

Temporal Choices in Prison: A Preliminary Exploration of the Psychological Characteristics of Inmates' Decision-Making*

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Abstract

Understanding the behavioral decision-making mechanisms of incarcerated individuals is crucial for crime prevention and correction. Through three studies, this paper preliminarily examined differences and associations between incarcerated individuals and the general population in death-related thoughts, subjective life expectancy, risk propensity, zero-outcome sensitivity, and intertemporal decision-making. Study 1 compared incarcerated individuals and the general population on decision-related variables and found that incarcerated individuals showed a stronger preference for immediate rewards, higher risk propensity in domains such as safety, cooperation and competition, and morality, and lower levels of both death-related thoughts and subjective life expectancy than the general population. Study 2 indicated that incarcerated individuals were more sensitive to expected outcomes involving zero gains, which may further strengthen their preference for immediate rewards. Based on this, the present study attempted to conceptualize and quantify “zero-outcome sensitivity” as an indicator for distinguishing groups and individuals with different traits, and constructed a moderated mediation model in Study 3 to explore its deeper mechanisms. The results suggest a nonlinear relationship between death-related thoughts and subjective life expectancy moderated by risk propensity, which in turn is associated with intertemporal decision-making and zero-outcome sensitivity; this moderation pattern was more pronounced in the sample of incarcerated individuals. These findings may provide empirical references for individual assessment of incarcerated individuals, prediction of criminal risk, and the development of more effective correctional measures.

Full Text

Temporal Choices in Prison: A Preliminary Exploration of the Psychological Characteristics of Inmates’ Decision-Making*

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Abstract Understanding the behavioral decision-making mechanisms of inmates is crucial for crime prevention and correction. Through three studies, this article preliminarily examines the differences and associations between prison inmates and the general population in death thoughts, subjective life expectancy, risk propensity, zero-outcome sensitivity, and intertemporal decision-

making. Study 1 compared inmates and the general population on decision-related variables and found that inmates showed a stronger preference for immediate rewards, higher risk propensity in domains such as safety, cooperation/competition, and morality, and lower levels of both death thoughts and subjective life expectancy than the general population. Study 2 suggests that inmates are more sensitive to expected outcomes involving zero gains, which may further strengthen their preference for immediate rewards. On this basis, the present research attempts to conceptualize and quantify “zero-outcome sensitivity” as an indicator for distinguishing groups and individuals with different traits, and in Study 3 constructs a moderated mediation model to explore its deeper mechanisms. The results suggest that death thoughts and subjective life expectancy exhibit a nonlinear relationship moderated by risk propensity, which is further associated with intertemporal decision-making and zero-outcome sensitivity; this moderating pattern is more pronounced in the inmate sample. These findings may provide empirical reference for individual assessment of inmates, prediction of criminal risk, and the development of more effective correctional measures.

Keywords crime, intertemporal decision-making, risk propensity, death thoughts, subjective life expectancy, zero-outcome sensitivity

1 Introduction

Criminal behavior is viewed as a choice made by individuals after weighing potential benefits against possible costs (Cornish & Clarke, 1986), but this perspective often overlooks the internal psychological characteristics of criminal decision-makers. In reality, many criminal decisions display a kind of “myopia” toward long-term consequences (Madon et al., 2013), that is, a stronger preference for immediate small rewards while neglecting larger delayed benefits. This phenomenon is essentially a problem of intertemporal choice, namely how individuals weigh gains and losses occurring at different points in time (Loewenstein et al., 2003).

When performing intertemporal decision-making tasks, individuals’ perception of time is affected by environmental uncertainty. The isolation and uncertainty of the prison environment weaken individuals’ psychological sensitivity to the future, causing their mental horizon to become more confined to the present (Varghese et al., 2014).

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From this perspective, individuals become especially sensitive to the potential outcomes of each choice, particularly those outcomes that imply “nothing gained despite effort.”

For example, expectations of a “zero” outcome are no longer psychologically neutral; rather, they are often perceived as a loss, thereby triggering a motivation to avoid zero outcomes. If weighing the future is a matter of time, and the perception of “zero” is a matter of value judgment, then death-related thinking is the key factor linking the two. In the prison context, social isolation, restricted freedom, and uncertainty about the remainder of life may intensify survival anxiety and death anxiety, thereby exacerbating temporal short-sightedness and the tendency to avoid ending up with nothing.

1.1 Intertemporal Decision Making among Incarcerated Individuals

The earliest intertemporal phenomenon to attract economists’ attention was the discovery that, when decision makers face choices across time, they tend to prefer options with immediate outcomes, even when future returns are more substantial (O’ Donoghue & Rabin, 1999). To quantitatively analyze decisions at different time points at the psychological level, scholars introduced the concept of “time discounting.” It refers to the discounting or depreciation in subjective value that occurs because future rewards are delayed in time, and it is a key indicator for measuring individual impulsivity and self-control (Frederick et al., 2002; Kirby et al., 1999). In line with another body of research showing that time discounting may be mutually causal with criminal behavior (Lee et al., 2017), delay discounting is also closely associated with gambling behavior in prison (Smith et al., 2022): incarcerated individuals are more inclined to choose immediate gambling rewards while neglecting longer-term negative consequences.

However, evaluating the future does not concern time alone. Delay itself carries an inherent risk—the future reward may fail to materialize because of various variables and thus involves uncertainty (Frederick et al., 2002). Therefore, to fully understand “short-sightedness” in intertemporal decision making, it is necessary to examine how individuals evaluate and respond to risk. Risk-taking propensity refers to the extent to which an individual is willing to engage in risky activities. Studies have shown that incarcerated individuals are highly sensitive to risky situations, and this sensitivity in turn affects their risk evaluations of different options in intertemporal decision making (Houser et al., 2019). Risk-taking propensity among different types of offenders shows domain specificity (Wang et al., 2009; Weber et al., 2002); that is, individuals exhibit different risk tendencies across contexts such as finance, safety, morality, and sexual relationships (Harer & Langan, 2001; Ryder, 2017; Lahn, 2005; Smith et al., 2022; Marshall, 2018). This decision-making tendency is closely related to personality traits such as sensation seeking, jointly forming an individual’s distinctive pattern of risk behavior.

Delay discounting manifested in intertemporal decision making, together with individuals' risk-taking propensity under uncertainty, constitutes two basic dimensions for understanding individual decision-making behavior. Both are associated with higher-order self-regulation ability and impulsivity traits (Kirby et al., 1999). Therefore, the present study examines these two dimensions simultaneously in order to provide a more comprehensive portrait of the decision-making characteristics of incarcerated individuals.

Risk-taking propensity not only reflects "what" an individual chooses, but also affects "how" the individual views the world. The Cognitive-Affective Processing System (CAPS) theory holds that individuals' stable dispositions can serve as an "orienting framework" that systematically influences how they process other psychological information, such as beliefs, emotions, and cognition (Mischel & Shoda, 1995). This study analyzes intertemporal decision making as the core dependent variable, while also examining how risk-taking propensity, as a core personality trait, influences individuals' intertemporal decisions, and explores the characteristics of different groups on these two variables. In subsequent mechanistic analyses, we will further test the moderating role played by risk-taking propensity. The present study proposes:

H1: Incarcerated individuals differ significantly from the general population in intertemporal decision-making behavior and in risk propensities across different domains.

1.2 Context and Mindset: The Special Role of "Zero" in Decision-Making

1.2.1 The "Zero-Gain Effect" : The Influence of Decision Frames on Incarcerated Individuals

After identifying differences in incarcerated individuals' basic decision-making traits, understanding the mechanisms through which these differences arise becomes the next focus of inquiry. Decision-making does not occur in a vacuum; it is highly susceptible to the influence of contextual framing. Given that incarcerated individuals are long-term residents of a special environment of "deprivation," their perceptions of and responses to a state of "zero gain" may differ significantly from those of the general population. Therefore, this study takes the "zero-gain effect" as a specific point of entry to explore how the wording of decision frames, as an external factor, influences incarcerated individuals' intertemporal choices.

In intertemporal decision-making, "zero," as a state of no gain or no loss, is an important reference point for decisions (Davidai & Tepper, 2023). Studies have shown that "zero" has a special psychological effect in decision-making: its presence or absence influences people's perceptions of risk and their choices. An explicitly labeled "zero-gain" option is very likely to be interpreted by individuals as a certain state of "getting nothing" or as a potential "loss," thereby being as-

signed excessive psychological weight and ultimately affecting the final decision (Fan et al., 2022; Reyna et al., 2021). This effect may be even more pronounced among incarcerated individuals. When facing uncertainty, their low self-control and high impulsivity, combined with the negative emotions brought about by long-term deprivation, may make them especially sensitive to the prospect of “gaining nothing” (Heath & Tversky, 1991; Loewenstein et al., 2001).

Among the general population, making the zero gain hidden within an option explicit can induce cognitive trade-offs and reduce preference for immediacy (Magen et al., 2008). This effect stems from asymmetric subjective opportunity costs: an explicit “zero” makes individuals notice the previously overlooked opportunity cost of impulsiveness, thereby triggering more rational cognitive trade-offs (Read et al., 2017; Shen et al., 2019). However, we infer that this effect may be reversed among incarcerated individuals who have long been in a state of resource deprivation; their decisions are more likely to be driven by immediate negative feelings (Loewenstein et al., 2001). At this point, an explicit “zero” is no longer merely cognitive information, but a strong affective cue that triggers the perception of certain loss. To avoid gaining nothing, people will quickly lock onto any certain gain and choose the immediate option. Accordingly, we propose the following hypothesis:

H2: Under a framing that emphasizes “zero gain,” incarcerated individuals’ preference for immediacy is significantly higher than that of the general population.

1.2.2 “Zero-Outcome Sensitivity” : From Contextual Effects to Individual Traits

The “zero-gain effect” reveals the significant influence of decision frames on incarcerated individuals’ behavior, but this is more an eliciting effect of the external context; behind it there may be more stable individual psychological differences. This study attempts to move from effect to trait and explain the concept of “zero-outcome sensitivity,” which refers to the special cognitive and emotional sensitivity, as well as behavioral avoidance tendency, that individuals display when facing potential outcomes of “getting nothing” or “effort coming to nothing.”

Prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992) takes the status quo as the reference point and emphasizes loss aversion and the general avoidance of losses. Tri-reference point theory (Wang & Johnson, 2012; Wang Xiaotian & Wang Peng, 2013) takes the task bottom line as the reference point and emphasizes failure aversion and the general avoidance of failure. Both decision theories suggest that, when making decisions, people facing possible success,

failures, gains, and losses, making the “zero outcome” an important indicator for weighing different options. Zero-outcome sensitivity reflects the intensity with which an individual perceives “zero” as a decision-making indicator. Imprison-

ment itself constitutes a persistent state of “absence” : incarcerated persons lose freedom, normal social relationships, and a sense of control over the future. Against this background, the outcome of “zero” fits the existential condition of incarcerated persons. Echoing the sense of “nothingness” described by the existentialist philosopher Sartre, the concept of “zero-outcome sensitivity” can, at the operational level, capture the distinctive psychological response that arises from existential anxiety when individuals face the possibility that their efforts may be futile.

At the decision-making level, an individual with high “zero-outcome sensitivity” will show lower tolerance for uncertainty in future returns. Because the future may yield nothing at all, immediate returns become the only certain option for avoiding this “risk of zero,” which directly strengthens the tendency toward immediate gratification in intertemporal decision-making. Thus, individuals who are highly sensitive to “zero outcomes” place greater weight on immediate benefits; to avoid the potential of “gaining nothing,” they are more likely to prefer immediate rewards in intertemporal decisions. Sensitivity to and avoidance of zero outcomes therefore constitute a distinctive decision-response pattern among incarcerated persons.

1.3 An Integrated Model of Existential Mindset, Risk Propensity, and Decision-Making Mechanisms

Zero-outcome sensitivity reveals the proximal response pattern of incarcerated persons when they face futility, but its causes remain unclear. Is there a deeper psychological root that gives incarcerated persons a fundamentally different perception of the concepts of “zero” or “nothingness” ? We speculate that this surface-level decision sensitivity stems from a more fundamental structure of temporal perception—namely, awareness of the finitude of life. By depriving individuals of freedom, isolating them from society, and amplifying the uncertainty of their remaining lives, the prison environment constantly reminds incarcerated persons of the accessibility of death (Pyszczynski et al., 1999). This existential mindset further shapes the temporal framework of individual decision-making and may be the common psychological root underlying zero-outcome sensitivity and myopia in intertemporal decision-making. In addition, individuals’ affective response pattern to uncertain situations—that is, risk propensity—may moderate the strength of the above pathway. This section constructs an integrated model to explore the complex psychological mechanisms behind the decision-making patterns of incarcerated persons.

1.3.1 The Deep Influence of Existential Mindset: Death Thought and Subjective Life Expectancy Death thought refers to an individual’ s cognitive and affective responses to the finitude of one’ s own life. Accordingly, this study operationally defines it as the product of the frequency of death thought and the intensity of emotional response, in order to comprehensively reflect the individual’ s internal experience of death thought. Specifically, the

more frequently one thinks about death and the stronger the accompanying fear, the greater its psychological effect. Thinking about death may prompt individuals to seek immediate meaning and a sense of value to counter existential anxiety, thereby altering their decision preferences (Pyszczynski et al., 2005). Long-term imprisonment, meanwhile, can make incarcerated persons more pessimistic about the future and generate death-related negative emotions (Cohen & Taylor, 1972). It can therefore be inferred that, in a highly uncertain prison context, frequent death thought intensifies the sense that the future is uncontrollable and magnifies the psychological cost of possibly gaining nothing in the future; this motivation to avoid potential losses also promotes a preference for immediate rewards.

Closely related to death thought is subjective life expectancy. It refers to an individual's estimate of the length of their remaining life and is the most direct expression of an individual's perception of future time, fundamentally shaping the temporal framework of their decisions (Wang et al., 2019, 2022, 2024). Previous research (Wang et al., 2009) found that individuals' subjective life expectancy is negatively correlated with risk propensity. Given the high-risk characteristics of criminal behavior and the unpredictability of the prison environment, incarcerated persons may have shorter subjective life expectancy. Future Time Perspective (FTP) theory holds that individuals with lower life expectancy are more inclined to focus on short-term benefits (Carstensen et al., 1999). [[unclear: the next sentence begins with the visible character “相,” but the remainder is not visible on this page]]

Conversely, when individuals establish an emotional connection with a vivid, concrete “future self,” they are more inclined to pursue long-term goals and development (Hershfield et al., 2011). In addition, lower subjective life expectancy means that individuals perceive their future time resources as more limited. Within this urgent temporal framework, any zero outcome that may lead to wasted waiting time is assigned a higher psychological opportunity cost, thereby increasing sensitivity to zero outcomes. Based on the above analysis, we infer:

H3a: Compared with the general population, incarcerated individuals differ significantly in death thinking and subjective life expectancy; death thinking can significantly predict subjective life expectancy and individuals' two types of decision responses—zero-outcome sensitivity and intertemporal decision making—and subjective life expectancy can also significantly predict these two decision responses. The above associations are expected to hold in both groups.

1.3.2 Mediating Path: From Death Thinking to Decision Outcomes

Subjective life expectancy does not exist in isolation; death thinking often indirectly affects decision making by influencing individuals' perception of future time.

When individuals are in negative situations, death thinking is activated, leading

them to form pessimistic estimates of the remaining length of life. As discussed above, this compressed subjective life expectancy not only makes them more inclined toward short-term gain in intertemporal decision making, to pursue immediate gratification, and increases impulsive risk-taking and tendencies toward illegal and criminal behavior (Frederick et al., 2002; Wilson & Daly, 2006), but also significantly increases their sensitivity to zero outcomes.

There are differing views regarding the relationship between death thinking and subjective life expectancy. Some perspectives hold that death thinking triggers defensive mechanisms and thus leads individuals to overestimate life expectancy (Pyszczynski et al., 2005). However, other perspectives argue that it strengthens pessimistic expectations about the future (Carstensen et al., 1999). We believe that these two views are not contradictory; they can be reconciled over a longer interval in the process of death thinking. That is, the relationship between death thinking and subjective life expectancy is not simply linear, but may instead take the form of an inverted U-shaped curve. This inverted U-shaped relationship suggests that moderate death thinking can stimulate life planning and thereby increase life expectancy; however, when the intensity and frequency of death thinking are too high, the anxiety thereby induced may lead to pessimistic expectations. Based on this, we propose:

H3b: Subjective life expectancy mediates the relationship between death thinking and individuals' decision responses; there is an inverted U-shaped curvilinear relationship between death thinking and subjective life expectancy, and this relationship exists in both incarcerated individuals and the general population.

1.3.3 Integrated Model: The Moderating Role of Risk Propensity

The psychological pathway described above—“death thinking → subjective life expectancy → decision outcomes”—does not operate in exactly the same way for everyone. As a stable decision-making trait, risk propensity may play a key moderating role in this process.

According to the “risk-as-feelings” theory (Loewenstein et al., 2001), individuals' affective responses to risky situations directly guide decision making. In a prison environment, incarcerated individuals' decisions are more susceptible to negative emotions. Death thinking, as a cognitive activity capable of arousing strong emotions, becomes more salient in the stressful context of incarceration. Negativity bias theory (Rozin & Royzman, 2001) indicates that negative information carries greater psychological weight in individuals' cognitive processing. Therefore, individuals' risk propensity may significantly moderate this death thinking that is imbued with negative perceptions, and ultimately affect their subjective life expectancy.

Specifically, risk propensity influences the affective and cognitive responses individuals generate when confronting death thinking. For example, when facing death thinking, individuals with high risk propensity may exhibit a life-expectancy adjustment pattern that is entirely different from that of individ-

uals with low risk propensity—the former may be more likely to “live in the moment,” further compressing their perception of future time; the latter may be more cautious. In addition, the prison environment itself may distort the indivi-

individuals’ risk perception and behavior (Slovic, 1987), making the mechanism by which risk propensity exerts its moderating effect more complex. Even when incarceration environments are similar, risk propensity may still moderate upstream variables, leading different groups to exhibit heterogeneity in decision-making. Accordingly, we propose the final core hypothesis of this study:

H3c: Individual risk propensity significantly moderates the path from death-related thinking to subjective life expectancy, and this pattern of moderation differs significantly between incarcerated individuals and the general population.

To systematically examine the psychological mechanisms underlying the “myopia” in incarcerated individuals’ decision-making, this study designed three progressively layered studies, following the logic of “phenomenon observation → preliminary mechanism exploration → model integration.” First, we systematically compare group differences between incarcerated individuals and the general population in intertemporal decision-making and other variables, thereby laying the foundation for subsequent model construction. Next, we experimentally test incarcerated individuals’ distinctive behavioral responses to zero-payoff outcomes in delayed options, attempting to conceptualize and quantify this response as “zero-outcome sensitivity,” thus providing empirical evidence for constructing an integrated model. Finally, we integrate the above variables to construct a moderated mediation model, and use multi-group analysis to test whether this psychological process differs significantly between incarcerated individuals and the general population. The core of this series of studies is a systematic comparison between groups. Through this multidimensional exploration, we aim to achieve a more comprehensive understanding of incarcerated individuals’ behavioral patterns and provide empirical reference for formulating more effective crime-prevention and correctional interventions.

2 Study 1: A Comparative Study of Intertemporal Decision-Making Between Incarcerated Individuals and the General Population

The purpose of this study was to compare incarcerated individuals and the general population in terms of risk, decision-making, and related behavioral styles, and to reveal the overall psychological characteristics of incarcerated individuals’ intertemporal decision-making.

2.1 Participants

This study adopted a matched design to control for the potential influence of demographic variables such as age, gender, and highest educational attainment on intertemporal decision-making, thereby ensuring the validity and reliability of the comparison. The participants included incarcerated individuals from a prison in Changchun, Jilin Province, as well as general-population participants recruited through the Jianshu platform who were selected to match the incarcerated individuals as closely as possible in gender, age, and educational attainment. This study used G*Power 3.1 to calculate the sample size: Study 1 was based on an independent-samples t test, with the effect size set at $d = 0.50$, the significance level at $\alpha = 0.05$, and statistical power at $Power = 0.80$. The calculation indicated that 64 participants were needed in each group, with a planned total sample size of 128. In practice, a total of 410 incarcerated individuals participated in the study. After excluding incomplete questionnaires, the final sample included in the analysis consisted of 248 incarcerated individuals and 248 age- and gender-matched participants from the general population (for the detailed distribution of participants' basic information, see Supplementary Materials, Appendix Table 1).

Chi-square tests showed no significant differences between the two groups in the proportional distributions of gender, age group, or educational attainment, indicating that the participant groups were well matched. To control for order effects, two versions of the scales were designed for each group of participants; the content was identical, but the order of the questions differed. Data collection strictly followed ethical requirements and principles of privacy protection, and full communication was maintained with the prison administration to ensure the smooth implementation of data collection.

2.2 Experimental Materials and Procedure

(1) Measurement of intertemporal decision-making

Following the research paradigm commonly used in previous studies of intertemporal decision-making, this study adopted a choice-based method and constructed an intertemporal decision-making questionnaire with reference to the hyperbolic discounting model (Wang & Dvorak, 2010). Participants were required to complete 14 choice items, choosing between an immediate smaller gain (SS option A) and a delayed larger gain (LL option B). Of the 14 items, 7 involved smaller amounts ranging from 600 yuan to 4,500 yuan; the other 7 involved amounts ranging from 10,000 yuan to 90,000 yuan. Compared with titration methods that require calculating a specific discount rate (e.g., "How much money now is subjectively equivalent to 1,000 yuan three years from now?"), the choice method is more intuitive, reduces participants' cognitive burden, and is more suitable for incarcerated populations with relatively lower educational levels. Traditional scoring methods for intertemporal decision-making require high-quality indifference points as well as relatively stable and

rational choice preferences. However, incarcerated individuals' intertemporal choices vary greatly and contain many breakpoints, making the traditional conversion paradigm for discount rates inapplicable. Accordingly, in this study, the total number of SS options selected across multiple intertemporal choices was used as the quantitative indicator of delay discounting. This more concisely reflects participants' tendency toward immediate gratification under different decision-making contexts: the more often a participant chose the SS option, the more inclined the participant was toward immediate rewards and the higher the level of delay discounting. This intuitive scoring method is more robust, is less sensitive to outliers, and does not severely affect the mean and variance as outliers do in continuous data. Similar choice paradigms have also been applied in behavioral economics, such as the multiple price list method, and in psychological research on delay discounting (Kirby & Maraković, 1996).

(2) Measurement of risk propensity

In recent years, researchers in the field of decision-making have developed the Domain-Specific Risk-Taking scale (DOSPERT) (Blais & Weber, 2001; Mellers et al., 1997). This scale evaluates individuals' overall risk propensity through a total score and reveals differences in risk propensity across domains through subscale scores.

The DOSPERT scale used in the present study integrates the original scale developed by Weber et al. (2002) and subsequent revised versions (Wang et al., 2009, 2016). The final scale contains 31 items and six risk-domain factors, including recreational/natural risk, safety risk, cooperation/competition risk, ethical risk, financial risk, and reproductive risk, assessing individuals' behavioral tendencies in six core risk contexts. The item design of the scale not only covers modern life scenarios but also addresses risk contexts with long-term evolutionary stability, such as intergroup competition and cooperation, the risk of cheating in the moral domain, exploration, trade-offs between high pay and high reproductive risk, and investment risk. The scale showed good internal consistency in the present study (reliability coefficients: incarcerated individuals, 0.90; general population, 0.82).

(3) Measurement of death-related thinking

To comprehensively capture the psychological salience and impact of death-related thinking, rather than merely measuring the trait of death anxiety, the operational definition in this study integrates its two core components: cognition and emotion.

Our theoretical basis derives from terror management theory's distinction between death accessibility and death-related affect: conscious death cues and the accessibility of unconscious death trigger different defensive pathways (Pyszczynski, et al., 1999). Drawing on this "accessibility-affect" dual-component logic (Petty et al., 2007), we treat the frequency of death-related thinking as the ease with which it enters consciousness, representing the "accessibility" of death-related thought, and regard fear as the "emotional

intensity” after the thought has been activated. We infer that an individual’s thoughts must simultaneously possess a certain degree of occurrence

frequency and sufficient emotional weight can produce a substantive psychological impact. Therefore, this study designed the following two questions and used the product of the two as an exploratory indicator of the “death-thought index,” in order to quantify this psychological salience:

1. In the past three years, on average, how often have you thought that you will one day die?
 - A. Never thought about it
 - B. Thought about it at intervals (the frequency must be specified)
2. If, when you think that you “will ultimately die one day and completely disappear from this world,” do you feel fear? Please use a rating from 1 to 5, where 1 means not afraid at all and 5 means extremely afraid.

Although this multiplicative operation remains exploratory in its definition, it is more consistent with the purpose of the present study, which examines death thoughts from an adaptive perspective, and therefore differs from standard scales that primarily measure anxiety traits.

(4) Subjective life-expectancy measurement

The subjective life-expectancy measurement tool used in the study by Wang et al. (2009) was adopted. This measure requires participants to estimate their probability of being alive at different future age stages, from which a subjective life-expectancy value is calculated. Specifically, starting from age 20, participants estimate their probability of surviving through each subsequent 10-year interval (expressed as a percentage), and then the total number of years of subjective life expectancy is obtained using the formula $[20 + \text{sum of } (P_i \times 10)]$. For example, if a participant believes that he or she is very likely to live to age 70, is less certain about living to age 80, and has only a very low probability of living to age 90, then he or she might respond as follows: ages 20–29: 100%; ages 30–39: 100%; ages 40–49: 98%; ages 50–59: 95%; ages 60–69: 90%; ages 70–79: 80%; ages 80–89: 50%; ages 90–99: 5%. Based on this series of estimates, the participant’s subjective life expectancy would be calculated as

$$(20 + 10 + 10 + 9.8 + 9.5 + 9 + 8 + 5 + 0.5) = 81.8 \text{ years.}$$

2.3 Data Analysis and Results

Data analysis was conducted using SPSS 26.0. Specifically, matched-effects tests, descriptive statistics, tests of differences between groups, and analyses of the criminal-background influence on intertemporal decision-making among incarcerated individuals were performed. To meet the prerequisites for parametric tests, Shapiro-Wilk tests of normality were first conducted for each group

of data. The results showed that the data in most groups did not significantly deviate from a normal distribution ($p > 0.05$). For the small number of groups showing slight deviations, given that their sample sizes were relatively large (each group $N > 30$), according to the central limit theorem, the F test in ANOVA still has relatively good robustness (Glass et al., 1972). Next, Levene's test was used to assess the homogeneity of variances between groups. If the homogeneity-of-variance test was passed, the standard t value or F value was reported; if variances were unequal, the corrected t value or the Welch-corrected F value was reported.

2.3.1 Comparative Study of Incarcerated Individuals and the General Population

Descriptive statistics and tests of differences were conducted for incarcerated individuals and the general population on intertemporal decision-making (large and small amounts), risk tendency (total score and scores for six risk domains), and related variables. The results are shown in Table 1.

Table 1 Descriptive Statistics and Difference Tests for the Different Groups

Variable	Incarcerated individuals ($M \pm SD$)	General population ($M \pm SD$)	t value	Cohen's d
Intertemporal decision-making	6.33 $\pm$ 3.80	4.34 $\pm$ 2.25	7.11**	0.64
Small-amount intertemporal decision-making	3.52 $\pm$ 1.93	2.67 $\pm$ 1.22	5.81**	0.52
Large-amount intertemporal decision-making	2.81 $\pm$ 2.09	1.67 $\pm$ 1.25	7.45**	0.67
Risk propensity	94.06 $\pm$ 19.36	84.88 $\pm$ 12.79	6.23**	0.56
Recreational risk	12.98 $\pm$ 4.78	9.63 $\pm$ 3.56	8.86**	0.80
Safety risk	17.46 $\pm$ 4.03	15.98 $\pm$ 3.57	4.34**	0.39

Variable	Incarcerated individuals ($M \pm SD$)	General population ($M \pm SD$)	t value	Cohen's d
Cooperation/competition risk	20.38 $\pm$ 4.87	18.67 $\pm$ 4.12	4.22**	0.38
Moral risk	17.52 $\pm$ 4.88	14.07 $\pm$ 3.52	9.03**	0.81
Financial risk	16.27 $\pm$ 4.50	17.94 $\pm$ 3.47	-4.64**	-0.42
Fertility risk	9.46 $\pm$ 4.11	8.59 $\pm$ 2.86	2.72**	0.24
Death reflection	6.14 $\pm$ 6.38	7.35 $\pm$ 5.44	-2.23*	-0.21
Subjective life expectancy	76.71 $\pm$ 11.45	78.61 $\pm$ 8.75	-2.08*	-0.19

Note: ** $p < 0.01$, * $p < 0.05$, ($*$) $p < 0.10$; the same below.

The data show that incarcerated individuals reported choosing immediate rewards significantly more often than the general population, indicating that incarcerated individuals were more inclined to choose immediate rewards in decision-making. In addition, for small-amount intertemporal decision-making, incarcerated individuals scored significantly higher than the general population; for large-amount intertemporal decision-making, incarcerated individuals likewise scored significantly higher than the general population. These results indicate that incarcerated individuals showed a stronger tendency toward immediate gratification across monetary contexts involving different amounts.

In terms of risk propensity, incarcerated individuals scored significantly higher than the general population. Specifically, in the five domains of recreational risk, safety risk, cooperation/competition risk, moral risk, and fertility risk, incarcerated individuals scored significantly higher than the general population. However, in the domain of financial risk, incarcerated individuals scored significantly lower than the general population.

By contrast, in terms of death reflection, incarcerated individuals scored significantly lower than the general population, indicating that incarcerated individuals had a lower level of cognition concerning death; in terms of subjective life expectancy, incarcerated individuals scored significantly lower than the general population, showing that they had lower expectations regarding their future lifespan.

After the preliminary analyses revealed significant differences between incarcerated individuals and the general population in intertemporal decision-making and related variables, a multivariate analysis of variance (MANOVA) was further conducted to examine differences between the groups in the number

of immediate-reward choices in large-amount and small-amount intertemporal decision-making after controlling for covariates such as age, gender, and educational attainment. The results showed that there were significant differences between the groups in the number of immediate-reward choices in both large-amount and small-amount intertemporal decision-making. The main effect of decision-maker identity was significant, Wilks' $\lambda = 0.90$, $F(2, 490) = 28.02$, $p < 0.001$, $\eta^2 = 0.10$, with a medium effect size, indicating that decision-maker identity had a significant influence on intertemporal decision-making, and that the incarcerated group was more inclined to choose immediate rewards. The regression data showed that all groups exhibited a relatively high tendency to choose immediate rewards in small-amount decisions, and incarcerated individuals were again significantly higher than the general population in this tendency.

2.3.2 Comparison of Differences in Related Decision-Making Behaviors Among Incarcerated Individuals with Different Criminal Backgrounds

After confirming that incarcerated individuals and the general population differed significantly in intertemporal decision-making and related psychological characteristics, the next step was to further explore

Criminal-background variables: how they affect incarcerated individuals' intertemporal decision-making (small and large amounts) and risk propensity (total score and the six risk-domain factors). Criminal-background variables include: 1. total sentence length; 2. reason for imprisonment (theft/injury/fighting/infringement/economic offenses/other); 3. crime type (property/violent); and 4. behavioral type (planned offending/impulsive offending).

Considering the distributional characteristics of sentence-length data, which include extremely long sentences, and following the standards for classifying sentence length in the *Guiding Opinions on Sentencing for Common Crimes* issued by the Supreme People's Court of China, sentence length was converted into a categorical variable for the analysis of variance: short-term imprisonment (fixed-term imprisonment of less than three years), medium-term imprisonment (fixed-term imprisonment of more than three years and less than ten years), and long-term imprisonment (fixed-term imprisonment of more than ten years, life imprisonment, or the death penalty). This was done to reduce the influence of extreme values on the results. The specific results of the relevant t tests and one-way analyses of variance are shown in Table 2.

Table 2. Analysis of the effects of criminal background (summary of t values/ F values)

Variable	Sentence length: $F(2, 245)$	Sentence length: η^2	Reason for imprisonment: $F(5, 238)$	Reason for imprisonment: η^2	Planned/impulsive type: $t(215)$	Planned/impulsive type: hen' s d	Property/violent crime: $t(246)$	Property/violent crime: hen' s d
Intertemporal decision-making	3.44*	0.03	2.07(*)	0.04	-0.89	-0.13	1.49	0.20
Small-amount in-tertempo-ral decision-making	2.44	0.02	1.69	0.03	-0.70	-0.10	1.52	0.20
Large-amount in-tertempo-ral decision-making	3.78*	0.03	2.51*	0.05	-0.97	-0.14	1.30	0.17
Risk propensity	9.08**	0.07	7.19**	0.13	-3.63**	-0.52	-1.13	-0.15
Recreation risk	9.47**	0.07	6.12**	0.11	-2.87**	-0.41	0.28	0.04
Safety risk	4.15*	0.03	4.09**	0.08	-2.95**	-0.42	0.10	0.01
Cooperation/competition risk	3.83/0.02	0.03	1.71	0.04	-2.54*	-0.36	-1.03	-0.14
Moral risk	5.66**	0.04	5.12**	0.10	-2.33*	-0.33	-2.50*	-0.33
Financial risk	2.85(*)	0.02	1.94	0.04	-2.20*	-0.32	0.38	0.05
Reproduction risk	4.45*	0.04	6.29**	0.12	-2.17*	-0.33	-1.99*	-0.26
Death thinking	5.66**	0.04	5.20**	0.10	3.98**	0.49	-1.77(*)	-0.22

		Reason for im- prison- ment:	Reason for im- prison- ment:	Planned/impulsive type:	Planned/impulsive type:	Property/violent crime:	Property/violent crime:
	Sentence length:	Sentence length:	Sentence length:	Sentence length:	Sentence length:	Sentence length:	Sentence length:
Variable	$F(2, 245)$	η^2	$F(5, 238)$	η^2	$t(215)$	d	$t(246)$
Subjective life ex- pectancy	2.59(*)	0.02	2.21(*)	0.05	-1.20	-0.17	1.17

As shown in Table 2, sentence length differed significantly in large-amount intertemporal decision-making, with long-term prisoners more inclined to choose immediate gains. Long-term prisoners also had higher risk-propensity scores, with significant differences in the total risk-propensity score and in the domain-factor scores for recreational risk, safety risk, moral risk, and reproductive risk. Long-term prisoners also showed more active death thinking.

Reason for imprisonment showed significant differences in intertemporal decision-making, especially large-amount intertemporal decision-making; significant differences were also found in the total risk-propensity score, in the factor scores for recreational risk, safety risk, moral risk, and reproductive risk, and in death thinking. In terms of reason for imprisonment, incarcerated individuals imprisoned for infringement-related offenses showed high risk propensity in almost all risk domains, and differed significantly from those imprisoned for other reasons, indicating the distinctiveness of those imprisoned for infringement-related offenses in terms of risk propensity.

Within the behavioral-type grouping, incarcerated individuals who had committed impulsive crimes scored significantly higher than those who had committed planned crimes on the total risk-propensity score and on the factor scores of each subdomain. The level of active death thinking among incarcerated individuals who had committed planned crimes was also significantly higher than that among those who had committed impulsive crimes.

After further classifying reasons for imprisonment, incarcerated individuals imprisoned for violent crimes differed from those imprisoned for property...

-type offenders showed a significantly higher risk tendency. No significant differences were found between the two groups on the other variables (intertemporal decision-making, risk tendency, death-related thoughts, and subjective life expectancy), indicating that subdividing reasons for imprisonment into property crimes and violent crimes has limited explanatory power for the data in this study.

2.4 Summary

The results of this study confirm that incarcerated individuals do differ significantly from the general population in intertemporal decision-making, risk tendency, death-related thoughts, and subjective life expectancy. Specifically, compared with the general population, incarcerated individuals exhibit a stronger tendency toward immediate gratification and higher risk propensity, but lower levels of active death-related thought and lower subjective life expectancy. Further internal analysis of the incarcerated group indicates that these decision-making characteristics are significantly associated with criminal-background factors. Multiple factors in criminal background significantly affected large-amount intertemporal decision-making, risk tendency (including the six risk domains of recreational risk, safety risk, cooperation/competition risk, moral risk, financial risk, and reproductive risk), and death-related thoughts, but no significant effect was found for subjective life expectancy. Overall, these results basically support the inferences of H1 and H3a.

3 Study 2: An Experimental Study Comparing the Zero-Payoff Effect in Intertemporal Decision-Making Across Different Groups

Study 1 demonstrated at the descriptive level that incarcerated individuals indeed exhibit a significant short-sightedness phenomenon in intertemporal decision-making. However, the mechanism underlying this phenomenon remains not entirely clear. We speculate that it stems not only from traditional temporal discounting, but also from a distinctive sensitivity to “zero payoff” (H2). Although Study 2 used the same batch of participants as Study 1, the present study treats it as an independent study, because its research design and purpose are entirely different. Unlike the descriptive nature of Study 1, Study 2 is an experimental study. By manipulating variables, it tests whether the proximal mechanism of the zero-payoff effect truly exists; this is a key step in constructing the final integrated psychological model in Study 3.

The zero-payoff effect refers to the distinctive psychological response elicited by the numerical value “zero” in the expected outcome of a decision, as well as its influence on an individual’s intertemporal choice. As a special group, incarcerated individuals may, during decision-making, have a distinctive psychological response to “zero,” and therefore may show a stronger preference for immediate rewards. Based on this inference, while keeping the core information of the decision scenario consistent, this study systematically manipulated the framing of “zero payoff,” compared intertemporal decision-making differences between incarcerated individuals and the general population under different framings, and explored the specific influence of different framing methods on incarcerated individuals’ internal choice behavior.

3.1 Research Design and Participants

Study 2 and Study 1 used the same batch of participants, including 248 incarcerated individuals and 248 participants from the general population matched by age and gender. This study used G*Power 3.1 to calculate the sample size: Study 2 was based on a two-factor analysis of variance (2 groups $\times$ 3 zero-payoff framing groups), with effect size set at ($f = 0.25$), significance level ($\alpha = 0.05$), and statistical power (Power = 0.80), yielding

The planned total sample size was 120 participants. The actual total sample size was 496 participants.

This experiment adopted a two-factor between-subjects design: 2 groups (population: inmates, ordinary people) $\times$ 3 groups (position of the zero-benefit statement: pre-position group, post-position group, double group). The independent variables were population and the position of the zero-benefit statement, and the dependent variable was the number of times option A was chosen in the intertemporal decision task.

Referring to the average sample size per group used in relevant studies of intertemporal decision-making, which is approximately 61 participants (Caruso et al., 2008), this experimental study planned an average sample size of more than 60 participants per group. Participants were recruited separately from a prison in Changchun, Jilin Province, and from the ordinary population, and sex, age, highest educational attainment, and other demographic variables were matched between the two groups. Participants were randomly assigned to the pre-position group, post-position group, and double group. There were ultimately 496 valid participants, including 248 inmates and 248 ordinary people. The results of the chi-square tests showed that, across the three groups, there were no significant differences between the two populations in the distributions of sex, age group, and educational attainment, indicating that the participant groups were well matched. Basic information on participants in each group and the matching test results are shown in Supplementary Materials Appendix Table 2.

3.2 Experimental Materials

- (1) Intertemporal decision task: Referring to the methods of Kirby and Maraković (1996) and Wang and Dvorak (2010), the intertemporal decision task in this experiment included seven choice questions. Participants were required to choose between receiving a smaller amount of money immediately (SS option A) and receiving a larger amount of money in the future (LL option B), with amounts ranging from 1,000 yuan to 6,200 yuan. The scoring method was the total number of times the SS option was chosen, reflecting the individual's tendency toward immediate choice; the more often the SS option was chosen, the more the individual was inclined toward immediate rewards.

- (2) Zero-benefit effect: Drawing on the research design of Magen et al. (2008), this experiment manipulated the position of the zero-benefit statement in the options so that participants would more clearly recognize the “zero benefit” present in the options, thereby examining the influence of this awareness on intertemporal decision-making. Different positions of the zero-benefit statement were set in the experimental materials for different groups. In the pre-position group, the zero-benefit statement was placed before the LL option; in the post-position group, the zero-benefit statement was placed after SS option A; and in the double group, double zero-benefit statements were used. The specific statements were as follows:

Pre-position group example

- A. Receive 3,600 yuan now
- B. Receive 0 yuan now, and receive 6,200 yuan after 7 days

Post-position group example

- A. Receive 3,600 yuan now, and receive 0 yuan after 7 days
- B. Receive 6,200 yuan after 7 days

Double group example

- A. Receive 3,600 yuan now, and receive 0 yuan after 7 days
- B. Receive 0 yuan now, and receive 6,200 yuan after 7 days

3.3 Data Analysis and Results

This study employed two-way ANOVA and chi-square tests to compare the intertemporal decision choices of incarcerated individuals and the general population under different zero-gain expression-position groups—that is, the number of times SS immediate rewards were chosen across the seven items. The results of the two-way ANOVA showed a significant main effect of group ($F(1, 490) = 28.75, p < 0.001, \eta^2 = 0.06$), reaching a medium effect size by conventional standards. This indicates that incarcerated individuals and the general population differed significantly in the number of immediate options selected in intertemporal decision-making. Post hoc multiple comparisons showed that, under all three zero-gain expression-position conditions, incarcerated individuals selected immediate options significantly more often than the general population. The main effect of zero-gain expression position was also significant ($F(2, 490) = 12.73, p < 0.001, \eta^2 = 0.05$), indicating that different positions had different effects on the number of immediate options selected, although the effect size was relatively small. Post hoc multiple comparisons showed that, among incarcerated individuals, the number of immediate options selected in the preposed zero-gain expression group was significantly higher than in the postposed group and the double-expression group, suggesting that preposed zero-gain expression had the most pronounced enhancing effect on preference for immediate gains.

However, the effects of the three zero-gain expression positions were not significant in the general population ($F(2, 245) = 1.57, p = 0.211 > 0.05, \eta^2 = 0.01$), as shown in Figure 1.

Figure 1. Effect of zero-gain expression on intertemporal decision-making (number of times the immediate reward was selected)

Considering that the number of participants within each group was unequal and the variances were slightly heterogeneous, nonparametric tests were used for further tests of differences. Chi-square tests were used to compare the distributional differences between incarcerated individuals and the general population in each group in choosing the immediate option versus the delayed option. The results are shown in Table 3.

Table 3. Chi-square test results for immediate option A and delayed option B

Group	Population	Option A	Option B	χ^2	df
Preposed group	Incarcerated individuals	405	260	49.307**	1
Preposed group	General population	277	388	49.307**	1
Postposed group	Incarcerated individuals	255	242	3.755($p = 0.053$)	1
Postposed group	General population	191	306	3.755($p = 0.053$)	1
Double-expression group	Incarcerated individuals	255	242	16.658**	1

General population	191	306
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Note: The chi-square test was used to compare differences between groups in the distribution of choosing A versus choosing B within each condition.

The results showed that the chi-square tests further supported the findings of the two-way analysis of variance. In the preposed and dual groups, the proportion of incarcerated individuals choosing the immediate option was significantly higher than that of the general population ($ps < 0.001$), with this difference being most pronounced in the preposed group. In the postposed group, although the proportion of incarcerated individuals choosing the immediate option was

higher than that of the general population, the statistical test showed only marginal significance ($p = 0.053$). Therefore, the position of the zero-gain statement had a significant effect on both the frequency and proportion of choosing the immediate option, and placing the zero-gain statement before the options strengthened the preference for immediate choice.

3.4 Summary

This study examined differences between incarcerated individuals and the general population in how they are influenced by the zero-gain effect in intertemporal decision-making. The results indicate that incarcerated individuals are more sensitive to zero-gain statements and have lower tolerance, thereby tending to choose immediate gains. This finding verifies Hypothesis **H2** and is also of important significance for understanding the characteristics of decision-making behavior among incarcerated populations.

4 Study 3: A Moderated Mediation Model of Death Reflection, Subjective Life Expectancy, and Risk Propensity

Study 3 constructed an integrated model to examine the joint mechanisms by which death reflection, subjective life expectancy, and risk propensity influence individuals' decision responses. Building on the empirical foundations of the first two studies, this study proposed a hypothesized psychological-process model (see Figure 2). The model treats intertemporal decision-making and zero-outcome sensitivity as two parallel dimensions of decision response influenced by the same survival-cognition pathway, with a focus on the internal logic from death reflection to subjective life expectancy and the moderating role of risk propensity therein.

Translated diagram content:

- Risk propensity → moderating path from death reflection to subjective life expectancy
- Death reflection → subjective life expectancy
- Death reflection → zero-outcome sensitivity
- Subjective life expectancy → zero-outcome sensitivity
- Subjective life expectancy → intertemporal decision-making
- Death reflection → intertemporal decision-making

Figure 2. Hypothesized Psychological-Process Model of Intertemporal Decision-Making

4.1 Participants

This study used G*Power 3.1 to calculate the sample size. Because Study 3 was based on a structural equation model (SEM), a conservative setting based on a “small-to-medium” effect size ($f^2 = 0.05$) was first adopted, and the 11 predictors in the most complex model were considered, including quadratic terms, interaction terms, and all control variables. Under this setting ($\alpha = 0.05$, Power = 0.80), the minimum required total sample size was calculated to be $N = 356$. The incarcerated participants who actually took part in the study came from a prison in Changchun, Jilin Province, and 348 valid questionnaires were recovered.

To meet SEM requirements for sample size, and considering the limited number of incarcerated participants, the study chose to add data from the general population and to match the proportions of key variables such as gender, age, and educational attainment as closely as possible to those of the incarcerated sample. Through the Jienshu platform, general-population participants matched to the incarcerated participants were selected, yielding 533 valid questionnaires. The final analytic sample included 348 incarcerated individuals (220 men and 128 women) and 533 members of the general population (375 men and 158 women), for a total sample size of 881. The actual sample sizes of the three studies were all far higher than the planned sample sizes, mainly because: the special nature of the prison environment made data collection difficult and data quality relatively poor, so the sample size was enlarged to compensate for invalid data; because of the complexity of the matching design and data collection, the sample size was enlarged to improve statistical power; SEM requirements for sample size had to be met; and incarcerated individuals show relatively large individual differences, so enlarging the sample helps improve the robustness and generalizability of the results.

The frequency distributions of age across different age groups for the incarcerated and general-population participants were as follows:

Incarcerated participants: 118 people aged 18–30, 123 people aged 31–40, 75 people aged 41–50, and 32 people aged 51 or above;

General-population participants: 203 people aged 18–30, 167 people aged 31–40, 122 people aged 41–50, and 41 people aged 51 or above.

The frequency distributions of educational attainment for the incarcerated and general-population participants were as follows:

Incarcerated participants: 37 people in the college/junior-college-or-above group, and 311 people in the high-school/secondary-vocational-school-or-below group;

General-population participants: 176 people in the college/junior-college-or-above group, and 357 people in the high-school/secondary-vocational-school-or-below group.

4.2 Study Materials and Procedure

Death contemplation: The measurement materials were the same as those in Study 1.

Risk propensity: The measurement materials were the same as those in Study 1. (Reliability coefficients: incarcerated participants 0.90, general-population participants 0.91.)

Subjective life expectancy: The measurement materials were the same as those in Study 1.

Zero-outcome sensitivity: Zero-outcome sensitivity refers to an individual's sensitivity, in intertemporal decision-making, to the framing of zero gains in expected outcomes, manifested as an upward shift in preference for immediate rewards. This study adopted a standardized difference-score method. First, the immediate-preference scores were calculated separately for the 14 intertemporal decision items in Study 1 and for the 7 intertemporal decision items completed by participants in Study 2 after receiving the zero-outcome framing. Then, within each participant's own group, these two total scores were converted into standardized scores. The final quantitative indicator of zero-outcome sensitivity was the difference between these two standardized scores. This method places scores from two different scales on the same metric for comparison, thereby more robustly reflecting the net effect of zero-outcome framing on individuals' intertemporal decision-making.

Intertemporal decision task: To improve measurement sensitivity and examine individuals' intertemporal decision-making behavior in greater depth, on the basis of the 14 intertemporal decision tasks in Study 1, this study added 7 choice items. The change in the new items lay in the time element of SS option A, which was adjusted from the original "amount available today" to "amount available tomorrow." This adjustment was intended to capture participants' time preferences in intertemporal decision-making more broadly and to expand the items' ability to discriminate individual differences.

Examples of added items:

A. Receive 1,800 yuan after 1 day

B. Receive 2,000 yuan after 3 years and 17 days

Control variables: Taking into account the special characteristics of incarcerated persons, the study also collected relevant information on imprisonment and demographic variables. According to research by the Risk Assessment and Correction Center for Incarcerated Persons at China University of Political Science and Law and the Institute of Psychology, Chinese Academy of Sciences, risk assessment methods and dimensions for incarcerated persons include suicidal, violent, and escape tendencies, as well as risk cognition and adventure psychology (Zhang Zhensheng et al., 2021). Another study on the relationships among impulsivity, self-control, and social adaptation among incarcerated per-

sons showed that incarcerated persons convicted of different types of crimes differ significantly in these respects; those convicted of economic crimes perform better in social adaptation, which may be related to the degree to which they value future returns (Ye Qingyan et al., 2018). Therefore, when analyzing incarcerated persons' mortality thinking, risk tendency, and temporal discounting rate, we controlled for the effects of demographic variables (age, gender, and educational level) and criminal-background information (sentence length, reason for imprisonment, and type of crime).

4.3 Data Analysis

4.3.1 Data Preprocessing and Cluster Analysis

Because some of the data in this study were collected by questionnaire, exploratory factor analysis was used to test for possible common method bias. Using Harman's single-factor test, the explanatory rate of the first common factor extracted was 36.47%, which is less than 40%. Thus, the data in this study did not show serious common method bias. Considering that some variables showed slight skewness (e.g., the skewness of mortality thinking was 0.98), the model used robust maximum likelihood estimation (MLR) for parameter estimation; this method can provide more robust parameter estimates and model-fit test statistics for non-normal data. To avoid multicollinearity, all continuous variables involving quadratic terms or interaction terms (mortality thinking and risk tendency) were mean-centered. Missing values were imputed using multiple imputation.

To explore the characteristics of subgroups with different risk tendencies, the K-means clustering method was used to analyze participants' risk-tendency scores. The optimal number of clusters was determined to be 2 using the elbow method (see Figure 3). By comparing the mean risk-tendency scores of the two clusters obtained, the cluster with significantly higher scores was named the "risk-preference group," and the cluster with significantly lower scores was named the "risk-avoidance group." Internal validity indices were used to evaluate the reasonableness of the K-means clustering results. The average silhouette coefficient was 0.53, falling between 0.5 and 0.7, indicating that the clustering results had reasonable internal cohesion and separation. The Bootstrap method was used to assess the stability of the clustering results. Across 100 resampling tests, the average Jaccard similarity coefficients of the two clusters were 0.949 and 0.936, respectively, indicating that the membership composition of the two clusters was highly consistent. Meanwhile, the mean number of "dissolved" occurrences during resampling was 0, indicating that neither cluster "dissolved," further supporting the stability of the K-means clustering solution. This clustering result was incorporated into subsequent group comparisons and path analyses to reveal differences in decision-making behavior among groups with different risk tendencies.

Left panel title: Using the elbow method to determine the optimal number

of clusters (incarcerated individuals)

Right panel title: Using the elbow method to determine the optimal number of clusters (general population)

Axis labels: Cluster number; total within-cluster sum of squares

Figure 3. Elbow plots of cluster analysis for different groups

Descriptive tests were conducted for different groups. The correlation analysis results indicated that correlations existed among the main variables planned for inclusion in the model, as well as between the main variables and the control variables. These needed to be controlled in subsequent analyses, in order to control for irrelevant variables and accurately estimate the core path coefficients. The correlation-analysis matrices for each group are shown in Supporting Material Appendix Table 3a; the tests of between-group differences in the key path coefficients for each group are shown in Supporting Material Appendix Table 3b; and the descriptive statistics for the main variables in each group are shown in Supporting Material Appendix Table 4.

4.3.2 Construction of the Mediation Model

SEM analyses were conducted using R (version 4.5.0) and the `lavaan` package (version 0.6-19) to test the proposed moderated mediation model. Based on Hypothesis H3, zero-outcome sensitivity and intertemporal decision-making were specified as dependent variables, death thought as the independent variable, subjective life expectancy as the mediator, and risk propensity as the moderator between the independent variable and the mediator. Meanwhile, to test the possible curvilinear relationship between death thought and subjective life expectancy, the squared term of death thought was also included in the model. Demographic variables (age, gender, and educational level) were included in the model as control variables. For incarcerated individuals, prison-background variables (sentence length, reason for imprisonment, and type of crime) were additionally included as control variables. Apart from differences in control variables, the model structure, variable measurement methods, and subsequent parameter-estimation methods were kept consistent across the two groups.

Because the death-thought variable showed a moderate degree of skewness (skewness = 0.98), robust maximum likelihood estimation (MLR) was used in structural equation modeling, providing more robust parameter estimates, standard errors, and model-fit test statistics for non-normal data. To avoid the multicollinearity that may arise when linear terms, squared terms, and interaction terms of the independent variables are simultaneously included in the model, death thought and risk propensity were mean-centered. The squared term and interaction term were then generated through orthogonal polynomials. After processing, all variance inflation factors (VIFs) were no greater than 10, indicating that the model did not suffer from multicollinearity. The model-fit results showed that the model for the incarcerated-individual group had good fit (SB $\chi^2/df = 1.55$, CFI = 0.994, TLI = 0.969, RMSEA = 0.038, SRMR =

0.012), and the model fit for the general-population group was also acceptable (SB $\chi^2/df = 3.12$, CFI = 0.979, TLI = 0.915, RMSEA = 0.078, SRMR = 0.027), although the RMSEA was close to the acceptable upper limit of 0.08. To evaluate the robustness and generalizability of the model, we conducted five-fold

Cross-validation showed that the mean fit indices for the model among incarcerated individuals were: CFI = 0.993, TLI = 0.974, RMSEA = 0.026, SRMR = 0.024. These indices indicate that the model for incarcerated individuals demonstrated good fit stability and generalizability across different data subsets. The mean fit indices for the general-population model were: CFI = 0.962, TLI = 0.849, RMSEA = 0.097, SRMR = 0.036. Among these, TLI was below 0.90 and RMSEA was above 0.08, suggesting that the stability of the fit of the general-population model in cross-validation was relatively weak, and that subsequent studies may need to interpret the model's generalizability more cautiously. Overall, the model structure for the incarcerated-individual group showed relatively good fit and robustness across the tests. The initial fit of the general-population model was acceptable, but some indices in the cross-validation suggested that its stability warrants further examination. Subsequent analyses tested the specific hypothesized relationships based on the path coefficients in the model.

The significance of each basic path in the model was examined. Table 4 presents the standardized path coefficients (β), standard errors, and significance levels of this integrated model in the two groups—in the incarcerated-individual group and the general population—using subjective life expectancy, zero-outcome sensitivity, and intertemporal decision-making as dependent variables, respectively. All analyses were conducted after controlling for the corresponding demographic variables and prison-background variables specific to incarcerated individuals, to ensure that the estimated relationships between the dependent variables and independent variables were not affected by potential confounding factors.

Table 4. Path analysis of the moderated mediation model in different groups

Predicted path	Incarcerated individuals ($N = 348$) β (SE)	General population ($N = 533$) β (SE)
Dependent variable: subjective life expectancy		
Death-related thinking	−0.03 (0.05)	−0.10* (0.05)
Quadratic term for death-related thinking	−0.03 (0.05)	−0.03 (0.05)
Death-related thinking $\times$ risk propensity	−0.06(0.05)	−0.08(0.06)

Predicted path	Incarcerated individuals ($N = 348$) β (SE)	General population ($N = 533$) β (SE)
Quadratic term for death-related thinking $\times$ risk propensity	-0.38^{**} (0.05)	-0.18^{**} (0.05)
Dependent variable: zero-outcome sensitivity		
Subjective life expectancy	-0.03 (0.06)	0.17^{**} (0.05)
Death-related thinking	-0.10^* (0.05)	0.28^{**} (0.04)
Dependent variable: intertemporal decision-making		
Subjective life expectancy	0.14^{**} (0.05)	0.18^{**} (0.05)
Death-related thinking	0.26^{**} (0.05)	0.23^{**} (0.04)

Note: $N_{\text{incarcerated individuals}} = 348$, $N_{\text{general population}} = 533$.

The results showed that, among incarcerated individuals, death-related thinking had a direct effect on both zero-outcome sensitivity and intertemporal decision-making. At the same time, the effect of death-related thinking on subjective life expectancy was moderated by risk propensity. The pathways in the general population were similar to those in the incarcerated-individual group, but they differed in the specific pattern of path strength and moderation effects. In particular, the effects of death-related thinking and subjective life expectancy on zero-outcome sensitivity were in opposite directions across the two groups. The simple main-effect path from death-related thinking to subjective life expectancy was not significant, whereas the interaction between the quadratic term for death-related thinking and risk propensity significantly predicted subjective life expectancy. This indicates that the effect of death-related thinking on subjective life expectancy is conditional and is moderated by risk propensity.

4.3.4. Test of Moderating Effects and Moderated Mediation Effects

To present the moderating role of risk tendency more intuitively and to test the moderated mediation effect, we further conducted visualization of the moderating effect and mediation-effect analyses under different conditions. Based on the clustering results, the participants were divided into a risk-preference group and a risk-avoidance group.

Using the `lavaan` package in R together with the `semTools` package, we estimated and tested the moderated mediation effect. The Bootstrap method was used (1,000 repeated samples) to estimate and test the conditional indirect effect under different conditions whereby death thoughts influence decision outcomes through subjective life expectancy. The interaction plot of the moderating effect (see Figure 4) intuitively displays, for different groups under different risk tendencies, the relationship between death thoughts and subjective life expectancy. In the figure, the horizontal axis represents the “death thoughts” variable after centering; the 0 point on the horizontal axis represents the mean level of death-thought scores within that group.

Visible labels in Figure 4. Left panel title: “Moderating-effect plot for incarcerated individuals.” Right panel title: “Moderating-effect plot for the general population.” Vertical axis: “Subjective life expectancy.” Horizontal axis: “Death thoughts” / “Death thoughts (standardized score).” Legend: blue line = “Risk-avoidance group” ; red line = “Risk-preference group.”

Note 1: The shaded regions in the figure represent 95% confidence intervals.

Note 2: To visualize the interaction effect, the curves in this figure were plotted based on a simple quadratic regression model without control variables (`lm(y ~ poly(x, 2, raw = TRUE))`). The model-fitting equations are as follows:

Incarcerated individuals, risk-preference group: Subjective life expectancy = $80.21 + 0.36 \times \text{Death thoughts} - 0.001 \times \text{Death thoughts}^2$

Incarcerated individuals, risk-avoidance group: Subjective life expectancy = $73.64 - 0.55 \times \text{Death thoughts} + 0.003 \times \text{Death thoughts}^2$

General population, risk-preference group: Subjective life expectancy = $83.20 + 0.04 \times \text{Death thoughts} - 0.05 \times \text{Death thoughts}^2$

General population, risk-avoidance group: Subjective life expectancy = $77.94 - 0.29 \times \text{Death thoughts} + 0.02 \times \text{Death thoughts}^2$

Figure 4. Interaction among death thoughts, subjective life expectancy, and risk tendency in different groups

As shown in the figure, risk tendency exerted a significant moderating effect on the relationship between death thoughts and subjective life expectancy in both groups, but the patterns differed significantly. To quantify the shapes of the curves, simple quadratic regression models consistent with the plotting logic were run (see Note 2 of Figure 4). The results revealed significant group differences: among incarcerated individuals, the two curves showed significant and

completely opposite nonlinear relationships. The risk-preference group exhibited a significant inverted-U-shaped curve. According to the unstandardized coefficients and the vertex formula, its peak occurred at a centered death-thoughts score of approximately 2.53; the risk-avoidance group exhibited a significant U-shaped curve, with its trough occurring at a centered death-thoughts score of approximately 3.33. In the general population, a similar moderating pattern was also observed, but the effect was relatively weaker: the risk-preference group likewise showed a significant inverted-U-shaped curve, with its peak very close to the mean, at approximately 0.36; the quadratic coefficient for the risk-avoidance group did not reach statistical significance, and no obvious curvilinear relationship was observed. This visualization analysis and the corresponding vertex calculations clearly corroborated our H3c hypothesis: risk tendency is a key moderating variable for understanding how death thoughts affect subjective life expectancy, and this moderat-

mechanism is especially pronounced among the incarcerated population.

The results of the moderated mediation analysis (see Table 5) specifically quantify the indirect effects whereby death-related thoughts influence the two decision outcomes through subjective life expectancy under different conditions. Because the relationship between death-related thoughts and subjective life expectancy is nonlinear, when estimating the indirect effects we calculated the indirect effects when death-related thoughts were at a relatively low level ($M - 1SD$), at the mean level (M), and at a relatively high level ($M + 1SD$). By comparing the indirect effects at these three points, we describe how the indirect influence of death-related thoughts on the final outcomes changes as the level of death-related thoughts itself increases.

Table 5. Analysis of conditional effects under different risk propensities and levels of death-related thoughts

Moderating variable	Group	Independent variable	Outcome sensitivity	Conditional indirect effect	Conditional total effect	Conditional total effect
				[95% BCa CI]: Intertemporal decision-making	[95% BCa CI]: Intertemporal decision-making	[95% BCa CI]: Intertemporal decision-making
Incarcerated individuals	Risk-prefering group	Death-related thoughts: low ($M - 1SD$)	0.21	-0.09	0.14	0.14
			[-0.78, 1.31]	[-0.68, 0.40]	[-0.85, 1.29]	[-0.45, 0.66]

Moderating variable	Group	Independent variable	Conditional indirect effect	Conditional indirect effect	Conditional total effect	Conditional total effect
			[95% BCa CI]: Zero-outcome sensitivity	[95% BCa CI]: Intertemporal decision-making	[95% BCa CI]: Zero-outcome sensitivity	[95% BCa CI]: Intertemporal decision-making
Incarcerated individuals	Risk-preferring group	Death-related thoughts: mean (M)	0.01 [−0.09, 0.11]	−0.004 [−0.06, 0.06]	−0.06 [−0.20, 0.11]	0.23 [0.09 , 0.38]
Incarcerated individuals	Risk-preferring group	Death-related thoughts: high ($M + 1SD$)	−0.19 [−1.35, 0.85]	0.08 [−0.40, 0.70]	−0.26 [−1.39, 0.80]	0.32 [−0.21, 0.93]
Incarcerated individuals	Risk-avoidant group	Death-related thoughts: low ($M - 1SD$)	−0.32 [−1.03, 0.14]	−0.34 [−1.06, 0.16]	−0.44 [−0.11, 0.05]	−0.11 [−0.84, 0.43]
Incarcerated individuals	Risk-avoidant group	Death-related thoughts: mean (M)	−0.03 [−0.09, 0.01]	−0.03 [−0.09, 0.01]	−0.15 [−0.28 , −0.01]	0.20 [0.08 , 0.31]
Incarcerated individuals	Risk-avoidant group	Death-related thoughts: high ($M + 1SD$)	0.26 [−0.22, 0.96]	0.28 [−0.27, 0.99]	0.14 [−0.36, 0.85]	0.50 [−0.02, 1.25]
General population	Risk-preferring group	Death-related thoughts: low ($M - 1SD$)	−0.67 [−1.75, 0.06]	−0.69 [−1.86, 0.07]	−0.43 [−1.50, 0.31]	−0.43 [−1.55, 0.31]

Moderating variable	Group	Independent variable	Conditional indirect effect	Conditional indirect effect	Conditional total effect	Conditional total effect
			[95% BCa CI]: Zero-outcome sensitivity	[95% BCa CI]: Intertemporal decision-making	[95% BCa CI]: Zero-outcome sensitivity	[95% BCa CI]: Intertemporal decision-making
General population	Risk-preferring group	Death-related thoughts: mean (M)	0.04 [−0.03, 0.13]	0.04 [−0.03, 0.14]	0.28 [0.15 , 0.41]	0.31 [0.19 , 0.44]
General population	Risk-preferring group	Death-related thoughts: high ($M + 1SD$)	0.77 [0.04 , 1.91]	0.77 [0.04 , 1.91]	0.98 [0.25 , 2.16]	1.04 [0.31 , 2.22]
General population	Risk-avoidant group	Death-related thoughts: low ($M - 1SD$)	0.02 [−0.12, 0.23]	0.01 [−0.13, 0.32]	0.34 [0.16 , 0.55]	0.21 [0.02 , 0.50]
General population	Risk-avoidant group	Death-related thoughts: mean (M)	0.006 [−0.01, 0.03]	0.003 [−0.03, 0.03]	0.33 [0.21 , 0.43]	0.20 [0.08 , 0.32]
General population	Risk-avoidant group	Death-related thoughts: high ($M + 1SD$)	−0.01 [−0.21, 0.16]	−0.005 [−0.28, 0.16]	0.32 [0.08 , 0.50]	0.19 [−0.11, 0.39]

Note: Bold confidence intervals are significant at the 95% level.

The indirect-effect tests show that the mediating effect is conditional and that there are significant differences between the two populations. Among incarcerated individuals, whether in the risk-preferring group or the risk-avoidant group, at all levels of death-related thoughts, the instantaneous indirect effects of death-related thoughts on zero-outcome sensitivity and intertemporal decision-making

through subjective life expectancy were nonsignificant; all 12 of the 95% confidence intervals for the incarcerated group included 0. This indicates that, among incarcerated individuals, death-related thoughts influence intertemporal decision-making mainly through a direct-effect pathway rather than through mediation by subjective life expectancy. By contrast, in the general population, we observed a precise and conditional indirect effect. This effect appeared only in the risk-preferring group, and only when death-related thoughts were at a high level did death-related thoughts exert a significant positive indirect influence on zero-outcome sensitivity and intertemporal decision-making through subjective life expectancy.

Therefore, the hypothesized mediation pathway in H3b is not supported among incarcerated individuals. This mechanism appears to be specific to risk-preferring individuals in the general population and is activated only under particular conditions.

4.4 Summary

By analyzing the roles of death thoughts, subjective life expectancy, and risk propensity in sensitivity to zero outcomes and intertemporal decision-making, the study found that death thoughts were significantly associated with both zero-outcome sensitivity and preferences in intertemporal decision-making. However, contrary to Hypothesis H3b, the current data did not support the mediating role of incarcerated individuals' subjective life expectancy; this mediation pathway reached significance in the present sample only among the general population. The results suggest partial support for H3c: risk propensity played a key moderating role in the nonlinear relationship between death thoughts and subjective life expectancy.

5 Discussion

5.1 Impulsivity and Foresight: Dissecting the Behavioral Characteristics of Incarcerated Individuals

Study 1 showed that incarcerated individuals had a stronger tendency toward immediate gratification than the general population, consistent with previous findings on impulsivity and time preference among incarcerated individuals (Lee et al., 2017; Smith et al., 2022). The present study reveals why and how incarcerated individuals exhibit such decision-making myopia. At the “how” level, previous research has mostly attributed this broadly to low self-control, whereas Study 2 suggests that incarcerated individuals show distinctive affective avoidance in zero-gain descriptions of delayed options; this impulsivity reflects their high sensitivity to “absence of gains.” At the “why” level, the model results of Study 3 suggest that such decision-making myopia may result from the joint influence of individuals' survival mindset and risk propensity. This supports a context-specific explanation: the prison environment may affect individuals' perceived value of future time (Varghese et al., 2014). To avoid “present nothing-

ness”(zero outcomes) and cope with “ultimate nothingness”(death), incarcerated individuals naturally place greater value on certain immediate returns. In the present sample, this tendency manifested as an adaptive characteristic rather than pure irrational impulsivity.

The results of Study 3 indicate that risk propensity plays a crucial moderating role in intertemporal decision-making. At the same time, incarcerated individuals exhibited a distinctive risk pattern: they showed higher risk propensity in domains such as entertainment, safety, cooperation/competition, and morality, but significantly lower risk propensity than the general population in the financial-risk domain; moreover, this pattern did not vary by type of crime. This finding revises the stereotype that financial offenders have high risk propensity (Rice, 2006; Leoffler & Nagin, 2021). Such avoidance of financial risk may stem from a sense of economic deprivation in the prison environment: when resources are extremely limited, any small financial loss carries considerable psychological weight, leading individuals to show very low tolerance for potential losses and thus to exhibit conservative and avoidant tendencies when facing economic choices. Therefore, this behavior may reflect an adaptive decision-making logic formed under specific survival pressures among incarcerated individuals, rather than simply trait-based risk propensity.

In addition, Study 1 also found that incarcerated individuals’ level of death thoughts was significantly lower than that of the general population, which contradicts the inference proposed in our introduction. However, this does not mean that incarcerated individuals lack existential anxiety; rather, it may reflect a psychological defense mechanism. In a high-pressure prison environment, individuals activate defensive mechanisms to reduce the threat brought about by mortality salience (Pyszczynski et al., 2005). To maintain everyday psychological functioning, incarcerated individuals tend to adopt cognitive-suppression strategies, focus their attentional resources on immediate survival tasks, and actively avoid deep processing of the future (Liem & Kunst, 2013). Therefore, low measured scores may not indicate an absence of death thoughts, but rather the manifestation of their defensive suppression.

This helps explain the nonlinear relationship between death thoughts and subjective life expectancy in Study 3: only when death thoughts exceed the suppression threshold,

only then will the subjective temporal horizon be significantly compressed, thereby exacerbating decision-making myopia.

5.2 The Trap of “Zero” : How Frames Shape Decisions

Study 2 experimentally manipulated the zero-payoff effect, showing that incarcerated individuals were more susceptible to zero-payoff descriptions and exhibited stronger immediate preferences, especially when “zero payoff” was emphasized before the delayed option. This finding supports the research hypothesis: incarcerated individuals may have heightened sensitivity to “zero” as a

special reference point. This is consistent with prior findings on the distinctive psychological effects of “zero” in decision-making (Fan et al., 2022; Reyna et al., 2021). In intertemporal decision-making, the special status of “zero” is particularly salient because it represents a potential outcome of the delayed option—if one waits, one may ultimately gain nothing (Read et al., 2005). According to prospect theory (Kahneman & Tversky, 1979), people are not fully rational when evaluating probabilities; instead, they rely on a probability-weighting function. This function typically takes an S-shaped curve: the slope is smaller in the middle, indicating relative insensitivity to changes in moderate-probability events, whereas the slope is steep near 0 and 1, indicating that people are highly sensitive to changes in small-probability and large-probability events, especially certainty events (events with probability 1 or 0), producing the certainty effect. When an option involves “zero payoff,” because its certainty is that nothing can be obtained, its weight is therefore substantially amplified, leading people to pay more attention to that option. The context of long-term incarceration may strengthen incarcerated individuals’ sensitivity to certain outcomes; “zero” is assigned a stronger psychological weight as a certain loss (Urminsky & Kivetz, 2011). However, because it functions as a loss frame with negative attributes, it may trigger stronger avoidance tendencies among incarcerated individuals, leading them to choose a smaller immediate reward in order to avoid the potential risk of loss. This phenomenon is also related to loss aversion: people are more inclined to avoid losses than to pursue equivalent gains (Tversky & Kahneman, 1992).

The results of this study contrast with the classic “hidden-zero effect” (Magen et al., 2008). Existing research has consistently shown that explicitly presenting “zero” can promote rational trade-offs by making opportunity costs salient (Read et al., 2017; Shen et al., 2019). Our study, however, found that among incarcerated individuals, an explicit zero-payoff frame instead significantly strengthened immediate preference. This difference highlights the particularity of the studied population: for the general population, zero is a cognitive reference point used to calculate future gains and losses; for individuals long subjected to deprivation, it more closely resembles an emotional trigger, readily activating underlying loss-aversion responses (Loewenstein et al., 2001). Under specific circumstances, its intensity may override cognitive calculation of future costs, producing a reversal in decision behavior. This suggests that, in special populations and under stressful contexts, the psychological mechanism of decision-making may shift from being cognition-dominated to emotion-dominated.

5.3 Psychological Mechanisms of Intertemporal Decision-Making among Incarcerated Individuals

Study 3 examined the psychological mechanisms underlying intertemporal decision-making among incarcerated individuals. The results suggest that incarcerated individuals’ decision-making myopia stems not only from traditional temporal discounting, but may also be related to avoidance of “gaining noth-

ing.” By quantifying the zero-payoff effect, this study proposes “zero-outcome sensitivity” as an indicator for distinguishing group characteristics. Unlike traditional temporal discounting at the cognitive level, zero-outcome sensitivity quantifies a distinctive psychological process—an emotion-based avoidance response triggered by “zero.” The results show that, as two parallel modes of decision response, zero-outcome sensitivity and intertemporal decision-making share similar deep psychological antecedents.

By using an integrated model, this study attempted to explore the deeper psychological mechanisms involved in decision-making. The data challenged our initial mediation hypothesis: the mediating effect of subjective life expectancy among incarcerated individuals was not supported. Instead, the data pointed to a simpler and more powerful conclusion: death-related thinking influences intertemporal decision-making through a direct effect pathway. By comparison, in the risk-preference group of the general population, when death-related thinking

When it is at a high level, the effect of this mediating pathway is significant. This suggests that the decision-making mechanisms of the two groups differ: among risk-preferring individuals in the general population, decisions may, under specific conditions, be indirectly influenced by subjective life expectancy, whereas among incarcerated individuals this mediating pathway is blocked, and decisions are manifested primarily as a direct association with death-related thoughts.

The results also suggest a nonlinear mechanism in this mediating pathway. We initially hypothesized an inverted U-shaped relationship between death-related thoughts and subjective life expectancy, but the findings point to a more complex pattern moderated by risk propensity. This finding revises the simple linear assumptions of prior work based on future time perspective theory (Carstensen et al., 1999) or the dual-process defense model of death-related thoughts (Pyszczynski et al., 2005). Behind this may lie a three-stage mechanism of “suppression-activation-overload”: for risk-preferring incarcerated individuals, low levels of death-related thoughts readily trigger defensive suppression, whereby individuals actively avoid deeper processing of the future; moderate levels of death-related thoughts, however, can activate the search for meaning and thereby increase subjective life expectancy; when the intensity of death-related thoughts is too high and exceeds cognitive load, it may induce anxiety and thus compress subjective life expectancy. This offers one possible explanation for how the two classical theories may be activated under different traits and at different intensities. For risk-avoidant incarcerated individuals, by contrast, the two variables show a positive U-shaped relationship, reflecting a different psychological pathway: individuals with low levels of death-related thoughts are in a state of defensive avoidance; as such thoughts increase, rising anxiety leads to a decline in expectancy; but when the level of death-related thoughts becomes extremely high, health-management motivation may instead be triggered, causing life expectancy to rebound. In the general population, this

regulatory pattern is weaker, highlighting the distinctiveness of the incarcerated sample.

In addition, there are group differences in the direction by which death-related thoughts and subjective life expectancy predict sensitivity to null outcomes. According to regulatory focus theory (Brockner & Higgins, 2001; Higgins, 1997), this may be because incarcerated individuals are more inclined toward a promotion focus; longer life expectancy implies more opportunities to pursue goals, thereby increasing tolerance for null outcomes. The general population may be more inclined toward a prevention focus; longer life expectancy strengthens the motivation to take precautions, increasing sensitivity to null outcomes. Although the above discussions concerning the “suppression-activation-overload” mechanism, existential health-management motivation, and regulatory focus are illuminating, they currently remain primarily theoretical inferences. This study did not directly test the relevant psychological processes, and whether these theoretical explanations are well founded still requires further verification in future research through the measurement of process variables, qualitative interviews, or longitudinal designs.

The integrated model in this study fit well among incarcerated individuals, but performed poorly in cross-validation with the general population. This difference in fit is a theoretical finding of the present study. It suggests that the results reflect psychological mechanisms jointly involving survival mentality and risk propensity, and may not constitute a universal model. Rather, in the sample of this study, they show a specific adaptability of incarcerated individuals under conditions of confinement, providing statistical-level inferential evidence for group differences.

5.4 Risk and Time: Joint Decision-Making Strategies

By simultaneously examining risk propensity and intertemporal decision-making, this study offers a new theoretical perspective for linking these two classical domains of decision-making. Previous research has often treated the two as independent individual-difference variables, whereas the findings of this study reveal a more direct correspondence between them.

The results of Study 3 indicate that risk propensity is not only related to immediate preferences; as a core trait, it also participates in and regulates the deeper psychological pathways of intertemporal decision-making. This finding strongly supports the view that, when individuals evaluate uncertainty in risk and time delays in intertemporal decision-making, highly similar psychological processing strategies may be activated. On the one hand, delay itself carries a kind of inherent

the risks involved—that future rewards may fail to materialize (Frederick et al., 2002); on the other hand, when options simultaneously contain risk and delay, individuals may even use interchangeable weighting strategies when processing probabilistic uncertainty and temporal distance (Weber & Chapman, 2005).

The findings of the present study echo this point at the mechanistic level: the pattern of risk propensity among incarcerated individuals is closely associated with their construction of temporal frames, suggesting that the two may share a more fundamental decision-making heuristic concerning how to respond to an “uncertain future.”

5.5 Practical Implications

This study provides preliminary experimental evidence for understanding the psychological characteristics of crime and for formulating preventive and correctional measures for crime. Through group-comparison analyses and decision-making models, we established baseline data for different groups with respect to the zero-outcome effect and decision-making models. Based on the empirical results of this study, the relevant findings can provide reference evidence for the following lines of work:

- (1) **Individual assessment and intervention:** By comparing individual-level data with group-level data, practitioners can assess deviations in cross-temporal decision-making, risk propensity, and sensitivity to zero outcomes, and develop individualized correctional intervention plans.
- (2) **Evaluation of intervention effects:** Individuals can be assessed before and after intervention to measure the effectiveness of the intervention measures.
- (3) **Model-assisted prediction:** In the future, individual data may be entered into the decision-making model of this study as one quantitative indicator for risk assessment, to judge the status of rehabilitation. By continuously collecting and updating data, the model can also be further optimized, thereby improving prediction accuracy.

In addition, the findings of this study also provide directional implications for the design of subsequent interventions:

- (4) **Reference for correctional interventions:** Given incarcerated individuals’ particular sensitivity to “zero,” it is recommended that administrators use framing cautiously in everyday communication and policy messaging. At the same time, the results of this study provide theoretical guidance for the future development of contextualized correctional programs. For example, future research could further examine whether simulated zero-gain contexts can be used to help train incarcerated individuals’ capacity for delayed gratification and tolerance of negative emotions (Yang et al., 2014). However, the present study has not directly tested specific correctional programs or delayed-gratification training. Whether such approaches can effectively improve impulsive decision-making and reduce recidivism in real-world settings still requires further applied empirical investigation.

5.6 Research Limitations and Prospects

This study achieved preliminary empirical results in revealing the psychological mechanisms underlying decision-making among incarcerated individuals. However, owing to objective constraints, the following limitations remain and should be further addressed in future research:

First, the sample of incarcerated individuals in this study mainly came from prisons in specific regions, which to some extent limits the scope of applicability of the conclusions. Meanwhile, in Study 1 and Study 2, due to real-world constraints, some participants with lower educational attainment were excluded to ensure the rigor of education-level matching, resulting in a reduction in the effective sample size. The matching design of this study ensured that, after controlling for the interference of education level, the differences in decision-making between incarcerated individuals and the general population remained reliable. Nevertheless, this difference in sample selection may have had some influence on the study results. Future research should expand to more regions and sample types to verify the generalizability of the conclusions.

Second, this study indirectly inferred environmental effects through group comparisons. Although it was not possible to directly isolate specific variables such as incarceration-related pressure, the integrated model showed a high degree of fit among the incarcerated participants in this study, thereby confirming its distinctive value as a context-specific model. Future research could adopt a longitudinal design, tracking individuals before imprisonment, after imprisonment, and after release upon completion of their sentences, so as to more precisely disentangle the unique influence of the prison environment. More specific prison-environment assessment questionnaires could also be used as covariates to directly test the effects of these contextual factors. In addition, subsequent studies could introduce non-incarcerated but high-stress comparison groups—such as low-income manual laborers—to further optimize contextual control.

Third, Study 2 focused on the eliciting effect of zero-gain framing, and its results clearly demonstrated the strengthening effect of framing on the immediate preferences of incarcerated individuals. Future research should add a “no zero-gain” baseline control group to more deeply verify the independence of the concept of “zero-outcome sensitivity” and explore its relationship with other psychological variables, such as regulatory focus and psychological resilience.

Fourth, this study made an innovative attempt to quantify “death thinking” and “zero-outcome sensitivity.” The “death thinking” index adopted a multiplicative algorithm of “frequency $\times$ fear intensity,” which was an exploratory attempt to capture the psychological salience and impact of individuals’ death-related thoughts. By contrast, “zero-outcome sensitivity” was quantified using a difference method based on standardized scores, making it methodologically robust as well. Although the psychometric properties of the above measurement tools still require further examination, this quantitative exploration based on terror management theory and the standardized-score difference method provides

an empirical foundation for subsequent research. Future studies may further consolidate the robustness of the conclusions by unifying task parameters or developing specialized scales.

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Time Choices Behind Bars: A Preliminary Exploration of Decision-Making Behaviors of Prison Inmates

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Abstract

Criminal behavior poses a substantial burden on society, necessitating a deeper understanding of the decision-making processes within incarcerated populations for effective prevention and rehabilitation. This study investigated the differences in intertemporal decision-making, risk propensity, death awareness, subjective life expectancy, and tolerance for expected zero returns between inmates and the general population. We hypothesize that inmates would exhibit a stronger preference for immediate rewards, higher risk propensity in specific decision domains, weaker death awareness, and lower subjective life expectancy compared to the general population controls. We also proposed and explored a novel concept of “zero-outcome sensitivity” as a new index of impulsivity distinguishing inmates and the general population in intertemporal decision-making.

This research comprised three interrelated studies. Study 1 compared intertemporal decision-related variables between inmates and an age-and-gender matched control group recruited from the general population. Participants

completed questionnaires and tasks to measure their intertemporal choice preferences between immediate versus delayed rewards, risk propensities across task domains (financial, gambling, personal safety, and social competition), death awareness, and subjective life expectancy. Study 2 focused on the impact of expected zero returns on decision-making, presenting participants with scenarios that emphasized the potential for a zero gain. Study 3 constructed a moderated mediation model for inmate and control groups, incorporating thoughts about death, subjective life expectancy, risk propensity, zero-outcome sensitivity and delay discounting patterns. The analyses of the results were controlled for demographic factors such as gender, age, educational level, and criminal background in the inmate group.

The findings revealed that inmates demonstrated a significantly stronger preference for immediate rewards than the general population. Regarding risk propensity, inmates exhibited higher risk-taking tendencies in gambling, personal safety, and social competition domains but lower risk propensity in the financial domain. Furthermore, inmates reported lower death awareness and subjective life expectancy. Notably, inmates displayed a heightened sensitivity to and lower tolerance for scenarios involving expected zero returns, which intensified their preference for immediate gratification. The moderated

mediation model in Study 3 indicated a complex, non-linear relationship between death awareness and subjective life expectancy, with risk-taking propensity as a moderator. Building on multiple replications of the zero-outcome effect, this study attempts to conceptualize “zero-outcome sensitivity” by quantifying this effect and using it as an indicator to distinguish between different groups and individuals, highlighting its capacity to interpret inmates’ decision-making processes and underscoring the model’s utility in capturing nuanced behavioral patterns across diverse scenarios.

This research identified key distinctions in decision-making behaviors between inmates and the general population, elucidating the underlying psychological mechanisms. The study’s theoretical contributions include conceptualizing and quantifying “zero-outcome sensitivity” and discovering a non-linear relationship between death awareness and subjective life expectancy, modulated by risk preferences. These findings provide empirical evidence for more accurate individual assessments of inmates and criminal risk assessment. The implications of this study also extend to practical applications in criminal justice, potentially leading to more effective interventions to reduce recidivism and promote rehabilitation.

Keywords Incarceration, Intertemporal decision-making, Risk preference, Death awareness, Life expectancy, Zero-outcome sensitivity

Supporting Materials Statement

The supplementary data and measurement instruments for this study have been fully compiled in the “Supporting Materials” file, which readers may access online.

The supporting materials include the following:

Supplementary data tables: Supplementary Table 1 (demographic information of participants in each group in Study 1), Supplementary Table 2 (basic information and matching tests for participants in each group in Study 2), Supplementary Table 3a (correlation-analysis matrix of the main variables and control variables for each group in Study 3), Supplementary Table 3b (correlation coefficients of the main variables for each group in Study 3 and tests of between-group differences), and Supplementary Table 5 (descriptive statistics of the main variables for participants in each group in Study 3).

Study-related scales and experimental materials: including the basic information questionnaire, the intertemporal decision-making questionnaire used in Studies 1 and 3, the domain-specific risk-propensity scale, the items measuring the Death Thought Index, the subjective life-expectancy measurement matrix, and the complete task materials for the “zero-outcome effect” behavioral experiment for the preposed group, postposed group, and dual group in Study 2.

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

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