# Steeper Delay Discounting for Potentially Real versus Hypothetical Cigarettes (but not Money) in Czech Republic Smokers 

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#### Abstract

A relatively large literature suggests that hypothetical and potentially real monetary rewards yield similar patterns of responses in delay (DD) and probability (PD) discounting. However, the much smaller literature concerning hypothetical versus potentially real cigarettes is more mixed and the generalizability of findings from both of these literatures outside the United States is unclear. The present study extended research comparing hypothetical and potentially real delayed and probabilistic monetary and cigarette outcomes to adult smokers $(N=59)$ in the Czech Republic using a within-subjects design. Comparison of hypothetical versus potentially real outcomes across tasks revealed Czech smokers discounted the value of potentially real cigarettes (but not money) more steeply than hypothetical cigarettes on the DD, but not PD, task. Findings also suggest a gender effect in which male participants discounted the value of money and cigarette outcomes more than did women for DD (but not PD). The relevance to methodological factors, cultural factors, and gender effects in discounting are discussed.


Keywords Delay discounting • Probability discounting • Hypothetical outcomes • Cigarette smoking • Gender

## Introduction

Delay discounting (DD) and probability discounting (PD) are behavioral measures of choice that indicate the extent to which an individual is sensitive to delayed (in DD ) and probabilistic (in PD ) rewards. In humans, DD is measured by posing a series of choices between a relatively small reward available right now (e.g., \$10) and a larger reward available after a delay (e.g., $\$ 100$ in a day). The size of the small reward is adjusted across subsequent questions (e.g., \$20, \$30) and a similar series of questions is asked using several different delays (e.g., 1 week, 1 month, 1 year). Preferences for smaller-sooner and larger-

[^0]delayed rewards is indicated as a series of indifference points indicating the current subjective value of the reward at the different delays. The preference for smaller-sooner rewards is consistent with the behavioral definition of impulsive choice (Rachlin et al., 1991). PD is similar, except that individuals choose between a series of smaller-certain rewards (e.g., \$10 for sure) and larger, but probabilistic rewards (e.g., a $50 \%$ chance of $\$ 100$ ). As in DD, the smaller-certain amount is adjusted and a similar series of choices is given for several probabilities (e.g., $10 \%, 25 \%$ ). A tendency to choose the probabilistic rewards in PD indicates a pattern of risk-taking, or insensitivity to probabilistic rewards (see Green \& Myerson, 2004).

Patterns of DD are associated with many problem health outcomes, including illicit drug use and abuse (MacKillop et al., 2011), cigarette smoking (Bickel et al., 1999), sexual risktaking (e.g., Johnson \& Bruner, 2012; Mahoney \& Lawyer, 2018; Lawyer \& Schoepflin, 2013), and obesity (Rasmussen et al., 2010), among others. The relationship between DD and health problems led DD to be described as a "transdisease" process (Bickel et al., 2012, 2019; Bickel \& Mueller, 2009) that may be a fundamental mechanism for health problem behaviors. The literature on PD and health-related decisions is a bit more sparse, but suggests that patterns of PD are associated with cigarette smoking (Reynolds et al., 2004), gambling (Holt et al., 2003),
sexual risk-taking (Mahoney \& Lawyer, 2018), and body fat percentage (Rasmussen et al., 2010). Taken as a whole, the preference for smaller more immediate rewards (in DD) and larger and riskier rewards (in PD) represent important decision-making factors that underlie a range of health problem behaviors.

Given the clear relationship between discounting and human health decisions, it is important that discounting procedures yield valid data regarding decisions for health-relevant outcomes. One important concern is the predominant use of hypothetical rewards to characterize patterns of discounting. In the vast majority of discounting studies, participants make choices between hypothetical rewards that they will not receive. Hypothetical rewards offer several advantages over using real rewards (e.g., where providing real rewards is unethical, infeasible, or even illegal), but skepticism about analogousness of real and hypothetical rewards is appropriate. A number of studies directly compare patterns of discounting for hypothetical rewards to discounting for potentially real (participants receive one or more randomly selected rewards from their pool of responses) rewards, typically money. Most of this research compares real and hypothetical rewards for DD using nondrug-using samples and suggests that discounting for hypothetical monetary rewards yields data that are indistinguishable from those that are real (Johnson \& Bickel, 2002; Lagorio \& Madden, 2005; Lawyer et al., 2011; Madden et al., 2003, 2004; Robertson \& Rasmussen, 2018; cf. Hinvest \& Anderson, 2010). The results of the few studies comparing real and hypothetical monetary rewards in substance-using or -dependent participants (Baker et al., 2003; Green \& Lawyer, 2014; Lawyer et al., 2011) reported the same outcomes. The vast majority of these studies used a withinsubjects design in which each participant's response patterns vis-à-vis hypothetical rewards are compared to their response patterns vis-à-vis real rewards, though several studies (Green \& Lawyer, 2014; Madden et al., 2004) made between-groups comparisons. Most of these studies also used a lottery system in which the participant received one or more of their choices in the real outcomes condition, though Hinvest and Anderson (2010) delivered the outcome after each DD choice.

Fewer studies have investigated PD for potentially real and hypothetical rewards and the conclusions are mixed. Green and Lawyer (2014; using a between groups design) and Lawyer et al. (2011) and Robertson and Rasmussen (2018; using within-subjects designs) found similar patterns of discounting across hypothetical or potentially real monetary rewards. It is worth noting that two other studies (Hinvest \& Anderson, 2010; Jikko \& Okouchi, 2007) reported on studies comparing PD for real and hypothetical monetary outcomes. In these studies, real rewards were delivered after each choice (rather than chosen at random after the task). The results were inconsistent: Jikko and Okouchi found different patterns of PD for money, but Hinvest and Anderson did not. The limited number of studies on the issue and the inconsistency in the
findings for (potentially) real and hypothetical outcomes calls for more research to clarify the issue.

One issue that is relatively unaddressed in this context is the growing research literature making it clear that patterns of discounting are not uniform across commodities. For example, people tend to discount the value of consumable rewards (e.g., food, drugs) at a steeper rate than nonconsumable rewards (e.g., money) even when the value of the commodities is standardized (Estle et al., 2007; Green \& Myerson, 2004; Odum \& Rainaud, 2003). This is likely because monetary rewards are "fungible" (Holt et al., 2016) commodities that retain their value over time and can be exchanged for other rewards. Indeed, cigarette smokers tend to discount the value of food and cigarettes more steeply than money and health outcomes (Odum et al., 2002).

This raises the question about whether patterns of discounting for potentially real and hypothetical outcomes are similar in the context of nonmonetary rewards. Two studies compared real and hypothetical nonmonetary rewards, but yielded different findings. Green and Lawyer (2014) compared discounting patterns for hypothetical and potentially real money and cigarettes in a sample of smokers. As mentioned above, they found that smokers discounted hypothetical and potentially real money similarly, but they found also that smokers yielded steeper patterns of DD and PD for potentially real cigarettes than for hypothetical cigarettes. This raises the possibility that the equivalence of discounting for real and hypothetical rewards might not be uniform across commodities. However, Robertson and Rasmussen (2018) found that discounting for hypothetical and potentially real food rewards were statistically equivalent. It is possible that differences between these studies are tied to differences in methodological design (Robertson and Rasmussen's used of a within-subjects design; Green and Lawyer used a between groups design), commodity (food vs. cigarettes), or substance-use status (nonclinical college students vs. cigarette smokers). The divergent findings among these studies indicate a significant need for continued research.

Another methodological issue in the discounting literature that has received relatively little attention is the extent to which data gathered in one culture meaningfully generalizes to others. All available research concerning real and hypothetical discounting rewards reviewed here has come from the United States (except for Hinvest \& Anderson, 2010, which was conducted in England). As such, the findings from the studies published to date on this particular methodological issue have unclear generalizability vis-à-vis other countries and cultures. There are important cultural factors (e.g., perception of and attitudes about time) that should raise concern about generalizing discounting findings across cultures, but only a couple of studies have examined discounting from a cross-cultural perspective. Du et al. (2002) compared DD and PD for money across U.S., Chinese, and Japanese samples
and found culturally specific differences in DD and PD. Wang et al. (2016) surveyed students from 45 different countries with a series of decision-making questions, some of which mimic $D D$ and found significant variability in time discounting across countries. As such, although the process of discounting is likely universal, the generalizability of methodological comparisons should be established across cultural contexts to ensure the validity of discounting data.

The purpose of the present study was to extend the comparison of potentially real and hypothetical money and cigarettes in DD and PD in a community sample of adult smokers from the Czech Republic. This study helps address two important gaps in the discounting literature. First, it represents the first effort to determine if findings about potentially real versus hypothetical money and cigarettes in the United States generalize to smokers in the Czech Republic. Second, it extends the existing research on hypothetical versus potentially real rewards to smokers recruited from a community sample.

## Method

## Participants

Adult smokers $(N=59)$ residing mainly in the community of Prague, Czech Republic, were recruited using a snowball technique, including participants that had already participated in previous studies and were interested in this study. Further recruitment was done using public newspaper announcements, leaflets, and promotion on a social network (Facebook) advertising the study. The data collection took place at the National Institute of Mental Health in Klecany and then at the University of New York in Prague. All participants were at least 18 years of age. The sample was relatively evenly split between male $(N=26)$ and female $(N=33)$ participants. The mean age of the sample was 36.7 years of age ( $S D=12.3$ ). Participants were included based on their own perception of being a smoker and interest in the study revealing further information about their habits. The sample as a whole scored, on average, a $4.19(S D=2.4)$ on the Fagerstrom Test for Cigarette Dependence (FTCD; Fagerstrom, 2012; Heatherton et al., 1991). If the participant scored six points and higher, they were evaluated as being nicotine-dependent; however, due to the small representation of nicotine-dependent individuals, the group was not further divided, representing a smoking population as a whole.

## Measures

## Delay and Probability Discounting Tasks

Data for delay and PD for money and cigarettes were established using a web application that posed questions using
the same algorithm used in previous research (Baker et al., 2003; Lawyer et al., 2011). The large amount for the monetary tasks was 250 Czech Koruna (Kč), which is similar in value to \$10USD. The large amount for the cigarette tasks was 20 cigarettes. Indifference points for both rewards were established across five different delays (1 day, 7 days, 1 month, 6 months, and 1 year) and five different probabilities $(90 \%, 75 \%, 50 \%, 25 \%$, and $10 \%)$ with the smaller-sooner and certain amounts adjusted incrementally.

Participants completed four different DD tasks and four different PD tasks. Within each task, participants answered discounting questions in relation to money (two tasks) and cigarettes (two tasks). Within each commodity, participants answered discounting questions in relations to purely hypothetical and potentially real rewards. In hypothetical rewards tasks, participants were informed that they would not receive any of the rewards. In the potentially real tasks, participants were informed that one of their questions would be chosen at random and they would receive whichever choice they made (i.e., the smaller-sooner or the larger-delayed reward in the DD task or the smaller-certain or probabilistic reward in the PD task). The instructions associated with each task were drawn from previous similar studies (Lawyer et al., 2011) and were presented in the Czech language.

## Procedure

Procedures were similar to those reported in Lawyer et al. (2011). All participants provided informed consent upon arriving to the laboratory, followed by a brief demographics survey and the FTCD. Participants completed all discounting tasks and self-report measures in a single session lasting approximately 45 min . In each session, participants completed discounting tasks in a counterbalanced fashion such that discounting for one commodity (money or cigarettes) was completed before moving on to the next commodity. The order of hypothetical and potentially real tasks also was counterbalanced.

## Compensation

At the end of the session, one question from the potentially real DD and PD tasks for each commodity (one for money; one for cigarettes) was ostensibly chosen at random and each participant received the rewards associated with their choices on each question. In reality, only PD questions were chosen for compensation, given complications associated with the delivery of delayed rewards. After a question was selected at random, the actual reward was determined by drawing poker chips from a bag based on the probability in the randomly selected question. Participants could receive up to 250 Kč based on their responses to the potentially real rewards. The same procedure took place for potentially real cigarette
reward, which could result in one pack of 20 cigarettes. In a case in which participants received no money or cigarette rewards due to chance, they were compensated with 150 Kč (however, all participants received money, cigarettes, or both).

## Statistical Methods

## Characterization of Discounting

Rate of discounting was calculated by fitting the hyperbolic decay function (Mazur, 1987) to individual and group-median indifference point data using nonlinear regression in GraphPad Prism®. Due to significant skew in the distribution, the $b$ values were $\log _{10}$-transformed for parametric analysis. Residual sum of squares (RSS) was used to characterize model fit in place of $\mathrm{R}^{2}$, because nonlinear regression can produce uninterpretable $\mathrm{R}^{2}$ values (Johnson \& Bickel, 2008). Discounting also was characterized by estimating individual area under the curve (AUC; Myerson et al., 2001) values for all discounting tasks. AUC provides an atheoretical characterization of discounting that complements $b$ values derived from the hyperbolic model. AUC values range from 0 to 1 , with small numbers indicate more impulsive choice in DD and less risky choice in PD.

We also we characterized the frequency of nonsystematic response patterns using Johnson \& Bickel (2008) atheoretical algorithms used to identify patterns of discounting that deviate significantly from generally expected patterns of decision making that may complicate interpretation of $b$ values derived from the hyperbolic function described above (see Smith et al., 2018). Consistent with Johnson \& Bickel (2008) a participant's discounting pattern was identified as "nonsystematic" if (1) any indifference point was greater than the previous one by greater than $20 \%$ and/or (2) the last indifference point was not less than the first by at least $10 \%$. These data were used descriptively and for separate analyses. All data were included in primary analyses.

## Results

## Initial Data Review

Technical issues led to one participant's DD for hypothetical money task to not be recorded. Initial exploration of findings suggested that there were significant gender effects across some of the discounting tasks. To characterize potential gender effects without increasing the likelihood of Type I errors from multiple comparisons, we used a series of mixedmethods ANOVA to test for differences in discounting across outcomes (hypothetical and potentially real) across each task with gender entered as a covariate. Each mixed-model ANOVA was conducted using $\log _{10}$-transformed $b$ values
and raw AUC values in separate analyses for each discounting task.

## Nonsystematic Response Patterns

Visual inspection of the frequency of nonsystematic response patterns suggests that a nontrivial number of response patterns that deviated from broad expectations about discounting patterns, especially in the DD tasks and for Johnson \& Bickel's (2008) second algorithm. This suggests that indifference points for a significant number of participants did not diminish as a function of delay. A comparison of the frequency of nonsystematic response patterns for DD versus PD indicated that the rate of nonsystematic responding was significantly greater for $\mathrm{DD}(M=1.28 ; S D=1.5)$ than for $\mathrm{PD}(M=.57$; $S D=1.07$ ) (paired samples $t(57)=4.06, p<.001)$. There were no differences in rate of nonsystematic responding for gender or commodity.

## Comparison of Hypothetical Versus Potentially Real Rewards

Fit of the hyperbolic decay function to hypothetical and potentially real money and cigarettes are shown in Table 1 and suggest no difference in mean model fit across tasks. Table 2 shows the frequency of nonsystematic response patterns across tasks. Figure 1 shows median indifference point values (with the hyperbolic decay function fit to median indifference point data), mean AUC estimates, and median (untransformed) b values for delay discounting tasks. Figure 2 shows the same data for probability discounting.

## Delay Discounting

Money The mixed-model ANOVAs revealed no differences in rates of DD for real and hypothetical money when looking at $\log _{10}$-transformed $b$ values $[F(1,56)=1.07, p>.05$, partial $\left.\eta^{2}=.02\right]$ or area under the curve $[F(1,56=1.95, p>.05$, partial $\eta^{2}=.03$ ) (see Fig. 1). However, there was a significant effect for gender for both $\log _{10}$-transformed $b$ values $[F(1,56)$

Table 1 Median (upper, lower quartiles) residual sum of squares (RSS) values produced by the hyperbolic decay function when fit to individual choice patterns across hypothetical and potentially real rewards

|  | Hypothetical | Potentially Real | Z | sig |
| :--- | :--- | :--- | :--- | :--- |
| Money Discounting |  |  |  |  |
| Delay $.05(.01, .12)$ $.05(.01, .14)$ -.52 ns <br> Probability $.05(.02, .12)$ $.07(.02, .13)$ -1.78 ns <br> Cigarette Discounting     <br> Delay $.04(.01, .11)$ $.05(.01, .13)$ -.83 ns <br> Probability $.05(.02, .12)$ $.04(.01, .11)$ -.499 ns |  |  |  |  |

Table 2 Frequency of nonsystematic response patterns across discounting tasks ( $N=59$ total for all tasks*)

|  | Algorithm |  |  |
| :--- | :--- | :--- | :--- |
|  | 1 | 2 | Either |
| Delay Discounting |  |  |  |
| Hypothetical Money | 2 | 19 | 20 |
| Potentially Real Money | 4 | 15 | 17 |
| Hypothetical Cigarettes | 3 | 21 | 22 |
| Potentially Real Cigarettes |  | 14 | 15 |
| Probability Discounting | 2 | 4 |  |
| Hypothetical Money | 1 | 5 | 6 |
| Potentially Real Money | 2 | 8 | 6 |
| Hypothetical Cigarettes | 2 | 11 | 9 |
| Potentially Real Cigarettes |  |  | 12 |

*data were missing for one DD task for hypothetical monetary outcomes
$=13.78, p<.001$, partial $\left.\eta^{2}=.20\right]$ and area under the curve $[F$ (1, $56=13.02, p=.001$, partial $\eta^{2}=.19$ ). There were no interactions (see Fig. 3).

Cigarettes The mixed-model ANOVAs revealed no differences in rates of DD for real and hypothetical cigarettes when comparing $\log _{10}$-transformed $b$ values $[F(1,57)=3.16, p=.08]$, but there was an effect for area under the curve $[F(1,57=4.51$, $p=.04$, partial $\eta^{2}=.07$ ) (see Fig. 1). In addition, there was a significant effect for gender for both $\log _{10}$-transformed $b$ values $\left[F(1,57)=7.38, p=.009\right.$, partial $\left.\eta^{2}=.12\right]$ and area under the curve $\left[F\left(1,57=6.12, p=.016\right.\right.$, partial $\left.\eta^{2}=.10\right)$ (see Fig. 3).

## Probability Discounting

Money The mixed-model ANOVAs revealed a nonsignificant trend toward differences in rates of PD for real and hypothetical money when looking at $\log _{10}$-transformed $b$ values $[F(1$, 57) $=4.00, p=.05$, partial $\left.\eta^{2}=.07\right]$ an no effect for area under the curve $\left[F\left(1,57=.14, p>.05\right.\right.$, partial $\eta^{2}=.002$ ) (see Fig. 2). There were no gender effects or interactions (see Fig. 3).

Cigarettes The mixed-model ANOVAs revealed no differences in rates of discounting for real and hypothetical cigarettes when comparing $\log _{10}$-transformed $b$ values $[F(1,57)=1.44, p>.05]$ or

Fig. 1 Comparison of delay discounting for hypothetical and potentially real money (left) and cigarettes (right). The top panels show the median subjective value of hypothetical and real rewards. The middle panels show mean $( \pm$ SEM) $\log _{10}$-transformed $b$ values calculated using the hyperbolic decay function. The lower panels show mean ( $\pm$ SEM) area under the curve (AUC) values







Fig. 2 Comparison of probability discounting for hypothetical and potentially real money (left) and cigarettes (right). The top panels show the median subjective value of hypothetical and real rewards. The middle panels show median $( \pm$ SEM) $b$ values calculated using the hyperbolic decay function. The lower panels show mean ( $\pm$ SEM) area under the curve (AUC) values






area under the curve $\left[F\left(1,57=2.02, p>.05\right.\right.$, partial $\left.\eta^{2}=.03\right)$ (see Fig. 2). There were no gender effects or interactions (see Fig. 3).

## Discussion

The findings of the present study add to a large literature regarding important methodological aspects of the
discounting paradigm, which has become one of the most commonly used behavioral measures of impulsive choice in the research literature. It also extends the relatively small number of studies on commodity-specific discounting patterns to a novel community sample of participants and raises potentially interesting questions about gender differences in discounting.

When comparing patterns of delay and PD for relatively small amounts of money (an amount approximately

Fig. 3 Gender comparisons for delay and probability discounting for money and cigarettes (hypothetical and potentially real outcomes combined) between male $(\mathrm{N}=26)$ and female $(\mathrm{N}=$ 33) participants

equivalent to \$10USD) we found no empirical distinction between patterns of DD and PD for hypothetical and potentially real monetary rewards. This is consistent with the majority of studies comparing DD patterns for hypothetical and potentially real monetary rewards among a range of samples (Bickel et al., 2009; Johnson \& Bickel, 2002; Madden et al., 2003; Lawyer et al., 2011) and, most important for this study, cigarette smokers (Lawyer et al., 2011). It is also consistent with studies published to date finding functional equivalence for PD when comparing hypothetical outcomes with both real (Hinvest \& Anderson, 2010) and potentially real rewards (Lawyer et al., 2011; cf. Jikko \& Okouchi, 2007).

A less clear picture emerged, though, when comparing hypothetical and potentially real cigarettes. In this study, Czech smokers exhibited more impulsive DD patterns for potentially real than for hypothetical cigarettes. It is worth noting that this difference was evident for the AUC estimates rather than the $b$ parameter derived from the hyperbolic decay function. In this case, AUC should be considered the better metric of discounting, because the frequency of "flat" nonsystematic response patterns for DD threatens the interpretability of the $b$ parameter of the hyperbolic decay function derived using nonlinear regression (see Johnson \& Bickel, 2008). Regardless, these findings suggest that Czech smokers discount the value of potentially real cigarettes more steeply than hypothetical cigarettes, at least for DD.

These findings are consistent with Green and Lawyer's (2014) findings among U.S. smokers and suggest similar patterns among Czech smokers. This may be relevant to discounting researchers studying discounting for cigarettes across cultural contexts, but the place of these findings in the larger commodity-specific discounting literature is less clear. Our findings are inconsistent with Robertson and Rasmussen's (2018) findings that DD for potentially real versus hypothetical food is statistically equivalent. This may have some bearing on the growing literature on commodity-specific DD in which a growing number of studies examine DD in relation to an ever-increasing number of nonmonetary commodities. Commodity-specific discounting is important in light of studies suggesting that discounting for health-related commodities (e.g., sex, food) predict some human health problem behaviors better than does discounting for money (e.g., Lawyer \& Schoepflin, 2013; Rasmussen et al., 2010). Taken together, these findings suggest that continued focus on methodological aspects of DD across and within cultural contexts is warranted.

Unlike DD, we found no difference between potentially real and hypothetical cigarettes on the PD task. It is not clear why we did not replicate Green and Lawyer's (2014) findings that smokers exhibited steeper PD for potentially real versus hypothetical outcomes. It is possible that the difference in findings indicates that Green and Lawyer's findings simply do not extend to Czech samples, that they represent Type I
error, or that any effect for potentially real outcomes on PD for cigarettes is quite small. Given Robertson and Rasmussen's (2018) findings indicating statistical equivalence of PD for food, it would be reasonable to assert that PD for nonmonetary outcomes do not differ when they are potentially real or hypothetical, but more research on this issue would enhance confidence in such assertions.

One potentially interesting and unexpected set of findings in this study is the gender differences in the DD measures. Our findings that men discounted the value of delayed (but not probabilistic) money and cigarettes more than did women should be considered provisional because the study was not designed to test for gender differences and the relatively small sample size makes broad generalizations problematic. However, these findings might be relevant to the small and mixed literature that yields divergent findings that men are steeper discounters than women (Kirby \& Marakovic, 1996; Wilson \& Daly, 2004), women were steeper discounters than men (Beck \& Triplett, 2009; Mahoney \& Lawyer, 2018), and that there are no gender differences in discounting (e.g., Epstein et al., 2003; Mahoney \& Lawyer, 2018), at least for money. An even smaller literature on gender differences in discounting for commodities other than money suggests that men tend to discount steeper than do women (Johnson \& Bruner, 2012; Lawyer \& Schoepflin, 2013), at least in the context of sexual rewards. Gender differences for sexual outcomes correspond well to evolutionary perspectives on gender and the value of immediate sexual opportunities (Haselton \& Buss, 2000) and to data regarding gender differences in sex drive (e.g., Baumeister et al., 2001), but it is not clear why men and women might discount the value of cigarettes differently, as our data suggest. These differences cannot be explained via gender differences in dependence, because there were no gender differences on the FTCD. At any rate, conclusions about gender differences in discounting should await theory-driven research with sufficient sample sizes (or perhaps a metaanalysis) to better determine the role of gender, perhaps as a moderator of discounting patterns.

This is the first study to date to examine patterns of discounting for hypothetical versus potentially real monetary and nonmonetary rewards in a population outside the United States. The extension of findings from one culture into another represents an important step in determining the extent to which cultural factors may influence findings from decisionmaking studies. The small sample size in this study precludes broad assertions about how the findings speak to culturally specific patterns of discounting, but this research represents a small step toward determining the extent to which findings drawn from one nation (the United States) extend to another (the Czech Republic). Levinson and Peng (2007) argue that behavioral economics research has largely ignored the role of cultural factors in economic decision making and demonstrated that data from behavioral paradigms that might
appear to represent relatively universal processes can yield different choice patterns across different cultures. Their culturally oriented lamentation from years has gone largely unaddressed in discounting research, though Du et al. (2002) first compared discounting patterns across cultures and Kim et al. (2012) reported significant differences in discounting patterns across U.S. and Korean students. Although our article did not directly compare U.S. and Czech patterns of responding, the differences seen in Czech participants compared to similar studies suggests that the discounting literature would benefit from drawing cultural connections between behavioral economic patterns of decision making.

Availability of Data and Materials Data supporting the findings reported in this manuscript can be acquired by contacting the corresponding author.

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## Declaration

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest. This research involved human subjects participants and was approved by the Czech National Institute for Mental Health Institutional Review Board prior to study commencement. All participants provided informed consent prior to their participation.

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