircase module of time-discounting)*

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sociodemographic						
Gender (female)	-.03	-.03	-.02	.03	.03	.02
Age	.01	.01	.05	.02	.01	.00
Education	.20	.17	.14	.10	.10	.09
Economic status	-.04	-.06	-.06	-.06	-.05	-.05
Health	.01	.04	.02	.02	.03	.04
Income related						
Household income		.12	.11	.07	.07	.04
Subjective SES		.05	.06	.06	.06	.02
Control related						
Self-control			-.22	-.19	-.22	-.16
Delay of gratification			-.25	-.20	-.20	-.14
Risk preference			.03	.05	.05	.07
Cognitive						
CRT				-.18	-.18	-.20
Working memory				-.06	-.06	-.05
Financial literacy				.36	.35	.35
Negative experiencing						
Stress					-.11	-.06
Negative affect					.03	.03
Financial hassles						-.18
Cognitive load						.00
R^2	.04	.06	.11	.16	.17	.19
R^2 change	-	.02	.05	.05	.01	.02

Note. Standardized regression coefficients are reported

Table 5 *Latent variables hierarchical regression analysis of predictors of time-discounting (N = 485; DV = Staircase module of time-discounting)*

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sociodemographic						
Gender (female)	-.09	-.09	-.12	-.07	-.06	-.06
	.03	**.04**	**.03**	**.10**	**.11**	**.11**
Age	-.05	-.05	-.05	-.06	-.07	-.08
	-.14	**-.14**	**-.13**	**-.15**	**-.17**	**-.17**
Education	.12	.11	.06	.03	.02	.03
	.10	**.10**	**.07**	**.02**	**.02**	**.02**
Economic status	.00	.00	.01	.01	.01	.01
	-.01	**-.01**	**.00**	**.02**	**.01**	**.02**
Income related						
Household income		.04	.04	.01	.01	.01
		-.01	**-.01**	**-.05**	**-.06**	**-.05**
Subjective SES		-.02	-.04	-.03	-.03	-.04
		.02	**.03**	**.04**	**.04**	**.04**
Control related						
Self-control			-.12	-.06	-.06	-.06
			-.20	**-.15**	**-.13**	**-.13**
Delay of gratification			-.28	-.21	-.19	-.19
			-.21	**-.11**	**-.09**	**-.09**
Risk preference			.00	-.01	-.01	-.01
			.06	**.05**	**.06**	**.06**
Frugality			.02	.02	.03	.03
			-.02	**-.02**	**-.01**	**-.01**
Spendthrift			-.04	-.05	-.05	-.04
			-.06	**-.07**	**-.07**	**-.07**
Cognitive						
CRT				.08	.05	.05
				.00	**-.03**	**-.03**
Working memory				-.12	-.11	-.11
				-.09	**-.09**	**-.08**
Financial literacy				.12	.13	.13
				.29	**.29**	**.29**
Negative experiencing						
Stress					-.09	-.09
					-.07	**-.07**
Negative affect					.08	.08
					.08	**.08**
Cognitive load					-.09	-.09
					-.11	**-.11**
Trustfulness						.03
						.02
R^2	.02	.02	.09	.12	.12	.12
	.04	**.04**	**.08**	**.18**	**.18**	**.18**
R^2 change	-	.00	.07	.03	.00	.00
	-	**.00**	**.04**	**.09**	**.00**	**.00**

Note. Standardized regression coefficients are reported

Table 6 *Latent variables hierarchical regression analysis of predictors of time-discounting (N = 240; DV = Staircase module of time-discounting)*

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sociodemographic						
Gender (female)	-.06	-.05	-.04	-.03	-.03	-.03
	-.15	**-.15**	**-.14**	**-.12**	**-.13**	**-.12**
Age	.00	.06	.07	.05	.05	.04
	.05	**.07**	**.10**	**.08**	**.08**	**.07**
Education	.12	.09	.11	.08	.08	.08
	.08	**.07**	**.06**	**-.02**	**-.02**	**-.02**
Economic status	.01	-.07	-.06	-.06	-.07	-.06
	.01	**-.01**	**-.01**	**.01**	**.02**	**.02**
Income related						
Household income		.29	.29	.27	.26	.26
		.08	**.07**	**.02**	**.03**	**.03**
Subjective SES		-.09	-.07	-.07	-.07	-.07
		.01	**.04**	**.05**	**.05**	**.05**
Control related						
Self-control			.06	.03	.06	.05
			.11	**.13**	**.12**	**.12**
Frugality			.02	.01	.02	.02
			.02	**-.01**	**-.01**	**-.01**
Spendthrift			-.13	-.12	-.12	-.13
			-.04	**.01**	**.01**	**.00**
Cognitive						
CRT				.00	.00	.01
				-.25	**-.25**	**-.24**
Working memory				-.12	-.11	-.11
				-.15	**-.16**	**-.16**
Financial literacy				.09	.09	.06
				.46	**.46**	**.44**
Negative experiencing						
Stress					-.06	-.05
					.03	**.04**
Trustfulness						.07
						.05
R^2	.02	.07	.09	.09	.09	.10
	.03	**.04**	**.05**	**.18**	**.18**	**.18**
R^2 change	-	.05	.02	.00	.00	.01
	-	**.01**	**.01**	**.13**	**.00**	**.00**

Note. Standardized regression coefficients are reported

more general in this study) and especially by the fact that susceptibility to bias was not measured in the present study. On the other hand, financial literacy appears to be a promising factor in explaining time-discounting. Further research on the topic could be focused on its skill component rather than on financial knowledge (see, e.g., Topa et al., 2018). 2) By including a whole spectrum of different variables as predictors of time-discounting, a small step has been made towards a better understanding of its determinants in spite of the null results (except for financial literacy and the general delay of gratification tendency that showed themselves to be substantially significant predictors of time-discounting in monetary choices). Despite including multiple theoretically relevant variables, the study failed to explain a notable percentage of the variance in time-discounting in monetary choices. This corroborates the evidence that time-discounting is a stable trait which is only marginally determined by other stable factors (for a more extensive discussion, see, e.g., Meier & Sprenger, 2015; Odum, 2011a). Instead, the existing evidence suggests that time-discounting could be altered by shocks or crises (Bickel et al., 2016; Guiso et al., 2018). 3) Furthermore, we argue that a trade-off between immediate albeit smaller rewards and bigger but more distal rewards creates a paradox in decision-making. This is because maximization should be both economically rational and the intrinsically motivated desire of a person to make a profit (Frederick et al., 2002). However, this is not always the case – the effort to maximize profit may vary across cultures (Du et al., 2002; Chen et al., 2005). In some cultures, people's behavior tends to be driven by collectivist values. This means that an individual is often more focused on collective goals, even at the expense of personal benefit. This could significantly reduce the tendency to act impulsively. On the other hand, in some cultures, people may focus more on achieving personal goals which would lead to higher impulsivity in decision-making processes (see Kim et al., 2012).

Despite its benefits, the present study has several limitations. Firstly, we decided to take a broader view instead of an in-depth focus on a specific determinant of time-discounting. Thus, the study explored how well combinations of different characteristics related to a person predict the person's time-discounting in monetary choices. As such, we provide an overview of the results and some general explanations without delving deep into the psychological mechanics and discussion of specific relationships. Secondly, although we a real reward time-discounting scenario, it was not possible to match the size of the rewards involved in the hypothetical and real time-discounting tasks. To learn more about the difference in time-discounting between real and hypothetical choices, see Xu et al. (2016). Thirdly, the categorization of the variables into blocks should not be considered the only option and there are several alternatives on how to do it. Other researchers are welcome to use the data presented in this study and test their models.

In summary, the factors related to a person only account for a small proportion of the variance in time-discounting in monetary choices. As has been shown by Odum (2011a, 2011b), delay discounting could be considered a stable personality trait. If the theoretically relevant characteristics of a person only marginally explain time-discounting in monetary choices (across different measures and scenarios), a better understanding of time-discounting probably lies within factors that go beyond the person who is making the decision. Such factors include actual shocks and crises (e.g., Bickel et al., 2016; Guiso et al., 2018) or aspects of the reward (e.g., its size or

time interval; Harman et al., 2020). Studying how these aspects determine time-discounting and what interventions (i.e., training programs) are the most effective for getting control over the decision from external factors to the person could be a way forward to global improvement in rational decision-making.

Acknowledgement

This work was funded by the Slovak Research and Development Agency [project nos. APVV-15-0404 and APVV-20-0319], the Research Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and Slovak Academy of Science [VEGA under the contract no. 1/0559/21] and project PRIMUS/20/HUM/009.

Authors' ORCID

Lenka Vargová
https://orcid.org/0000-0002-8758-0997
Matúš Adamkovič
https://orcid.org/0000-0002-9648-9108

References

Adamkovič, M. (2020). Consequences of poverty on economic decision-making: Assessing the verisimilitude of the cognitive mechanism. *Frontiers in Psychology, 11.* https://doi.org/10.3389/fpsyg.2020.00171

Amlung, M., Vedelago, L., Acker, J., Balodis, I., & MacKillop, J. (2016). Steep delay discounting and addictive behavior: A meta-analysis of continuous associations. *Addiction, 112*(1), 51–62. https://doi.org/10.1111/add.13535

Aranovich, G. J., McClure, S. M., Fryer, S., & Mathalon, D. H. (2016). The effect of cognitive challenge on delay discounting. *NeuroImage, 124*, 733–739. https://doi.org/10.1016/j.neuroimage.2015.09.027

Bačová, V., & Šrol, J. (2021). Cognitive predictors of delay discounting in monetary choices. *Studia Psychologica, 63*(2), 129–142. https://doi.org/10.31577/sp.2021.02.817

Basile, A. G., & Toplak, M. E. (2015). Four converging measures of temporal discounting and their relationships with intelligence, executive functions, thinking dispositions, and behavioral outcomes. *Frontiers in Psychology, 6*. https://doi.org/10.3389/fpsyg.2015.00728

Białek, M., Bergelt, M., Majima, Y., & Koehler, D. J. (2019). Cognitive reflection but not reinforcement sensitivity is consistently associated with delay discounting of gains and losses. *Journal of Neuroscience, Psychology, and Economics, 12*(3-4), 169–183. https://doi.org/10.1037/npe0000111

Białek, M., & Sawicki, P. (2018). Cognitive reflection effects on time discounting. *Journal of Individual Differences, 39*(2), 99–106. https://doi.org/10.1027/1614-0001/a000254

Bickel, W. K., Wilson, A. G., Chen, C., Koffarnus, M. N., & Franck, C. T. (2016). Stuck in time: Negative income shock constricts the temporal window of valuation spanning the future and the past. *PLOS ONE, 11*(9), e0163051. https://doi.org/10.1371/journal.pone.0163051

Brown, J. R., Ivković, Z., & Weisbenner, S. (2015). Empirical determinants of intertemporal choice. *Journal of Financial Economics, 116*(3), 473–486. https://doi.org/10.1016/j.jfineco.2015.04.004

Chen, H. (Allan), Ng, S., & Rao, A. R. (2005). Cultural differences in consumer impatience. *Journal of Marketing Research, 42*(3), 291–301. https://doi.org/10.1509/jmkr.2005.42.3.291

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385. https://doi.org/10.2307/2136404

Daugherty, J. R., & Brase, G. L. (2010). Taking time to be healthy: Predicting health behaviors with delay discounting and time perspective. *Personality and Individual Differences, 48*(2), 202–207. https://doi.org/10.1016/j.paid.2009.10.007

Du, W., Green, L., & Myerson, J. (2002). Cross-cultural comparisons of discounting delayed and probabilistic rewards. *The Psychological Record, 52*(4), 479–492. https://doi.org/10.1007/bf03395199

Epper, T. F., & Fehr-Duda, H. (2012). The missing link: Unifying risk taking and time discounting. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2175461

Falk, A., Becker, A., Dohmen, T. J., Huffman, D., & Sunde, U. (2016). The preference survey module: A validated instrument for measuring risk,

time, and social preferences. *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.2725874

Farah, M. J., & Hook, C. J. (2017). Trust and the poverty trap. *Proceedings of the National Academy of Sciences, 114*(21), 5327–5329. https://doi.org/10.1073/pnas.1704798114

Fields, S. A., Lange, K., Ramos, A., Thamotharan, S., & Rassu, F. (2014). The relationship between stress and delay discounting. *Behavioural Pharmacology, 25*(5–6), 434–444. https://doi.org/10.1097/fbp.0000000000000044

Fields, S. A., Ramos, A., & Reynolds, B. A. (2015). Delay discounting and health risk behaviors: The potential role of stress. *Current Opinion in Psychology, 5*, 101–105. https://doi.org/10.1016/j.copsyc.2015.07.003

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19*(4), 25–42. https://doi.org/10.1257/089533005775196732

Frederick, S., Loewenstein, G., & O'Donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature, 40*(2), 351-401. https://doi.org/10.1257/002205102320161311

Giatti, L., Camelo, L. do V., Rodrigues, J. F. de C., & Barreto, S. M. (2012). Reliability of the MacArthur Scale of Subjective Social Status – Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *BMC Public Health, 12*(1), 1096. https://doi.org/10.1186/1471-2458-12-1096

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: A life history theory approach. *Journal of Personality and Social Psychology, 100*(6), 1015–1026. https://doi.org/10.1037/a0022403

Guiso, L., Sapienza, P., & Zingales, L. (2018). Time varying risk aversion. *Journal of Financial Economics, 128*(3), 403–421. https://doi.org/10.1016/j.jfineco.2018.02.007

Hamilton, R., Thompson, D., Bone, S., Chaplin, L. N., Griskevicius, V., Goldsmith, K., … & Zhu, M. (2018). The effects of scarcity on consumer decision journeys. *Journal of the Academy of Marketing Science, 47*(3), 532–550. https://doi.org/10.1007/s11747-018-0604-7

Haushofer, J., & Fehr, E. (2014). On the psychology of poverty. *Science, 344*, 862–867. https://doi.org/10.1126/science.1232491

Harman, M., Kodak, T., & McKerchar, T. (2020). Effects of reward magnitude frames on measures of delay discounting in a hypothetical money scenario. *Journal of the Experimental Analysis of Behavior, 114*(2), 193–202. https://doi.org/10.1002/jeab.620

Hinvest, N. S., & Anderson, I. M. (2010). The effects of real versus hypothetical reward on delay and probability discounting. *Quarterly Journal of Experimental Psychology, 63*(6), 1072–1084. https://doi.org/10.1080/17470210903276350

Hirsh, J. B., Guindon, A., Morisano, D., & Peterson, J. B. (2010). Positive mood effects on delay discounting. *Emotion, 10*(5), 717–721. https://doi.org/10.1037/a0019466

Hirsh, J. B., Morisano, D., & Peterson, J. B. (2008). Delay discounting: Interactions between personality and cognitive ability. *Journal of Research in Personality, 42*(6), 1646–1650. https://doi.org/10.1016/j.jrp.2008.07.005

Holm, J. E., & Holroyd, K. A. (1992). The Daily Hassles Scale (Revised): Does it measure stress or symptoms? *Behavioral Assessment, 14*(3-4), 465–482. https://doi.org/10.1037/t57783-000

Holmes, C., Owens, M., Beach, S. R. H., McCormick, M., Hallowell, E., Clark, U. S., … & Sweet, L. H. (2020). Peer influence, frontostriatal connectivity, and delay discounting in African American emerging adults. *Brain Imaging and Behavior, 14*(1), 155–163. https://doi.org/10.1007/s11682-018-9977-y

Huffman, D., Maurer, R., & Mitchell, O. S. (2019). Time discounting and economic decision-making in the older population. *The Journal of the Economics of Ageing, 14*, 100121. https://doi.org/10.1016/j.jeoa.2017.05.001

Hurwitz, A., & Sade, O. (2020). An investigation of time preferences, life expectancy, and annuity versus lump sum choices: Can smoking harm long-term saving decisions? *Journal of Economic Behavior & Organization*, 180, 812–825. https://doi.org/10.1016/j.jebo.2019.05.011

Kaplan, B. A., Amlung, M., Reed, D. D., Jarmolowicz, D. P., McKerchar, T. L., & Lemley, S. M. (2016). Automating scoring of delay discounting for the 21- and 27-item Monetary Choice Questionnaires. *The Behavior Analyst, 39*(2), 293–304. https://doi.org/10.1007/s40614-016-0070-9

Kidd, C., Palmeri, H., & Aslin, R. N. (2013). Rational snacking: Young children's decision-making on the marshmallow task is moderated by be-

liefs about environmental reliability. *Cognition, 126*(1), 109–114. https://doi.org/10.1016/j.cognition.2012.08.004

Kim, S. J., Kim, H. J., & Kim, K. (2020). Time perspectives and delay of gratification – the role of psychological distance toward the future and perceived possibility of getting a future reward. *Psychology Research and Behavior Management, 13*, 653–663. https://doi.org/10.2147/prbm.s246443

Kim, B., Sung, Y. S., & McClure, S. M. (2012). The neural basis of cultural differences in delay discounting. *Philosophical Transactions of the Royal Society B: Biological Sciences, 367*(1589), 650–656. https://doi.org/10.1098/rstb.2011.0292

Koritzky, G., & Yechiam, E. (2010). On the robustness of description and experience based decision tasks to social desirability. *Journal of Behavioral Decision Making, 23*(1), 83–99. https://doi.org/10.1002/bdm.660

Lastovicka, J. L., Bettencourt, L. A., Hughner, R. S., & Kuntze, R. J. (1999). Lifestyle of the tight and frugal: Theory and measurement. *Journal of Consumer Research, 26*(1), 85–98. https://doi.org/10.1086/209552

Lerner, J. S., Li, Y., & Weber, E. U. (2013). The financial costs of sadness. *Psychological Science, 24*, 72–79. https://doi.org/10.1177/0956797612450302

Littrell, S., Fugelsang, J., & Risko, E. F. (2020). Not so fast: Individual differences in impulsiveness are only a modest predictor of cognitive reflection. *Personality and Individual Differences, 154*(109678), 109678. https://doi.org/10.1016/j.paid.2019.109678

Liu, L., Feng, T., Suo, T., Lee, K., & Li, H. (2012). Adapting to the destitute situations: Poverty cues lead to short-term choice. *PLoS ONE, 7*(4), e33950. https://doi.org/10.1371/journal.pone.0033950

Liu, L., Feng, T., Chen, J., & Li, H. (2013). The value of emotion: How does episodic prospection modulate delay discounting? *PLoS ONE, 8*(11), e81717. https://doi.org/10.1371/journal.pone.0081717

Lusardi, A. (2008). *Financial Literacy: An Essential Tool for Informed Consumer Choice?* National Bureau of Economic Research. https://doi.org/10.3386/w14084

Madden, G. J., Begotka, A. M., Raiff, B. R., & Kastern, L. L. (2003). Delay discounting of real and hypothetical rewards. *Experimental and Clinical Psychopharmacology, 11*(2), 139–145. https://doi.org/10.1037/1064-1297.11.2.139

Malesza, M. (2019). Stress and delay discounting: The mediating role of difficulties in emotion regulation. *Personality and Individual Differences, 144*, 56–60. https://doi.org/10.1016/j.paid.2019.02.035

Malkoc, S. A., Zauberman, G., & Bettman, J. R. (2010). Unstuck from the concrete: Carryover effects of abstract mindsets in intertemporal preferences. *Organizational Behavior and Human Decision Processes, 113*(2), 112–126. https://doi.org/10.1016/j.obhdp.2010.07.003

Manning, J., Hedden, T., Wickens, N., Whitfield-Gabrieli, S., Prelec, D., & Gabrieli, J. D. E. (2014). Personality influences temporal discounting preferences: Behavioral and brain evidence. *NeuroImage, 98*, 42–49. https://doi.org/10.1016/j.neuroimage.2014.04.066

Meier, S., & Sprenger, C. D. (2015). Temporal stability of time preferences. *Review of Economics and Statistics*, 97(2), 273–286. https://doi.org/10.1162/rest_a_00433

Mishra, S., & Lalumière, M. L. (2016). Associations between delay discounting and risk-related behaviors, traits, attitudes, and outcomes. *Journal of Behavioral Decision Making, 30*(3), 769–781. https://doi.org/10.1002/bdm.2000

Odum, A. L. (2011a). Delay discounting: Trait variable? *Behavioural Processes, 87*(1), 1–9. https://doi.org/10.1016/j.beproc.2011.02.007

Odum, A. L. (2011b). Delay discounting: I'm a k, you're a k. *Journal of the Experimental Analysis of Behavior, 96*(3), 427–439. https://doi.org/10.1901/jeab.2011.96-423

Oldrati, V., Patricelli, J., Colombo, B., & Antonietti, A. (2016). The role of dorsolateral prefrontal cortex in inhibition mechanism: A study on cognitive reflection test and similar tasks through neuromodulation. *Neuropsychologia, 91*, 499–508. https://doi.org/10.1016/j.neuropsychologia.2016.09.010

Pepper, G. V., & Nettle, D. (2017). The behavioural constellation of deprivation: Causes and consequences. *Behavioral and Brain Sciences, 40*. https://doi.org/10.1017/s0140525x1600234x

Prelec, D., & Loewenstein, G. (1997). Beyond time discounting. *Marketing Letters, 8*, 97–108. https://doi.org/10.1023/A:1007993512698

Read, D., & Read, N. (2004). Time discounting over the lifespan. *Organizational Behavior and Hu-*

man Decision Processes, 94(1), 22–32. https://doi.org/10.1016/j.obhdp.2004.01.002

Rick, S. I., Cryder, C. E., & Loewenstein, G. (2008). Tightwads and spendthrifts. *Journal of Consumer Research, 34*(6), 767–782. https://doi.org/10.1086/523285

Ruggeri, K., Panin, A., Vdovic, M., Većkalov, B., Abdul-Salaam, N., Achterberg, J., … & Garcia-Garzon, E. (2022). The globalizability of temporal discounting. *Nature Human Behavior*. https://doi.org/10.1038/s41562-022-01392-w

Shamosh, N. A., DeYoung, C. G., Green, A. E., Reis, D. L., Johnson, M. R., Conway, A. R. A., … & Gray, J. R. (2008). Individual differences in delay discounting. *Psychological Science, 19*(9), 904–911. https://doi.org/10.1111/j.1467-9280.2008.02175.x

Shamosh, N. A., & Gray, J. R. (2008). Delay discounting and intelligence: A meta-analysis. *Intelligence, 36*(4), 289–305. https://doi.org/10.1016/j.intell.2007.09.0

Silverman, I. W. (2003). Gender differences in delay of gratification: A meta-analysis. *Sex Roles 49*, 451–463. https://doi.org/10.1023/A:1025872421115

Stanovich, K. E., West, R. F., & Toplak, M. E. (2016). *The rationality quotient: Toward a test of rational thinking.* MIT press.

Steinberg, L., Graham, S., O'Brien, L., Woolard, J., Cauffman, E., & Banich, M. (2009). Age differences in future orientation and delay discounting. *Child Development, 80*(1), 28–44. https://doi.org/10.1111/j.1467-8624.2008.01244.x

Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality, 72*(2), 271–324. https://doi.org/10.1111/j.0022-3506.2004.00263.x

Topa, G., Hernández-Solís, M., & Zappalà, S. (2018). Financial management behavior among young adults: The role of need for cognitive closure in a three-wave moderated mediation model. *Frontiers in Psychology, 9*. https://doi.org/10.3389/fpsyg.2018.02419

Waegeman, A., Declerck, C. H., Boone, C., Van Hecke, W., & Parizel, P. M. (2014). Individual differences in self-control in a time discounting task: An fMRI study. *Journal of Neuroscience, Psychology, and Economics, 7*(2), 65–79. https://doi.org/10.1037/npe0000018

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Wills, T. A., Bantum, E. O., Pokhrel, P., Maddock, J. E., Ainette, M. G., Morehouse, E., & Fenster, B. (2013). A dual-process model of early substance use: Tests in two diverse populations of adolescents. *Health Psychology, 32*(5), 533–542. https://doi.org/10.1037/a0027634

Xu, S., Pan, Y., Wang, Y., Spaeth, A. M., Qu, Z., & Rao, H. (2016). Real and hypothetical monetary rewards modulate risk taking in the brain. *Scientific Reports, 6*(1). https://doi.org/10.1038/srep29520