Mechanisms and Applicability of Temporal Personality in Intertemporal Choice

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Abstract

Time personality represents the aggregate of stable time perspectives held by individuals and constitutes an important temporal factor that influences and predicts intertemporal decision-making. Although time personality encompasses numerous research topics, its conceptualization remains without a unified definition. Current research on time personality and intertemporal decision-making predominantly centers on "time perspective." With the advancement of time perspective research, expanding the conceptual connotation of "time personality" through the lens of "time perspective" facilitates the elucidation of mechanisms through which different time perspectives affect intertemporal decision-making. This paper examines the mechanisms by which existing time perspectives influence intertemporal decision-making through analysis of four-factor and five-factor models of time personality, discusses the operational modes of time perspectives from a holistic standpoint, and proposes an integrated mechanistic framework. Future research should further expand the conceptual connotation of "time personality," explore the interactive effects among various time perspectives, and construct a comprehensive theoretical model linking time perspectives with intertemporal decision-making.

Full Text

The Mechanisms and Applicability of Time Personality in Intertemporal Decision-Making

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Abstract: Time personality represents the aggregate of stable time-related beliefs held by individuals and constitutes a crucial temporal factor influencing and predicting intertemporal decision-making. While time personality encompasses numerous research topics, its conceptualization lacks a unified definition.

Existing research on time personality and intertemporal decision-making has primarily focused on "time perspective." As research on time perspective advances, expanding the conceptual connotations of "time personality" through "time perspective" can help elucidate the mechanisms through which different temporal beliefs affect intertemporal decisions. This paper examines the mechanisms by which existing temporal beliefs influence intertemporal decision-making based on four-factor and five-factor models of time personality, discusses the operational modes of temporal beliefs from a holistic perspective, and proposes an integrated mechanistic framework. Future research should further expand the conceptual connotations of "time personality," explore interactions among temporal beliefs, and construct a theoretical model of temporal beliefs and intertemporal decision-making from a comprehensive perspective.

Keywords: time personality; intertemporal decision-making; time perspective; procrastination

1 Introduction

Time and intertemporal decision-making are intimately connected. From everyday purchases (whether to buy early for immediate enjoyment or wait for Double Eleven sales) to major investments like property (whether to pay in full upfront or through mortgages), all require consideration of temporal spans. Intertemporal decision-making involves weighing alternatives occurring at different time points to make a choice (Liang & Liu, 2011). However, individuals hold vastly different temporal beliefs, which may undergo temporary or persistent changes with shifting decision contexts and eras, ultimately affecting intertemporal decisions (Li et al., 2016; Wang, 2019; Stolarski et al., 2020). Kaufman et al. (1991) first proposed the concept of time personality to describe individuals' preferences for task quantity within unit time, distinguishing between polychronicity and monochronicity types. As research on trait-like temporal beliefs progressed, scholars further defined time personality as the personality characteristics and individual differences manifested in temporal contexts (Lü & Huang, 2005; Chen & Zheng, 2011). Currently, no consensus exists regarding the definition of time personality.

Regarding its conceptual 内涵, researchers have proposed a four-factor model (Usunier & Valette-Florence, 2007) comprising time linearity and economicity, time orientations, obedience to time, and time persistence, as well as a five-factor model (Francis-Smythe & Robertson, 1999) including time awareness, punctuality, planning, polychronicity, and impatience. These dimensional models depict how different temporal beliefs influence individual psychology and behavior based on fundamental characteristics of time perception. In terms of conceptual extension, time personality encompasses numerous temporal beliefs such as time perspective, time management disposition, and view of time, each reflecting one or multiple dimensional attributes of time personality with corresponding operational definitions (Xu et al., 2019; Stolarski et al., 2015; Huang & Zhang, 2001). Therefore, time personality can be considered an umbrella term for var-

ious trait-like temporal beliefs, with traits, motivation, cognition, and emotion constituting its fundamental attributes affecting individuals. Although the concept of time personality and its position within the psychological phenomenon system remain unsettled, substantial research has demonstrated the predictive validity of different temporal beliefs under the time personality umbrella for intertemporal decision-making (Tao et al., 2015; Xu et al., 2019; Kedia et al., 2019; Li et al., 2018; Wu & He, 2012). However, some studies have yielded contradictory findings (Andre et al., 2018), casting doubt on the predictive validity of time personality. The primary reasons lie in the lack of consensus on conceptual definition, unclear mechanisms of action, and the absence of a dedicated theoretical framework for time personality and intertemporal decision-making to explain and synthesize complex pathways of influence. Therefore, this paper analyzes the primary pathways through which time personality influences intertemporal decision-making, elucidates its mechanisms through theoretical explanations and empirical research, discusses its applicability as a predictive factor, and attempts to formulate an integrated mechanistic framework to enhance understanding of time personality' s role in intertemporal decision-making and facilitate rational decision-making.

2.1 Time Personality and Time Perspective

Time perspective refers to individuals' views, attitudes, and beliefs regarding past, present, and future time, as well as their relative attention to past and future (Lü & Huang, 2005; Zimbardo & Boyd, 1999), playing a crucial role in driving personal intertemporal decisions (Fung & Isaacowitz, 2016). Research on time personality and intertemporal decision-making has primarily centered on time perspective (Daugherty et al., 2010; Teuscher & Mitchell, 2011; Van et al., 2008), with time perspective showing the greatest similarity to time personality in both conceptual connotations and decision-making mechanisms. Conceptually, Mello & Worrell (2015) expanded the conceptual 内涵 of "time perspective" by constructing a "basic-macro dimension model" (see Figure 1 [Figure 1: see original paper]), where past, present, and future constitute the basic dimensions, while time attitudes, time frequency, time orientation, time meaning, and time relation represent macro-dimensions measuring individual differences in time perspective. Time perspective demonstrates strong associations with time personality dimensions: time orientation is a shared dimension; time relation correlates with time persistence; time attitudes relate to impatience; time meaning corresponds to time linearity and economicity; and time frequency relates to punctuality and planning. Although time perspective falls within the scope of time personality, its more sophisticated measurement tools have enabled deeper research, and its "basic-macro dimension model" offers greater macro-level comprehensiveness than partial dimensional models of time personality. However, time perspective cannot encompass dimensions directly reflecting cognitive processes such as time awareness and polychronicity within time personality. Regarding decision-making mechanisms, time perspective operates through: (1) modes of time perception, (2) attitudinal-belief approaches,

(3) cognitive-motivational processes, and (4) trait-like differences and stability (Andre et al., 2018; Siu et al., 2014; Mello et al., 2016; Stolarski et al., 2015).

Time perspective and time personality share fundamentally similar operational modes, both influencing individual decision-making processes through traits, motivation, temporal cognitive patterns, and emotion. Thus, exploring the conceptual connotations of time personality can facilitate investigation of corresponding temporal beliefs, while conceptual exploration of temporal beliefs can reciprocally supplement time personality' s conceptual 内涵. However, limited by the slow development of time personality measurement tools, few studies have further defined the time personality concept. Currently widely adopted scales include the Time Personality Indicator (TPI) developed by Francis-Smythe & Robertson (1999) based on the five-factor model, and the time personality scale developed by Chen et al. (comprising dimensions of time obedience, time allocation, time planning, and time pressure) (Li et al., 2017). Future efforts should attempt to integrate dimensional models of time perspective and time personality to further develop time personality scales and explore the core concept of time personality.

2.2 The Role and Mechanisms of Time Perspective in Intertemporal Decision-Making

As a personality trait, time perspective is crucial for individuals' intertemporal decision-making behaviors. Mischel and Metzner (1962) first examined the relationship between time perspective and intertemporal decision-making using a self-developed time perspective scale, finding that participants with weaker future time perspective showed stronger preferences for immediate small rewards in subsequent intertemporal decision tasks. Subsequent researchers using various scales—including Zimbardo and Boyd' s (1999) Zimbardo Time Perspective Inventory (ZTPI), Carstensen and Lang' s (1995) Future Time Perspective Scale (FTPS), Strathman et al.' s (1994) Consideration of Future Consequences Scale (CFCS), and Lü and Huang' s (2011) Future Time Perspective Scale—have consistently found strong correlations between time perspective and intertemporal decision-making. Specifically, individuals with future time perspective prefer "larger but later" delayed options, whereas those with present/past time perspective prefer "smaller but sooner" immediate options (Kim et al., 2020; Li et al., 2018; Tao et al., 2015; Song & Feng, 2017). Experimental priming studies that temporarily altered the time orientation dimension of time perspective have yielded similar results (Lin & Epstein, 2014; Nan & Qin, 2019; Zhuang et al., 2017), showing that individuals focusing on present time are more likely to ignore long-term consequences and choose immediate gratification options such as drinking, smoking, and unhealthy diets. Conversely, individuals valuing future time pay greater attention to negative decision consequences and are more willing to choose delayed healthy options.

From the perspective of operational mechanisms, cognitive-motivational processes represent the primary pathway through which time perspective influences

intertemporal decision-making. Kooij et al.'s (2018) meta-analysis revealed that future time perspective strongly activates individuals' cognitive patterns of pursuing future achievement, health, and maximum benefits, positively affecting attention allocation, emotional states, and memory retrieval regarding delayed rewards (Andre et al., 2018; Nan & Qin, 2019), thereby amplifying estimations of delayed rewards and generating controlled motivation that ultimately leads to choosing delayed rewards. In contrast, the cognitive pattern of present time perspective more likely amplifies individuals' attention and emotional valence toward immediate rewards (Pearce et al., 2021), resulting in hedonic impulsive motivation.

However, under specific temporal contexts, the mechanisms of time perspective may not be consistent, as they relate to context-induced changes in perceived time models. Wu and He (2012) presented decision tasks with the reminder that "choosing immediate reward means delayed reward becomes 0 (unobtainable)," finding that individuals with future time perspective shifted their preferences to immediate options when facing "zero delayed reward." Li et al. (2018) asked adolescents with future time perspective to imagine their health, cognitive, and emotional status at age 70, discovering that the imagination group actually preferred immediate rewards more than the non-imagination group. The commonality between these studies lies in their state-level alteration of certain time perspective dimensions: loss reminders may change time attitudes toward immediate/delayed rewards, triggering negative emotions in temporal direction (Tamm et al., 2014); while future imagination manipulations state-dependently induce changes in time awareness and time attitude dimensions, strengthening individuals' thinking about the connection between present and future and eliciting negative emotions from "death awareness" (Wang et al., 2019). These contexts temporarily alter one or multiple dimensions of time perspective, causing changes in individuals' time perception patterns and resulting in inconsistent intertemporal decision preferences. This does not imply changes in the trait attributes of time perspective; rather, contexts related to temporal direction affect the activation of specific dimensional attributes without altering individuals' inherent time perspective.

2.3 Other Time Personality Constructs and Intertemporal Decision-Making

Beyond time perspective, procrastination, view of time, and time management disposition have gradually become focal points in time and intertemporal decision-making research. First, procrastination refers to a relatively stable behavioral tendency to consciously delay or postpone completing established goals (Wu et al., 2016). Previous research indicates that compared to non-procrastinators, procrastinators are more sensitive to delayed time and more prone to impulsivity. Kedia et al. (2019) directly examined the relationship between intertemporal decision-making and procrastination, finding that procrastination correlates with high delay discounting. Procrastinators may

misestimate waiting time, perceiving it as longer, which leads to impatience and impulsive motivation, making them prefer immediate rewards (Ni et al., 2019; Wolters et al., 2017).

Second, view of time is primarily classified into linear and cyclical views based on people' s understanding of time. Individuals with linear view of time perceive time as an irreversible forward-moving line (e.g., "the dead cannot be resurrected"), whereas those with cyclical view of time believe time recurs in cycles (e.g., belief in "reincarnation"). View of time corresponds to the time linearity and economicity dimension of time personality. Xu et al. (2019) temporarily primed linear and cyclical views of time, finding that individuals with linear view of time, being more sensitive to forward-extending and changing time, perceived elapsed time as irretrievable and tended to estimate delayed intervals as longer, thus preferring delayed options. Conversely, individuals with cyclical view of time, being more sensitive to repeatedly cycling time, perceived events as undergoing periodic changes and tended to underestimate delayed intervals, thus preferring immediate options. The influence of view of time on intertemporal decision-making operates through differences in time meaning: individuals with different views of time define time differently, leading to changes in time perception patterns and consequently differences in intertemporal decisions.

Finally, time management disposition is a dynamic personality characteristic closely related to people' s attitudes toward time and time values, comprising time value sense and time monitoring view (Huang & Zhang, 2001). Time management disposition corresponds to the planning and time linearity/economicity dimensions of time personality. Research generally indicates that individuals lacking time management disposition are more likely to experience time pressure (Donnelly et al., 2019) and feel time scarcity when performing time-related tasks. Due to time pressure, individuals tend to be impulsive in decision-making and ultimately prefer immediate rewards (Sohn & Lee, 2017).

Time personality serves as an umbrella term for time belief research. Although time perspective involves the broadest range of time personality dimensions, and the development of time perspective research has macroscopically expanded the theoretical construction of time personality—partially compensating for the lack of macro-level comprehensiveness in time personality dimensional models—the two have yet to be organically integrated. Moreover, procrastination, view of time, and time management disposition similarly involve interactions among one or more time personality dimensions in affecting decision-making processes and may share common temporal dimensions, suggesting potentially similar mechanisms of influence on decisions. However, different temporal beliefs emerge around specific temporal contexts and differ essentially in conceptual connotations, thus exerting potentially fixed influences on decisions. For example, procrastination easily triggers temporal anxiety within time dimensions, so procrastinators' negative emotions when facing decision waiting time may represent a fixed mechanism affecting decisions (Wu et al., 2016).

3 Theoretical Explanations of Time Personality in Intertemporal Decision-Making

Time personality influences intertemporal decision-making through four operational modes, emphasizing its characteristics in time perception, emotional attitudes, cognitive-motivational processes, and individual differences. Currently, specialized decision-making theories correspond to these operational modes.

3.1 Dynamic Cognitive Model

Traditional intertemporal decision-making theories posit that individuals statically allocate attentional resources to time and value dimensions, making one-time evaluations of both dimensions. However, recent research indicates that attentional resources dynamically shift between dimensions during decision-making, with choices emerging through repeated comparisons of differences between time and value dimensions—so-called "single dimension priority." Based on this notion, Dai and Busemeyer (2014) proposed the Attribute-Wise Diffusion Model (AWDM), suggesting that individuals continuously evaluate time and value across two decision options during intertemporal decision-making, with these evaluations gradually accumulating until a choice is made or attentional resources continue to be allocated for comparison. Additionally, AWDM posits that individuals' initial attentional states affect subsequent evaluation accumulation processes. However, differences in time personality influence attentional characteristics during decision-making: individuals generally hold specific temporal beliefs that create different attentional biases toward time and value dimensions. For instance, present time perspective individuals, being more "time orientation" focused on the present while neglecting future time, pay greater initial attention to options corresponding to immediate time (Nan & Qin, 2019). Therefore, AWDM cannot reflect how time personality affects attentional preferences in decision-making. In recent research, Dai et al. (2018) revised the model by proposing a dynamic cognitive model, suggesting that individuals have distinct discrimination thresholds when attending to immediate and delayed options, with these thresholds showing substantial individual differences influenced by temporal beliefs. Thus, the dynamic cognitive model can effectively reflect the process mechanism through which time personality influences intertemporal decision-making by affecting attentional preferences.

3.2 Perceived Time Based Model

The Perceived Time Based Model (PTBM) posits that individuals' perception of delayed time directly influences intertemporal decision-making (Kim & Zauberman, 2009). Specifically, shorter time interval perception reduces the perceived waiting time for delayed rewards, demonstrating greater patience and preference for delayed rewards; whereas longer time interval perception not only reduces "waiting patience" but also amplifies potential risks behind time (Bradford et al., 2019), potentially causing individuals to abandon delayed rewards. However,

time personality may alter time length perception experiences during decision-making, thereby affecting decision outcomes. To address this, PTBM introduces a "time sensitivity" parameter to reflect individual sensitivity to perceiving delayed time length in decision-making, with more sensitive individuals better detecting time differences between immediate and delayed options. In summary, PTBM has been widely used to explain why individual differences in time perception length lead to different decision preferences (Suo et al., 2014; Xu et al., 2019). However, researchers often neglect discussion of time personality when using PTBM to explain decision results. "Time sensitivity" actually corresponds to the "time awareness" dimension, reflecting the strength of individuals' connection between present and future. The main reason researchers neglect this temporal dimension' s effect on time perception may be the difficulty in quantifying "time awareness," as no effective tools exist to specifically differentiate individuals' differences in "time relation." Therefore, future research could attempt to develop corresponding measurement tools to explore the mechanism through which time personality influences intertemporal decision-making via time perception.

3.3 Temporal Motivational Theory

Temporal Motivational Theory (TMT) explains the cognitive-motivational process through which time personality influences intertemporal decision-making (Steel & König, 2006). TMT posits that motivation arises from four core features: value, expectancy, time, and different gain/loss situations. Changes in value expectancy during decision-making constitute the decisive factor for decision motivation, with time being the key factor affecting value expectancy. On one hand, as time progresses, the subjective value of directly obtainable rewards decreases exponentially, while the subjective value of unobtained rewards rises rapidly, making individuals more inclined toward unobtained rewards. On the other hand, time attitudes reflected by time personality similarly affect decision subjective value. For example, present time perspective individuals hold positive emotions toward immediate preferences (Nan & Qin, 2019; Smith et al., 2020), while procrastinators delay the process of waiting for delayed rewards (Wolters et al., 2017). Such time attitude-triggered emotions or experiences lead to underestimation of delayed rewards, thereby strengthening individuals' motivation to choose immediate rewards. Although cognitive-motivational processes represent the primary operational mode of time personality, TMT does not provide precise descriptions of the "cognitive" process, leaving unclear which psychological attributes are involved between time personality and motivation. Currently known is that time personality can influence decision motivation through time perception, attention, and memory (Andre et al., 2018; Nan & Qin, 2019; Witowska et al., 2020).

3.4 Construal Level Theory

Construal Level Theory (CLT) posits that anticipating and interpreting distant future events can only involve vague features, whereas anticipating present and near-future events constructs more concrete features in the mind. According to CLT, intertemporal decision outcomes depend on differences in individuals' construal levels of present or future scenarios induced by time personality (Trope & Liberman, 2011). Regarding direct effects, Cheng et al. (2012) found that individuals with future time perspective significantly enhance future construal levels, enabling clear representation of future options' benefits and time during decision-making, with full consideration of risks and feasibility. However, construal level may also be moderated by context. For instance, numerous studies have found (Li et al., 2015; Li et al., 2018; Gidlöf et al., 2020) that pregnant women are more future-oriented in time orientation, exhibiting stronger future construal levels—that is, compared to non-pregnant women, pregnant women can more clearly anticipate scenarios such as "future child' s birth, learning, and life." Therefore, CLT effectively explains why differences in temporal beliefs lead to different scenario expectations, but how temporal beliefs influence construal levels remains unclear. The possible reason is that individuals employ different cognitive processing modes when making decisions across different time ranges (Lin & Epstein, 2014; Masuda & Nisbett, 2001). When processing modes constrain scenario construction, the role of temporal beliefs becomes prominent, thereby affecting individuals' construal levels and further influencing decision-making processes.

4 From "Single" to "Holistic" Mechanisms

When examining the influence mechanisms of any trait-like temporal belief on intertemporal decision-making, one can analyze how a particular temporal belief affects individual decision-making processes through interactions among one or multiple dimensions from time personality' s dimensional models. Moreover, one or multiple temporal dimensions can be analyzed using corresponding theoretical models. For example, procrastination is highly correlated with task emotions in the future time direction (Wu et al., 2016) and involves less consideration of procrastination consequences under future time (Ferrari, 2000). These correspond to the "time anxiety" and "time orientation" macro-dimensions of time perspective, and when these two dimensions operate, they activate corresponding emotional and attentional characteristics, causing changes in perceived time patterns (Zhang et al., 2016) that ultimately affect decision-making. This aligns with PTBM' s viewpoint. More importantly, when analyzing a particular temporal belief, the more dimensions involved, the more complex its pathways influencing intertemporal decision-making, and the more likely prediction biases become. Such biases may primarily arise from individual differences. For instance, individuals may simultaneously hold both "cyclical" and "linear" views of time due to combined effects of "regional culture" and "acquired experience," thus possessing different "time linearity and economicity" beliefs. To accurately

predict intertemporal decision-making through "view of time" in such cases, one could attempt to "quantify" and analyze individuals' strength of "time linearity and economicity" beliefs to further differentiate the influence degrees of the two views of time, thereby approximating real decision outcomes.

Regarding the "holistic" mechanism of time personality, due to its involvement of numerous dimensions, the individual differences manifested by time personality are difficult to determine through "quantification." However, one can analyze how it influences intertemporal decision-making from the perspectives of formation, situational characteristics, and development. First, holistically speaking, time personality formation is a slow process influenced by genetics and inherent culture (Stolarski et al., 2015), while acquired temporal attitude experiences also function in decision-making processes. Therefore, time personality' s influence may result from genetic-experiential interactions. Second, "situation" may be a necessary condition for time personality expression. Time personality manifests as temporal beliefs in specific contexts, and intertemporal decision-making primarily anticipates future time. When the decision context matches individuals' time personality (e.g., "purchasing insurance" matching "future time perspective," "completing work before deadline" matching "procrastination"), the corresponding time personality may more easily exert influence, thereby affecting decision-making through attention, emotion, and memory. Finally, time personality is not constantly stable. Presented experiential conditions may temporarily alter certain dimensions of time personality. For example, view of time can be activated through language (Xu et al., 2019). However, time personality possesses trait attributes (Stolarski et al., 2020), so such priming may not affect individuals' inherent time personality itself.

5 Applicability Issues of Time Personality Across Time Horizons—Behavioral and Neural Perspectives

Although time personality in intertemporal decision-making affects people' s evaluation of immediate and delayed options, delay length may influence time personality activation. That is, the predictive validity of time personality for intertemporal decision-making may not be fixed across different time horizons but may have certain applicable ranges. The primary reason lies in potential differences in individuals' cognitive processing modes across time horizons. Analytical and holistic processing represent two modes for processing decision information (Masuda & Nisbett, 2001). In analytical mode, people deconstruct all factors influencing decisions for individual judgment but are highly susceptible to emotion and attention interference (Gallagher & Dagenbach, 2007). In holistic mode, people comprehensively consider factors like time and value but are easily influenced by decision background framing (McElroy & Seta, 2003). Time personality is closely related to changes in decision background framing. Förster et al. (2004) found that time personality functions to activate situational expectations, while Lin and Epstein (2014) directly stated that time personality' s influence on intertemporal decision-making depends on activated expected

scenarios, with individuals comprehensively considering decision processes from constructed scenarios representing the primary operational mode of time personality. Therefore, under expected scenarios, individuals may more likely adopt holistic processing mode. Using CLT as the basic framework (Trope & Liberman, 2011): under short delay intervals, individuals construct decision scenarios more clearly. According to the dynamic cognitive model, individuals then adopt analytical mode to repeatedly discriminate time and value in intertemporal decisions (Amasino et al., 2019), where environmental and cognitive factors may contribute more strongly to decisions than time personality. Under long delay intervals, the clarity of decision scenario construction rapidly decreases, and people' s decisions often rely on personality and experience. At this point, the stable attitudinal motivation expressed by time personality helps enhance construal levels, enabling individuals to process decision information using holistic mode (Li et al., 2018). Therefore, time personality' s contribution to predicting intertemporal decision-making may be greater under long delay intervals, and decision information clarity will also strengthen the connection between time personality and construal levels, further improving predictive effects.

At the neurophysiological level, intertemporal decision-making shows prolonged activation in the ventromedial prefrontal cortex (vmPFC) (Ikink et al., 2019), while vmPFC is highly correlated with procrastination (Zhang et al., 2016). Guo et al. (2017) used VBM technology to identify vmPFC as an overlapping activation region between future time perspective and intertemporal decision-making, suggesting vmPFC may be the shared neural substrate between time personality and intertemporal decision-making. vmPFC activation is closely related to situational expectations. McCormick et al. (2018) used fMRI to find that vmPFC first initiates situational expectations during decision-making, then causes hippocampal activation to construct scenarios, which subsequently feeds back to vmPFC for adjustment to complete decision scenario expectation. However, constructing decision scenarios is more difficult over long time distances (Paternoster & Pogarsky, 2009), resulting in lower decision information clarity. Nevertheless, certain time personality types can enhance vmPFC region to achieve clarity in decision information to some extent (e.g., future time perspective) (Fung & Isaacowitz, 2016). Therefore, both behavioral and neural perspectives suggest: (1) The farther the delay interval from the decision point, the greater time personality' s contribution to intertemporal decision-making and the stronger its predictive validity; (2) The clearer the decision background information, the greater time personality' s contribution to intertemporal decision-making and the stronger its predictive validity.

6 Research Outlook

Current research has explored time personality' s influence on intertemporal decision-making, but important mechanistic studies remain incomplete. The mechanisms of time personality are illustrated in Figure 2 [Figure 2: see original paper]. Future research should focus on addressing the following issues:

6.1 Expanding the Conceptual Connotations of Time Personality

First, the conceptual definition of time personality remains inadequate. Existing research lacks consensus on time personality dimensions. However, as research on specific temporal beliefs like time perspective deepens, conceptual exploration progresses more rapidly for these constructs than for time personality itself. Based on time perspective research regarding personality traits (Wu & He, 2012; Zimbardo & Boyd, 2008), cognition (Göllner et al., 2018; Stolarski et al., 2020; Witowska et al., 2020), motivation (Andre et al., 2018; Mello & Worrell, 2015), and emotion (Kooij et al., 2018; Mello et al., 2016), the dimensions of time perspective have been clarified from more macroscopic perspectives. Future research could further investigate the relationships between time personality dimensions and those of time perspective and other temporal beliefs, expanding time personality' s conceptual connotations from more macroscopic perspectives and constructing time personality dimensional models. This would not only help clarify the fundamental connections between time personality and its constituent temporal beliefs but also facilitate accurate description of the process mechanisms through which other temporal beliefs influence intertemporal decision-making.

6.2 Exploring Interactive Effects Among Temporal Beliefs on Intertemporal Decision-Making

Individuals do not exhibit only one temporal belief during decision-making. For example, the same individual may simultaneously activate future time perspective and present time perspective during decision-making (Chen et al., 2018). Researchers have also found that time perspective can predict individuals' procrastination status, and both may simultaneously affect cognitive and behavioral processes (Kim et al., 2017; Sirois, 2014). For intertemporal decision-making, distinguishing the effects and magnitudes of different temporal beliefs is crucial for accurately predicting decision outcomes. Conceptually, present time perspective, future time perspective, and procrastination share certain temporal dimensions, thus exhibiting similar operational modes in their decision-making effects. For instance, both procrastination and time perspective can influence decision-making by altering self-control motivation (Ballard et al., 2017; Kim et al., 2017; Kedia et al., 2019). Therefore, future research could explore differences among temporal beliefs across temporal dimensions based on time personality dimensional models, helping to clarify the interactive effects of temporal beliefs on intertemporal decision-making.

6.3 Constructing an Integrative Theory of Temporal Beliefs and Intertemporal Decision-Making

Existing theories can only explain the role of individual temporal dimensions and fail to fully 诠释 the mechanisms of temporal beliefs. Constructing a holis-

tic model requires addressing the following questions: (1) Is there a common mechanism for how various temporal beliefs are moderated by decision contexts? Numerous studies have found that loss contexts (Wu & He, 2012), future expectations (Li et al., 2018), and self-other decision contexts (Maglio, 2020; Stephan et al., 2011) all produce opposite results when using time personality to predict decision outcomes, possibly because the influence degree of time personality is weakened under different decision contexts. According to Lewin' s formula, individual decision behavior depends on both personality characteristics and environmental features. In this regard, Bond (2013) proposed that contexts first trigger expectations, and the experiences or social norms corresponding to expectations are the main reasons why personality characteristics become obscured. Therefore, future research could explore the mechanisms of decision contexts on time personality from perspectives such as experiential aspects activated by situational expectations. (2) How does time personality influence decision-making through time perception? Recent research indicates that time personality affects individuals' time perception patterns (Xu et al., 2019; Siu et al., 2014; Witowska et al., 2020), which further influence decision motivation. Although PTBM involves time personality and time perception, it fails to explain the mechanism through which time personality affects time perception (Kim & Zauberman, 2009). Witowska et al. (2020) proposed that the "neuroticism" trait underlying time personality is the real cause affecting time perception, with individuals showing more unbalanced temporal beliefs exhibiting more pronounced neuroticism, which affects executive control functions and leads to underestimation of past time intervals. Therefore, future research could expand studies on temporal beliefs and other personality traits to explore the role of time perception in time personality and decision-making. In summary, addressing these two questions would significantly advance the construction of holistic theoretical models, helping us understand time personality' s mechanisms from an integrative perspective and improve its predictive validity for intertemporal decision-making.

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