Framing effects in intertemporal decision-making within the loss domain affect debt restructuring decision preferences.

Authors: Ma Jiatao, Li Shu, He Guibing, Li Shu, He Guibing

Date: 2025-11-05T00:00:00+00:00

Abstract

Framing effect constitutes a robust phenomenon that violates the axioms of rational decision-making. This study aims to examine whether framing effects exist in intertemporal decision-making within the domain of losses and to explore their potential implications for debt restructuring policy. The findings reveal: (1) For a single option with invariant debt maturity and total amount, different frames significantly influence debtors' acceptance. Compared with high-frequency framing (e.g., weekly payments), low-frequency framing (e.g., annual payments) substantially enhances debtors' acceptance rates; (2) For binary choices with varying debt maturities but constant total amounts, different descriptive frames significantly affect debtors' preferences. Compared with high-frequency framing/conventional timeline, low-frequency framing/compressed timeline leads debtors to prefer the initial debt option with higher interest rates and shorter terms. The observed decision preferences conform to the predictions of the "Graph-edited Equate-to-differentiate Model." This study advances understanding of intertemporal decision-making in the domain of losses, provides a novel tool for the "temporal nudge toolbox," and furnishes psychological science support for debt restructuring policy evaluation and debt management optimization.

Full Text

The Framing Effect of Cross-Period Temporal Choice in the Loss Domain Influences Debt-Swapping Decision Preferences

MA Jia-Tao[1,2]**, LI Shu**[1]**, HE Gui-Bing**[1]
([1] Department of Psychology and Behavioral Sciences, Zhejiang University, Hangzhou 310058, China)

([2] Department of Psychology, Hangzhou Normal University, Hangzhou 311121, China)

Abstract

The framing effect represents a robust phenomenon that violates rational decision-making axioms. This study aims to examine whether the framing effect exists in cross-period temporal choice in the loss domain and explore its potential implications for debt-swapping policy. The findings reveal: (1) For a single debt plan with constant maturity and total amount, different frames significantly influence debtors' acceptance. Compared with high-frequency frames (e.g., weekly payments), low-frequency frames (e.g., annual payments) substantially increase debtors' acceptance; (2) For binary choices between plans with different maturities but constant total debt, descriptive frames significantly affect debtors' preferences. Compared with high-frequency/conventional timeline frames, low-frequency/compressed timeline frames make debtors more inclined to accept the initial debt plan with higher interest rates and shorter duration. Observed decision preferences align with predictions from the Graph-edited Equate-to-differentiate Model. This study initiates understanding of cross-period temporal choice in the loss domain, provides a new tool for the "temporal nudge toolbox," and offers psychological science support for evaluating debt-swapping policies and optimizing debt management.

Keywords: debt swap, loss domain, cross-period temporal choice, framing effect, nudge
Classification Code: B849: C91

1.1 What Is Debt Resolution?

By the end of June 2025, outstanding local government debt in China had reached nearly 52 trillion yuan (Ministry of Finance, 2025), equivalent to the combined GDP of Japan and Germany and exceeding the annual economic output of major world economies. This continuously expanding debt constitutes a significant "gray rhino" risk facing China' s economy. Failure to address it promptly could trigger systemic economic crises and threaten national security (Luo et al., 2017). Debt resolution refers to mechanisms through which governments or enterprises take measures to reduce or eliminate debt burdens, aiming to optimize debt structure and alleviate fiscal pressure. In November 2024, the Standing Committee of the National People' s Congress passed the *Local Government Debt Risk Resolution Plan* (Xinhua News Agency, 2024), involving 12 trillion yuan—the largest debt resolution action in recent years.

Common debt resolution measures include debt swapping, fiscal fund repayment, and introducing social capital. Among these, debt swapping has attracted particular attention due to its priority in the policy system. Its core logic involves issuing new debt with lower interest rates and longer maturities to replace existing high-interest, short-term debt while keeping the principal unchanged (Qiu et al., 2022). For instance, China' s 2015 debt-swapping policy converted government debt with an average maturity of approximately three years into new debt with an average maturity of about six years, effectively extending debt terms (Li et al., 2015). However, debt-swapping policy design contains a theoretical dilemma: although the operation "neither cancels nor reduces the total debt," it expects debtors to develop differentiated preferences between "initial debt plans" and "swapped debt plans." This process essentially requires debtors' decision-making to deviate from the "invariance axiom" in normative theory. Yet existing knowledge has not established a systematic explanatory framework for how debt swapping overcomes this theoretical constraint.

The "Asian disease problem" in risky decision-making research has revealed that individual decisions may violate the invariance axiom (Tversky & Kahneman, 1981). However, academic consensus on the psychological mechanisms underlying such violations remains elusive: whether they stem from "compensatory/alternative-based" strategies (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992) or "non-compensatory/dimensional" strategies (Gigerenzer & Gaissmaier, 2011; Li, 2001) remains controversial (see Luckman et al., 2020 for strategy classification). More importantly, unlike well-studied risky decisions (e.g., the Asian disease problem), debt swapping essentially belongs to the underexplored domain of intertemporal choice. Clearly, knowledge accumulated from risky decision research cannot directly explain how debt swapping in intertemporal contexts changes debt preferences and choices without altering total debt.

Based on this analysis, debt-swapping policy design embodies multiple challenges for behavioral decision research, providing a natural experimental field for testing theories and refining policy tools. This study offers an opportunity to serve national strategic needs while exploring scientific unknowns, which we find deeply motivating. We hope this research can contribute to deepening China' s debt policy research and advancing intertemporal decision theory, providing psychological science support for "preventing and resolving major risks."

1.2 The Framing Effect: Violating the Invariance Axiom

The invariance axiom in decision theory states that different descriptions of the same object should not cause preference changes (Arrow, 1982). Applied to debt contexts, the simplest example treats the "same object" as a "single debt plan." For instance, two descriptive frames for a debt of 120,000 yuan over 10 years:

Annual Payment Frame: Pay 12,000 yuan annually for 10 years.
Monthly Payment Frame: Pay 1,000 yuan monthly for 120 months.

According to the invariance axiom, the annual and monthly frames should elicit identical debt acceptance preferences because both maintain unchanged total debt (120,000 yuan) and unchanged maturity (10 years or by the end of the 10th year)—that is, "neither canceling nor reducing total debt." However, this seemingly logical axiom is frequently violated in reality. Consider these examples:

a) Two frames for "ice' s melting point temperature" :
Celsius Frame: 0°C
Fahrenheit Frame: 32°F

According to the invariance axiom, describing ice' s melting point as 0°C should not feel lower than describing it as 32°F. Yet comedian Joe Wong, in a White House Correspondents' Dinner performance, joked about "quickly solving global warming" by "changing thermometers from Fahrenheit to Celsius," amusing President Biden and other dignitaries[1].

b) Two frames for "seven chestnuts daily" :
Morning-Three-Evening-Four Frame: Three chestnuts in the morning, four in the evening.
Morning-Four-Evening-Three Frame: Four chestnuts in the morning, three in the evening.

According to the invariance axiom, preferences should not differ between frames. However, *Zhuangzi* · *Qiwulun* records that when a monkey keeper said, "Three in the morning and four in the evening," the monkeys were angry; but when he said, "Four in the morning and three in the evening," they were delighted.

These examples and decades of behavioral economics research demonstrate that different descriptions of the same object can reverse preferences, showing the invariance axiom can be violated (e.g., Levin et al., 1998; Levin et al., 2002; Li, 1998; Li et al., 2000). Systematic decision preference changes caused by altered descriptions are called framing effects (Kahneman & Tversky, 1982; Tversky & Kahneman, 1981). In risky decisions, Tversky and Kahneman (1981) found risk aversion with "gain"frames and risk-seeking with "loss"frames. In multi-attribute decisions, describing meat as "75% lean" rather than "25% fat" significantly increases purchase intention (Levin & Gaeth, 1988). Larrick and Soll (2008) found that using GPM (gallons per mile) instead of MPG (miles per gallon) promotes selection of fuel-efficient vehicles. Sun et al. (2012) manipulated the salience of physical attribute differences across graphical representations and found that preferences could be influenced by graphical framing despite unchanged information. Framing effects now have important applications in marketing (Nan et al., 2023), business management (Tang et al., 2020), and serve as a foundation for nudge strategies (Thaler & Sunstein, 2008; He et al., 2018).

Can we apply the framing effect—"changing description without changing facts," a choice architecture that neither restricts freedom nor uses economic levers or administrative commands (Thaler & Sunstein, 2008; Thaler et al., 2014; Thaler, 2021)—to alter debtors'preferences and resolve debt resolution challenges in "promoting stable economic growth" ? This was the focus of the *Acta Psychologica Sinica* 2018 special column "Small Nudges, Big Changes: Behavioral Decision-Making Boosts Social Development" (He et al., 2018; Zhang, 2016), and remains theoretically and practically significant in 2025 (Bonini et al., 2018; Gigerenzer et al., 2018; Sunstein, 2014; Thaler & Sunstein, 2008).

Before attempting to use choice architecture to change debt preferences, researchers face two key unknowns.

1.3 Unknown 1: Framing Effects in Debt-Swapping Problems

The decision structure of debt-swapping problems can be described as converting a single debt plan (e.g., "120,000 yuan over 10 years") into a paired choice between:

Initial Debt Plan: Pay 12,000 yuan annually for 10 years.
Swapped Debt Plan: Pay 1,200 yuan annually for 100 years.

The two plans differ in duration but maintain constant total debt (both require repaying 120,000 yuan). This is the basic fact of "debt swapping." In debt-swapping problems, the concept of the "same object" in the invariance axiom changes structurally. In single debt plans, the "same object" is the plan itself described differently; in debt-swapping problems, the "same object" is the "paired debt plans (10-year vs. 100-year)" considered as a whole requiring different descriptions. When exploring framing effects that "change description without changing facts," we currently know little about whether framing effects operate in "single debt plan" scenarios, nor whether they function in "paired debt plan" scenarios.

1.4 Unknown 2: Framing Effects from "Loss/Time Period" Variables

Although existing research has verified framing effects from textual descriptions in risky and certain decisions (e.g., Li & Adams, 1995; Li & Xie, 2006; Tversky & Kahneman, 1981) and graphical descriptions (Sun et al., 2012), and framing effects exist between intertemporal and spatial decisions (Kang et al., 2025; Kuang et al., 2023), researchers remain unclear whether the specific "loss/time period" variable in "replacing short-term debt with long-term debt" problems generates framing effects. This is because textual descriptions of two plans:

Plan 1 (Initial Debt): Repay 100,000 tons of rice annually for 4 years.
Plan 2 (Swapped Debt): Repay 50,000 tons of rice annually for 8 years.

Or graphical descriptions (see Figure 1 [Figure 1: see original paper]) both point to debt swapping as a special cross-temporal decision that remains underexplored. Specifically: (1) Debt swapping is not a cross-point temporal choice or what classical literature calls "intertemporal choice" (choosing between "smaller-sooner" and "larger-later" options, Frederick et al., 2002; Loewenstein & Prelec, 1992), but rather a cross-period temporal choice (choosing between "larger-shorter" and "smaller-longer" options)[1] (Ma, He, & Li, 2023; 2024). (2) Debt swapping is not in the traditional gain domain (e.g., receiving money) but in the loss domain (e.g., losing money, Shen et al., 2023; Shen et al., 2024; Ma et al., 2021; Sun et al., 2022). Current understanding of "loss/period" cross-temporal decisions remains limited. This dual "loss/period" characteristic prevents traditional intertemporal theories from explaining debt-swapping behavior using known "time discounting" functions like hyperbolic discounting (Frederick et al., 2002).

A study by Ma et al. (2024) on laboratory-derived estimates of time preference predicting real-world behaviors provides empirical support for this theoretical distinction. Following Bartels et al. (2023), they constructed laboratory-derived time preference estimation tasks for gain and loss domains separately, for both cross-point and cross-period temporal choices, and corresponding real-world behavior tasks (detailed in Appendix 1).

The results showed that only when "laboratory-derived time preference estimates" and "real-world behaviors" matched did their measurements show "homogeneous" positive correlations (see the blue diagonal from top-left to bottom-right in Figure 2 [Figure 2: see original paper], where darker blue indicates more positive correlation and darker orange indicates more negative correlation). This confirms that cross-point and cross-period temporal choices are fundamentally different decision types whose predictive validity cannot substitute for each other; decisions in gain versus loss contexts differ essentially, with time preferences under different gain/loss conditions reflecting different decision types. In other words, we cannot expect knowledge accumulated in the gain domain to understand preferences in the loss domain (Ma et al., 2021; Xu et al., 2009), nor can we rely on knowledge from cross-point temporal choices to generalize to cross-period temporal choices (Ma et al., 2023).

Correlation Matrix Heatmap Correlation Matrix Heatmap
-0.19 -0.19 -0.08 -0.08 point_{{{gain}}*{{money}}}* *point*{{{gain}}*{{money}}}* *-0.08 -0.08 -0.09 -0.09 point*{{{loss}}*{{money}}}* *point*{{{loss}}*{{money}}}* *-0.12 -0.12 -0.08 interval*{{{gain}}*{{money}}}* *-0.08 interval*{{{gain}}*{{money}}}* *-0.11 -0.11 -0.06 -0.06 interval*{{{loss}}*{{money}}}* *interval*{{{loss}}*{{money}}}* *point*{{{pure}}*{{gain}}}* *point*{{{pure}}*{{loss}}}* *point*{{{pure}}*{{gain}}}* 点收益点损失段收益段损失 *interval*{{{pure}}*{{gain}}}* *point*{{{pure}}*{{loss}}}* *interval*{{{pure}}*{{loss}}}* *interval*{{{pure}}_{{gain}}}

Laboratory-Derived Time Preference Estimates
Real-World Behaviors

Figure 2. Heatmap of correlation coefficients between "laboratory-derived time preference estimates" and "real-world behaviors" (plotted using data from Ma et al., 2024). Given adequate sample size (N = 1200), all coefficients reached statistical significance; only coefficient values (effect sizes) are shown without additional significance markers.

In summary, debt swapping essentially constitutes a choice problem in the loss domain and cross-period temporal choice—an area that academia has not yet deeply explored. Existing decision theories focus primarily on cross-point temporal choice in the gain domain (traditional intertemporal choice problems), attempting explanation and prediction through exponential discounting models, hyperbolic discounting models, etc., though these theories remain controversial (see Green et al., 1994; Green & Myerson, 2004; Zhang et al., 2022; Liu et al., 2015; Zhang et al., 2018; Zhou et al., 2019). In loss-domain cross-point temporal choice, these theories already show limitations (e.g., inability to explain negative discounting, Sun et al., 2020; Sun et al., 2022); their applicability to cross-period temporal choice is even more restricted, as they cannot calculate discounts for "time periods" using functions that discount by "time points (ti)."

Therefore, this study aims to explore the mechanism of framing effects in the unknown territory of "cross-period temporal choice in the loss domain,"providing theoretical foundations for applying framing effects to debt swapping, thereby guiding or nudging desired debt repayment behaviors.

2 Study 1: Framing Effects in Single Debt Plans

Study 1 investigates whether different descriptions (i.e., different frames) of a single debt plan with "constant debt maturity and total amount" can trigger framing effects.

We propose a hypothesis about the mechanism generating framing effects in cross-period temporal choice: When continuous outcomes across options are identical (or subjectively "equated" as identical, Δ outcome_A,B 0), people in the gain domain tend to choose options where positive outcomes are perceived as lasting longer; whereas in the loss domain (e.g., debt repayment), they prefer options where negative outcomes are perceived as lasting shorter. The "opposite" direction predicted for the loss domain may stem from two psychological mechanisms: (1) "Early departure, early revival" (Sun et al., 2020; Sun et al., 2015); and (2) "Out of debt, out of burden" (Liu et al., 2018). Accordingly, to elicit different debt acceptance preferences across frames, at least one frame must make the "continuous time period" appear longer or shorter than the other.

According to time perception theory (Kim & Zauberman, 2009; Zauberman et al., 2009), subjective time perception does not linearly reflect objective time but follows a concave nonlinear psychophysical function. For example, Zauberman et al. (2009) measured perceptions of future time spans and found a nonlinear mapping between subjective and objective time: "one year" feels shorter than "four consecutive three-month periods." Thus, lower-frequency repayment frames (e.g., annual payments) may make negative outcomes feel relatively shorter, while higher-frequency frames (e.g., monthly or weekly payments) may be perceived as longer, exacerbating aversion to negative events (see time unit effect, Jiang, 2013).

Integrating theoretical analyses of "continuous negative outcome differences" (Δ outcome, i.e., "early departure, early revival," "out of debt, out of burden") and "continuous time period differences" (Δ period, i.e., subjective duration differences from nonlinear time perception), Study 1 hypothesizes: For a single debt plan with constant maturity and total amount, compared with high-frequency frames (e.g., weekly payments, perceived as longer duration), low-frequency frames (e.g., annual payments, perceived as shorter duration) significantly increase decision-makers' acceptance of the debt plan.

To test this hypothesis, this study employs both between-subjects (Study 1a) and within-subject (Study 1b) designs to systematically examine how different repayment frequency frames affect debt acceptance.

2.1.1 Method

This study used a 2 (repayment frequency: annual vs. monthly) × 2 (presentation format: text vs. graphic) between-subjects design. Power analysis via G*Power 3.1 (Faul et al., 2009) with conservative estimates set effect size f at 0.15, significance level α at 0.05, and statistical power at 95%, indicating a minimum required sample size of 175 per condition. Ultimately, 1,200 participants were recruited online through a survey platform (M_{age} = 30.21, SD = 8.05, 861 females, 339 males).

Participants were randomly assigned to one of four groups (text-annual, text-monthly, graphic-annual, graphic-monthly). The task asked participants to imagine repaying a 120,000-yuan debt and rate their acceptance of the plan on a 7-point scale (1 = completely unacceptable, 7 = completely acceptable). The text-annual frame stated: "Pay 12,000 yuan annually for 10 years" ; the text-monthly frame: "Pay 1,000 yuan monthly for 120 months." Graphic frames presented corresponding visualizations (see Appendix 2). All study data are publicly available at https://www.scidb.cn/s/qaAfiy.

2.1.2 Results

A two-way ANOVA revealed significant main effects of presentation format ($F(1, 1196) = 21.33$, $p < 0.001$, $^{2}p = 0.018$) and repayment frequency ($F(1, 1196) = 26.80$, $p < 0.001$, $^{2}p = 0.022$), and a significant interaction ($F(1, 1196) = 4.20$, $p = 0.041$, $^{2}p = 0.003$). Simple effects analysis (see Figure 3 [Figure 3: see original paper]) showed that in the text condition, acceptance was significantly higher for the annual frame (M_{annual} = 5.00, SD = 1.58) than the monthly frame (M_{monthly} = 4.35, SD = 1.83, $F(1, 598) = 26.10$, $p < 0.001$). In the graphic condition, acceptance was also higher for the annual frame (M_{annual} = 5.23, SD = 1.33) than the monthly frame (M_{monthly} = 4.95, SD = 1.42, $F(1, 598) = 4.89$, $p = 0.027$). Additionally, in the monthly frame, graphic presentation yielded significantly higher acceptance than text ($F(1, 598) = 22.22$, $p < 0.001$); in the annual frame, graphic presentation also showed higher acceptance than text, though not significantly ($F(1, 598) = 3.30$, $p = 0.069$).

cond2 Monthly Frame: Pay 1,000 yuan monthly for 120 months month Annual Frame: Pay 12,000 yuan annually for 10 years cond1

Figure 3. Acceptance of debt repayment plans across presentation format (text vs. graphic) and repayment frequency (monthly vs. annual). Lower repayment frequency (annual) yields higher acceptance. * $p < 0.05$; *** $p < 0.001$

These results demonstrate that regardless of text or graphic presentation, acceptance of the same debt plan differs significantly across frames, supporting our hypothesis: when a frame makes negative outcomes appear to "last shorter," people are more likely to accept the described repayment plan.

2.2 Study 1b: Framing Effects in Single Debt Plans—Evidence from Within-Subject Design

To test framing effect robustness under more stringent conditions, Study 1b adopted a within-subject design. This represents an important experimental improvement for two reasons: First, in classic between-subjects designs, significant framing effects might result from large effects on a small subset of participants while having no effect—or opposite effects—on others (Levin et al., 2002). Second, within-subject designs make it easier for participants to recognize that debt plans described with different time frames are essentially the same "constant maturity and total amount" problem. Thus, within-subject design constitutes a "harsher and more unfavorable" test of framing effects (Levin et al., 1987; Stanovich & West, 1998). Additionally, Study 1b added a weekly payment frame to further test robustness and generalizability.

2.2.1 Method

This study used a mixed design with 3 (repayment frequency: annual vs. monthly vs. weekly, within-subject) × 2 (presentation format: text vs. graphic, between-subjects). Based on Study 1a' s effect size, we set $f = 0.15$, $\alpha = 0.05$, power = 95%, requiring at least 388 participants.

The procedure involved three survey waves with balanced order across annual, monthly, and weekly frames. Wave 1 randomly assigned participants to six groups (text-annual, text-monthly, text-weekly, graphic-annual, graphic-monthly, graphic-weekly). Participants imagined purchasing a high-performance computer for 20,000 yuan on installment. Repayment plans were: text-annual: "Pay 10,000 yuan annually for 2 years" ; text-monthly: "Pay 833.3 yuan monthly for 24 months" ; text-weekly: "Pay 192.3 yuan weekly for 104 weeks." Graphic frames corresponded visually (see Appendix 3). Participants rated acceptance on a 7-point scale (1 = completely unacceptable, 7 = completely acceptable). Waves 2 and 3 were released three days apart, maintaining presentation format but rotating repayment frequencies. Ultimately, 403 participants completed all three waves ($M_{age} = 29.06$, $SD = 8.27$, 263 females, 140 males).

2.2.2 Results

A repeated-measures ANOVA with repayment frequency as the within-subject factor and presentation format and order as between-subject factors showed a significant main effect of repayment frequency ($F(2, 794) = 66.22$, $p < 0.001$, $^{2}p = 0.143$) and a significant interaction between presentation format and repayment frequency ($F(2, 794) = 4.34$, $p = 0.013$, $^{2}p = 0.011$). Neither the order $\times$ frequency interaction ($F(4, 794) = 0.30$, $p = 0.879$) nor the three-way interaction ($F(4, 794) = 0.82$, $p = 0.510$) was significant, indicating no order effects. Participants showed significantly higher acceptance in the monthly frame ($t(397) = 7.86$, $p_{holm} < 0.001$, Cohen' s $d = 0.455$) and annual frame ($t(397) = 10.41$, $p_{holm} < 0.001$, Cohen' s $d = 0.675$) compared with the weekly frame, and higher acceptance in the annual frame than the monthly frame ($t(397) = 3.90$, $p_{holm} < 0.001$, Cohen' s $d = 0.220$). Graphic presentation yielded higher acceptance than text ($t(397) = 2.72$, $p_{holm} = 0.007$, Cohen' s $d = 0.197$).

Post-hoc tests across presentation formats (see Figure 4 [Figure 4: see original paper]) revealed that in the text condition, acceptance was significantly higher for the monthly frame ($M_{monthly} = 4.93$, $SD = 1.56$) than the weekly frame ($M_{weekly} = 4.08$, $SD = 1.80$, $t(397) = 7.10$, $p_{holm} < 0.001$, Cohen' s $d = 0.580$), and higher for the annual frame ($M_{annual} = 5.30$, $SD = 1.29$) than both weekly ($t(397) = 9.25$, $p_{holm} < 0.001$, Cohen' s $d = 0.846$) and monthly frames ($t(397) = 3.34$, $p_{holm} = 0.005$, Cohen' s $d = 0.266$). In the graphic condition, acceptance was higher for monthly ($M_{monthly} = 5.13$, $SD = 1.28$) and annual frames ($M_{annual} = 5.38$, $SD = 1.22$) than the weekly frame ($M_{weekly} = 4.65$, $SD = 1.46$, $t(397) = 4.02$, $p_{holm} < 0.001$, Cohen' s $d = 0.331$; $t(397) = 5.49$, $p_{holm} < 0.001$, Cohen' s $d = 0.505$), with annual frame acceptance higher than monthly but not significantly ($t(397) = 2.18$, $p_{holm} = 0.151$, Cohen' s $d = 0.174$).

Time Type Weekly Frame: Pay 192.3 yuan weekly for 104 weeks Monthly Frame: Pay 833.3 yuan monthly for 24 months month Annual Frame: Pay 10,000 yuan annually for 2 years Version

Figure 4. Acceptance of debt repayment plans across presentation format (graphic vs. text) and repayment frequency (weekly vs. monthly vs. annual). As repayment frequency decreases (weekly → annual), acceptance increases. ** $p < 0.01$; *** $p < 0.001$

In summary, even using the harsher within-subject design, Study 1b provides strong support for framing effects. Combined with Study 1a, we conclude that different descriptive frames for a single debt plan with constant maturity and total amount significantly affect acceptance. Specifically, individuals prefer "low repayment frequency" frames (i.e., those perceived as having shorter repayment duration), demonstrating robust framing effects.

3 Study 2: Framing Effects in Paired Debt Plans

Study 2 investigates whether different descriptions (i.e., frames) of binary choices between plans with "different debt maturities but constant total debt" can trigger framing effects. Extending Study 1' s hypothesis: If paired debt plans have identical continuous outcomes (or are subjectively "equated" as identical), then to elicit different preferences, at least one plan must create a perceptually longer or shorter "subjective duration" —perceived duration difference constitutes an important prerequisite for framing effects. This hypothesis aligns with the Graph-edited Equate-to-differentiate Model (GEM) (Sun et al., 2012), which posits that graphical framing effects follow a two-stage process: first, decision-makers edit graphical physical attributes, affecting perceived dimensional differences between options; then, these perceived differences influence final decisions according to equate-to-differentiate principles. In this study, graphical representations involve "time" and "outcome" dimensions in cross-temporal decisions. Based on Study 1' s "non-compensatory/dimensional" analysis of continuous negative outcome differences and continuous time period differences, and GEM' s predictions, we propose that manipulating subjective "continuous time period" perception can produce differential effects in the graphical editing stage, thereby affecting final decisions in the preference selection stage.

To test this hypothesis, Study 2 designed two methods to shorten subjective "continuous time period" perception. The first uses repayment frequency frames similar to Study 1: manipulating high-frequency frames (e.g., monthly) into low-frequency frames (e.g., annual). The second introduces an innovative compressed timeline frame: actively manipulating "equidistant frames" into "compressed, non-equidistant frames" to shape shorter duration perception. These frames are related: the "compressed time" frame corresponds to the "annual payment" frame (producing shorter duration perception), while the "non-compressed time" frame corresponds to the "monthly payment" frame (producing longer duration perception).

Thus, Study 2 hypothesizes: Compared with frames of "longer subjective duration" (e.g., "monthly" or "non-compressed timeline"), individuals in frames of "shorter subjective duration" (e.g., "annual" or "compressed timeline") show higher acceptance of the initial debt plan (higher interest rate, shorter duration). Study 2 also employs between-subjects (Study 2a) and within-subject (Study 2b) designs to systematically test how different time frames affect debt plan preferences.

3.1.1 Method

This study used a one-factor between-subjects design (time frame: monthly vs. annual vs. compressed). Power analysis via G*Power 3.1 (Faul et al., 2009) set effect size f at 0.15, α at 0.05, power at 95%, requiring at least 230 participants per condition. We recruited 900 participants (M_{age} = 30.03, SD =

8.24, 658 females, 242 males).

The task asked participants to imagine repaying a 100,000-yuan debt and choose between two plans (initial vs. swapped). To test repayment frequency framing, we manipulated frequency without changing debt maturity. In the monthly frame, both plans appeared in one graph: initial debt (5% interest, 36-month term) and swapped debt (2% interest, 84-month term). In the annual frame, frequencies were expressed in years: initial debt (5% interest, 3-year term) and swapped debt (2% interest, 7-year term). To test compressed timeline framing, we designed a compressed version based on the monthly frame by compressing common portions and reducing early-month displays to highlight relative later-period lengths—a common method for creating non-equidistant timelines that makes the initial debt line appear shorter without changing maturity, which remained reflected in the graph. Debt plans under each frame are shown in Figure 5 [Figure 5: see original paper] (see Appendix 4). Participants rated acceptance of both plans on a 7-point scale (1 = completely accept initial debt plan, 7 = completely accept swapped debt plan).

RMB (yuan) Initial Debt vs. Swapped Debt
RMB (10k) Initial Debt vs. Swapped Debt
Plan A (Initial Debt-36 months/5% interest)
Plan B (Swapped Debt-84 months/2% interest)
Plan A (Initial Debt-3 years/5% interest)
Plan B (Swapped Debt-7 years/2% interest)
RMB (yuan) Initial Debt vs. Swapped Debt
Plan A (Initial Debt-36 months/5% interest)
Plan B (Swapped Debt-84 months/2% interest)

Figure 5. Paired debt graphs under monthly (a), annual (b), and compressed (c) frames

3.1.2 Results

One-way ANOVA showed a significant main effect of time frame ($F(2, 897) = 5.58$, $p = 0.004$, ${}^2p = 0.012$). As shown in Figure 6 [Figure 6: see original paper], post-hoc tests revealed that compared with the monthly frame ($M_{monthly} = 4.31$, $SD = 2.04$), participants in the annual frame ($M_{annual} = 3.92$, $SD = 2.10$, $t(599) = 2.36$, $p_{holm} = 0.037$, Cohen' s $d = 0.192$) and compressed frame ($M_{compressed} = 3.77$, $SD = 2.04$, $t(599) = -3.23$, $p_{holm} = 0.004$, Cohen' s $d = 0.264$) preferred the "higher interest, shorter duration" initial debt plan.

Figure 6. Acceptance of debt repayment plans across frames. * $p < 0.05$; ** $p < 0.01$

3.2 Study 2b: Framing Effects in Paired Debt Plans—Evidence from Within-Subject Design

Study 2a revealed significant repayment frequency and compressed timeline framing effects using between-subjects design. Study 2b adopted a within-subject design to verify these conclusions under more stringent conditions, separating the two framing effects. Operationally, we extended the "annual/monthly" levels to "monthly/weekly" for repayment frequency framing, and increased the "compression magnitude" for compressed timeline framing.

3.2.1 Repayment Frequency Framing Experiment in Study 2b: Within-Subject Evidence This experiment used a within-subject design. Based on Study 2a' s effect size, we set f = 0.137, α = 0.05, power = 95%, requiring at least 176 participants. The procedure involved two survey waves with balanced monthly/weekly order. In Wave 1, participants were randomly assigned to monthly or weekly conditions, imagining a 100,000-yuan debt with initial and swapped plans (see Figure 7 [Figure 7: see original paper]). The monthly frame featured initial debt (6% interest, 24 months) vs. swapped debt (2% interest, 60 months); the weekly frame featured initial debt (6% interest, 104 weeks) vs. swapped debt (2% interest, 260 weeks). Measurement matched Study 2a (see Appendix 5). Wave 2 was released three days later, with participants switching conditions. Ultimately, 180 participants completed both waves (M_{age} = 29.93, SD = 8.16, 122 females, 58 males).

RMB (yuan) Initial Debt vs. Swapped Debt
RMB (yuan) Initial Debt vs. Swapped Debt
Plan A (Initial Debt-24 months/6% interest)
Plan B (Swapped Debt-60 months/2% interest)
Plan A (Initial Debt-104 weeks/6% interest)
Plan B (Swapped Debt-260 weeks/2% interest)

Figure 7. Repayment frequency frames in Study 2b: Paired debt graphs under monthly (a) and weekly (b) frames

Repeated-measures ANOVA showed a significant main effect of repayment frequency (F(1, 178) = 5.22, p = 0.024, ^{2}p = 0.028) and no significant order $\times$ frequency interaction (F(1, 178) = 0.12, p = 0.726), indicating no order effects. Post-hoc results (see Figure 8 [Figure 8: see original paper]) revealed that compared with the weekly frame (M_{weekly} = 4.88, SD = 1.84), participants in the monthly frame (M_{monthly} = 4.59, SD = 1.93, t(178) = 2.28, p_{holm} = 0.024, Cohen' s d = 0.153) preferred the "higher interest, shorter duration" initial debt plan.

Figure 8. Acceptance of debt repayment plans across frames. * $p < 0.05$

3.2.2 Compressed Timeline Framing Experiment in Study 2b: Within-Subject Evidence This experiment used a within-subject design. Based on Study 2a' s compression effect size, we set f = 0.190, α = 0.05, power = 95%, requiring at least 92 participants. Participants completed two waves with balanced normal/compressed order. Wave 1 randomly assigned participants to normal or compressed conditions, imagining a 100,000-yuan debt with initial and swapped plans (see Figure 9 [Figure 9: see original paper]). We manipulated line compression magnitude without changing debt maturity: initial debt was always 24 months at 6% interest; swapped debt was 60 months at 2% interest. Measurement matched Study 2a (see Appendix 6).

RMB (yuan) Initial Debt vs. Swapped Debt
RMB (yuan) Initial Debt vs. Swapped Debt
Plan A (Initial Debt-24 months/6% interest)
Plan B (Swapped Debt-60 months/2% interest)
Plan A (Initial Debt-24 months/6% interest)
Plan B (Swapped Debt-60 months/2% interest)

Figure 9. Compressed timeline frames in Study 2b: Paired debt graphs under normal (a) and compressed (b) frames

The survey distribution matched the repayment frequency experiment. Ultimately, 180 participants completed both waves (M_{age} = 29.88, SD = 8.19, 108 females, 72 males). Repeated-measures ANOVA showed no significant order × frequency interaction ($F(1, 178) = 3.89$, $p = 0.050$) but a significant main effect of frequency ($F(1, 178) = 20.68$, $p < 0.001$, $^{2}p = 0.104$). Post-hoc results (see Figure 10 [Figure 10: see original paper]) showed that compared with the normal frame (M_{normal} = 4.56, SD = 1.97), participants in the compressed frame (M_{compressed} = 3.93, SD = 1.98, $t(178) = 4.55$, p_{holm} < 0.001, Cohen' s d = 0.318) preferred the "higher interest, shorter duration" initial debt plan.

Figure 10. Acceptance of debt repayment plans across frames. *** $p < 0.001$

In summary, Study 2 found robust compressed timeline and repayment frequency framing effects: (1) Compared with conventional timeline frames, compressed timeline frames increase acceptance of shorter-duration debt; (2) Compared with high-frequency frames, low-frequency frames increase acceptance of shorter-duration debt. The commonality between these frames is that compressed timeline frames serve as "visual equivalents" of low-frequency frames, both making debt repayment "subjectively shorter" and thereby increasing acceptance of short-term debt.

From an applied perspective, compressed timeline framing holds greater potential. On one hand, it breaks fixed frequency limitations and flexibly manipulates "continuous time period" perception; on the other hand, as compression magnitude increases, individual preferences may even show strict choice reversal (Li, 2005), shifting from accepting swapped plans to accepting initial plans.

4 General Discussion

As debt resolution plans penetrate local governments and broadly impact socioeconomic conditions and households, this study explored framing effects in cross-period temporal choice in the loss domain through five experiments, yielding two core findings: First, different descriptions of the same single debt plan significantly affect individuals' acceptance of repayment plans; second, different descriptions of the same paired debt plans significantly affect preferences between initial and swapped debt. This study is the first to reveal repayment frequency and compressed timeline framing effects in loss-domain cross-period temporal choice, providing an important starting point for this field. The findings support the applicability of equate-to-differentiate theory, particularly the Graph-edited Equate-to-differentiate Model, in cross-period temporal choice. Overall, this research enriches intertemporal decision theory and provides practical "small nudges, big changes" strategies for national debt resolution policies and personal debt management, offering significant theoretical contributions and real-world implications.

4.1 Loss-Domain Cross-Period Temporal Choice and Mechanism Exploration

Traditional intertemporal decision research has focused on cross-point temporal choice in the gain domain. This study expands to cross-period temporal choice in the loss domain, providing methodological exemplars and discovering robust frequency and compressed timeline framing effects. Current utility-comparison models based on cross-point, compensatory, alternative-based approaches (see Kuang et al., 2023) cannot readily explain choice preferences under these newly discovered framing effects. However, these invariance axiom violations can be post-hoc explained by equate-to-differentiate theory applicable to risky, intertemporal, and spatial decisions (Li, 1994; 2016; Huang et al., 2023). Research (Jiang et al., 2016; Geng et al., 2023) has shown that in cross-point temporal choice (traditional intertemporal choice), people trade off differences between time points (Δ_{point}) and outcome differences ($\Delta_{outcome}$). In cross-period temporal choice, people may similarly follow equate-to-differentiate principles (Ma, 2025), substituting time period differences (Δ_{period}) for time point differences (Δ_{point}), thereby trading off period differences (Δ_{period}) and continuous outcome differences ($\Delta_{outcome}$).

Thus, our framing effects can be explained by integrating time perception theory and equate-to-differentiate theory. Manipulating repayment frequency or timeline compression changes individuals' perception of "continuous time periods," significantly affecting debt preferences. This mechanism reveals the operational path for nudging strategies: (1) To nudge initial debt repayment behavior (beneficial but counterintuitive), use framing effects to "equate" (subjectively minimize) differences in the "continuous outcome" dimension ($\Delta_{outcome}$) between initial and swapped plans. This leads people to choose the plan with shorter loss (repayment) duration on the most different "continuous time period" dimension—the "higher interest, shorter duration" initial plan. (2) To nudge swapped debt repayment behavior (reducing debt costs and fiscal pressure), "equate" differences in the "continuous time period" dimension (Δ_{period}). This leads people to choose the plan with smaller loss (repayment) outcomes on the most different "continuous outcome" dimension—the "lower interest, longer duration" swapped plan.

This study reveals key principles of debt repayment decisions, summarized in nudge tool manual language: The longer the described loss (repayment) period, the stronger the aversion to that plan. Following this principle, policymakers can promote desired repayment behaviors through temporal dimension adjustments.

4.2 Innovative Implications of the "Compressed Timeline" Method

This study' s "compressed timeline" manipulation offers methodological innovation for temporal framing research. Digital visualization technology enables flexible manipulation of temporal information presentation. Longer historical spans and larger datasets increase the need for non-equidistant timeline compression in limited space. For example, 200+ years of U.S. GDP changes can use "equidistant timeline frames" (see left side of Figure 11), while 2,000+ years of world GDP changes require digital visualization with "non-equidistant timeline frames" (see right side of Figure 11 [Figure 11: see original paper]). With digital technology proliferation, such "non-equidistant" compression methods have become increasingly diverse and accepted by the public.

Figure 11. Left: U.S. GDP changes using "equidistant timeline frame" ; Right: World GDP changes using "non-equidistant timeline frame" (source: https://howmuch.net/)

Our results show that following the Graph-edited Equate-to-differentiate Model, we can actively use "time compression" to describe loss (repayment) periods as desired longer or shorter durations, creating differential perceptions and preferences for initial versus swapped debt plans.

Thus, the framing effects revealed in this study—especially compressed timeline framing—show high application potential in fintech, policy communication, and health management fields that handle massive temporal data. This discovery adds low-cost, easy-to-implement tools to the behavioral nudge toolkit. Particularly in today' s digital wave, our flexible temporal information presentation strategies open new avenues for policymakers: through careful timeline frame design and optimization, they can significantly influence public policy understanding and acceptance. This strategy requires no economic incentives or coercive measures, merely improving information architecture to effectively help people make better decisions.

4.3 Limitations and Future Directions

To construct experimental tasks for framing effect research, this study necessarily abstracted complex real-world factors. In actual debt decisions, capital liquidity, opportunity cost perception, and macroeconomic environments may affect repayment preferences. Moreover, real repayment decisions often involve details like beginning-of-period vs. end-of-period payments that could be influential. Future research should measure and manipulate these real-world debt factors and conduct field experiments in authentic debt contexts to differentiate and identify various influencing mechanisms.

In Study 2, experimental materials used simple interest calculations common in local government and mortgage debt scenarios. However, since instructions did not explicitly state this, participants might have misunderstood the calculation method (e.g., assuming compound interest), affecting their judgment of the "constant total debt" premise. Despite this potential ambiguity, it does not affect our core conclusions for three reasons: First, the direction of framing effects remained consistent across studies, suggesting independence from numerical calculation differences. Second, graphical presentation prevented participants from discerning "simple vs. compound interest" subtleties. Third, within-subject designs controlled for individual differences (e.g., calculation method comprehension). Future studies should explicitly state calculation methods. Appendix 7 supplements debt calculation processes and actual totals for each sub-study, ensuring transparency and replicability.

Mechanism validation and theoretical model comparison constitute crucial future directions. At the mechanism level, this study used equate-to-differentiate theory to explain framing effects, but empirical testing remains needed. Future research should employ more ecologically valid designs, combined with time perception measurements and neuroimaging, to systematically reveal nonlinear time perception characteristics and their mechanisms in cross-period temporal choice. For theoretical comparison, future studies should systematically compare traditional discounting theories applicable to cross-point temporal choice with equate-to-differentiate theory in cross-period contexts, particularly examining explanatory power in "mixed point-period decision" scenarios. For example, Aesop' s fable *The Goose That Laid the Golden Eggs* describes an intertemporal choice involving both "time point" (kill the goose tomorrow) and "time period" (receive a golden egg daily) options. Analyzing such composite decisions can systematically evaluate different theoretical frameworks regarding applicable boundaries, predictive accuracy, and explanatory mechanisms, laying foundations for integrating intertemporal decision theories.

The compressed timeline framing effect discovered in Study 2 represents an important innovation. Future research should explore its cognitive basis and psychological mechanisms from multiple angles. Methodologically, mathematical modeling can characterize subjective time perception functions, while eye-tracking can directly measure attention distribution patterns. Experimentally, systematically manipulating graphical parameters like x-axis interval density, axis scaling, and color contrast can test framing effect robustness, GEM mechanisms, and boundary conditions, providing more psychological science support for policy implementation.

The debt amounts in this study differ from real government debt scales of hundreds of millions, representing a limitation. Although framing effects as stable cognitive biases exist across amount levels—e.g., date/delay framing effects verified at ten-thousand-yuan levels (Jiang et al., 2016) and hundred-yuan levels (Read et al., 2005)—psychological representation differences across amount magnitudes may moderate framing effects. Future research should examine framing effects across different amount scales.

However, viewing this "debt amount magnitude"limitation from another perspective highlights broader application prospects. Chinese residents' debt burdens have reached alarming levels. According to the National Institute for Finance & Development (2024), by Q2 2024, household leverage reached 63.5%, with total household debt of approximately 86 trillion yuan and per capita debt of 60,800 yuan. Combined with National Bureau of Statistics (2025) data showing 2024 per capita disposable income of 41,314 yuan, the household debt-to-income ratio has reached 147%, far exceeding internationally recognized safety thresholds. Mortgage-bearing families face particularly severe pressure, with many confronting daunting repayment challenges in the short term. This stark reality underscores the universal practical significance of our research on debt problems—debt issues concern not only minority groups (e.g., government officials making debt resolution decisions) but relate to most social members' daily decisions.

In conclusion, this study systematically reveals repayment frequency and compressed timeline framing effects in loss-domain cross-period temporal choice for the first time, providing new tools with theoretical significance and practical value for "nudging farsighted behavior" that promotes social development (He et al., 2018; Zhang & Li, 2018). To existing nudge toolkits including background music (Zhou et al., 2022), ambient lighting (Geng et al., 2023), Buddhist venues (Wang et al., 2023), and token incentives (Jiang et al., 2025), we add an effective tool: framing effects in loss-domain cross-period temporal choice. Practical applications include: (1) Debt policy evaluation: providing psychological science for optimizing debt-swapping policies and designing more effective debt management; (2) Nudging repayment behavior: using framing effects to guide governments, enterprises, and individuals toward more reasonable debt choices, reducing irrational decision risks; (3) Social credit construction: providing choice architecture for designing debt default risk prevention mechanisms, promoting social credit system development.

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Appendix 1: Laboratory-Derived Time Preference Estimates and Real-World Behaviors

Laboratory-Derived Time Preference Estimates
Real-World Behaviors

Gain Domain Cross-Point

Receive 700 yuan immediately vs. receive 840 yuan in 12 months

Due to company financial constraints, two bonus payment options: (1) Employees receive the usual ~800 yuan bonus this month; (2) Company delays payment, employees receive 10% more bonus after 12 months.

Loss Domain Cross-Point
Lose 700 yuan immediately vs. lose 840 yuan in 12 months
A colleague plans to purchase a ~3,000-yuan item with two payment methods: (1) Cash payment (full payment now); (2) Credit card payment (future payment with interest).

Gain Domain Cross-Period
Receive 400 yuan daily for 50 days vs. receive 120 yuan daily for 200 days
An employee with 8,000-yuan monthly salary faces overseas assignment with two branch options: (1) Work half-year at branch with 18,000-yuan monthly salary; (2) Work one year at branch with 16,000-yuan monthly salary.

Loss Domain Cross-Period
Lose 400 yuan daily for 50 days vs. lose 120 yuan daily for 200 days
A colleague faces two installment repayment options: (1) Pay 2,100 yuan monthly for 3 months; (2) Pay 280 yuan monthly for 24 months.

Appendix 2: Study 1a Materials

Imagine you have a 120,000-yuan debt to repay. Please use a number between 1-7 to indicate your acceptance of the following repayment plan (1 = completely unacceptable; 7 = completely acceptable).

Text Frame Section
1) Text-annual frame: Pay 12,000 yuan annually for 10 years
2) Text-monthly frame: Pay 1,000 yuan monthly for 120 months

Graphic Frame Section
1) Graphic-annual frame:
RMB (10k) Debt Repayment Plan (10k/year)
Installment amount per period
Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10

2) Graphic-monthly frame:
   RMB (yuan) Debt Repayment Plan (yuan/month)
   Installment amount per period

Appendix 3: Study 1b Materials

Imagine you are considering purchasing a high-performance computer on installment with a total repayment of 20,000 yuan. Please use a number between 1-7 to indicate your acceptance of the following repayment plan (1 = completely unacceptable; 7 = completely acceptable).

Text Frames:
1) Text-weekly frame: Pay 192.3 yuan weekly for 104 weeks.
2) Text-monthly frame: Pay 833.3 yuan monthly for 24 months.
3) Text-annual frame: Pay 10,000 yuan annually for 2 years.

Graphic Frames:
1) Graphic-annual frame:
RMB (10k) Debt Repayment Plan (10k/year)
Installment amount per period

2) Graphic-monthly frame:
   RMB (yuan) Debt Repayment Plan (yuan/month)
   Installment amount per period

3) Graphic-weekly frame:
   RMB (yuan) Debt Repayment Plan (yuan/week)
   Installment amount per period

Appendix 4: Study 2a Materials

Imagine you have a 100,000-yuan debt to repay, with two repayment plans (Initial Debt Plan A and Swapped Debt Plan B) to choose from, as shown below. Please use a number between 1-7 to indicate your acceptance of the two plans (1 = completely accept Plan A; 7 = completely accept Plan B).

In the figure, blue represents Initial Debt Plan A; red represents Swapped Debt Plan B; the x-axis shows repayment time; the y-axis shows repayment amount.

1) Monthly frame:
   RMB (yuan) Initial Debt vs. Swapped Debt
   Plan A (Initial Debt-36 months/5% interest)
   Plan B (Swapped Debt-84 months/2% interest)

2) Annual frame:
   RMB (10k) Initial Debt vs. Swapped Debt
   Plan A (Initial Debt-3 years/5% interest)
   Plan B (Swapped Debt-7 years/2% interest)

3) Compressed frame:
   RMB (yuan) Initial Debt vs. Swapped Debt
   Plan A (Initial Debt-36 months/5% interest)
   Plan B (Swapped Debt-84 months/2% interest)

Appendix 5: Repayment Frequency Framing Materials in Study 2b

Imagine you have a 100,000-yuan debt to repay, with two repayment plans (Initial Debt Plan A and Swapped Debt Plan B) to choose from, as shown below. Please use a number between 1-7 to indicate your acceptance of the two plans (1 = completely accept Plan A; 7 = completely accept Plan B).

In the figure, blue represents Initial Debt Plan A; red represents Swapped Debt Plan B; the x-axis shows repayment time; the y-axis shows repayment amount.

1) Monthly frame
   RMB (yuan) Initial Debt vs. Swapped Debt
   Plan A (Initial Debt-24 months/6% interest)
   Plan B (Swapped Debt-60 months/2% interest)

2) Weekly frame
   RMB (yuan) Initial Debt vs. Swapped Debt
   Plan A (Initial Debt-104 weeks/6% interest)
   Plan B (Swapped Debt-260 weeks/2% interest)

Appendix 6: Compressed Timeline Framing Materials in Study 2b

Imagine you have a 100,000-yuan debt to repay, with two repayment plans (Initial Debt Plan A and Swapped Debt Plan B) to choose from, as shown below. Please use a number between 1-7 to indicate your acceptance of the two plans (1 = completely accept Plan A; 7 = completely accept Plan B).

In the figure, blue represents Initial Debt Plan A; red represents Swapped Debt Plan B; the x-axis shows repayment time; the y-axis shows repayment amount.

1) Normal frame
   RMB (yuan) Initial Debt vs. Swapped Debt
   Plan A (Initial Debt-24 months/6% interest)
   Plan B (Swapped Debt-60 months/2% interest)

2) Compressed frame
   RMB (yuan) Initial Debt vs. Swapped Debt
   Plan A (Initial Debt-24 months/6% interest)
   Plan B (Swapped Debt-60 months/2% interest)

Appendix 7: Debt Calculation Details

Study 1 used direct amount descriptions, strictly following the constant total debt principle. In Study 1a, both annual and monthly frames totaled 120,000 yuan; in Study 1b, all plans totaled ~20,000 yuan (specifically: annual 20,000 yuan; monthly and weekly 19,999.2 yuan). Notably, despite weekly and monthly frames having slightly smaller totals in Study 1b, annual frame acceptance remained highest, further verifying framing effect robustness.

Study 2 used interest rate + term descriptions with simple interest calculation (common for local government and mortgage debt). To ensure strict experimental control, Study 2 maintained consistent debt parameters across frames. For example, Study 2a’ s annual frame was constructed by summing 12-month payments from the monthly frame, ensuring identical total debt across frames.

All specific values are detailed in Supplementary Table 2 . These minor numerical differences do not affect conclusions because: (1) Difference magnitude is minimal with negligible visual impact; (2) Effect direction remains consistent across all conditions; (3) Within-subject designs ensured consistent participant understanding.

Supplementary Table 2. Total Debt Amounts and Calculation Details Across Studies

Study	Frame Type	Specific Plan	Total (yuan)
Study 1a	Annual frame	Pay 12,000 yuan annually for 10 years	120,000
	Monthly frame	Pay 1,000 yuan monthly for 120 months	120,000
Study 1b	Annual frame	Pay 10,000 yuan annually for 2 years	20,000
	Monthly frame	Pay 833.3 yuan monthly for 24 months	19,999.2
	Weekly frame	Pay 192.3 yuan weekly for 104 weeks	19,999.2
Study 2a	Initial debt	5% interest, 36 months/3 years	107,708
	Swapped debt	2% interest, 84 months/7 years	112,750
Study 2b-Monthly	Initial debt	6% interest, 24 months	106,250
	Swapped debt	2% interest, 60 months	105,080
Study 2b-Weekly	Initial debt	6% interest, 104 weeks	105,012
	Swapped debt	2% interest, 260 weeks	103,806
Study 2b-Compressed	Initial debt	6% interest, 24 months	106,250
	Swapped debt	2% interest, 60 months	105,080

[1] See https://www.pinghe.com/study/Oral/speech/2016-12-11/313.html

Note: Figure translations are in progress. See original paper for figures.