

The Processing Mechanism of Negative Discounting Behavior: An Explanation Based on Query Theory

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Abstract

Negative discounting behavior in intertemporal choice poses a challenge to traditional decision-making models based on the positive discounting assumption. Based on Query Theory, this research systematically explores the processing mechanisms of negative discounting behavior through four studies.

Study 1 and Study 2 employed the aspect-listing method and found that individuals who prioritized and performed more queries on “value-increasing” information regarding immediate losses were more inclined to choose the immediate loss; conversely, individuals who prioritized and performed more queries on “value-decreasing” information regarding immediate losses were more inclined to choose the delayed loss. Study 3 manipulated the query order to examine the causal impact of query sequence on negative discounting behavior, revealing that prioritizing the retrieval of reasons for immediate losses enhanced negative discounting behavior. Study 4 further demonstrated that as the loss amount increases, individuals are more inclined to choose delayed losses, the mechanism of which lies in the retrieval of more “value-decreasing” information regarding immediate losses and an earlier retrieval order. This research provides a new theoretical perspective for understanding negative discounting behavior and offers an empirical basis for behavioral interventions.

Full Text

The Processing Mechanism of Negative Discounting Behavior: An Explanation Based on Query Theory

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Abstract

Negative discounting behavior in intertemporal choice poses a significant challenge to traditional decision-making models based on the assumption of positive discounting. Grounded in Query Theory, this research systematically investigates the underlying processing mechanisms of negative discounting behavior across four studies. Study 1 and Study 2 employed the aspect-listing method and found that individuals who prioritized and generated more queries regarding “value-increasing” information for immediate losses were more likely to choose the immediate loss option. Conversely, individuals who prioritized and generated more queries regarding “value-decreasing” information for immediate losses were more inclined to choose the delayed loss option. Study 3 tested the causal impact of query order on negative discounting behavior by manipulating the sequence of information retrieval; the results demonstrated that prioritizing the retrieval of reasons for immediate losses enhanced negative discounting behavior. Furthermore, Study 4 revealed that as the magnitude of the loss increased, individuals became more likely to choose the delayed loss. The mechanism underlying this shift was the retrieval of more “value-decreasing” information regarding immediate losses, coupled with an earlier retrieval order for such information. Collectively, this research provides a new theoretical perspective for understanding negative discounting behavior and offers an empirical foundation for behavioral interventions.

Keywords: Negative Discounting Behavior, Query Theory, Intertemporal Choice, Time Discounting

1 Introduction

Intertemporal choice refers to the judgments and decisions individuals make when weighing costs and benefits that occur at different points in time [?, ?]. According to classical economic theory, these decisions typically involve a process of time discounting, wherein an individual’s subjective valuation of a future outcome tends to decrease as the delay to that outcome increases [?, ?, ?]. Research has demonstrated that higher rates of time discounting are positively correlated with risky behaviors such as depression, substance addiction, and obesity. Conversely, lower time discounting is more conducive to promoting long-term oriented behaviors, such as wealth accumulation and the maintenance of healthy habits [?, ?, ?, ?].

Currently, mainstream intertemporal choice models—including the discounted utility model, the hyperbolic discounting model, and the quasi-hyperbolic discounting model—are built upon the fundamental assumption of positive time discounting. These models consistently suggest that individuals generally exhibit a preference for immediate gains and an aversion to immediate losses; that

is, they tend to prefer receiving rewards sooner and postponing losses into the future [?, ?, ?, ?, ?, ?].

However, existing research has identified phenomena that contradict positive temporal discounting. When faced with negative events, individuals often tend to accelerate the occurrence of these events, exhibiting what is known as negative temporal discounting (referred to as negative discounting) [?, ?]. For example, in medical contexts, patients facing painful procedures such as chemotherapy often choose to undergo the treatment immediately, even when a delay would not increase physiological pain. This preference is driven by a desire to avoid the anxiety and psychological burden associated with the waiting period. Similarly, in debt scenarios involving interest-free or low-interest loans, individuals frequently forgo rational economic planning—such as installment payments—and instead choose to live frugally to repay the debt as quickly as possible. This behavior aims to alleviate psychological pressure, even at the cost of sacrificing other potential investment opportunities.

These real-world cases are consistent with the findings of Mischel et al. (1969), who observed that most participants prefer to accept an unpleasant experience immediately rather than delay it. Berns et al. (2006) also demonstrated that some participants are willing to accept a higher-intensity immediate electric shock to shorten the waiting time. Furthermore, research by Harris (2012) indicates that in non-monetary negative events, such as social exclusion or physical pain, individuals generally exhibit a tendency to deal with the situation as early as possible. Such negative discounting behavior poses a significant challenge to the assumption of positive time discounting, which serves as the foundation for most mainstream intertemporal choice models.

Exploring these processing mechanisms will help deepen our understanding of human negative discounting behavior while providing a critical basis for refining existing theoretical models. Multiple studies have revealed that the prevalence of this behavior in negative events ranges from 25% to 59%, which is significantly higher than the 2% to 9% observed in positive events [?, ?, ?, ?]. Given that negative discounting behavior is more typical and stable in the context of negative events, the present study focuses on the processing mechanisms of negative discounting behavior specifically within negative events.

In the field of intertemporal choice research, the underlying mechanisms of negative discounting behavior have long been a focal point of investigation. Mischel et al. (1969) interpreted this as a strategy aimed at alleviating psychological burden, suggesting that the process of waiting itself may exacerbate negative experiences. Loewenstein (1987) further advanced this discourse by introducing the concept of “anticipatory dread,” arguing that an individual’s emotional anticipation of a future negative event amplifies the negative utility of the delayed option. Empirical support for this mechanism was provided by Berns et al. (2006) through electric shock experiments. Harris (2012) expanded the conceptual framework of anticipatory dread, noting that it encompasses a broader range of emotional and cognitive components. Sun et al. (2015) further dis-

tinguished anticipatory responses into emotional anticipation and ruminative anticipation. More recently, Sun et al. (2022) validated the impact of anticipatory dread on negative discounting behavior by measuring and manipulating the dread itself.

Existing research primarily explains negative discounting behavior through the lens of “anticipatory dread.” While this perspective focuses on emotional mechanisms, it relatively overlooks the cognitive process mechanisms involved in decision-making—specifically, the critical role that the content and sequence of information retrieval play in the formation of decision preferences. Research suggests that decision preferences are influenced by memory encoding and retrieval processes [?, ?]. Consistent with this view, Kahneman et al. (1999) found that decision preferences are often built upon expectations of future experiences, which in turn are highly dependent on information extracted from memory.

To address the gaps in explaining the underlying cognitive processes, this study introduces Query Theory (QT) as a theoretical framework. QT posits that the formation of decision preferences is not a direct reflection of inherent values, but rather a constructive process based on sequential information retrieval [?, ?, ?]. According to QT, decision-makers typically decompose an evaluation problem into a series of “query sub-questions.” Due to the output interference mechanism, information retrieved by the queries executed first becomes more cognitively rich and highly accessible. Consequently, this information is assigned greater weight during subsequent integration, thereby shaping the final choice.

QT has been successfully applied to explain the phenomenon of discounting asymmetry in intertemporal choice. Research indicates that individuals construct intertemporal preferences by sequentially retrieving supportive arguments from memory [?, ?]. For instance, in delay-frame decisions, individuals tend to prioritize the retrieval of “reasons supporting immediate gains.” This process suppresses the accessibility of subsequent “reasons supporting delayed gains,” leading to high discount rates. Conversely, in acceleration-frame decisions, the query order is reversed. This theoretical framework has been extended to explain various decision-making phenomena, including the endowment effect, risk preferences, and social preferences [?, ?, ?, ?, ?].

Although queries cannot be directly observed, the resulting reasons can be tracked through the “aspect listing” method, which requires participants to systematically list the reasons supporting each option [?, ?, ?]. Within the framework of QT, this study categorizes the information content along two dimensions: Focus (immediate loss vs. delayed loss) and Valence (positive features vs. negative features). This categorization forms a 2×2 matrix (see). Information focusing on the positive features of immediate losses and the negative features of delayed losses is termed “value-increasing” information, as it enhances the relative value of the immediate loss. Conversely, information focusing on the negative features of immediate losses and the positive features of delayed losses is termed “value-decreasing” information.

Figure 2

Figure 1: Figure 2

The objective of this study is to explore how the content and sequence of internal queries influence negative discounting behavior. We hypothesize that individuals who prioritize and generate a greater number of queries for “value-increasing” information will prefer immediate losses, while those who prioritize “value-decreasing” information will prefer delayed losses. Furthermore, we examine whether the magnitude of loss influences negative discounting behavior by affecting the content and sequence of these queries.

2 Study 1: The Impact of Internal Query Content and Order on Negative Discounting Behavior—Decision-First

2.1 Research Objective The primary objective of Study 1 was to investigate how the content and sequence of internal queries influence negative discounting behavior within a “decision-first” framework.

2.2 Participants A total of 208 valid participants (80 males; $M_{age} \pm SD = 23.59 \pm 4.72$ years) were recruited. A post-hoc power analysis indicated that with the current sample size ($N = 208$, $f = 0.25$, $\alpha = 0.05$), the achieved statistical power was 0.904, which is considered sufficient [?, ?].

2.3 Research Tasks Binary Choice Paradigm: Adapted from Harris et al. (2012) and Sun et al. (2022), four negative events were selected: losing 100 RMB, being stung by a hornet, receiving a poor grade, and participating in an exam. Participants indicated their preference on a 7-point Likert scale (1 = “definitely prefer now” , 7 = “definitely prefer one week later”).

Aspect Listing Method: Participants wrote down all reasons considered during decision-making. Following the methodology of Johnson et al. (2007), participants provided at least two reasons and coded each based on “focus,” “valence,” and “weight” (importance on a scale of 1-10).

2.4 Results and Analysis Time Preference: Participants with scores < 3.5 were classified as having a “negative discounting tendency.” Results revealed that in the four scenarios, 52%, 52%, 59%, and 76% of participants exhibited negative discounting behavior (see

). A one-way repeated measures ANOVA showed a significant main effect of scenario, $F(3, 621) = 12.12, p < 0.001, \eta_p^2 = 0.06$.

Reason Weights: Statistical analyses (paired-sample t -tests and repeated-measures ANOVAs) indicated that the reasons initially retrieved by participants carried significantly higher weights than those retrieved subsequently across all

Figure 3

Figure 2: Figure 3

scenarios ($ps < 0.001$, see). This suggests that earlier-generated reasons play a more critical role in the decision-making process.

Query Content: A one-way repeated measures ANOVA on the query content index (value-increasing minus value-decreasing reasons) revealed a significant main effect for the type of negative event, $F(2.832, 586.268) = 18.42, p < 0.001, \eta_p^2 = 0.08$. Multiple linear regression analysis showed that value-increasing information significantly and negatively predicted choice scores (favoring immediate loss), while value-decreasing information significantly and positively predicted choice scores (favoring delayed loss) across all scenarios ($ps < 0.001$).

Query Order: Standardized Median Rank Difference (SMRD) was used to measure sequential tendency. A lower SMRD indicates earlier retrieval of value-increasing information. ANOVA revealed a significant main effect of scenario on SMRD, $F(3, 621) = 16.80, p < 0.001, \eta_p^2 = 0.08$. Simple linear regression showed that SMRD values significantly and positively predicted time preference choice ratings across all contexts ($ps < 0.001$).

3 Study 2: The Impact of Internal Query Content and Sequence on Negative Discounting Behavior—A Reasons-First Approach

Study 2 adopted a “reasons-first” approach to eliminate potential post-hoc rationalization bias by requiring participants to list reasons before making their final choice.

3.1 Participants The final sample consisted of 202 valid participants (94 males; $M_{age} \pm SD = 23.22 \pm 3.40$ years). Statistical power was 0.895.

3.2 Results and Analysis Time Preference: Across the four scenarios, 60%, 54%, 60%, and 75% of participants exhibited negative discounting behavior (see

). A significant main effect of scenario was found, $F(3, 603) = 6.61, p < 0.001, \eta_p^2 = 0.03$.

Reason Weights: Consistent with Study 1, the first reason retrieved carried significantly more weight than subsequent reasons ($ps < 0.001$, see).

Query Content and Order: ANOVA on the query content index revealed a significant main effect of scenario, $F(3, 603) = 11.96, p < 0.001, \eta_p^2 = 0.06$. Multiple regression confirmed that value-increasing and value-decreasing information significantly predicted choice scores ($ps < 0.001$). SMRD values also

Figure 5

Figure 3: Figure 5

differed significantly across scenarios, $F(3, 603) = 9.86, p < 0.001, \eta_p^2 = 0.05$, and served as significant positive predictors of preference ratings ($ps < 0.001$).

4 Study 3: Causal Test of Query Order

Study 3 directly manipulated the query order to examine its causal influence on negative discounting behavior.

4.1 Participants A total of 223 valid participants were assigned to either the immediate-reason-first group ($n = 111$) or the delayed-reason-first group ($n = 112$).

4.2 Results and Analysis Time Preference: Significant differences were observed in three scenarios: “losing 100 yuan” ($t(221) = -2.18, p = 0.030, d = 0.30$), “receiving a poor grade” ($t(221) = -2.39, p = 0.018, d = 0.33$), and “taking an exam” ($t(221) = -2.02, p = 0.045, d = 0.28$). Participants who listed reasons for immediate loss first had lower choice scores (more negative discounting) than those who listed reasons for delayed loss first. The “stung by a hornet” scenario was not significant ($p = 0.923$), likely due to the high biological threat and instinctive fear response overriding the cognitive manipulation.

Reason Weights: Across conditions, the reasons first retrieved consistently carried higher weights ($ps < 0.05$, see

), supporting the QT assertion that early information dominates decision-making.

5 Study 4: The Impact of Loss Magnitude

Study 4 explored how the magnitude of loss influences negative discounting behavior through the lens of QT.

5.1 Participants A total of 386 valid participants were randomly assigned to four loss magnitude groups: 10 RMB ($n = 93$), 100 RMB ($n = 97$), 1,000 RMB ($n = 98$), and 10,000 RMB ($n = 98$).

5.2 Results and Analysis Time Preference: Proportions of participants choosing immediate loss were 63%, 56%, 45%, and 37% for the respective magnitudes. A significant main effect of loss magnitude was found, $F(3, 382) = 5.15, p = 0.002, \eta_p^2 = 0.04$. As loss magnitude increased, participants showed a greater tendency to delay the loss (see [FIGURE:6]).

Query Content: A significant interaction between information type and loss magnitude was observed, $F(3, 382) = 3.43, p = 0.017, \eta_p^2 = 0.03$. Participants in the 10 RMB group queried significantly more “value-increasing” information, while those in the 10,000 RMB group queried more “value-decreasing” information. Mediation analysis confirmed that the difference in the number of reasons significantly mediated the effect of loss magnitude on choice (Effect = 0.37, $LLCI = 0.1423, ULCI = 0.5891$).

Query Order: SMRD values increased with loss magnitude, $F(3, 382) = 4.45, p = 0.004, \eta_p^2 = 0.03$. Mediation analysis showed that SMRD significantly mediated the relationship between loss magnitude and timing choice (Effect = 0.42, $LLCI = 0.1999, ULCI = 0.6528$).

6 Discussion

6.1 Main Findings This research indicates that negative discounting behavior is prevalent across various negative scenarios (52%-76%). Individuals who prioritized “value-increasing” information (e.g., “losing early for peace of mind”) exhibited negative discounting, while those prioritizing “value-decreasing” information (e.g., “time value of money”) exhibited positive discounting. The study confirms that the first reason retrieved carries the highest weight, and query order causally influences preferences. Furthermore, loss magnitude systematically adjusts the information retrieval bias, with larger losses prompting earlier and more frequent retrieval of value-decreasing information.

6.2 Theoretical and Practical Implications Query Theory provides a cognitive process model that complements the emotional “anticipatory dread” explanation. While dread explains the *motivation* to avoid waiting, QT reveals the *mechanism* of internal justification construction. The findings suggest that negative discounting is not a fixed bias but a malleable strategy dependent on cognitive retrieval paths.

Practically, these results offer a foundation for behavioral interventions. By guiding individuals to adjust their query sequence—such as focusing on the relief of being debt-free—policymakers and clinicians can nudge individuals toward adaptive intertemporal choices in finance, healthcare, and environmental protection.

6.3 Conclusion This research demonstrates that Query Theory effectively explains the processing mechanisms underlying negative discounting behavior. Negative discounting is driven by the prioritized retrieval of value-increasing information, a process that can be modified by external manipulation and is moderated by the magnitude of the loss. These findings deepen our understanding of intertemporal choice and provide a pathway for effective behavioral nudges.

Figure 1

Figure 4: Figure 1

Figure 4

Figure 5: Figure 4

Figures

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