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Waiting is painful: The impact of anticipated dread on negative discounting in the loss domain

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Abstract

According to the positive time-discounting assumption of intertemporal decision-making, people prefer to undergo negative events in the future rather than in the present. However, negative discounting has been identified in the intertemporal choice and loss domains, which refers to people's preference to experience negative events earlier rather than later. Studies have validated and supported the "anticipated dread" as an explanation for negative discounting. This study again explored the effect of anticipated dread on intertemporal choice using content analysis; that is, having participants identify anticipated dread among reasons for negative discounting. This study also validated the effect of anticipated dread on negative discounting by manipulating anticipated dread. This study adds empirical and direct evidence for the role of anticipated dread in negative discounting.

Keywords: intertemporal decision-making; negative discounting; anticipated dread

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1 Introduction

1.1 Negative discounting

Most current intertemporal decision models (e.g., Laibson, 1997; Loewenstein & Prelec, 1992; Samuelson, 1937) suggest that there is a time discounting process in intertemporal decision-making. However, in a few studies, especially exploring intertemporal choice involving the loss of money and other negative events, researchers have found a fundamental departure from time discounting, called *negative discounting*. According to the time discounting assumption, a loss that occurs in the future should have a smaller utility after discounting than the utility of the loss with the same magnitude that occurs now, thus people should choose to suffer the loss in the future rather than the present (i.e., a positive discount occurs). However, studies have shown that when faced with a present loss and a future loss of the same magnitude, many people prefer to take the loss now (i.e., a negative discount occurs). Although a few researchers have also reported negative discounting in the gain domain, the proportion is relatively low; most evidence of negative discounting is concentrated in the loss domain. For example, Barile et al. (2018) found that 2%–9% of the intertemporal choices for benefits in the money, environment, and health domains had negative discounting, and 25%–59% of the intertemporal choices regarding losses in the above domains had negative discounting. Therefore, this research focuses on exploring negative discounting in the loss domain.

1.1.1 Negative discounting for non-monetary losses

Negative discounting had been widely found for non-monetary losses. In the health domain, researchers examined time preferences for health loss and found that participants were more averse to future health loss and preferred that sickness come sooner (Hardisty & Weber, 2009; MacKeigan et al., 1993; Van der Pol & Cairns, 2000). Redelmeier and Heller (1993) asked participants to rate the degree of distress for physical or psychological ailments that occurred at different points in time, and negative discounting occurred when 10% of the participants perceived future occurrences as more distressing. In the environmental domain, Hardisty and Weber (2009, Study 1) asked participants to choose between 21 days of poor air quality now and a longer duration of poor air quality one year later and found that 35% of participants preferred to experience poor air quality now, exhibiting a negative or zero discounting rate. In other domains, Mischel et al. (1969) asked adults to rate their preference for negative events such as "eating bad-tasting food" and "drinking bitter-tasting liquids" at different times and found that the participants preferred immediate negative events. Loewenstein (1987) asked participants how much they would be most willing to pay to avoid receiving an electric shock stimulus that occurred at different times and found that participants were, on average, willing to pay more to avoid a stimulus that occurred in the future compared to a stimulus that occurred immediately. Berns et al. (2006) found that some participants preferred to accept a higher intensity, immediate electric shock stimulus

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rather than wait for a delayed occurrence of a smaller intensity stimulus. Harris (2012) found that for negative events such as "losing an irreplaceable photo" and "losing a good friend," participants preferred these negative events to occur in the present rather than in the future.

1.1.2 Negative discounting for monetary losses

Most studies on intertemporal decision-making have centered on the monetary domain, yet few studies have reported negative discounting in intertemporal decisions with loss. The classical intertemporal decision options currently used in most studies may prevent negative discounting from occurring because in the case of negative discounting, people prefer an immediate loss of equal or greater size than a loss that occurs in the future. However, in the classical intertemporal option composition, participants typically need to choose between a SS (Smaller-Sooner) loss and a LL (Larger-Later) loss, in which case only positive discounting can occur (Hardisty et al., 2012). Fortunately, a few researchers have begun to focus on this issue and have discovered negative discounting by modifying the composition of intertemporal decision options (Hardisty et al., 2012; Hardisty & Weber, 2009; Mitchell & Wilson, 2010; Van der Pol & Cairns, 2002). In these studies, researchers set options to allow for larger immediate losses and smaller future losses, thus discovering the negative discounting phenomenon. For example, Hardisty and Weber (2009) found that 28.5% of the participants had negative discounting in a loss of money scenario by changing the option setting for intertemporal decision-making.

In summary, a certain percentage of negative discounting is present in intertemporal choices involving negative events, whether they relate to monetary losses or other negative events. If we always restrict ourselves to studying intertemporal decisions within the framework of the discounting model, the interpretation and prediction of the observed outcomes will reach a dead end. If the disutility of future losses cannot be greater than the disutility of present losses after discounting, then the existence of negative discounting necessarily violates the maximization principle that has been upheld by mainstream economic and decision theories (Luce, 1959; Smith, 1776), and challenges the "avoidance of harm" principle advocated by evolutionary theory (Li et al., 2011; Schall, 2001; Steelandt et al., 2011).

1.2 Explanation of anticipated dread

The utility of future events is derived not only from the pain or pleasure caused by the occurrence of the event itself but also from the pain or pleasure experienced in anticipating it (Jevons, 1905; Hardisty et al., 2010). Loewenstein (1987) revised the classical discount utility model to explain why people experience negative discounting by adding the variable of anticipated dread, arguing that people's expectations about the future influence current choices. Specifically, Loewenstein (1987) speculated that when people are confronted with future negative events, they develop anticipated dread about those events and the process

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of waiting for them. This anticipated negativity then leads to future negative events being more distasteful overall than those that occur in the present; therefore, people prefer negative events that occur now, giving rise to negative discounting.

Other studies have validated and supported the interpretation of anticipated dread. Mischel et al. (1969), after finding that people prefer negative events that occur now, put forward a similar explanation to that of Loewenstein (1987). They argued that the process of waiting for a painful outcome is inherently aversive ("waiting for an aversive outcome is itself aversive," p. 372). Harris (2012) also supported the hypothesis of anticipated dread through an empirical study in which they asked participants to choose when to know how painful a vaccination was, and found that most participants preferred to learn about the pain immediately before the vaccination. Recently, Molouki (2019) and Hardisty and Weber (2020) provided direct evidence of the effect of anticipated dread on intertemporal preference by measuring feelings of anticipation of future events. Hardisty and Weber (2020) found that anticipatory asymmetry for positive and negative events explains why the desire for immediate positives is stronger than the desire to delay negatives. This anticipatory asymmetry occurs because when consumers think about a future positive event, they enjoy imagining it (savoring) while simultaneously disliking the feeling of waiting for it (impatience). However, when consumers think about a future negative event, they both dislike imagining it (dread) and dislike the feeling of waiting for it (impatience).

1.3 Hypothesis and research framework

In summary, the interpretation of anticipated dread for negative discounting has been supported by many studies, and the most direct evidence of the anticipated dread was scoring anticipated feelings of future events, which might be mandatory to some extent. This study likewise explored the effect of anticipated dread on intertemporal choice through content analysis; that is, having participants identify anticipated dread when listing reasons for negative discounting.

We conducted three experiments: Experiment 1 re-verified the prevalence of negative discounting in the domain of monetary and non-monetary losses; Experiment 2 explored the effect of anticipated dread on negative discounting through content analysis; and Experiment 3 validated the effect of anticipated dread on negative discounting by manipulating anticipated dread. See the online supplement on the Open Science Framework (https://osf.io/av8cd/) for data and materials used in the experiments. We reported all the experiments and the measures, manipulations, and exclusions they included. All sample sizes were determined before data analysis.

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2 Experiment 1: Prevalence of negative discounting

The purpose of Experiment 1 was to examine the prevalence of negative discounting in intertemporal decision-making involving negative events. Considering that few studies have reported negative discounting in the money domain, Experiment 1a was conducted to detect the prevalence of negative discounting in the area of losing money, and we also compared the negative discounting between the domains of gains and losses. Experiment 1b was conducted to compare the proportion of negative discounting in various negative events that happened in life. Five common negative events in life (i.e., losing money, receiving a painful physical stimulus, experiencing an embarrassing event, experiencing social rejection, and poor performance) were selected in a joint discussion with members of the research team to construct five intertemporal decision situations to examine participants' time preferences for when they would prefer to have a negative event occur. Both of the two experiments used a binary choice approach and participants were considered to exhibit negative discounting if they chose to have a negative event occur now rather than in the future.

2.1 Experiment 1a

2.1.1 Method

Participants. Power analysis was performed using the G*Power (Faul et al., 2007). We assumed a medium effect size of $f = 0.25$, a significance level of $\alpha = .05$, and a power of 80%, indicating a required sample of approximately 179 participants. A total of 329 college students (mean age 21.43 years, $SD = 1.96$) participated in the current experiment. Each participant received a small gift as a payment when completing the experiment.

Experimental materials and procedures. This experiment had a 2 (domain: gain vs. loss) × 4 (time: 3 days, 1 week, 1 month, 1 year) between-participants design. Participants were randomly divided into eight groups and tasked with making intertemporal choices in a questionnaire: (a) gain (loss) ¥ X now or (b) gain (loss) ¥ X in three days (one week, one month, and one year). Each group of participants completed 11 intertemporal choice questions with X ranging from ¥ 10 to ¥ 10,000. We set the amount of immediate loss and the amount of future loss to equal sizes, and negative discounting appeared if the participant chose the immediate loss.

2.1.2 Results

In the gain domain, participants made choices using positive discounting (i.e., choosing the immediate option) for almost all questions (95.1% on average), with negative discounting occurring for only 4.9% of questions, on average (i.e., choosing the future option). In

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the loss domain, negative discounting occurred for 41.0% of questions, on average (i.e., choosing the present option).

The ANOVA for 2 (domain: gain vs. loss) × 4 (delay:3 days, 1 month, 1 week, and 1 year) showed a significant domain effect on the proportion following the discounting model, with more negative discounting for intertemporal decisions in the loss domain ($F(1, 324) = 127.94$, $p < 0.001$, $\eta^2 = 0.28$); no significant effect of delay on the proportion following the discounting model ($F(3, 324) = 0.85$, $p = 0.469$, $\eta^2 = 0.01$). It follows that there was little negative discounting when money was gained and a significant proportion of negative discounting when money was lost.

2.2 Experiment 1b

2.2.1 Method

Participants. We assumed a medium effect size of $\varphi = 0.3$, significance level of $\alpha = .05$, and power of 80% in the power analysis, indicating a required sample of approximately 44 participants per group. To be on the conservative side, a total of 201 college students participated in the current experiment. Each participant received a small gift when completing the experiment as payment. Seven participants were excluded because of incomplete responses, and 194 valid responses were finally obtained (59 male and 135 female, mean age 20.89 years, $SD = 1.95$).

Experimental materials and procedures. Participants completed five situational choice questions involving five negative events: losing money (losing ¥100); receiving a physically painful stimulus (getting stung by a hornet); experiencing an embarrassing event (making a fool of themselves in front of classmates); suffering social rejection (being expelled from a club); poor performance (in a competition). For each scenario, participants were asked to select the time they would like this event to occur out of two time alternatives. Participants were randomly divided into two groups, with one group facing the two time alternatives of now vs. one week from now and the other group facing the time alternative of now vs. one year from now.

2.2.2 Results

As shown in Figure 1, regardless of whether the alternative was now vs. one week from now or now vs. one year from now, the majority of participants chose to experience the negative event now for all negative events, except for "lose ¥ 100," and more than 60% of participants chose to experience the negative event now — that is, more than 60% of participants showed negative discounting. The chi-square test showed that there was no significant difference between the choices of the two groups ($ps > 0.05$).

A chi-square test was conducted for the proportion of participants choosing the present option and the future option under each scenario. The results showed that the proportion

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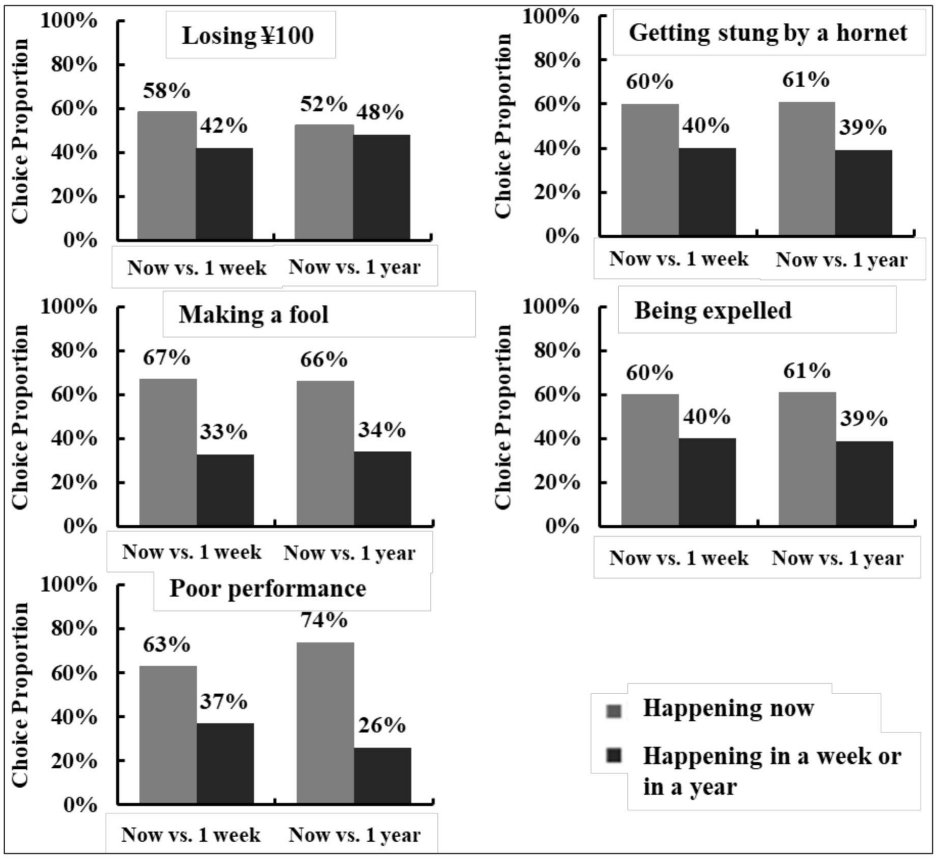

FIGURE 1: Proportion of respondents choosing immediate vs. future (1 week later or 1 year later) occurrence for five negative events.

of participants who chose the present option was significantly greater than the proportion choosing the future option in all scenarios. When the alternatives were now and one week later: $\chi^2_{\text{lose money}}(1, 107) = 2.70$, $p = 0.100$, $\varphi = 0.12$; $\chi^2_{\text{getting stung by a hornet}}(1, 107) = 4.12$, $p = 0.042$, $\varphi = 0.15$; $\chi^2_{\text{making a fool of themselves}}(1, 107) = 12.79$, $p < 0.001$, $\varphi = 0.26$; $\chi^2_{\text{being expelled}}(1, 107) = 4.12$, $p = 0.042$, $\varphi = 0.15$; $\chi^2_{\text{poor performance}}(1, 107) = 6.81$, $p = 0.009$, $\varphi = 0.19$. When the alternatives were now and one year later: $\chi^2_{\text{lose money}}(1, 87) = 0.10$, $p = 0.748$, $\varphi = 0.02$; $\chi^2_{\text{getting stung by a hornet}}(1, 87) = 4.15$, $p = 0.042$, $\varphi = 0.15$; $\chi^2_{\text{making a fool of themselves}}(1, 87) = 8.38$, $p = 0.004$, $\varphi = 0.21$; $\chi^2_{\text{being expelled}}(1, 87) = 4.15$, $p = 0.042$, $\varphi = 0.15$; $\chi^2_{\text{poor performance}}(1, 87) = 19.32$, $p < 0.001$, $\varphi = 0.32$.

The results of Experiment 1 showed that a significant proportion of negative discounting was present in intertemporal choices involving various negative events in the areas of both monetary loss and non-monetary loss. The proportion of participants experiencing negative discounting was roughly consistent across the various non-momentary loss scenarios, with more than 60% of participants experiencing negative discounting; the proportion of negative discounting in the scenario of losing money was less than the proportion of negative discounting in the other loss scenarios, at roughly 55%. Moreover, the proximity of future

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negative events had no effect on people's tendency to experience negative discounting, which suggests that negative discounting is, to a certain extent, a relatively strong phenomenon.

3 Experiment 2: Effect of anticipated dread on negative discounting — measuring anticipated dread

The findings of Experiment 1 suggest that negative discounting is widespread in intertemporal choices in the area of monetary and non-monetary losses. Experiment 2 was conducted to explore the effect of anticipated dread on intertemporal choice through content analysis; that is, having the participants identify anticipated dread when listing reasons for negative discounting.

Research on intertemporal decision-making has found that the magnitude of money affected the discount rate, which was known as the magnitude effect (Thaler, 1981). Most research on the magnitude effect has focused on the area of gaining money (e.g., Benhabib et al., 2010; Green et al., 1997; Kirby & Marakovic, 1996; Petry, 2001; Raineri & Rachlin, 1993). A few studies have also found magnitude effects in losses (Chapman, 1996; Hardisty, 2012; Mitchell & Wilson, 2010). The present experiment tested, again, whether magnitude affects negative discounting in losses. Previous research has found that magnitude effects existed not only in the money domain but also in other domains such as health (Chapman, 1996), therefore the present experiment explored not only the effect of the magnitude of money loss on negative discounting (Experiment 2a) but also the effect of the magnitude of physical pain (Experiment 2b). More importantly, the present study tested whether anticipated dread mediates the effect of the magnitude of the negative stimuli on the negative discounting.

3.1 Experiment 2a: Effect of anticipated dread on magnitude effect of negative discounting in the field of monetary loss

Experiment 2a explored whether the magnitude of money loss influenced the emergence of negative discounting, and examined whether anticipated dread mediated this process.

3.1.1 Method

Participants. We used the tool developed by Schoemann et al. (2017) to determine the sample size needed to test the mediating role of anticipated dread between the magnitude of money loss and negative discounting. Assuming small to moderate effect sizes (the correlations are equal to 0.3), setting power at 80% and bootstrap resampling at 5000, a total sample size of at least 166 people was suggested. In this study, we exceeded this minimum and recruited a total of 259 college students (170 female and 86 male, mean age 21.03 years, SD = 4.40; three participants did not report gender and seven participants did

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not report age) who participated in Experiment 2a. The participants received a small gift at the end of the experiment as a reward.

Experimental materials and procedures. Participants read a situation in which they were to imagine they were going to lose ¥ X for some reason and can choose to lose it at any time between now and 1 year in the future. The participant then drew a vertical line (|) on a 13.4-cm long line segment (the left end indicates a loss now and the right end indicates a loss 1 year from now) to indicate the time at which they would be willing to lose the money. Finally, the participants were asked to write as many reasons as possible for choosing that time to lose the money. Participants were randomly assigned to four groups, each group differing in terms of the magnitude of money loss, from smallest to largest, ¥ 10, ¥ 100, ¥ 1000, and ¥ 10,000.

3.1.2 Results

Time of losing money. There were 45.9%, 39.1%, 16.7%, and 11.3% of participants who wanted to lose money immediately (who drew a vertical line in the left end on the line segment) respectively in conditions of losing ¥ 10, ¥ 100, ¥ 1000, and ¥ 10,000. The mean time to lose ¥ 10 was M = 3.33 (SD = 4.95), the mean time to lose ¥ 100 was M = 4.64 (SD = 5.57), the mean time to lose ¥ 1000 was M = 7.12 (SD = 5.04), and the mean time to lose ¥ 10,000 was M = 8.29 (SD = 5.41). ANOVA showed a significant effect of the magnitude of money on the time chosen to lose it (F (3, 255) = 11.72, $p < 0.001$, $\eta^2 = 0.12$). Two-by-two comparisons revealed significant differences between ¥ 10 and ¥ 1000 and ¥ 10,000 (ps < 0.001); and between ¥ 100 and ¥ 1000 and ¥ 10,000 ($p = 0.032$ and $p < 0.001$); and non-significant differences (ps > 0.05) between ¥ 10 and ¥ 100 and between ¥ 1,000 and ¥ 10,000. In addition, the amount of money was normalized using log transformation for testing the overall effect of the magnitude of money on the time chosen to lose it. The linear regression showed that as the magnitude of money increased, participants were more inclined to lose money later ($\beta = 0.34$, $p < 0.001$).

Reason analysis. A total of 649 reasons were collected; 47 irrelevant reasons were removed, and 602 valid reasons were assessed, with an average of 2.32 reasons per participant. At ¥ 1000 and ¥ 10,000, participants listed, on average, 0.15 more reasons than for ¥ 10 and ¥ 100, which is consistent with the theory that most motivations for intertemporal decision-making increase with magnitude. The linear regression showed that as the magnitude of money increased, participants listed more reasons ($\beta = 0.12$, $p = 0.06$, almost significant).

A coding sheet containing 11 reasons was formed based on our hypothesis, previous research, and the reasons listed by the participants (see Table 1 for representative descriptions of each reason and predictions of decision propensity). Among the reasons found, "anticipated dread" was a key factor that we hypothesized would influence the phenomenon of negative discounting. When the participants mentioned the pain of thinking about future

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loss and the pain in the waiting process in their reasons (e.g., "It is better to lose it early and have peace of mind," "Long pain is better than short pain," "It is easier to lose it early, otherwise it is always on my mind and I have a lot of psychological pressure," or "It is better to lose it early and have no psychological burden"), then the reason was regarded as being related to anticipated dread. The four reasons for present bias, opportunity cost (investment, savings), time value of money, uncertainty, and resource insufficiency were taken from Hardisty et al. (2012). "Can afford to lose", "early compensation for losses", "mental preparation", and "instinctive avoidance" are representative reasons extracted from the categorization of the participants' reasons. Reasons that did not fall into any of these categories and did not predict decision tendency were classified as other reasons, such as "picked by intuition" and "I'll be free at that time." After forming the coding list for reasons, each reason was categorized by two independent coders to determine which of the 11 reason categories it belonged to. There were 563 reasons that were categorized consistently, with a categorization consistency coefficient of 0.935 for the two independent coders, and reasons that were not coded consistently were determined by a third coder.

Table 1: Reasons for time preference for losing money.

Reasons	**Representative descriptions**	**Time preference**
Present bias	"I don't like to procrastinate," "I want to lose early/quickly"	Now
Anticipated dread	"The sooner you lose it, the sooner you'll have peace of mind." "Long pain is better than a short one."	Now
Can afford to lose	"I can afford it now."	Now
Early compensation for losses	"The sooner you lose it, the sooner you make up for the loss."	Now
Opportunity costs (investment, savings)	"I can take my money and invest/save it now."	Future
The time value of money	"Money will be devalued later."	Future
Uncertainty	"The future is uncertain and maybe I will not lose it."	Future
Insufficient resources	"I don't have money now, but I will have money later."	Future
Mental preparation	"A psychological cushion for future losses."	Future
Instinctive avoidance	"Don't want to go through bad things right away and put it off as long as I can."	Future
Others	"Intuition," etc.	Uncertainty

Referring to Hardisty et al. (2012), the proportions of each reason at different magnitudes

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of money were counted, as shown in Table 2. The linear regression (the amount of money was normalized using log transformation for analysis) revealed that the proportion of reasons related to anticipated dread significantly decreased as the magnitude of money increased ($\beta = -0.24$, $p < 0.001$)[1] and that the proportion of reasons related to insufficient resources significantly increased as magnitude of money increased ($\beta = 0.27$, $p < 0.001$); the proportion of reasons related to mental preparation significantly increased as magnitude of money increased ($\beta = 0.17$, $p = 0.007$). The proportion of other reasons did not significantly change as the magnitude of money increased, although the trend of the average did show that the proportion of reasons related to opportunity costs increased with the magnitude of money. The bootstrap analysis found that the proportion of reasons related to anticipated dread was a mediating variable between the magnitude of money and choice of time at which to lose money (Figure 2; bias corrected, 95% confidence interval (CI) [0.4023, 1.1892]; sample size 259; number of bootstrap Resamples 5000). The CI does not contain 0, so the mediation test is significant.

Table 2: Proportion of each reason at different magnitudes of money.

Reasons	10 (N=61)	100 (N=64)	1000 (N=72)	10000 (N=62)	β	t
Present bias	0.01	0.01	0.005	0.01	–0.02	–0.25
Anticipated dread	0.40	0.35	0.19	0.20	–0.24	-3.88^{***}
Adequate resources	0.04	0.05	0.01	0.05	–0.04	–0.57
Early compensation for losses	0.04	0.06	0.05	0.04	–0.02	–0.38
Opportunity costs	0.01	0.01	0.02	0.03	0.08	1.23
The time value of money	0.08	0.10	0.09	0.10	0.03	0.44
Uncertainty	0.01	0.01	0.02	0.01	0.01	0.14
Insufficient resources	0.17	0.22	0.47	0.40	0.27	4.52^{***}
Mental preparation	0.01	0.02	0.05	0.06	0.17	2.73^{**}
Instinctive avoidance	0.03	0.07	0.05	0.08	0.09	1.43
Others	0.20	0.11	0.06	0.03		

Note: Standardized regression coefficients are shown. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

The results of Experiment 2a showed that the magnitude of money loss influenced the generation of negative discounting. Specifically, participants were more likely to exhibit

[1]Thanks to Editor Jonathan Baron's suggestion, we ruled out the hypothesis that the negative relationship between anticipated dread and the magnitude of money was caused by an increase in other reasons. We calculated the new proportion of reasons related to anticipated dread by subtracting the proportion of reasons related to insufficient resources and mental preparation. The linear regression showed that the new proportion of reasons related to anticipated dread was still significantly correlated with the magnitude of money ($\beta = -0.16$, $p = 0.02$).

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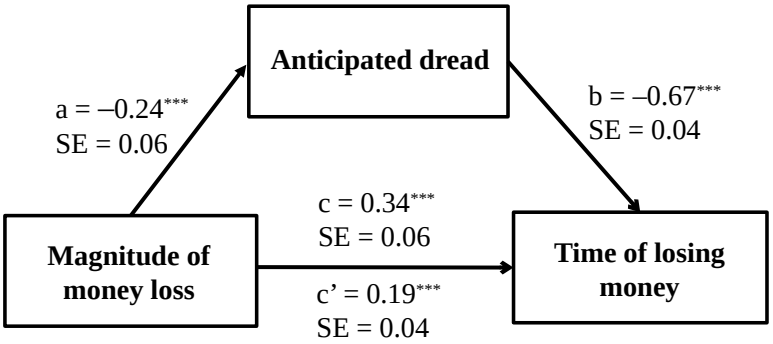

FIGURE 2: Mediation model: a is the effect of X on M, b is the effect of M on Y, c is the total effect of X on Y, and c' is the direct effect of X on Y. Paths are labeled with standardized regression coefficients and corresponding SEs (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$).

negative discounting when the amount of money lost was small compared to when the amount of money lost was large. Moreover, anticipated dread mediated the effect of the magnitude of money lost on the negative discounting. When the amount of money lost was small, anticipated dread appeared to be more important than the other factors influencing intertemporal decision-making, and people were more willing to lose money immediately; when the amount of money to be lost was large, anticipated dread was no longer the dominant factor, but other factors, such as insufficient resources, became more important, so people would prefer to lose money later.

3.2 Experiment 2b: Effect of anticipated dread on magnitude effect of negative discounting in the field of non-monetary loss

Experiment 2b explored whether the magnitude of the physical pain stimulus influenced the emergence of negative discounting and examined whether anticipated dread mediated this process.

3.2.1 Method

Participant. In line with Experiment 2a, we assumed small to moderate effect sizes to determine the sample size needed to test our mediation model in the current experiment. A total sample size of at least 166 people was suggested. In this study, we exceeded this minimum and recruited 234 college students (63 female and 171 male, mean age 19.99 years, SD = 1.31 (Fifteen participants did not report age)) who participated in Experiment 2b. The participants received a small gift at the end of the experiment as a reward.

Experimental materials and procedures. Participants were randomly assigned to four groups. The first group read a scenario in which they imagined that they were about to receive a painful stimulus that would cause the same level of pain as the pain caused by an injection, and they could choose to receive the painful stimulus at any time between

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now and one year in the future. Participants then answered three questions based on this scenario: (1) "When would you prefer to receive this pain stimulus?" Participants marked a vertical line (|) on a 13.3 cm long line segment (left end indicating receiving now, right end indicating receiving in 1 year) to indicate the time they would be willing to receive the pain stimulus. The participants then needed to write as many reasons as possible for why they choose that time to receive the pain stimulus. (2) "How much pain do you think this pain stimulus will cause? Please rate the scale on a scale of 1 for very mild pain, 4 for moderate pain, and 7 for very intense pain." (3) "Have you ever had an experience of being given an injection? (A. Yes; B. No)." The other three groups of participants read the same situations and answered the same questions as the first group of participants, except that the pain stimuli they faced were different. The pain stimuli faced by the other three groups of participants were hornet stings, being scalded with boiling water, and tooth extraction.

3.2.2 Results

Pain level. Two participants did not complete the reasons, and their data were excluded. Before analyzing the timing and reasons for receiving the pain stimuli, we compared the level of pain caused by the four painful stimuli. The mean pain level for the injection was $M = 2.95$ ($SD = 1.54$); the mean pain level for the hornet sting was $M = 3.84$ ($SD = 0.97$); the mean pain level for the boiling water scald was $M = 4.50$ ($SD = 1.70$); the mean pain level for the tooth extraction was $M = 5.08$ ($SD = 1.57$). The results of the analysis of covariance with pain experience as a covariate showed a significant main effect of pain category on pain level ($F(3, 227) = 21.71$, $p < 0.001$, $\eta^2 = 0.22$), and a non-significant main effect of pain experience on pain level ($F(1, 227) = 0.23$, $p = 0.63$). The two-way comparison of results showed significant differences in levels of pain between pain categories (ps < 0.05), except between hornet sting and being scalded by boiling water, and tooth extraction and being scalded by boiling water, which were not significant ($ps > 0.05$). These pain stimuli were ranked in descending order of pain: injection, hornet sting, being scalded with boiling water, and tooth extraction.

Time of pain. There were 54.4%, 36.2%, 41.4%, and 27.1% of participants who wanted to receive painful stimuli immediately (who drew a vertical line in the left end on line segment) respectively in conditions of injection, hornet sting, being scalded with boiling water, and tooth extraction. The time at which participants were willing to accept painful stimuli became later as the pain level increased, with a mean acceptance time of $M = 1.36$ ($SD = 3.08$) for injections; $M = 2.59$ ($SD = 3.94$) for hornet stings; $M = 2.94$ ($SD = 4.71$) for being scalded boiling water; and $M = 3.54$ ($SD = 4.69$) for tooth extractions. ANOVA results showed a significant effect of pain level on the time to receive pain, $F(3, 228) = 2.83$, $p = 0.039$, $\eta^2 = 0.036$. Two-by-two comparisons showed that the time to receive an injection was significantly earlier than the time to receive a tooth extraction ($p = 0.031$), and the difference in time to receive other pain stimuli was not significant ($ps > 0.05$). In

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addition, the linear regression revealed that as the self-reported pain level increased, the time at which participants were willing to accept the painful stimuli became later ($\beta = 0.44$, $p < 0.001$).

Reason analysis. A total of 553 reasons were collected and 29 irrelevant reasons were removed, resulting in 524 valid reasons, with an average of 2.26 reasons per participant. There was no significant difference in the number of reasons listed by participants with different pain levels (F (3, 228) = 1.71, $p = 0.165$).

Based on our hypothesis, previous studies, the reasons listed by the participants, and the coding list of reasons for the time chosen for money loss in Experiment 2a, a coding list of seven reasons was formed, and a representative description of each reason and the prediction for the decision tendency can be found in Table 3. When the participants mentioned the pain of thinking about the future and the pain in the waiting process in their reasons (e.g., "the sooner it is over, the sooner the peace of mind"; "long pain is better than short pain"; "waiting is painful"; "waiting is torturous"; "the more I wait, the more anxious and scared I get"), then this was considered as being related to anticipated dread. Also, as in Experiment 2a, present bias and uncertainty continued to be taken from the study by Hardisty et al. (2012). As there is no effect of opportunity cost (investment, savings), time value, or lack of resources in physical pain stimuli, these reasons were not included in the coding table. The three reasons for tolerable pain, psychological preparedness, and instinctive avoidance were representative reasons drawn from the categorization of the participants' reasons, which were also in the list of reasons for money loss in Experiment 2a. Reasons that did not fall into all of the above categories and did not predict decision tendency were classified as "other" reasons, such as "I chose by intuition" or "I was free at that time." After the coding table was formed, the reasons were categorized by two independent coders to determine to which of the seven categories of reasons in the coding table they belonged. There were 524 reasons categorized consistently, with a categorization consistency coefficient of 0.928.

Referring to Hardisty et al. (2012), the proportion of each reason at the different levels of pain were counted, as shown in Table 4. The linear regression revealed that the proportion of reasons related to anticipated dread significantly decreased with increasing pain level ($\beta = -0.18$, $p = 0.007$)[2]; the proportion of reasons related to can bear the pain significantly decreased with increasing pain level ($\beta = -0.20$, $p = 0.003$); the proportion of reasons related to uncertainty, mental preparation, and instinctive avoidance significantly increased with increasing pain levels ($\beta_{uncertainty} = 0.21$, $p < 0.001$; $\beta_{mental\ preparation} = 0.26$, $p < 0.001$; $\beta_{instinctive\ avoidance} = 0.32$, $p < 0.001$). The proportion of other reasons did not change significantly with pain level. The bootstrap analysis found that the proportion of reasons related to anticipated dread was a mediating variable between pain level and the time chosen

[2]Referring to Footnote 1, we calculated the new proportion of reasons related to anticipated dread by subtracting the proportion of reasons positively correlated with pain level. Linear regression showed that the new proportion of reasons related to anticipated dread was still significantly correlated with pain level ($\beta = -0.14$, $p = 0.05$).

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Table 3: Rationale coding table for time spent receiving painful stimuli.

Reasonss	**Representative descriptions**	**Time preference tendencies**
Present bias	"I don't like to procrastinate." "I like to do things quickly and neatly."	Now
Anticipated dread	"The sooner you lose it, the sooner you'll have peace of mind." "Long pain is better than a short one."	Now
Can bear the pain	"The pain is bearable."	Now
Uncertainty	"The future is uncertain and maybe I will not suffer."	Future
Mental preparation	"A psychological cushion for future suffering."	Future
Instinctive avoidance	"It hurts too much to take it." "The later the bad things happen, the better it is."	Future
Others	"Intuition," etc.	Uncertainty

to receive pain stimulus (Figure 3; (bias corrected, 95% CI [0.0596, 0.3971]; sample size 232; number of bootstrap resamples 5000). The CI does not contain 0, thus the mediation test is significant.

Table 4: Proportion of each reason at different levels of pain.

Reasons	Injection (N=57)	Hornets (N=58)	Boiling water (N=58)	Tooth extraction (N=59)	β	t
Present bias	0.04	0.03	0.03	0.04	–0.10	–1.50
Anticipated dread	0.55	0.47	0.40	0.38	–0.18	-2.70^{**}
Can bear the pain	0.13	0.08	0.09	0.06	–0.20	-3.02^{**}
Uncertainty	0.01	0.01	0.01	0.03	0.21	3.30^{***}
Mental preparation	0.04	0.16	0.12	0.18	0.26	4.08^{***}
Instinctive avoidance	0.04	0.11	0.15	0.20	0.32	5.11^{***}
Others	0.17	0.14	0.21	0.12		

Note: Standardized regression coefficients shown. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

The results of Experiment 2b were consistent with those of Experiment 2a, again demonstrating that the magnitude of the negative stimulus affects negative discounting. The results of Experiment 2b added further evidence for a magnitude effect by showing that such effects exist not only for monetary stimuli but also for non-monetary stimuli. Specifically, the results of Experiment 2b found that participants were more likely to experience negative discounting when the physical pain stimuli were small compared to when physical pain stimuli were large. Moreover, the anticipated dread mediated the effect of physical pain stimulus size on negative discounting. When the pain level is low, among all the factors

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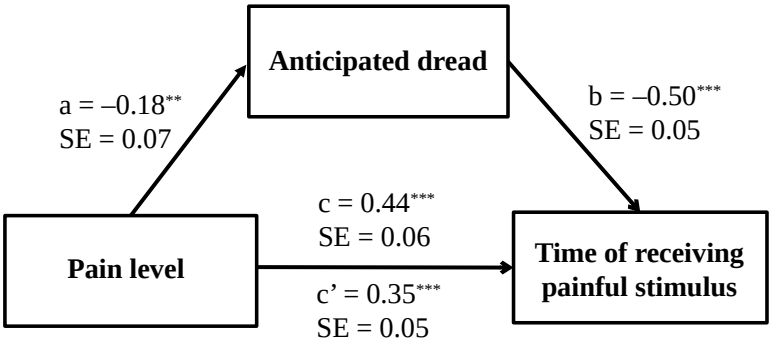

FIGURE 3: Mediation model: a is the effect of X on M, b is the effect of M on Y, c is the total effect of X on Y, and c' is the direct effect of X on Y. Paths are labeled with standardized regression coefficients and corresponding SEs ($^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$).

influencing intertemporal decision-making, anticipated dread factors dominated, and people were more willing to receive the pain stimulus immediacy; whereas, when the pain level is high, factors such as psychological preparation and instinctive avoidance became more important, so people preferred to delay the pain stimulus.

Experiment 2 again verified the existence of anticipated dread and its effect on negative discounting by asking subjects to write out the reasons for their intertemporal choice. The overall results suggested that people were more likely to experience negative discounting when faced with smaller negative stimuli than when faced with larger negative stimuli because the psychology of avoidance of anticipated dread dominated when the stimulus was smaller. These findings again provided direct evidence for the effect of anticipated dread on negative discounting.

4 Experiment 3: Effect of anticipated dread on negative discounting — manipulating anticipated dread

Experiment 2 revealed the mechanism of the effect of anticipated dread on the magnitude effect of negative discounting by measuring the reason proportion of anticipated dread. Experiment 3 manipulated the strength of anticipated dread to see if it affects the production of negative discounting to further reveal the effect of anticipated dread on negative discounting.

Query theory was proposed by Johnson et al. (2007) to explain the endowment effect. An important assumption of this theory is that, when individuals are faced with a decision, they naturally break it down into a series of queries, such as "Why do I choose A? Why do I choose B?" Query theory suggests that different response modes produce different query orders. For example, in the case of a binary choice, if the reasons for choosing A are extracted first, then A will be chosen; conversely, if the reasons for B are extracted first, then B will be chosen because there is output interference in the memory, such that recalling

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guided content in a list may lead to a weaker memory for the unguided parts of the list.

Applying this important assumption of query theory, Johnson et al. (2007) eliminated the endowment effect by changing the query order for buyers and sellers. Sellers (endowed) were asked to produce value-decreasing aspects first, and then value-increasing aspects, whereas buyers (not endowed) were asked to list value-increasing aspects before value-decreasing aspects. Researchers have also eliminated the delay/speedup and default effects by manipulating participants' query order (Dinner et al., 2011; Weber et al., 2007).

Experiment 3 attempted to manipulate participants' query order, to determine whether it would affect the feeling of the anticipated dread. The manipulation of query order in previous studies was to have participants list reasons in favor of Choice A first, or reasons in favor of Choice B first, thus eliciting different choice outcomes. In this experiment, we provided participants with the sets of reasons to support choices A and B, and manipulated the query order by manipulating the order in which participants read and transcribed two sets of reasons. According to query theory, participants decomposed the questions into "Why would I choose the negative event to occur now?" and "Why would I choose the negative event to occur in the future?" Based on the sets of reasons listed by participants for choosing the negative event to occur immediately and in the future, we constructed two anticipated feelings when participants thought about future negative events and the waiting process: anticipated positive feelings and anticipated dread. Participants were randomly divided into two groups, with one group reading and transcribing anticipated positive feelings before reading and transcribing anticipated dread, while the other group read and transcribed in the opposite order.

4.1 Method

4.1.1 Participant

The power analysis was performed using G*Power (Faul et al., 2007). Using a two-tailed independent sample t-test and assuming a medium effect size of $d = 0.5$, significance level of $\alpha = .05$, and power of 80%, the required sample size was 128 participants. In this study, we exceeded this minimum and recruited a total of 138 college students (99 female and 32 male, mean age 19.88 years, $SD = 1.17$. (Seven participants did not report gender and eight participants did not report age.) The participants received a small gift at the end of the experiment as a reward for taking part.

4.1.2 Experimental materials and procedures

The experiment had a one-factor between-subject design, with the order of transcribing reasons as the independent variable and the intertemporal preference for negative events as the dependent variable. The participants were randomly assigned to two groups: the positive-first group (transcribing anticipated positive feelings first) and the negative-first group (transcribing anticipated dread first).

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The experiment consisted of two tasks. The first task was the reason transcription task, that is, query order manipulation. After the transcription task, participants completed a series of intertemporal choices.

Transcription task

1. All of the participants first read a contextualizing passage: *Suppose you have a wisdom tooth and although there is currently no adverse condition related to it, the doctor recommends that this wisdom tooth be extracted for safety reasons. So, in five days the doctor will perform an extraction procedure on you, and because you are allergic tothe anesthetic, the doctor will remove the tooth without anesthetic.*
2. After reading the scenario, all participants were presented with two possible anticipated feelings about the tooth extraction procedure in five days. The two groups of participants read and copied two anticipated feelings in different orders. Participants in the positive-first group read the positive feelings first and then transcribed them, and then read the feelings of the anticipated dread and transcribed them. Those in the negative-first group read and transcribed the two anticipated feelings in the opposite order.

   (a) *I will have a tooth extraction in a few days. It will hurt very much. For these two days, I won't sleep well every day. I will keep thinking about the tooth extraction. The more I think about it, the more scared I am and the more upset I am.* (anticipated dread)

   (b) *I have a few more days before the extraction. Although it will hurt so much, luckily I can still enjoy a few days before the extraction. It would be better if the pain could come a day later. I can also prepare for the extraction in these two days. It would be nice if the doctor would change his mind in five days and say no extractions are needed.* (anticipated positive feelings)

The two anticipated-feeling descriptions were constructed from the reasons participants listed in Experiment 2b for choosing to receive physical pain stimulation now and for choosing to receive it later. The negative feelings while thinking about and waiting for the extraction procedure mainly reflect the content of anticipated dread; the positive feelings while thinking about and waiting for the extraction procedure mainly reflect instinctive avoidance, making mental preparations, and the uncertainty that participants experience when faced with the extraction procedure.

Manipulation test. After the transcription task, we tested the anticipated feelings of the two groups of participants facing tooth extraction in a few days. The participants were asked to rate their response to the following question on a 9-point scale (1 = very pleasant, 5 = neither pleasant nor unpleasant, 9 = very unpleasant): What do you anticipate your feelings will be while waiting for the time for tooth extraction to arrive?

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Other testing questions. To determine whether participants read the situation carefully before transcribing the anticipated feelings, participant completed three multiple-choice questions in the following order (the underlined options are the correct ones): (1) According to the above material, the reason you had your wisdom tooth extracted is: A. inflammation of the wisdom tooth, B, the wisdom tooth did not present a bad condition and the doctor recommended the extraction for safety; (2) According to the above material, do you take anesthetic when you have your tooth extracted? A. yes, B. no; (3) According to the above material, the time the doctor gives you to pull the tooth is: A. now, B. 5 days later, C. 1 month later. To ensure that the two anticipated feelings in the next transcription task were indeed representative of feelings that participants may experience, we needed to demonstrate that the tooth extraction procedure (without anesthesia) is indeed a painful event for the participants, so participants were also asked to rate the painfulness of the procedure (without anesthesia) on a 9-point scale (1 = not at all painful, 9 = very painful).

Intertemporal choice task. After completing the transcription task, both groups of participants completed the same five situational choice questions as in Experiment 1, with the alternative time options being now and one week later, and participants indicated their choices on a 6-point scale, with 1 = very definitely choosing now and 6 = very definitely choosing one week later.

4.2 Results

The participants were first tested on whether they read the context carefully. Twelve participants answered incorrectly on at least one question, leaving the suspicion that they did not fill out the questionnaire carefully, so we did not conduct a follow-up analysis of the data for these 12 participants. The remaining 126 participants answered all three multiple-choice questions correctly and completed the transcription task. A sensitivity analysis showed that the current samples provided 80% power to detect a minimum effect size of Cohen's $d = 0.5$.

The participants considered the extraction procedure (without anesthesia) to be a relatively painful event indeed, with a mean rating of $M = 6.92$ ($SD = 1.86$) for the level of pain. To test whether this level of pain was significantly higher than a moderate level of pain, a one-sample t-test (test value = 5) was conducted on the participants' scores, which revealed that the participants' scores were significantly higher than 5 (t (125) = 11.58, $p < 0.001$, $d = 1.03$). This result indicates that the participants perceived tooth extraction (without anesthesia) to be very painful, thus ensuring that the anticipated feelings transcribed by the participants were indeed the two kinds of feelings they were likely to experience. There was a significant difference in the anticipated feelings while waiting for the tooth extraction between the two groups of participants. Participants who first copied the negative feelings (anticipated dread) anticipated significantly higher unpleasant feelings ($M = 7.48$, $SD = 1.43$) than those who first copied anticipated positive feelings ($M = 6.65$, SD = 1.10); t

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(124) = 3.69, $p < 0.001$, $d = 0.66$). In other words, participants who first transcribed anticipated negative feelings felt a higher degree of anticipated dread than participants who first transcribed anticipated positive feelings.

Participants' temporal preferences regarding when negative events occur were then analyzed. Figure 4 shows the choice scores for the two groups of participants regarding the time of occurrence for five negative events, from which it can be seen that for all five negative events, the participants who copied the negative feelings first had smaller choice scores than those who copied the positive feelings first. The results of the independent samples t-test showed that for three events — "losing ¥ 100," "making a fool of myself in front of classmates," and "getting a bad grade in a competition," — the difference reached the following levels of significance respectively: $t_{\text{lost ¥ 100}}(124) = -2.88$, $p = 0.005$, $d = 0.51$; $t_{\text{made a fool of themselves in front of classmates}}(120.435) = -2.52$, $p = 0.013$, $d = 0.45$; and $t_{\text{got a bad grade in a competition}}(124) = -2.06$, $p = 0.042$, $d = 0.37$.

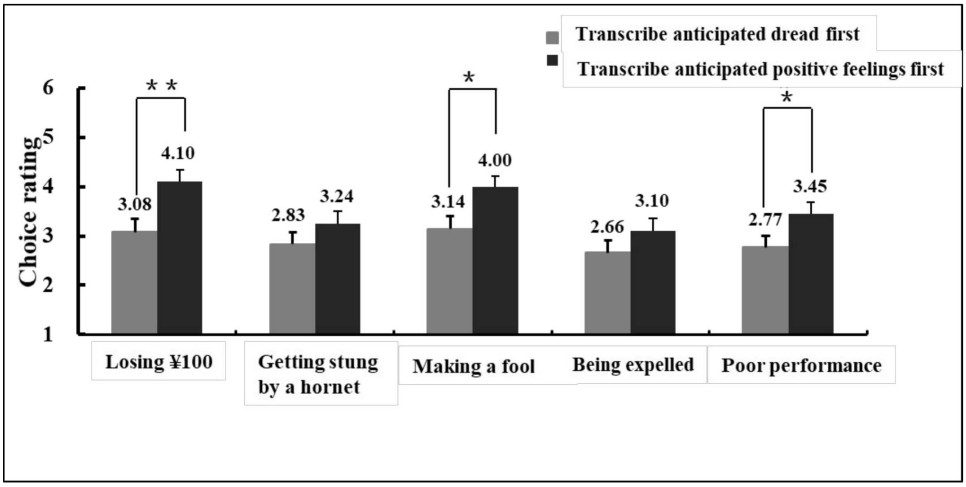

FIGURE 4: Selection scores for the two transcription order groups for the timing of five negative events (1 = very definitely pick now, 6 = very definitely 1 week later). *Note*: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Based on the classic method for manipulating query order, the present experiment applied a manipulation variant; although somewhat stringent, the manipulation was effective. The results showed that the order in which the anticipated feelings were copied affected decision-making behavior. Participants who first copied the feelings of anticipated dread were more likely to choose the negative event to occur immediately than participants who first transcribed the positive anticipated feelings. The results of Experiment 3 illustrated that transcribing the anticipated negative feelings first enhanced participants' anticipated dread towards the tooth extraction and then strengthened the general anticipated dread when faced with other future negative events in the following choice task; they thus showed a stronger tendency toward negative discounting. Experiment 3 further verified the effect of anticipated dread on negative discounting by manipulating anticipated dread.

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5 Discussion

This paper again verified the interpretation of anticipated dread for negative discounting by measuring and manipulating anticipated dread. Experiment 1 examined the prevalence of negative discounting in intertemporal choice involving negative events. The results revealed that negative discounting occurred for 40.89% of intertemporal choices in the loss domain (Experiment 1a), and more than 50% of participants chose for negative events to occur now in all intertemporal choice contexts involving a variety of negative events (Experiment 1b). The results of Experiment 1 and previous studies together suggest that the negative discounting phenomenon is a stable, strong phenomenon that is validated in a variety of research paradigms. These research paradigms include temporal preferences for when negative events occur (two-choice choice, multiple-choice choice) (Experiment 1; Harris, 2012); ratings of aversion to negative events that occur at different times (MacKeigan et al., 1993; Mischel et al., 1969; Redelmeier & Heller, 1993); bidding for negative events occurring at different times (Loewenstein, 1987); and measuring temporal discounting rates using choice and fill-in-the-blank (Hardisty et al., 2012; Hardisty & Weber, 2009). Experiment 2 explored the effect of anticipated dread on negative discounting by measuring the anticipated dread using the content analysis method. The results revealed that anticipated dread mediated the effect of the magnitude of the negative stimulus on the negative discounting. Experiment 3 explored the effect of anticipated dread on the negative discounting phenomenon by manipulating it. It was found that the strength of the anticipated dread influenced the strength of the tendency to discount negatively. The overall findings once again provide empirical evidence that people developed anticipated dread about negative events that occur in the future and then exhibited negative discounting.

5.1 Negative discounting for losing money

However, inconsistent with the studies of Yates and Watts (1975), we found that negative discounting did not exist only in intertemporal decisions involving non-monetary losses, but also exist in decisions involving monetary losses. Lowenstein (1987) argued that when people are faced with a monetary loss that occurs in the future, they do not have the same anticipated dread as they do about other negative events, and negative discounting does not occur. We speculated that the reason for the inconsistency between our results and those of Loewenstein (1987) may be how the earlier study examined intertemporal decisions for money loss: the bidding task. In the bidding task, the value of money is measured in monetary terms, and thus participants are guided to make decisions in accordance with the way value is assessed (i.e., positive discounting). Similarly, Yates and Watts' (1975) study did not find a negative discount phenomenon for the loss of money because of how the study was conducted: they gave participants a portion of start-up money first and then studied the intertemporal decision for money loss. According to the concept of reference points in

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prospect theory (Kahneman & Tversky, 1979), the "loss" in these experiments may not be a loss for the participants because of the prior giving of money to the participants.

In our studies, we used multiple research paradigms to discover that negative discounting also exists in decisions involving monetary losses, except that such decisions have a smaller tendency of negative discounting than decisions involving other negative events. In Experiment 1, the average percentage of participants experiencing negative discounting was 64% for negative events with non-monetary losses and 55% for negative events with monetary losses. In Experiment 2, the mean percentage of reasons listed by participants regarding anticipated dread was 28.0% when losing money and 45.0% when receiving physical pain stimuli; the mean acceptance time for losing money was 5.90 and the mean acceptance time for pain stimuli was 2.62. These results all indicated that negative events with non-monetary losses are more likely to cause anticipated dread and therefore more likely to generate negative discounting. This conclusion suggests that the phenomenon of negative discounting may be characterized by domain independence. This conclusion was consistent with the results of previous researchers who have compared intertemporal decision-making behavior across domains. For example, Chapman and Elstein (1995) and Chapman (1996) found very little correlation between discount rates in the health and money domains. Hardisty and Weber (2009) compared discount rates in the health, environmental, and money domains and found that the discount rates in the health loss domain were smaller than those in the environmental loss domain and in the loss of money domain. Both the domain independence of the negative discounting phenomenon and, more broadly, the domain independence of intertemporal decision-making challenges the assumption of the discount utility model that a person discounts outcomes for all domains using the same discount rate.

5.2 Magnitude effect of negative discounting

Most of the current research on the magnitude effect has focused on the domain of gaining money and only a few studies have explored the magnitude effect in the domain of money loss. This paper found a magnitude effect for negative discounting in the loss domain. The reason why negative discounting was more likely to occur when the amount of money lost was small was that the psychology of avoiding anticipated dread dominated for small amounts of money, while other factors that influence intertemporal decision-making, such as insufficient resources, dominated when the amount of money lost was large and thus prevented negative discounting. The magnitude effect of negative discounting found in this paper was in the same direction as the magnitude effect when losing money revealed by Mitchell and Wilson (2010) and Hardisty et al. (2012). Both studies found that the discount rate for smaller amounts of money loss was smaller than the discount rate when the amount of money lost was larger. However, Chapman (1996) found the opposite magnitude effect. The reasons may lie in whether the studies address negative discounting. Mitchell and Wilson (2010) and Hardisty et al. (2012) adapted the traditional composition of intertemporal

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options to allow negative discounting to be detected, making the different discount rates for different magnitudes and the different trend of magnitude effects. Furthermore, consistent with the magnitude effect of negative discounting in the money domain, this paper also found a magnitude effect for physical pain, which suggested a cross-domain consistency of magnitude effects of negative discounting.

5.3 Research limitations and future research

This study verified the effect of anticipated dread on intertemporal choice using the content analysis method. However, this study explored the overall anticipated negative feelings that individuals have in the face of future negative events, that is, anticipated dread, without analyzing the specific components of these anticipated feelings.

Some studies have questioned whether dread is not only emotional, but also contains a cognitive component. Although Berns et al. (2006) did not discuss "anticipated" dread, they speculated that "dread in the waiting process" derives, in part, from the attention devoted to the expected physical response and not simply from fear or anxiety. Furthermore, Sun et al. (2015) argued that anticipated dread might contain two components: that is, individuals not only develop anticipated emotions toward negative events but also a cognitive element – anticipated rumination — they worried that they would keep thinking about the delayed event during the waiting process, diverting cognitive resources that would otherwise be used for other tasks. Sun et al. (2020) further explored the rumination mechanism in detail. It was found that when "something tying one up' (e.g., an English oral exam) was imposed on the future, participants were more likely to choose to complete the negative event as early as possible. Moreover, Sun et al. (2016) found that individuals were more likely to exhibit negative discounting when making decisions for themselves than for others through the binary choice paradigm and titration task, which supported the emotional nature of anticipated dread to some extent. Similarly, the emotional nature of anticipated dread could be tested in the future by removing the emotion, such as keeping participants unaware of whether any particular gain or loss occurred as a result of the intertemporal choice or other concurrent time-varying events.[3] Future studies could also compare the cognitive and emotional factors driving the negative discounting of negative events using a cleverly arranged experimental paradigm.

Meanwhile, in terms of the source of anticipated dread, Sun et al. (2015) argued that there are two: one for the future event itself and one for the waiting process. The results of the present study imply that participants' anticipated dread of future negative events stemmed, to a large extent, from negative feelings about the waiting process. However, in Hardisty and Weber (2020), when participants scored their anticipated dread, only the individuals' anticipated feelings about future events were included, and the anticipated

[3]We thank Jonathan Baron for this idea of experimental design.

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feelings about the waiting process were excluded and referred to as "impatience." Future research should focus on and further explore this issue.

This paper explored the phenomenon of negative discounting in intertemporal decision-making from a group perspective. The results of this paper suggested that some people do not experience negative discounting. Future research could explore individual differences in negative discounting in terms of personality traits, cognitive characteristics, and decision-making contexts. Finally, the experimental materials used in this study were hypothetical choice situations. Although we examined how people expect to feel about future events before they make a choice, which must be hypothetical at that point, future research could consider linking the outcome of the choice with real rewards or experiences to enhance the external validity of the study.

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