Enjoy the Present, or Save for the Future? The Influence of Time Perspective on Intertemporal Decision-Making (Postprint)

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Abstract

This study examined the effects of linear and cyclical time perspectives on intertemporal decision-making through three experiments. Experiment 1 demonstrated that, compared to individuals with a cyclical time perspective, those with a linear time perspective exhibited a stronger tendency to select sooner options in intertemporal decisions (Hypothesis 1). Experiment 2 further validated Hypothesis 1 and confirmed the mediating role of time perception (Hypothesis 2). Experiment 3 investigated the moderating effect of time markers (marked vs. unmarked) on the main effect (Hypothesis 3). The experimental results revealed that in unmarked contexts, individuals with a linear time perspective preferred sooner options more than those with a cyclical time perspective; however, this effect was attenuated in marked contexts. This study reveals that time perspective can serve as an influencing factor on individuals' preferences in intertemporal decision-making and enriches research on intertemporal decisions from the perspective of subjective time perception.

Full Text

Enjoy the Present or Wait for the Future? The Effect of Time Perspective on Intertemporal Choice

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Abstract

This research investigated the effects of linear and circular time perspectives on intertemporal choice through three experiments. Experiment 1 demonstrated

that individuals with a linear time perspective, compared to those with a circular time perspective, showed a stronger preference for sooner options in intertemporal decisions (Hypothesis 1). Experiment 2 further validated Hypothesis 1 and confirmed the mediating role of subjective time perception (Hypothesis 2). Experiment 3 examined the moderating effect of time markers (marker present vs. absent) on the main effect (Hypothesis 3). The results revealed that in the absence of markers, individuals with a linear time perspective preferred sooner options more than those with a circular time perspective; however, this effect was attenuated when markers were present. This study reveals that time perspective can serve as an influencing factor on individuals' intertemporal choice preferences and enriches research on intertemporal choice from the perspective of subjective time perception.

Keywords: linear time perspective; circular time perspective; time perception; intertemporal choice; time marker

Classification: B849:C91

1. Introduction

Intertemporal choice refers to the process of weighing costs and benefits at different time points to make decisions (Frederick, Loewenstein & O' Donoghue, 2002). Previous research has often described this process as a choice between a smaller-sooner option and a larger-later option (May, 2017; Read, Frederick & Scholten, 2013; 江程铭, 刘洪志, 蔡晓红, 李纾, 2016). The time factor plays a crucial role in intertemporal choice research (Loewenstein & Thaler, 1989). Most prior researchers have examined intertemporal choice preferences from the perspective of objective time, finding that individuals have different preferences for values at different objective time points. However, this line of research has neglected the possibility that individual differences in subjective time perception may constitute an important source of variation in intertemporal choice preferences (索涛, 张锋, 赵国祥, 李红, 2014). Consequently, some researchers have proposed a subjective time perception-based model of intertemporal choice from the perspective of subjective time (Kim & Zauberman, 2009), suggesting that individuals may develop different preferences for options in intertemporal choice due to differences in their subjective perception of the same objective time interval.

Following this theoretical perspective, existing research has explored how various factors not directly related to time itself can alter intertemporal choice preferences by influencing individuals' subjective time perception, such as spatial distance (Kim, Zauberman & Bettman, 2012), sexual cues (Kim & Zauberman, 2013), and individual impulsivity traits (Barkley, Edwards, Laneri, Fletcher & Metevia, 2001). However, the existing literature has rarely examined subjective time perception from factors directly related to time itself. Since people' s ability to judge time gradually develops through practical activities (McCormack, 2014), differences in individuals' understanding of time itself can affect subjective time perception (李爱梅, 孙海龙, 熊冠星, 王笑天, 李斌, 2016). Given that

individuals' tendency to overestimate or underestimate time can explain different intertemporal choice preferences (索涛等, 2014), research examining how individuals' general conception of time influences their time perception can help us better understand intertemporal choice preferences.

1.1 Time Perspective and Time Perception

Based on differences in how individuals understand time, two time perspectives can be distinguished: linear time perspective and circular time perspective (Caillois & McKeon, 1963; Overton, 1994). Individuals with a linear time perspective view time as a straight line—a linear, unidirectional process that continuously extends forward, develops and changes, and passes irretrievably once gone (Baltes, 1987; Lightfoot & Lyra, 2000). In contrast, individuals with a circular time perspective understand time as a circle, a cyclical motion of constant repetition where things change periodically over time (Sheth & Shimojo, 2000; Yamada, 2004). Those with a circular time perspective believe time is a closed loop of constant repetition that focuses on the past, pursues stability and symmetry, and represents a reversible process of constantly returning to the origin (Yamada, 2004; Yamada & Kato, 2006).

People develop different time perspectives because they observe and understand time differently in practice. Individuals with a linear time perspective divide time into past, present, and future, forming the notion that history continuously moves forward and cannot turn back (Caillois & McKeon, 1963). The circular time perspective emerges from people' s observations of surrounding phenomena (such as tidal changes, seasonal cycles, and celestial movements), forming an evolutionary concept of cyclical repetition (Yamada & Kato, 2006).

These differences in cognitive approaches lead individuals with the two time perspectives to behave differently in future time-related behaviors. Research on emotions has found that individuals with a circular time perspective believe life has a repetitive rhythm and pace. Although negative emotions caused by external events disrupt this rhythm, they believe the future will eventually return to its original pace (Ruscher, 2012). Additionally, other studies have found that individuals with a linear time perspective more strongly anticipate positive changes in the future and are therefore less willing to save in the present (Tam & Dholakia, 2013).

These behavioral tendencies indicate that individuals with different time perspectives have different expectations about future changes. Individuals with a linear time perspective believe history continuously evolves forward, with things changing significantly from past to future over time (Lightfoot & Lyra, 2000). In contrast, individuals with a circular time perspective associate time with repetitive events, such as the daily cycle of sunrise and sunset, believing the future is a cyclical continuation of the past. Moreover, compared to those with a linear time perspective, individuals with a circular time perspective do not have clear expectations of better or worse outcomes in the future (Graham,

1981). Therefore, when judging a future time period, individuals with a linear time perspective (compared to those with a circular time perspective) tend to perceive greater change in events.

People' s perception of external event changes often influences their subjective time perception. Time is invisible and abstract. When judging time subjectively without objective timing instruments, we habitually rely on visible event changes as reference points. Existing research has found that people's perception of time is actually a perception of events and motion (Gibbons, Brandler & Rammsayer, 2003), and judgments of time duration represent a perception of the amount of event change (Poynter & Homa, 1983). Using external event changes to grasp the passage of time provides an excellent operational description of time perception processing (黄希庭, 徐光国, 1997). For the same physical time interval, the greater the degree of event change people perceive, the longer their estimate of that interval (Block, 1978; Fraisse, 1984). Individuals' time perspectives influence expectations of future event changes, and those with a linear time perspective (compared to those with a circular time perspective) expect greater changes in the future. Consequently, individuals with a linear time perspective make longer subjective time judgments for the same time interval than those with a circular time perspective.

1.2 Time Perspective and Intertemporal Choice

Traditional economic theory understands intertemporal choice as a process of discounting and comparing values at different time points at a certain rate (Samuelson, 1937), with early models reflecting all psychological factors in decision-making as a single discount rate variable (Frederick et al., 2002). Many scholars have improved these models by considering how objective time changes option values to explain why psychological discount rates vary with objective time (Kassam, Gilbert, Boston, & Wilson, 2008). Present bias represents a typical phenomenon of different intertemporal choice preferences across objective times, referring to people' s tendency to overvalue the present in temporal discounting (Kim & Zauberman, 2009; 梁竹苑, 刘欢, 2011).

However, beyond objective time, subjective time perception constitutes an important variable to consider in intertemporal choice. Researchers have found that perceived time length increases non-linearly from near to far, with more distant time being subjectively perceived as shorter (Zauberman, Kim, Malkoc, & Bettman, 2009). Consequently, previous research has proposed a subjective time perception-based model of intertemporal choice, explaining the present bias phenomenon from the perspective of subjective time perception (Kim & Zauberman, 2009; Takahashi, 2006). Existing studies have found that many factors can alter intertemporal choice preferences by influencing subjective time perception length. When these factors make subjective future time perception longer, people prefer sooner options in intertemporal decisions (Barkley et al., 2001; Kim & Zauberman, 2013; Kim et al., 2012; 李爱梅等, 2016; 索涛等, 2014).

Subjective time perception in intertemporal choice represents an estimation of future time (the interval between options). People' s relevant beliefs significantly influence this estimation result. Since time perspective constitutes a general conception of how people understand time, it affects time perception in intertemporal decisions, thereby influencing intertemporal choice outcomes.

The influence of time perspective on future time perception primarily occurs through expectations of future change. People' s perception and judgment of time length actually represent perception and judgment of events and motion (Gibbons et al., 2003). In research on duration judgment, researchers believe that when greater event change occurs within a time period, people make longer subjective judgments of that period (Brown, 1995; Poynter & Homa, 1983). When people believe more steps exist between the final outcome and the current state, their expected time length also becomes longer (Siddiqui, May, & Monga, 2014). Therefore, individuals with a linear time perspective (compared to those with a circular time perspective) expect greater future change and judge the same interval length to be longer.

Based on this reasoning, this study proposes the following hypotheses:

Hypothesis 1: In intertemporal choice, individuals with a linear time perspective, compared to those with a circular time perspective, show stronger preferences for sooner options.

Hypothesis 2: In intertemporal choice, subjective time perception mediates the effect of time perspective on intertemporal choice preferences.

1.3 Boundary Conditions of the Effect of Time Perspective on Intertemporal Choice Preferences

Time is abstract, and individuals need to rely on other cues to make subjective judgments about time length (Gibbons et al., 2003). This study proposes that time perspective serves as a cue for individuals to judge future time. Individuals infer event changes that will occur within future time periods based on their understanding of time, thereby judging the length of future time and consequently influencing intertemporal decisions. However, when individuals do not rely on such cues for judgment, we would expect differences in perceived future time length between individuals to disappear, thus not causing differences in intertemporal choice. We believe that time marker information represents one factor influencing people' s use of time perspective to perceive time length.

Since time length perception is affected by individuals' perception of events occurring within that time period, information about future time markers can influence individuals' time judgments. Future time markers refer to events that will occur in the future. These events serve as reference cues for time judgment, and when individuals are informed that certain events will occur in the future, their future time perception is affected (May, 2017). The quantity information of events, as a type of future time marker information, can influence individuals'

time judgments (Block & Zakay, 1997).

When external information informs individuals about what events will occur in the future, this future time marker information becomes a more direct and salient cue for future time judgment—in other words, a more diagnostic cue (Lynch Jr, Marmorstein & Weigold, 1988). When more diagnostic cues are absent, the time perspective cue plays a primary role; when more diagnostic cues are present, we can expect differences in future subjective time judgment caused by different time perspectives to diminish. Therefore, in the process of judging intertemporal decisions, when no additional future time marker information exists, individuals are more likely to rely on time perspective for future time judgment, and thus time perspective influences intertemporal choice preferences through subjective perception of the interval time. However, when clear external cues serve as time markers (such as information about the specific number of events that will occur in the future), individuals' reliance on time perspective decreases, and consequently the influence of time perspective on intertemporal choice preferences weakens. Based on this reasoning, this study proposes the following hypothesis:

Hypothesis 3: In intertemporal choice scenarios, when external time marker cues are absent, individuals with a linear time perspective (compared to those with a circular time perspective) show stronger preferences for sooner options; however, when external time marker cues are present, this difference weakens or disappears.

1.4 The Current Research

To test these hypotheses, we conducted three experiments. Experiment 1 examined the influence of linear and circular time perspectives on intertemporal choice, thereby testing Hypothesis 1. Experiment 2 altered the manipulation method of time perspective to further validate Hypothesis 1 and tested the mediating role of subjective time perception, namely Hypothesis 2. Experiment 3 investigated the boundary conditions of the effect of time perspective on intertemporal choice preferences by manipulating the presence or absence of external time markers, thereby testing Hypothesis 3.

Experiment 1

Purpose

The primary purpose of Experiment 1 was to validate the effect of different time perspectives on intertemporal choice preferences. To test this effect, we compared preference differences between sooner and later options under two conditions: linear time perspective and circular time perspective. We predicted that individuals with a linear time perspective, compared to those with a circular time perspective, would show a stronger tendency to choose sooner options.

Method

Participants Experiment 1 employed a single-factor, two-level (time perspective: linear versus circular) between-subjects design. Participants were randomly assigned to one of two experimental groups. A total of 61 students from a university in Wuhan (36 females, 25 males) participated in the experiment, with a mean age of 23.51 years (SD = 2.64). The linear time perspective group comprised 31 participants, and the circular time perspective group comprised 30 participants.

Procedure Participants were informed that they were participating in a study on consumption levels. We had participants complete two tasks related to time perspective (sentence manipulation and event recall) to manipulate their time perspective, after which they completed the intertemporal choice task.

Taking the linear time perspective group as an example, we first conducted sentence manipulation of time perspective. Participants read well-known poems and selected appropriate options to fill in. The linear time perspective group' s poems included phrases such as "Time flies like a shuttle, time flies like an arrow," "The sun and moon, once past, cannot be chased again," and "Flowing water will not return, time will not turn back." We then asked participants to read a description of time perspective and engage in related event recall (Tam & Dholakia, 2013). The linear time perspective material read as follows: "Our daily life consists of separate periods, just as we bid farewell to childhood and enter adolescence, and then from adolescence enter adulthood. Our lives cannot start over; many things, once past, disappear and will not happen again." After reading, participants were asked to recall a real-life example consistent with the poems and description, and to record this event. The time perspective manipulation for the circular time perspective group was similar to that for the linear time perspective group, differing only in the manipulation sentences and descriptions (details available in the appendix).

Following Rachlin and Jones (2008), we had participants in both groups complete an intertemporal choice task. The specific choice scenario was as follows: "Recently, you bought a sports lottery ticket. Today, after the draw, you discover you have won. You call customer service to inquire about how to claim your prize. The customer service representative indicates that you can choose to receive a smaller amount today, or wait 30 days to receive a larger amount. Please make your choice among the following options." There were nine sets of options, each presenting a choice between a sooner option (receive now) and a later option (receive after a 30-day delay). The amount for the "receive after 30 days" option was fixed at 200 yuan, while the sooner option amounts in the nine sets increased incrementally from 20 yuan to 180 yuan in steps of 20 yuan. Participants made nine choices, selecting option 1 or 2 for each set.

The nine choice sets were as follows: - Set 1: 1. Receive 20 yuan now; 2. Receive 200 yuan in 30 days - Set 2: 1. Receive 40 yuan now; 2. Receive 200 yuan in

30 days - ···- Set 9: 1. Receive 180 yuan now; 2. Receive 200 yuan in 30 days

We measured participants' intertemporal choice preferences through the subjective value of the later option. The calculation method for the subjective value of the later option was: if a participant chose option 1 (or option 2) in all nine sets, the subjective value was 10 (or 190); if a participant chose option 2 in the early sets and option 1 in the later sets, we calculated the average of the sooner option amount in the set where they first chose option 1 and the sooner option amount in the previous set, using this average as the subjective value of the later option. A larger subjective value of the later option indicated stronger participant preference for the later option. At the end of the experiment, we collected participants' demographic information and manipulation check data. No participants identified the true purpose of the experiment, and all participants were included in the final analysis.

Results

Manipulation Check. We examined the effectiveness of the time perspective manipulation. Drawing on previous studies (Moser, Stauffacher, Krütli, & Scholz, 2012; Ruscher, 2012; Tam & Dholakia, 2013), we measured participants' time perspective tendency using six adapted items on a 7-point Likert scale. The first three items reflected a linear time perspective, while the last three items reflected a circular time perspective. We reverse-coded the scores of the last three items and calculated the average together with the scores of the first three items to represent participants' time perspective tendency score. Higher scores indicated a stronger tendency to view time linearly, while lower scores indicated a stronger tendency to view time circularly. The results showed that the time perspective manipulation was successful (Cronbach' s $= 0.89$, M_linear $= 4.87$, M_circular $= 3.39$, $t(59) = 5.43$, $p < 0.01$, ^{2}_p $= 0.33$).

Main Effect Analysis. We conducted an ANOVA with time perspective as the independent variable and the subjective value of the intertemporal choice task as the dependent variable. The results showed that the subjective value of the linear time perspective group (M_linear $= 129.35$, SD $= 39.15$) was smaller than that of the circular time perspective group (M_circular $= 150.67$, SD $= 38.41$), and the difference between the two groups was significant ($F(1, 59) = 4.60$, $p < 0.05$, ^{2}_p $= 0.07$). This indicates that compared to participants in the circular time perspective group, participants in the linear time perspective group perceived the value of the later option as lower and showed stronger preference for the sooner option, thereby validating Hypothesis 1.

Discussion

The results of Experiment 1 indicate that even when facing the same intertemporal choice task, consumers' intertemporal choices differ significantly when their time perspectives differ. When confronted with identical intertemporal choices, participants with a linear time perspective showed stronger preference for sooner

options compared to participants with a circular time perspective.

Although Experiment 1 validated the effect of linear and circular time perspectives on intertemporal choice, we have yet to examine the mechanism through which time perspective influences intertemporal choice. For this reason, we conducted Experiment 2 to investigate the mediating role of subjective time perception in the effect of time perspective on intertemporal choice.

Experiment 2

Purpose

The main purpose of Experiment 2 was to examine whether time perception mediates the effect of different time perspectives on intertemporal choice preferences and to further validate Hypothesis 1.

Method

Participants Experiment 2 also employed a single-factor, two-level (time perspective: linear versus circular) between-subjects design. Participants were randomly assigned to one of two experimental groups. A total of 64 students from a university in Wuhan (40 females, 24 males) participated in this experiment.

Procedure In this experiment, we continued to use sports lottery red packets as the experimental stimulus for the intertemporal choice task. However, unlike Experiment 1, we manipulated time perspective using pictorial materials to exclude potential interference from the sentence manipulation method, which might cause participants to experience a sense of time poverty, thereby generating time pressure and negative emotions (李爱梅等, 2016) that could affect experimental results.

Taking the circular time perspective group as an example, participants first read a picture related to time perspective (Figure 1 [Figure 1: see original paper]) and a paragraph of description:

Figure 1 Circular Time Perspective Manipulation

Picture description: "The above image shows the growth process of a fruit tree, from budding, to growing taller, to dense foliage, to bearing fruit, and then from the fruit falling to the soil and sprouting again the next year, continuously cycling and developing. Humans, like trees, continuously reproduce generation after generation, and our lives also experience this cycle, for example, the continuous alternation of spring, summer, autumn, and winter each year, the endless cycle of seven days each week, and every day we repeat the same activities—working, studying, eating, and resting." After reading this information, participants in each group recalled a real-life example consistent with it and recorded this event. The time perspective manipulation for the linear time perspective

group was similar to that for the circular time perspective group, differing only in the manipulation pictures and descriptions.

All participants were randomly assigned to either the linear time perspective group or the circular time perspective group and were informed that they were participating in a study on consumption levels. We first had participants complete a task related to time perspective, manipulating their time perspective through material reading and event recall (Ruscher, 2012). Next, we had participants in both groups complete an intertemporal choice task. Participants needed to imagine the following scenario: "Recently, you bought a sports lottery ticket. Today, after the draw, you discover you have won. You call customer service to inquire about how to claim your prize. The customer service representative indicates that you can choose to receive the prize today, or you can choose to receive it in 30 days. If you receive it today, you will get 200 yuan. If you receive it in 30 days, please estimate an amount that you are fairly confident you could receive, such that its value is equivalent to receiving 200 yuan today." Participants filled in the corresponding amount to indicate the subjective value of the sooner option (receiving 200 yuan today), with larger numbers indicating stronger preference for the sooner option (Kim & Zauberman, 2013).

Subjective time perception was measured by asking participants to estimate the length of the interval time in the intertemporal decision using a number between 1 and 100, with larger numbers indicating longer subjective time perception and smaller numbers indicating shorter subjective time perception (刘扬, 孙彦, 2016). Finally, we measured participants' time perspective tendency using the same method as in Experiment 1, collected demographic information, and asked participants to guess the research purpose. No participants identified the true purpose of the experiment, and therefore all participants were included in the analysis.

Results

Manipulation Check. We examined the effectiveness of the time perspective manipulation (Cronbach' s = 0.85). The results showed that the manipulation of participants' time perspective was successful (M_linear = 5.58, M_circular = 3.53, t(62) = 6.92, p < 0.01, ^{2}_p = 0.44).

Main Effect Analysis. We conducted an ANOVA with time perspective as the independent variable and the subjective value of the sooner option as the dependent variable. The results showed that the subjective value of the linear time perspective group (M_linear = 303.64, SD = 92.19) was greater than that of the circular time perspective group (M_circular = 256.61, SD = 81.67), and the difference between the two groups was significant (F(1, 62) = 4.64, p < 0.05, ^{2}_p = 0.07). This indicates that compared to participants in the circular time perspective group, participants in the linear time perspective group perceived the subjective value of the sooner option as higher and showed stronger preference for the sooner option in intertemporal decisions. These findings again

validated Hypothesis 1.

Mediation Analysis. We conducted an ANOVA with time perspective as the independent variable and subjective time perception in the intertemporal choice task as the dependent variable. The results showed that time perspective had a significant effect on subjective time perception ($F(1, 62) = 4.47$, $p < 0.05$, ^{2}_p = 0.07), meaning that participants in the circular time perspective group perceived the time interval in the intertemporal choice task as shorter than those in the linear time perspective group (M_circular = 45.65, SD = 24.11; M_linear = 59.03, SD = 26.35).

Next, we used the Bootstrap method proposed by Hayes (2013) and the SPSS macro developed by him for testing. We selected Model 4, set Bootstrap resampling to 5000 iterations, used time perspective as the independent variable, subjective time perception as the mediator, and the subjective value of the sooner option as the dependent variable to run the indirect effect analysis. The results indicated that time perception had a significant effect on the subjective value of the later option ($b = 2.03$, $SE = 0.36$, $p < 0.01$). The conditional indirect effect of time perspective on subjective value was -27.14, with a 95% confidence interval of [-57.78, -2.64] that did not include zero, indicating a significant effect. However, the direct effect of -19.88 was not significant (95% CI: [-56.75, 16.98] included zero). See Figure 2 [Figure 2: see original paper] for details. Therefore, time perception mediated the effect of time perspective on intertemporal choice. The experimental results supported Hypothesis 2.

Figure 2 Mediating Role of Subjective Time Perception in Experiment 2

Discussion

The results of Experiment 2 showed that when individuals with different time perspectives made choices on the same intertemporal decision task, participants with a linear time perspective perceived the subjective value of the sooner option as higher than those with a circular time perspective, indicating stronger preference for the sooner option, thereby validating Hypothesis 1. Additionally, Experiment 2 demonstrated that the effect of time perspective on intertemporal choice occurs through individuals' subjective time perception of the intertemporal options, with subjective time perception playing a mediating role in the influence of time perspective on intertemporal choice. In other words, the results of Experiment 2 also supported Hypothesis 2. In this experiment, we used a different time perspective manipulation method from Experiment 1, and the experimental results were consistent with those of Experiment 1, indicating the robustness of our findings.

Experiment 3

Purpose

The main purpose of Experiment 3 was to investigate the boundary conditions of the effect of time perspective on intertemporal choice by introducing time marker types. We predicted that in the absence of time markers, differences would exist in how linear and circular time perspectives affect intertemporal choice; however, when time markers are present, the influence of linear and circular time perspectives on intertemporal choice would weaken, thereby testing Hypothesis 3. Additionally, this experiment adopted the same time perspective manipulation method as Experiment 2 and added manipulation check questions for participants' emotions to facilitate examination of whether emotion represents a significant confounding variable for the experimental results.

Method

Participants Experiment 3 employed a 2 (time perspective: linear versus circular) × 2 (time marker: with marker versus without marker) between-subjects design. Participants were randomly assigned to one of four experimental groups. A total of 128 students from a university in Wuhan participated in this experiment, of whom 6 failed to complete the association task as required. The final valid sample consisted of 122 students (78 females, 44 males) with a mean age of 20.46 years (SD = 1.78). Both the linear with marker group and the circular with marker group had 30 participants each, while both the linear without marker group and the circular without marker group had 31 participants each.

Experimental Manipulations We manipulated participants' time perspective using the same method as in Experiment 2. Time markers were provided by giving participants information about future events that might occur. This information was not directly related to the intertemporal choice. The event information differed for different time marker groups. The information presented in the with marker group included specific events and quantities, while the without marker group was only informed that events would occur but was not presented with specific quantity information. Specifically, the event used in Experiment 3 involved asking participants to imagine they had a friend planning fitness exercises. Participants in the with marker group were told the specific number of times this friend planned to exercise during the same time interval as the main (intertemporal choice) task, while participants in the without marker group were only told that the friend would exercise during that future time period without specific frequency information.

Procedure First, all participants were informed that they were participating in a study on exercise behavior and answered some exercise-related questions (e.g., "Does exercise make you happy?"). Next, participants were told to assume they had a friend who would plan fitness exercises in the future and were asked to recommend exercise programs to this friend.

Subsequently, depending on their assigned time perspective manipulation group, participants completed the corresponding time perspective manipulation task—the same picture- and text-guided event recall task as in Experiment 2.

Afterward, we presented the same intertemporal choice scenario information to all groups. The intertemporal choice scenario was as follows: "You participated in a survey in a class, and the organizer will pay you a certain remuneration. You have two options: you can choose to receive it immediately after class, or you can choose to receive it in 49 days. If you choose to receive it immediately, you can get 50 yuan. Now we would like to know: if you choose to receive the remuneration in 49 days, what is the minimum amount you would require to be willing to choose the 49-day delay?" After presenting the intertemporal choice scenario but before participants made their valuation of the subjective value of the sooner option, depending on their assigned time marker group, participants received different time marker prompt information. Participants in the with marker group received the prompt that the aforementioned friend planned to schedule 15 fitness training sessions during these 49 days. Participants in the without marker group were only prompted that the friend planned to schedule fitness training during these 49 days without specific frequency information.

Afterward, participants filled in the corresponding amount to indicate the subjective value of the sooner option, with larger numbers indicating stronger preference for the sooner option. Participants then used a number between 0 and 100 to represent their subjective time perception, following the same method as in Experiment 2. Finally, we collected relevant manipulation check information and participants' demographic information and asked participants to guess the research purpose. No participants identified the true purpose of the experiment.

Results

Manipulation Check. We examined the effectiveness of the time perspective manipulation (Cronbach' s = 0.83). Participants' time perspective tendency differed significantly across different time perspective manipulation conditions (M_linear = 5.61, M_circular = 4.28, $F(1, 118) = 71.74$, $p < 0.01$, ^{2}_p = 0.38). The effect of time marker ($F(1, 118) = 0.45$, $p = 0.51$, ^{2}_p = 0.00) and the interaction effect between time perspective manipulation and time marker ($F(1, 118) = 0.56$, $p = 0.46$, ^{2}_p = 0.01) were not significant. These results indicate that the time perspective manipulation was effective. We measured participants' emotions using a 7-point semantic differential scale composed of four word pairs (bad mood/good mood, impatient/at ease, sad/happy, depressed/cheerful) (Swinyard, 1993). The results showed that participants' average emotion was neutral to slightly positive (M = 4.57, SD = 0.92), with no differences across manipulation conditions. Time perspective ($F(1, 118) = 0.46$, $p = 0.50$, ^{2}_p = 0.00), time marker ($F(1, 118) = 0.86$, $p = 0.36$, ^{2}_p = 0.01), and their interaction effect ($F(1, 118) = 0.68$, $p = 0.41$, ^{2}_p = 0.00) had no effect on participants' emotions.

Main Effect Analysis. We conducted an ANOVA on the sample with subjective value of the sooner option as the dependent variable, time perspective as the independent variable, and time marker as the moderator[2]. The results showed a significant interaction effect between time marker and time perspective on intertemporal choice preference ($F(1, 118) = 4.26$, $p < 0.05$, $^2\_p = 0.04$). Simple effects analysis indicated that in the without marker condition, participants in the circular time perspective group showed higher preference for the later option compared to those in the linear time perspective group ($M\_linear = 143.23$, $SD = 60.45$; $M\_circular = 105.32$, $SD = 41.53$; $F(1, 118) = 8.28$, $p < 0.01$, $^2\_p = 0.11$). However, in the with marker condition, the effect of time perspective on intertemporal choice preference was not significant ($M\_linear = 110.17$, $SD = 44.11$; $M\_circular = 109.33$, $SD = 49.94$; $F(1, 118) = 0.01$, $p = 0.95$, $^2\_p = 0.00$). These results are consistent with our proposed Hypothesis 3.

Mediation Analysis. First, we conducted an ANOVA on subjective time perception in the intertemporal choice task with time perspective as the independent variable and time marker as the moderator. The results showed a significant interaction effect between time marker and time perspective on subjective time perception ($F(1, 118) = 4.36$, $p < 0.05$, $^2\_p = 0.04$). Simple effects analysis indicated that in the without marker condition, participants in the circular time perspective group perceived time as shorter than those in the linear time perspective group ($M\_linear = 63.52$, $SD = 14.35$; $M\_circular = 54.13$, $SD = 18.53$; $F(1, 118) = 4.97$, $p < 0.05$, $^2\_p = 0.08$). However, in the with marker condition, the effect of time perspective on time perception weakened ($M\_linear = 49.70$, $SD = 15.00$; $M\_circular = 53.77$, $SD = 22.21$; $F(1, 118) = 0.69$, $p = 0.41$, $^2\_p = 0.01$).

Next, we used the Bootstrap method to test the mediating effect. We set resampling to 5000 iterations and used Model 7, with time perspective as the independent variable, time marker as the moderator, subjective time perception as the mediator, and intertemporal choice preference as the dependent variable to run the mediation analysis. The results found that only in the without marker condition did the mediating effect of time perception between time perspective and intertemporal choice tendency reach significance (95% CI: [-34.96, -2.63] did not include zero), with a conditional indirect effect of -17.74. In contrast, in the with marker condition, the mediating effect of time perception between time perspective and intertemporal choice tendency was not significant (95% CI: [-9.58, 26.01] included zero). The indirect effect of the moderating role was significant (95% CI: [-52.08, -1.91] did not include zero). See Figure 3 [Figure 3: see original paper] for details. This demonstrates that time marker, as a moderating variable, affects intertemporal choice by moderating the mediation. Only in the condition without significant markers does time perspective influence intertemporal choice through differences in time perception. This finding again confirms the mediating role of time perception.

Figure 3 Moderated Mediation Effect in Experiment 3

Discussion

The results of Experiment 3 indicate that in the without time marker condition, differences exist in how linear and circular time perspectives influence intertemporal choice through time perception; however, in the with time marker condition, this difference weakens, thereby validating Hypothesis 3. When significant time markers are present, concrete external cues become the primary basis for people' s time length judgments, with less reliance on indirect judgment through general time perspective. Consequently, differences in event sensitivity between the two time perspectives no longer affect intertemporal choice.

Although Experiment 3 used different option amounts and time intervals from the previous two experiments, the results again validated the mediating role of subjective time perception. That is, time perspective and time markers influence intertemporal choice by affecting time perception, thereby providing further evidence for the validity of Hypotheses 1 and 2.

General Discussion

5.1 The Influence of General Conceptions of Time on Intertemporal Choice

This study begins from differences in people's general conceptions of time, revealing time perspective as a new factor influencing individuals' intertemporal choice preferences. Previous research exploring antecedents of time perception ability in intertemporal choice has focused primarily on aspects not directly related to time itself, such as personality traits and situational factors (Barkley et al., 2001; Reynolds & Schiffbauer, 2004; Wittmann, Leland, Churan & Paulus, 2007; 李爱梅等, 2016), without distinguishing differences in how people understand time itself. This study explores this angle and finds that time perspective has a significant effect on intertemporal choice preferences. Compared to individuals with a linear time perspective, those with a circular time perspective show stronger tendency to choose later options (Experiment 1), and time perception mediates the effect of time perspective on intertemporal choice (Experiment 2). In other words, time perspective reflects different views of time itself, with different perspectives leading to differences in expected future change, which in turn creates differences in time perception and consequently influences intertemporal choice preferences.

5.2 The Moderating Role of Time Markers on the Effect of Time Perspective

This study also identifies the boundary conditions of the effect of time perspective on intertemporal choice, finding that time markers included in the external context moderate the influence of time perspective on intertemporal choice. People do not always infer time through abstract concepts; therefore, the effect of time perspective on intertemporal choice preferences exists only under specific

circumstances. Experiment 3 in this study found that time markers moderate the effect of time perspective on intertemporal choice. Specifically, only in conditions without significant markers does time perspective influence intertemporal choice through differences in time perception, while in conditions with significant markers, this effect weakens. In other words, when people make rapid, intuitive time judgments, time perspective is more likely to serve as a basis for judgment, and the effect of time perspective on intertemporal choice preferences exists. When people have concrete external time cue information, they tend to judge time more objectively and accurately, reducing their reliance on time perspective as an abstract concept, and consequently weakening the effect of time perspective on intertemporal choice preferences.

5.3 The Influence of Time Perspective on Behavior

This study investigates the role of time perspective from a longitudinal time dimension, broadening research on the two time perspectives in the domain of human behavior. Previous research on how different time perspectives influence behavioral differences has mostly elaborated from a cross-sectional time dimension. For example, savings behavior involves whether individuals with different time perspectives perform or do not perform savings at the current time point (Tam & Dholakia, 2013), and research on emotional distress explores whether individuals with different time perspectives can overcome current sadness, without specifically comparing choice behaviors at two time points. In contrast, this study elaborates the influence of different time perspectives in the intertemporal choice domain from a longitudinal two-time-point dimension (now and 30 days later). The research context of the intertemporal choice task in this study is based on the financial domain and uses simple intertemporal choice scenarios to measure people' s intertemporal choice behaviors. However, future research could also investigate the effect of time perspective in other domains (such as life tasks, health, or environmental protection).

This study finds that people' s preferences in intertemporal decisions are influenced by the time perspective they hold. Compared to individuals with a circular time perspective, those with a linear time perspective show stronger preference for sooner options. This occurs because time perspective affects people' s perception of future time length, with time perception under a linear time perspective being longer than under a circular time perspective. When clear time marker cues are present, the influence of time perspective on time judgment weakens, and consequently its influence on intertemporal choice preferences also weakens.

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[2] Some extreme values interfered with the data results in Experiment 3. Specifically, in the original data for the subjective value of the later option, the mean

of participants' responses was 122.70 (SD = 73.36), with three participants' responses exceeding the value of mean plus three standard deviations (342.78), at 450, 480, and 500 respectively. The first participant belonged to the circular without marker group, while the latter two belonged to the linear without marker group. In subsequent analyses, this study performed truncation on these three extreme values, uniformly adjusting them to 250 (the highest value among other participants was 250).

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