Time, money, and happiness: Does putting a price on time affect our ability to smell the roses? ☆

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ABSTRACT

DeVoe and House (2012; Experiment 3) demonstrated that the process of thinking about one's income in relation to time (i.e., as an hourly wage) affected the enjoyment that participants derived from pleasurable experiences. Participants compelled to think of "time is money" experienced more impatience and less enjoyment in reaction to listening to a pleasurable piece of music compared to participants not asked to think of time as money. These effects were attenuated when participants were financially compensated for this leisure time. This suggests that putting a price on time can influence enjoyment of leisure activities, depending on the degree to which individuals are compensated for engaging in these activities. To determine the reliability, and magnitude, of the reported effects, two preregistered high-powered close replications were conducted. These independent replication attempts, as well as the analyses on the combined sample, failed to replicate the original pattern of findings. The results of the current studies suggest that, using these operationalizations of the study variables, the interactive effects of compensation and calculation cannot be considered robust and may not consistently predict happiness or impatience.

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1. Introduction

In a series of recent experiments, DeVoe and House (2012) demonstrated that thinking about one's income in relation to time (i.e., as an hourly wage) reduced the happiness that participants derived from pleasurable experiences. Specifically, when compelled to think of "time is money", participants experienced more impatience and less enjoyment in reaction to listening to a pleasurable piece of music compared to participants not asked to think of time as money. This effect was attenuated, however, when participants were financially compensated for this leisure time. Being compensated for one's time resulted in increased enjoyment, and decreased impatience while listening to the pleasant music for those in the "time is money" mindset. These findings suggest that thoughts relating to time and money can affect how people experience pleasurable events. This work provides a novel approach for investigating the association between time and money by demonstrating that thoughts relating to time and money may be reliably activated with fairly simple manipulations using online samples.

The novel effects reported by DeVoe and House (2012) – that putting a price on time can influence enjoyment of leisure activities, depending on the degree to which individuals are compensated for engaging in these activities – have potentially significant implications for the development of programs motivating participation in leisure activities. A goal of science, however, is the collection of accurate explanations of naturally occurring phenomena, a process requiring the direct replication of effects to establish the presence, and magnitude, of these effects in the target population (e.g., Koole & Lakens, 2012). With this in mind, we conducted two preregistered independent direct/close replication attempts of DeVoe and House (2012) study 3.[1] We wished to determine the reliability, and magnitude, of the reported effects in an effort to help build a cumulative knowledge base and better understand the phenomenon. We also felt that replicating these results was particularly important given the substantial amount of interest and attention it generated among social psychologists and business researchers, practitioners and media. For instance, since its publication in 2012, the article has been cited 21 times according to Google scholar and 9 times on PsycINFO, and has been viewed and/or downloaded 261 times on the Research gate and Academia.edu online research

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[1] Study 3 was selected as it replicates and extends upon the mediation analysis of study 2, by manipulating participants' perceptions of the economic implications of wasting time. The study therefore seemed to represent all constructs within this program of research. Furthermore, the compensation manipulation used in this study has not been tested prior to Devoe and House (2012).

networking platforms.[2] This research was also featured in such premiere outlets as Scientific American Mind, The Financial Times, The Wall Street Journal, The Huffington Post, NBC News and The Globe and Mail. Additionally, the "time is money" effect has been conceptually replicated by Whillans and Dunn (2015), demonstrating its influence on the likelihood of enacting environmentally friendly behaviors. Notably, Whillans and Dunn also pre-registered the methods and hypotheses of some of their studies.[3]

2. Method

For our first replication attempt, we recruited a large sample of participants online via Amazon's Mechanical Turk and used the same procedures, measures, sampling type, and population of the DeVoe and House study. Participants were recruited by inviting them to "take part in a short academic survey" with the keywords "survey" and "demographics". The study was only made available to participants within the United States with an average completion rate higher than 75%. Our approach to conducting a direct replication followed very closely the "Replication Recipe" recommendations laid out by Brandt et al. (2014). For example, we (a) contacted the original authors prior to the beginning of data collection to acquire procedural and methodological details and followed as direct as possible the methods of the original study, (b) increased sample size in each replication attempt to ensure high statistical power (final N = 266 and 254 for replication attempts 1, 2, respectively vs. Original study N = 145), and (c) preregistered the study prior to data collection, publicly disclosing all study details via the Open Science Framework (OSF) (Wagenmakers, Wetzels, Borsboom, van der Maas, & Kievit, 2012).[4] The original authors shared all the study materials, and we used the same sample type, sampling frame (average age was 34.2 years), and base compensation ($1.00 per participant). We then shared the results of our first replication attempt, as well as our data and syntax for our analyses, with the original authors prior to our second replication attempt. The primary rationale for the second replication attempt was to provide greater opportunity to obtain a pattern of effects consistent with those reported by DeVoe and House. No methodological details were changed from the first replication attempt. Regarding the number of participants for each replication attempt, our goal was to have at minimum 50 participants per study condition, and we oversampled in each replication attempt to assure this minimum after removal of participants for not meeting inclusion criteria.

The design of the study is a 2 ("time is money" mindset vs. control mindset) by 2 (additional compensation received vs. no additional compensation received) between subjects factorial design. Participants in the Time/Money condition completed a calculation task that involved determining their hourly wage starting from their annual income to activate a "time is money" mindset. In the control condition, the calculation task consisted of multiplying together random 5-digit numbers. In the compensation condition, participants were informed that they would be paid an additional $0.50 for listening to a music track, while those in the non-compensation condition were not offered this extra monetary incentive.

In accordance with the analytical approach used by DeVoe and House, we conducted a 2 (calculation: time/money vs. control calculations) × 2 (additional explicit compensation for listening to music vs. no additional compensation) between-subjects ANOVA. Enjoyment derived from listening to the music was examined first, followed by impatience experienced while listening to the music. The dependent variables of enjoyment and impatience were captured using a 3-item and 6-item self-report measure respectively. As per the exclusion

criteria used by DeVoe and House (2012), in our first replication sample, eight participants were excluded from the analysis after reporting that they experienced some technical problem listening to the music that played during the study. In addition, we removed three participants who reported that they had participated in a similar study previously. In our second replication sample, twenty-five participants who reported that they experienced some technical problem listening to the music that played during the study were excluded from the analysis. We also removed three participants who reported that they had participated in a similar study previously.

3. Results

Presented in Tables 1 and 2 are the results reported by DeVoe and House (2012) (study 3), as well as the results for the same analyses in both of our replication samples as well as for our combined sample. The means for both dependent variables across the four experimental conditions for the original and two replication studies are presented in Figs. 1–3. Overall, we did not replicate the pattern of findings reported by DeVoe and House (2012) (study 3) in either replication attempt. There were no main effects of calculation or compensation on happiness. In our first replication attempt only, a significant calculation × compensation interaction on happiness did emerge, but as shown in the top panel of Fig. 2 the nature of this interaction was contrary to that obtained by DeVoe and House (see top panel of Fig. 1). Simple effects analyses revealed that this interaction was driven by differences in compensation received in the control condition rather than the time/money condition. Specifically, participants who performed meaningless calculations reported greater enjoyment when they were explicitly compensated for listening to the music (M = 73.94, SD = 18.51) than when not compensated (M = 63.64, SD = 27.72), F(1, 262) = 7.04, p = .008, η_p^2 = .026. In contrast, participants who calculated their hourly wage did not differ in enjoyment scores from the music whether explicitly compensated to listen to it (M = 66.59, SD = 22.37) or not (M = 72.38, SD = 20.17), p = .150. This finding is inconsistent with DeVoe and House's results that found participants in the time/money condition derived significantly more enjoyment from the music when explicitly compensated than when not, while participants in the control condition did not differ in enjoyment whether compensated or not.

A similar pattern of results were obtained in an analysis using the impatience measure as the dependent variable, but again only in the first replication attempt (see bottom panel of Fig. 2). No significant main effect of calculation or compensation conditions emerged, but there was a significant calculation × compensation interaction. Simple effects analyses indicated a marginally significant effect whereby participants in the control condition reported lower levels of impatience when explicitly compensated to listen to the music (M = 32.06, SD = 22.50) compared to when they were not (M = 38.79, SD = 25.56), F(1, 262) = 2.611, p = .107, η_p^2 = .010. Participants in the time/money condition did not report significant differences in impatience when they were compensated for listening to the music (M = 38.94, SD = 26.11) compared to when they were not (M = 33.67, SD = 22.83), p = .222. Interestingly, although only approaching marginal significance (p = .107), the pattern of effects obtained in our sample was again in the opposite direction to that reported by DeVoe and House (i.e., participants in the control condition displayed less impatience when explicitly compensated than when not, while those in the time money condition did not differ in level of impatience during the pleasant listening experience; see bottom panel of Fig. 1).

To be consistent with the analytic approach of DeVoe and House (2012), we next conducted regression analyses to determine whether the calculation × compensation interaction on happiness in our first replication attempt was mediated by ratings of impatience (mediated moderation). The calculation × compensation interaction initially predicted happiness β = −.175, t(262) = −2.881, p = .004, but remained

Table 1
Main and interaction effects on happiness in DeVoe and House (2012) and the current studies.

Study	N	Calculation condition		Compensation condition		Interaction effect				Power[a]
		F	p	F	p	F	df	p	η_p^2	
DeVoe & House Study 3	145	<1	–	4.53	.04	4.81	141	.03	.033	.598
Replication 1	266	.062	.804	.651	.420	8.30	262	.004	.031	.851
Replication 2	254	.016	.899	2.40	.122	.216	250	.643	.001	.835
Replication 1 + 2 (merged)	520	.023	.880	2.57	.109	3.09	517	.079	.006	.988

[a] Power estimates were calculated using G*Power 3, post-hoc power analysis. *Power* is the probability of detecting DeVoe and House's interaction effect (or a larger effect), if it exists, based on the effect-size estimate in their original study.

Table 2
Main and interaction effects on impatience in DeVoe and House (2012) and the current studies.

Study	N	Calculation condition		Compensation condition		Interaction effect				Power[a]
		F	p	F	p	F	df	p	η_p^2	
DeVoe & House Study 3	145	<1	–	5.08	.026	7.13	141	.008	.048	.766
Replication 1	266	.087	.769	.059	.808	4.01	262	.046	.015	.954
Replication 2	254	.026	.871	3.14	.078	.976	250	.324	.004	.946
Replication 1 + 2 (merged)	520	.001	.978	2.03	.154	.469	516	.494	.001	.999

[a] Power estimates were calculated using G*Power 3, post-hoc power analysis. *Power* is the probability of detecting DeVoe and House's interaction effect (or a larger effect), if it exists, based on the effect-size estimate in their original study.

significant when impatience was entered into the model, $\beta = -.088$, $t(262) = -2.053$, $p = .041$. The effect of experienced impatience also significantly predicted happiness $\beta = -.718$, $t(264) = -16.767$, $p < .001$. This pattern of effects suggest that the calculation × compensation interaction was partially mediated by experienced impatience (Sobel test $z = 1.99$, $p < .05$). DeVoe and House (2012) also found evidence of mediation (study 3), but as already noted the effect mediated in our first replication attempt is not consistent with the effect reported, and mediated, in the original study.

3.1. Analyses of combined replication samples and meta-analysis

Analyses were conducted on the combined replication samples (N = 520). No statistically significant main or interactive effects emerged when predicting happiness or impatience (see Tables 1 and 2). To obtain a more precise estimate of the effect size of the primary comparison in the DeVoe and House study 3 (i.e., between happiness and impatience scores of participants compensated, or not, in the "time is money" condition), a random effects meta-analysis was conducted for each dependent variable (see Figs. 4 and 5[5]). Each meta-analysis contained 3 independent effects (i.e., $k = 3$) with a total of 314 participants in the "time is money" condition. For the meta-analysis on happiness ratings there was a weighted mean effect size of $d = .22$, 95% CI [−.35, .78], and significant variation in the effect sizes between studies was evident (i.e., the magnitude of the effect sizes differed between studies), $Q(2) = 11.35$, $p = .003$. For the meta-analysis on impatience ratings there was a weighted mean effect size of $d = -.29$, 95% CI [−.86, .29], and significant variation in the effect sizes between studies was also evident, $Q(2) = 11.60$, $p = .003$. The results of the meta-analyses therefore suggest the effect sizes of the comparison of interest are not significantly different from zero. Furthermore, the confidence intervals are consistent with a moderate positive effect all the way to a small negative effect for happiness ratings, and with a small positive effect all the way to a moderate negative effect for impatience ratings.

4. General discussion

Our findings, failing to provide evidence for the reliability, robustness and magnitude of the original results, are difficult to reconcile with DeVoe and House for several reasons. Our samples were high-powered, and we were faithful to all procedural and methodological details of the original study. The demographics of our samples closely matched those of DeVoe and House in terms of age ($M = 34.2$, $SD = 11.6$ in DeVoe & House vs. $M = 31.9$, $SD = 9.37$). Both of our replication attempts had a significantly higher percentage of males (60.7% male across the two replication studies vs. 43% male in DeVoe & House, 2012; all p's < .001), but there is no a priori reason to expect that this might have influenced the size and direction of the effect (and of course if there is, we couldn't possibly match an exact gender split which would otherwise compromise random assignment). Reliabilities of the scales in both of our samples were high ($\alpha = .876$ and .893 for impatience, $\alpha = .846$ and .831 for enjoyment). Importantly, our replication attempts were also preregistered, which rules out selective reporting being responsible for our results. Furthermore, we followed as exactly as possible the methods of the original study and adhered closely to the "Replication Recipe" guidelines (Brandt et al., 2014), even using the original study materials as programmed in the authors' Qualtrics account. Taken together, this suggests that although it is difficult to establish reasons why replication attempts fail, it is highly unlikely that the differences between the reported replication attempts and the original study were responsible for the conflicting outcomes observed.

Our failure to replicate Devoe and House's findings across both attempts warrants a discussion of the possible explanations for the observed volatility of this effect.[6] First, it is necessary to take into account any changes in the MTurk population that may have occurred over the four years since the original study was conducted. Study 3 of Devoe and House (2012) was conducted in October 2010, while our two replication attempts were conducted in March and April 2014 respectively. Extant research provides reason to believe that the MTurk population has seen significant changes over this 4 year time period. One important dimension that has seen change is the expertise of

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[5] Data and R code for these analyses are available at this link: https://osf.io/ryfse/.

[6] The authors acknowledge the comments of an insightful reviewer as to why the two replication attempts may have failed to replicate the original effect established by DeVoe and House (2012).

Fig. 1. Effects on happiness and impatience in DeVoe and House (2012) Study 3.

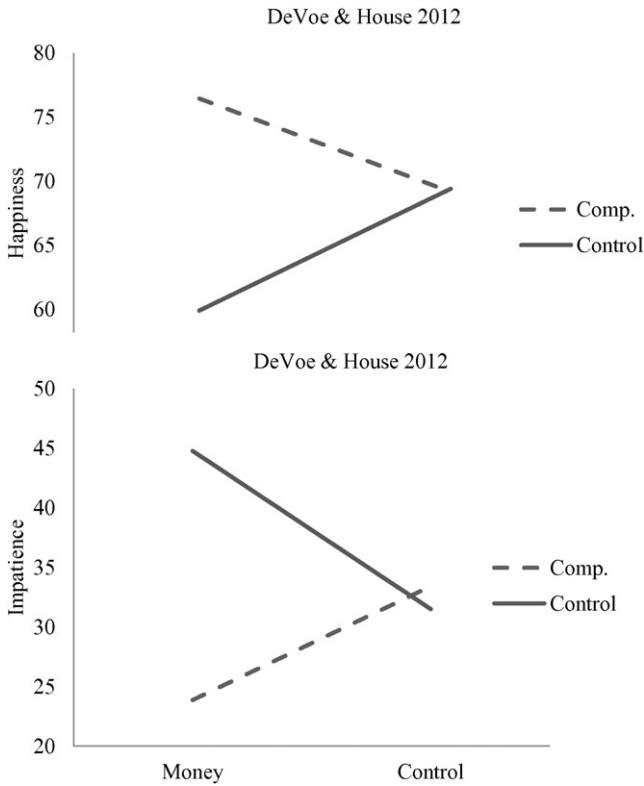**Fig. 3.** Effects on happiness and impatience in replication attempt 2.

MTurk workers. Paolacci and Chandler (2014) found evidence in the MTurk requester history that about 10% of workers are responsible for completing 41% of tasks. Furthermore, more experienced workers have become more familiar with classic paradigms within the
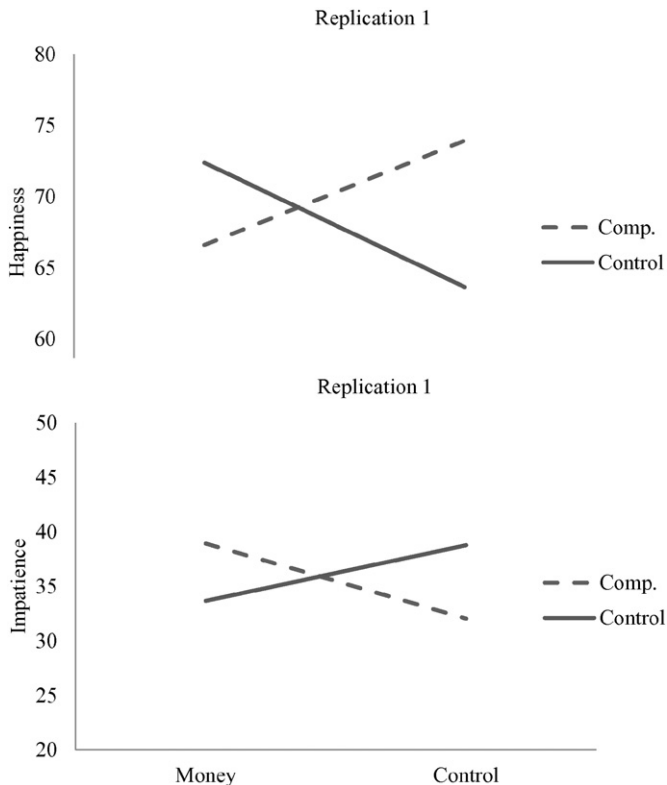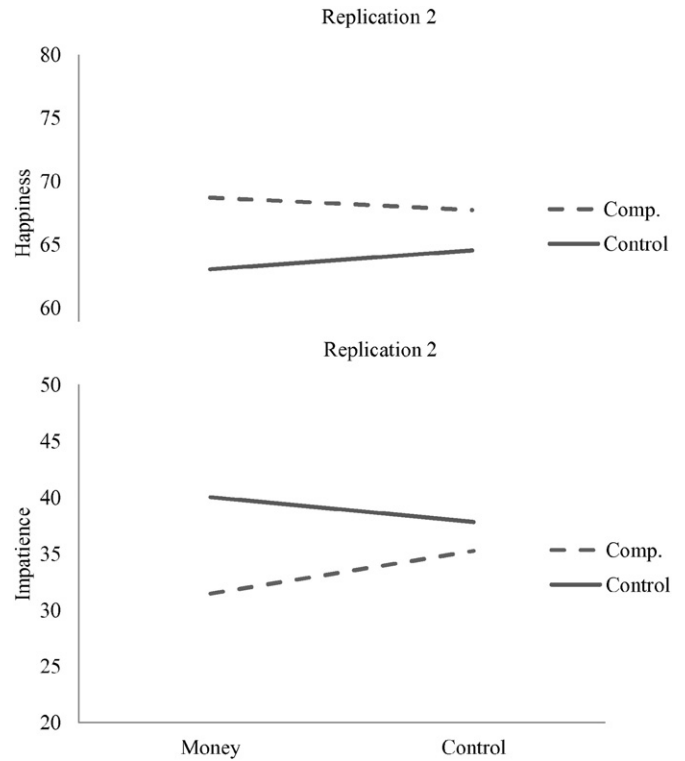

Fig. 2. Effects on happiness and impatience in replication attempt 1.

behavioral sciences (Chandler, Mueller, & Paolacci, 2014; Fort, Adda, & Cohen, 2011).

Examining this expertise from a more longitudinal perspective, Rand et al. (2014) report that in 2013 the median MTurk worker had participated in 300 academic studies (20 of which had taken place in the previous week alone). This suggests that the extensive prior experience MTurk workers have accrued from participating in academic studies can influence their responses in subsequent experiments. As Rand et al. (2014, p. 4) summarize: "the MTurk subject pool has been transformed from naïve to highly experienced over the time period spanned by our 15 studies". The authors' tracked the effectiveness of a manipulation of time pressure from February 2011 to February 2013 and observed systematic attenuation of their manipulation. This finding demonstrates the potential for MTurk participants' prior experience with academic studies to reduce the effectiveness of experimental manipulations. However, it is important to note that more research is needed to better understand what effects are vulnerable to such attenuation, as many other paradigms have been shown to be robust to the effects of worker experience (Crump, McDonnell, & Gureckis, 2013). Nevertheless, it remains possible that the failure to replicate the "time is
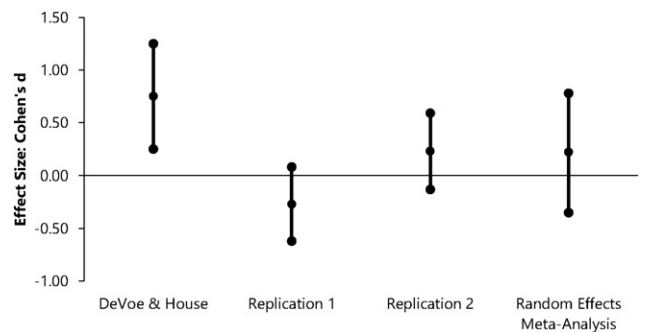

Fig. 4. Random effects meta-analysis on happiness ratings in the "time is money" condition comparing participants compensated or not for their time. Error bars are 95% confidence intervals.
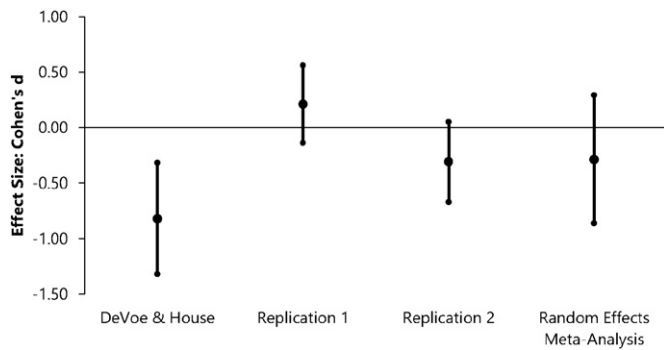
Fig. 5. Random effects meta-analysis on impatience ratings in the "time is money" condition comparing participants compensated or not for their time. Error bars are 95% confidence intervals.

money" effect is a function of researchers' repeated sampling from the markedly dynamic MTurk population. Importantly, this may pose additional challenges for future close replications attempts employing MTurk samples.

Second, it is possible that the diverging results may have occurred as a function of sampling error. The assumption that methodologically identical studies will produce consistent results if an effect is "real", should be qualified by the fact that sampling error and measurement error are present in every study, and that both can produce fluctuations in estimates (Stanley & Spence, 2014). Importantly, sampling error is linearly related to the heterogeneity of the population from which samples are drawn (Suen & Ary, 1989) and the MTurk population is much more heterogeneous than typical undergraduate samples commonly employed in such studies. Therefore, that we fail to replicate Devoe and House's effect may speak to the fact that sampling error can serve as a barrier to getting consistent results on Mturk. Taken together, both of these potential explanations point to the degree of uncertainty present in any estimated effect and the potential downsides of an over-saturated Mturk participant pool.

It is also possible, however, that the effect obtained in Study 3 of DeVoe and House occurred by chance (i.e., a Type I error). If this were the case, no consistent pattern of effects (main or interactive effects) would therefore be expected to emerge across multiple direct replications of the original study given the lack of systematic variance across study conditions. The results of the meta analyses suggest the true effect sizes can range from positive to negative for both dependent variables, with one implication being that a clear "time is money" effect in this particular context may not exist. On the other hand these results may imply the presence of an untested moderator responsible for systematically shifting the effects. The results we have presented do not provide unequivocal support for either of these possibilities. Thus, it is important that researchers consider taking a step back to better understand the phenomenon and accumulate substantive evidence to be able to

determine the presence, magnitude, and the reliability of the reported effects. Understanding of size and direction of such effects can only be achieved by conducting sound close replication attempts and publishing the results (even when null) (Nosek, Spies, & Motyl, 2012; Open Science Collaboration, 2012; Young, Ioannidis, & Al-Ubaydli, 2008). We suggest that future independent studies examining the effects of putting participants in "time is money" mindset on enjoyment of pleasurable experiences should be conducted using the results reported here as a reference point to further assess reproducibility and consistency of the effects obtained in the current studies.

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