

---

AI translation · View original & related papers at  
[chinaxiv.org/items/chinaxiv-202311.00246](https://chinaxiv.org/items/chinaxiv-202311.00246)

---

## Individual and Collective Temporal Self-Evaluation: Behavioral and ERP Evidence

**Authors:** Zhang Feng, Pi Yu, Li Xiaobao, Zhang Feng

**Date:** 2023-11-19T00:00:00+00:00

### Abstract

Using event-related potential (ERP) technology and temporal self-referential tasks, this study investigated college students' individual temporal self-evaluation and collective temporal self-evaluation through two series of experiments. The results revealed that participants employed more positive words and fewer negative words to evaluate both individual self and collective self across past, present, and future dimensions, and that individual self-evaluation showed a positive incremental effect across the past, present, and future dimensions. For both individual self and collective self, negative words elicited larger LPC amplitudes than positive words in the past and present dimensions, whereas no significant difference in LPC amplitude was found between positive and negative words in the future dimension. These findings indicate that both individual temporal self-evaluation and collective temporal self-evaluation among Chinese college students exhibit a cross-temporal positive bias. Furthermore, both individual and collective temporal self-evaluation demonstrate a negative bias effect at the neurophysiological level. Therefore, collective temporal self-evaluation and individual temporal self-evaluation of Chinese college students share similar cognitive-neural characteristics, providing partial support for the interdependent self-construal theory.

### Full Text

## Individual and Collective Temporal Self-Evaluation: Evidence from Behavior and ERP

ZHANG Feng, PI Yu, LI Xiaobao

(Institute of Psychology and Behavior, Henan University, Kaifeng 475004, China)

## Abstract

Using event-related potential (ERP) technology and a temporal self-reference task, two experiments were conducted to investigate individual and collective temporal self-evaluation among college students. The results showed that participants used more positive words and fewer negative words to evaluate past, present, and future individual and collective selves, with a positive incremental effect in individual self-evaluation across the three time dimensions. For both individual and collective selves, negative words elicited larger LPC amplitudes than positive words in the past and present dimensions, while no significant difference in LPC amplitude was found between positive and negative words in the future dimension. These findings indicate that Chinese college students exhibit a positive bias across time in both individual and collective temporal self-evaluation. Moreover, both types of evaluation show a negativity bias effect at the neurophysiological level. Therefore, collective temporal self-evaluation shares similar cognitive-neural characteristics with individual temporal self-evaluation among Chinese college students, providing supporting evidence for the theory of interdependent self-construal.

**Keywords:** individual temporal self-evaluation, collective temporal self-evaluation, temporal self-reference paradigm, event-related potential

## Introduction

Self is a central topic in psychological research. Both individual self and collective self represent forms of self-representation (Brewer & Gardner, 1996; Ellemers, 2012), with the former emphasizing personal uniqueness and the latter highlighting self-definition through group identity. Although individual self occupies a core position in self-structure, research on collective self helps understand group goals, emotions, and behaviors (Gao & Wang, 2017; Liu et al., 2022). Studies have found that, similar to individual self, both explicit and implicit collective selves involve positive emotional experiences, demonstrating emotional consistency between individual and collective selves (Wang et al., 2022; Zheng, 2018). However, self can be divided along the temporal dimension into past self, present self, and future self. Individuals' cognition and evaluation of various characteristics of their past, present, and future selves constitute temporal self-evaluation, which not only serves the important function of maintaining self-identity but also influences emotional experience and goal pursuit (Huang & Xia, 2004; Luo & Huang, 2011; Zhang et al., 2021). Therefore, it is necessary to investigate whether the affective biases in individual and collective self-evaluation exhibit consistency across time.

Temporal Self-Appraisal Theory (TSA), proposed based on Western cultural contexts, suggests that people intentionally derogate their past self to maintain a positive current self-concept (Wilson & Ross, 2000, 2001). Wilson and Ross (2001, 2002) found that college students provided more positive descriptions of their present self than their past self, and middle-aged adults evaluated

their present self more positively than their past self, indicating that Westerners deliberately derogate past self to maintain a favorable present self. However, domestic research findings do not support TSA. Luo et al. (2010) ERP study showed that Chinese college students exhibited equally strong positive and negative evaluations of past and present selves, with even more positive bias toward future self. Luo (2011) found that college students used more positive words and fewer negative words to evaluate past, present, and future selves; positive evaluation of future self was higher than that of present and past selves, while no difference existed between past and present selves. Yao and Zhang (2013) demonstrated that college students with different self-esteem levels showed no significant differences in past positive events whether temporally close or distant from the present, suggesting that Chinese college students hold positive attitudes toward both present and past selves and do not selectively approach past positive events to maintain current positive self-esteem. These results imply that Chinese people have positive feelings toward past, present, and future selves, with the most positive attitude toward future self.

Cultural differences in self-esteem may account for the discrepancies in temporal self-evaluation between Eastern and Western participants (Huang & Yin, 2012). Research has found that people in Western cultures have higher self-esteem levels than those in Eastern cultures (Cai et al., 2007; Cai et al., 2011), more frequently express positive self-evaluations publicly, and exhibit stronger self-enhancement bias (Ross & Wilson, 2002, 2003). In fact, modesty carries important interpersonal significance in Eastern cultures, where personal self-esteem is implicit and restrained (Hu & Huang, 2009). Relative to Westerners, Easterners neither excessively derogate past self nor overly elevate present self (Brown, 2006; Cai et al., 2007). Therefore, although individuals in Eastern cultural contexts hold positive attitudes toward both past and present selves, no significant differences exist between them (Yao & Zhang, 2013). Currently, despite Luo et al. (2010) and Luo (2011) having explored individual temporal self-evaluation, no domestic research has examined the characteristics and underlying neurocognitive mechanisms of collective temporal self-evaluation.

Recently, Western scholars have investigated collective temporal self by asking participants to describe positive and negative events about their nation in the past and future within limited time. The results revealed that Americans and Canadians described more negative national events and fewer positive national events, indicating a negative bias toward both past and future of their nation (Shrikanth et al., 2018; Shrikanth & Szpunar, 2021). Yamashiro and Roediger III (2019) used a similar method and found that participants reported more negative future events about America but recalled more positive events about America's past. Topcu and Hirst (2020) asked American participants to describe 15 past and 15 future collective events and found that participants evaluated future events more positively than past events. These findings suggest that Western participants' attitudes toward collective temporal self are not always consistent, which may be related to self-construal in Western culture. Markus and Kitayama (1991) distinguished between independent self-construal

and interdependent self-construal based on cultural differences between East and West. In Western individualistic cultures, self-esteem emphasizes personal achievements and qualities, with individuals existing independently from groups (Gorodnichenko & Roland, 2012). Independent individuals value personal values (such as freedom) more, whereas interdependent individuals focus more on group-related values (such as belonging) (Verplanken et al., 2009). Therefore, Westerners typically possess an independent self, emphasizing independence, autonomy, and stability in self-definition (Cross et al., 2011), resulting in relatively diverse evaluations of collective temporal self (nation).

In Eastern collectivist cultures, individual self-esteem emphasizes sociality and holism (Gorodnichenko & Roland, 2012). According to interdependent self-construal theory, Easterners' self-construal incorporates the self of larger social groups (such as family and nation), perceiving themselves as connected to important social relationships, emphasizing attention to others and social integration, and promoting identification and solidarity among group members (Markus & Kitayama, 1991; Kraus & Kitayama, 2019; Boylan et al., 2021). Researchers have primed independent or interdependent self-construal by placing participants in individualistic or collectivistic contexts and found that participants developed matching cognitive tendencies: independent self-construal priming produced more individual self-cognition, whereas interdependent self-construal priming produced more collective self-cognition (Trafimow et al., 1991; Mandel, 2003). Studies asking Chinese participants to describe positive and negative individual and collective events in the past and future found that participants described more positive events and fewer negative events across both temporal dimensions, indicating that Chinese participants hold positive attitudes toward both individual and collective selves in the past and future (Liu et al., 2009; Guo, 2020; Mert et al., 2023). Furthermore, research has found that Chinese people also exhibit positive bias toward current individual and collective selves (Wang et al., 2022). Therefore, based on interdependent self-construal theory grounded in Eastern cultural contexts (Markus & Kitayama, 1991; Liu & Zou, 2007), we can hypothesize that in China, a typical collectivist nation, people's collective temporal self-evaluation shares similar characteristics with individual temporal self-evaluation, namely a positive bias.

This study aims to employ a temporal self-reference paradigm and event-related potential (ERP) technique to investigate individual and collective self-evaluation among Chinese college students across past, present, and future dimensions. Research has identified P300 as an important indicator of self-related processing, reflecting top-down attentional bias and cognitive evaluation of self-relevant stimuli (Tacikowski & Nowicka, 2010; Gray et al., 2004). Evidence shows that P300 neural activity during collective self-referential processing is similar to that during individual self-referential processing. For instance, when individuals perform decision-making tasks, judgments consistent with collective and individual selves elicit larger P300 amplitudes than judgments inconsistent with collective and individual selves (Fan et al., 2011; Zheng et al., 2018). This mirroring process suggests that individual and

collective temporal self-referential processes may share neural components. The late positive component (LPC), as a late positive component of P300, typically appears 300-800 ms after stimulus presentation (Luck & Kappenman, 2011) and serves as an EEG indicator of individual temporal self-evaluation (Luo et al., 2010; Luo et al., 2013). Therefore, this study primarily uses LPC as the EEG indicator for statistical analysis. Based on interdependent self-construal theory (Markus & Kitayama, 1991; Liu & Zou, 2007) and previous research (Liu et al., 2009; Mert et al., 2023; Guo, 2020; Wang et al., 2022), this study hypothesizes that Chinese people exhibit positive bias in both individual and collective self-evaluation across past, present, and future dimensions.

Methodologically, this study improves upon previous temporal self-reference paradigms (Luo et al., 2010) by adding a “non-self” experimental condition as a baseline, enabling participants to complete self-referential tasks within a social comparison context and yielding more ecologically valid results. Specifically, in Experiment 1’s individual temporal self-evaluation task, evaluation targets include not only individual self (“me”) but also non-individual self (“Zhangsan”). In Experiment 2’s collective temporal self-evaluation task, evaluation targets include both collective self (“Chinese”) and non-collective self (“Americans”).

## Experiment 1: Individual Temporal Self-Evaluation

### 2.1.1 Participants

Using G\*Power 3.1.9 software with a medium effect size ( $f = 0.25$ ,  $\alpha = 0.05$ ,  $1-\beta = 0.8$ ), the calculated minimum sample size was 13 participants. This study recruited 30 college students (15 males and 15 females,  $M = 20.97$  years,  $SD = 1.87$ ), including 10 sophomores, 8 juniors, and 12 seniors. All participants were right-handed, had normal or corrected-to-normal vision, no history of brain injury or physical and mental health problems, and provided informed consent. They received compensation after the experiment.

### 2.1.2 Experimental Design

A 3 (time: past, present, future)  $\times$  2 (reference object: individual self, non-individual self)  $\times$  2 (valence: positive, negative) within-subjects design was employed.

### 2.1.3 Experimental Materials

Forty positive and forty negative personality adjectives were selected from the “562 Personality Trait Adjectives Scale” (Huang & Zhang, 1992). The two word types differed significantly in desirability ( $M_{\text{positive}} = 5.74$ ,  $SD = 0.90$ ;  $M_{\text{negative}} = 3.27$ ,  $SD = 0.77$ ;  $t = 7.13$ ,  $p < 0.001$ ), but showed no significant differences in familiarity ( $M_{\text{positive}} = 3.03$ ,  $SD = 0.69$ ;  $M_{\text{negative}} = 2.99$ ,  $SD = 0.74$ ;  $t = 1.30$ ,  $p = 0.210$ ) or meaningfulness ( $M_{\text{positive}} = 2.99$ ,  $SD = 0.68$ ;  $M_{\text{negative}} = 2.93$ ,  $SD = 0.77$ ;  $t = 1.52$ ,  $p = 0.145$ ;  $ps > 0.05$ ).

### 2.1.4 Experimental Procedure

The experimental program was compiled using E-Prime 3.0 and run on a 19-inch Dell computer that automatically recorded responses. Each participant completed the task in an independent soundproof laboratory with eyes approximately 60 cm from the screen.

The formal experiment consisted of 3 blocks (past, present, and future) with a total of 480 trials. Each block had two phases: temporal self-priming and lexical judgment. The priming phase required participants to describe themselves five years ago/at present/five years later within two minutes. The judgment phase required participants to determine whether words presented at the center of the screen described themselves five years ago/at present/five years later or non-self (“Zhangsan”). The specific procedure is shown in Figure 1 [Figure 1: see original paper]. Before the formal experiment, participants completed 10 practice trials to familiarize themselves with the procedure.

### 2.1.5 EEG Recording and Processing

EEG data were recorded using a Brain Products EEG system with a 64-channel electrode cap based on the extended international 10-20 system. Electrode impedance was kept below 10 k $\Omega$ , sampling rate was 250 Hz, FCz served as the online reference electrode, and the GND electrode located between FP1 and FP2 was the ground. Electrodes placed approximately 1 cm above the center of participants’ left and right eyebrows (FP1, FP2) recorded electrooculographic activity. Offline analysis was performed after continuous recording, using bilateral mastoids (TP9, TP10) as offline reference electrodes, applying a 0.1-30 Hz bandpass filter, and automatically correcting artifacts. The analysis epoch was 1200 ms, including 200 ms before to 1000 ms after adjective presentation, with the -200 to 0 ms average amplitude serving as baseline. Trials with amplitudes exceeding  $\pm 80$  V were automatically rejected during averaging. Based on previous research (Luo et al., 2010; Luo et al., 2013) and the grand-averaged waveforms in this study, the LPC component (600-750 ms) was selected at electrode sites Cz, C3, C4, CP3, CPz, CP4, P3, Pz, and P4. LPC amplitudes were subjected to a 3 (time)  $\times$  2 (reference object)  $\times$  2 (valence) repeated-measures ANOVA, with p-values corrected using the Greenhouse-Geisser method and post-hoc pairwise comparisons corrected using the Bonferroni method (Greenhouse & Geisser, 1959).

## 2.2 Results and Analysis

The means and standard deviations of adjective selection ratios and LPC amplitudes under different conditions are presented in Table 1 .

### 2.2.1 Behavioral Results

A three-way repeated-measures ANOVA (time  $\times$  reference object  $\times$  valence) on adjective selection ratios revealed significant main effects of reference object,  $F(1, 29) = 7.90$ ,  $p = 0.009$ ,  $\eta^2_p = 0.21$ , and valence,  $F(1, 29) = 246.64$ ,  $p < 0.001$ ,  $\eta^2_p = 0.90$ . The interaction between time and valence was significant,  $F(2, 58) = 13.49$ ,  $p < 0.001$ ,  $\eta^2_p = 0.32$ . The interaction between reference object and valence was also significant,  $F(1, 29) = 10.33$ ,  $p = 0.003$ ,  $\eta^2_p = 0.26$ . The interaction between time and reference object was not significant,  $F(2, 58) = 0.46$ ,  $p = 0.633$ .

The three-way interaction among time, reference object, and valence was significant,  $F(2, 58) = 6.10$ ,  $p = 0.004$ ,  $\eta^2_p = 0.17$ . Simple effects tests showed that under both self and non-self reference conditions, positive word selection ratios were significantly higher than negative word ratios across past, present, and future dimensions ( $ps < 0.05$ ). Under self-reference conditions, participants' positive word selection ratio for future self was significantly higher than for past self ( $t = 3.17$ ,  $p = 0.011$ , 95% CI [2.80, 25.58]) and present self ( $t = 4.23$ ,  $p = 0.001$ , 95% CI [2.83, 11.32]), with no significant difference between past and present dimensions ( $p = 0.173$ ). Negative word selection ratio for past self was significantly higher than for future self ( $t = 5.22$ ,  $p < 0.001$ , 95% CI [8.20, 23.73]) and present self ( $t = 3.29$ ,  $p = 0.008$ , 95% CI [2.41, 18.69]), with no significant difference between present and future dimensions ( $p = 0.128$ ). Under non-self reference conditions, negative word selection ratio for past self was significantly higher than for future self ( $t = 2.79$ ,  $p = 0.028$ , 95% CI [0.70, 15.09]), with no other significant differences between conditions ( $ps > 0.33$ ). These results indicate that individual past, present, and future self-evaluations all exhibit positive tendencies, with an incremental effect of positive attitudes across the temporal dimension.

Further simple effects tests revealed that compared to others, participants tended to use more positive words ( $t = 1.77$ ,  $p = 0.090$ , 95% CI [-0.62, 8.13]) and fewer negative words ( $t = -2.46$ ,  $p = 0.020$ , 95% CI [-6.42, -0.60]) to evaluate future self, more negative words to evaluate present self ( $t = 2.19$ ,  $p = 0.037$ , 95% CI [0.39, 11.25]), and more negative words ( $t = 4.19$ ,  $p < 0.001$ , 95% CI [5.93, 17.23]) and fewer positive words ( $t = -2.43$ ,  $p = 0.022$ , 95% CI [-13.52, -1.16]) to evaluate past self.

Figure 2 [Figure 2: see original paper] Adjective selection ratios under different conditions (\*\*\*)  $p < 0.001$ , the same below)

### 2.2.2 ERP Results

A 3 (time)  $\times$  2 (reference object)  $\times$  2 (valence) repeated-measures ANOVA on LPC mean amplitudes revealed significant main effects of reference object,  $F(1, 29) = 15.68$ ,  $p < 0.001$ ,  $\eta^2_p = 0.35$ , with self-reference ( $1.35 \pm 0.25$  V) eliciting larger LPC amplitudes than non-self reference ( $0.86 \pm 0.27$  V). The main effect of valence was significant,  $F(1, 29) = 42.68$ ,  $p < 0.001$ ,  $\eta^2_p = 0.60$ , with negative

words ( $1.47 \pm 0.27$  V) eliciting larger LPC amplitudes than positive words ( $0.74 \pm 0.25$  V).

The interaction between time and reference object was significant,  $F(2, 58) = 3.51$ ,  $p = 0.036$ ,  $\eta^2_p = 0.11$ . Simple effects analysis showed that in the past dimension, individual self-reference ( $1.25 \pm 0.29$  V) elicited larger LPC amplitudes than non-individual self-reference ( $0.65 \pm 0.30$  V),  $F(1, 29) = 13.87$ ,  $p = 0.001$ . In the future dimension, individual self-reference ( $1.59 \pm 0.31$  V) elicited larger LPC amplitudes than non-individual self-reference ( $0.81 \pm 0.31$  V),  $F(1, 29) = 16.39$ ,  $p < 0.001$ . In the present dimension, no significant difference was found between individual self-reference ( $1.19 \pm 0.26$  V) and non-individual self-reference ( $1.13 \pm 0.31$  V) in LPC amplitude ( $p > 0.05$ ). Interactions between time and valence and between reference object and valence were not significant,  $p_s > 0.05$ .

The three-way interaction among time, reference object, and valence was marginally significant,  $F(2, 58) = 2.98$ ,  $p = 0.058$ ,  $\eta^2_p = 0.09$ . Simple effects analysis revealed that under self-reference conditions, negative words for past self elicited larger LPC amplitudes than positive words ( $p = 0.001$ , 95% CI [0.35, 1.27]), and negative words for present self elicited larger LPC amplitudes than positive words ( $p = 0.001$ , 95% CI [0.41, 1.44]), but no significant difference was found between negative and positive words for future self ( $p = 0.213$ ). Under non-self reference conditions, negative words elicited larger LPC amplitudes than positive words for past, present, and future non-self ( $p = 0.013$ , 95% CI [0.15, 1.17];  $p = 0.012$ , 95% CI [0.14, 1.07];  $p < 0.001$ , 95% CI [0.55, 1.62]). These results indicate that, compared to positive words, participants were more sensitive to negative words in past and present self-evaluation, demonstrating an emotional negativity bias effect. However, in future self-evaluation, participants' sensitivity to negative words decreased, with no significant difference from positive words.

Figure 3 [Figure 3: see original paper] Grand-averaged ERP waveforms for individual self-reference task across different time dimensions

Figure 4 [Figure 4: see original paper] ERP topographic maps for individual self-reference task across different time dimensions

## Experiment 2: Collective Temporal Self-Evaluation

### 3.1.1 Participants

The sample size calculation method was identical to Experiment 1, indicating a minimum requirement of 13 participants. This study recruited 24 college students, but one was excluded due to excessive EEG artifacts, leaving 23 valid participants (8 males;  $M = 20.74$  years,  $SD = 1.60$ ). All participants were right-handed, had normal or corrected-to-normal vision, no history of brain injury or physical and mental health problems, and provided informed consent. They received compensation after the experiment.

### 3.1.2 Experimental Design

A 3 (time: past, present, future)  $\times$  2 (reference object: collective self, non-collective self)  $\times$  2 (valence: positive, negative) within-subjects design was employed.

### 3.1.3 Experimental Procedure

The experimental procedure was similar to Experiment 1, with the difference that the target for description in the priming phase was Chinese people, and the reference objects in the lexical judgment phase were Chinese people (collective self) and Americans (non-collective self) from five years ago/at present/five years later.

### 3.1.4 EEG Recording and Processing

Identical to Experiment 1.

## 3.2 Results and Analysis

Descriptive statistics are presented in Table 2 .

### 3.2.1 Behavioral Results

A three-way repeated-measures ANOVA on adjective selection ratios revealed significant main effects of reference object,  $F(1, 22) = 9.59$ ,  $p = 0.005$ ,  $\eta^2_p = 0.30$ , and valence,  $F(1, 22) = 89.85$ ,  $p < 0.001$ ,  $\eta^2_p = 0.80$ . The interaction between time and valence was significant,  $F(2, 44) = 3.61$ ,  $p = 0.035$ ,  $\eta^2_p = 0.14$ . The interaction between reference object and valence was significant,  $F(1, 22) = 35.82$ ,  $p < 0.001$ ,  $\eta^2_p = 0.62$ . The interaction between time and reference object was not significant,  $F(2, 44) = 0.72$ ,  $p = 0.492$ .

The three-way interaction among time, reference object, and valence was significant,  $F(2, 44) = 4.19$ ,  $p = 0.022$ ,  $\eta^2_p = 0.16$ . Simple effects analysis indicated that under collective self conditions, positive word selection ratios were significantly higher than negative word ratios for past, present, and future selves ( $p < 0.001$ , 95% CI [48.57, 77.83];  $p < 0.001$ , 95% CI [47.22, 78.20];  $p < 0.001$ , 95% CI [63.98, 88.38]), with no significant differences in positive or negative word selection ratios across different time dimensions ( $ps > 0.05$ ). These results demonstrate that participants tended to use more positive words and fewer negative words to evaluate collective selves across past, present, and future. Under non-collective self conditions, only past positive word selection ratio was higher than past negative word ratio ( $t = 2.69$ ,  $p = 0.013$ , 95% CI [4.09, 31.62]). Across time dimensions, past positive word selection ratio for non-collective self was significantly higher than present positive word ratio ( $t = 4.32$ ,  $p = 0.001$ , 95% CI [4.57, 18.30]). These results indicate that participants tended to view collective selves positively across past, present, and future.

Further simple effects analysis revealed that participants' positive word selection ratios for past, present, and future collective selves were all significantly higher than for non-collective selves ( $p < 0.001$ , 95% CI [20.06, 37.40];  $p < 0.001$ , 95% CI [25.46, 47.63];  $p < 0.001$ , 95% CI [22.16, 47.02]), while negative word selection ratios were significantly lower ( $p = 0.015$ , 95% CI [-29.62, -3.61];  $p < 0.001$ , 95% CI [-39.08, -14.32];  $p < 0.001$ , 95% CI [-40.04, -16.78]).

Figure 5 [Figure 5: see original paper] Personality adjective selection ratios under different conditions (\*  $p < 0.05$ )

### 3.2.2 ERP Results

A 3 (time)  $\times$  2 (reference object)  $\times$  2 (valence) repeated-measures ANOVA on LPC mean amplitudes revealed significant main effects of reference object,  $F(1, 22) = 9.44$ ,  $p = 0.006$ ,  $\eta^2_p = 0.30$ , with collective self-reference ( $1.39 \pm 0.35$  V) eliciting larger LPC amplitudes than non-collective self-reference ( $0.92 \pm 0.29$  V). The main effect of valence was significant,  $F(1, 22) = 13.19$ ,  $p = 0.001$ ,  $\eta^2_p = 0.38$ , with negative words ( $1.45 \pm 0.33$  V) eliciting larger LPC amplitudes than positive words ( $0.86 \pm 0.31$  V).

The interaction between time and reference object was significant,  $F(2, 44) = 3.25$ ,  $p = 0.048$ ,  $\eta^2_p = 0.13$ . Simple effects analysis showed that in the past dimension, collective self-reference ( $1.24 \pm 0.36$  V) elicited larger LPC amplitudes than non-collective self-reference ( $0.79 \pm 0.27$  V),  $F(1, 22) = 6.70$ ,  $p = 0.017$ . In the future dimension, collective self-reference ( $1.70 \pm 0.40$  V) elicited larger LPC amplitudes than non-collective self-reference ( $0.96 \pm 0.36$  V),  $F(1, 22) = 14.74$ ,  $p = 0.001$ . In the present dimension, collective self-reference ( $1.23 \pm 0.34$  V) elicited larger LPC amplitudes than non-collective self-reference ( $1.02 \pm 0.30$  V), but the difference did not reach significance ( $p > 0.05$ ). Interactions between time and valence and between reference object and valence were not significant,  $p_s > 0.05$ .

The three-way interaction among time, reference object, and valence was marginally significant,  $F(2, 44) = 3.064$ ,  $p = 0.057$ ,  $\eta^2_p = 0.12$ . Simple effects analysis revealed that under collective self-reference conditions, negative words for past self elicited larger LPC amplitudes than positive words ( $p = 0.017$ , 95% CI [0.13, 1.17]), and negative words for present self elicited larger LPC amplitudes than positive words ( $p = 0.002$ , 95% CI [0.39, 1.45]), but no significant difference was found between positive and negative words for future self ( $p = 0.198$ ). Under non-collective self-reference conditions, negative words for future self elicited significantly larger amplitudes than positive words ( $p = 0.014$ , 95% CI [0.20, 1.56]), with no significant differences between positive and negative words in past and present dimensions ( $p = 0.491$ ;  $p = 0.073$ ). These results indicate that participants were more sensitive to negative words for past and present selves, showing an emotional negativity bias effect, while their sensitivity to negative words decreased in future self-evaluation, with no significant difference from positive words.

Figure 6 [Figure 6: see original paper] Grand-averaged ERP waveforms for collective self-reference task across different time dimensions

Figure 7 [Figure 7: see original paper] ERP topographic maps for collective self-reference task across different time dimensions

## General Discussion

This study employed an improved temporal self-reference experimental task by adding non-individual self and non-collective self conditions, enabling participants to evaluate individual self versus non-individual self (Experiment 1) and collective self versus non-collective self (Experiment 2) within a social comparison context, thereby better exploring individual and collective temporal self-evaluation. The results revealed that Chinese college students exhibit positive bias across time in both individual and collective temporal self-evaluation. From the temporal dimension of individual self, positive evaluation of future self was significantly higher than that of past and present selves, while negative evaluation of past self was significantly higher than that of present and future selves, indicating an upward trend in positive evaluation and a downward trend in negative evaluation of individual temporal self, revealing an incremental phenomenon in positive evaluation of individual self across past, present, and future dimensions. From the temporal dimension of collective self, although positive evaluation across past, present, and future dimensions did not show an incremental trend, a relatively stable positive bias was maintained.

### 4.1 Consistency Between Individual and Collective Temporal Self-Evaluation

Behavioral results showed that participants in both Experiments 1 and 2 used more positive words and fewer negative words to evaluate past, present, and future individual and collective selves, indicating that both individual and collective self-evaluation exhibit not only positive bias but also consistency across time, supporting our hypotheses. In collectivist cultural contexts, Chinese people possess strong collective identity and motivation to maintain positive group image, with substantial internal associations between individual self and collective self (Boldry & Gaertner, 2006; Zeng & Guo, 2012; Zheng et al., 2018). Over time, Chinese people's sense of national belonging becomes increasingly strong, and emotional experiences toward the nation gradually converge, leading to the internalization of national identity as part of the self (Guo, 2020). Therefore, Chinese participants' collective temporal self-evaluation shares similar patterns with individual temporal self-evaluation, exhibiting positive bias across time.

ERP results showed that under self-reference conditions, negative words for past and present individual and collective selves elicited larger LPC amplitudes than positive words, while no significant difference in LPC amplitude was found between positive and negative words for future self. This finding aligns with previous research (Luo et al., 2010), confirming the existence of emotional negativity bias in EEG studies of temporal self-evaluation, where negative words

elicit larger amplitudes than positive words, indicating greater sensitivity to negative than positive information (Huang & Luo, 2006; Kong et al., 2012). LPC is associated with stimulus emotional valence and arousal, with its amplitude reflecting underlying emotional responses and regulatory functions. Negativity bias exists in both early attention allocation and later evaluation/response preparation stages, suggesting that negative stimuli dominate in both early attentional preparation and cognitive evaluation stages (Huang & Luo, 2006). Under invalid cue conditions, individuals prioritize processing negative information, and the appearance of negative stimuli more readily activates LPC than positive stimuli, producing a “negativity bias” effect (Luo et al., 2010; Huang & Luo, 2009), which also emerges during individual self-evaluation (Grundy et al., 2015; Kong et al., 2012; Herbert et al., 2008). Functional magnetic resonance imaging studies have found that positive and negative stimuli produce unequal brain activation, with stronger responses to negative than positive stimuli (Lewis et al., 2007), primarily stemming from an adaptive “negativity bias” rooted in existing memories and life experiences rather than the yet-to-occur future (Vaish et al., 2008). Imagining positive future events shows stronger associations with anterior cingulate cortex and amygdala activity than imagining negative future events (Sharot et al., 2007). Therefore, in this study, when evaluating past and present selves, participants allocated more resources to process negative stimuli, eliciting larger LPC amplitudes. However, when evaluating future self, they were less sensitive to negative stimuli, with reduced LPC amplitudes for negative words that showed no significant difference from those for positive words.

In summary, this study found that Chinese college students exhibit similar cognitive-neural characteristics in collective temporal self-evaluation and individual temporal self-evaluation. Existing research shows that culture significantly influences self-construal (Zhu et al., 2007) and that self-representations differ between collectivist and individualist cultures, with collectivist culture priming reducing brain activation differences between self-reference and mother-reference conditions (Chiao et al., 2009). In the context of Chinese collectivist culture, mother-reference and self-reference are very similar in memory performance and self-awareness, sharing common neural mechanisms, indicating that mother is a component of Chinese collectivist self (Zhu & Zhang, 2001; Zhang et al., 2005). According to the degree-of-processing effect in self-referential processing, highly self-relevant stimuli receive prioritized processing compared to less self-relevant stimuli (Fan et al., 2016; Fan et al., 2013). In this study, using “Chinese” as the target for collective self-evaluation, the similarity between collective and individual self-evaluation at both behavioral and neural levels suggests that college student participants, as members of the Chinese group, have inseparable individual and collective (Chinese) selves, providing supporting evidence for interdependent self-construal theory (Markus & Kitayama, 1991; Liu & Zou, 2007).

## 4.2 Individual and Collective Temporal Self-Evaluation Based on Social Comparison Context

Temporal self-evaluation is influenced not only by temporal comparison but also closely related to social comparison evaluation (Festinger, 1954). Social comparison exists at both individual and collective levels (Wu et al., 2013). Therefore, to provide baseline conditions for the temporal self-reference task, this study added non-individual self and non-collective self conditions, enabling participants to conduct comparative evaluations between individual self and non-individual self and between collective self and non-collective self. This approach addresses the limitation of evaluating temporal self without social comparison context, allowing more effective investigation of individual and collective self-evaluation.

The behavioral results of this study revealed that compared to non-individual self, individuals showed significantly more positive evaluation of future self and more negative evaluation of past self relative to others. Compared to non-collective self, participants exhibited consistent positive evaluation of collective self across past, present, and future. Research indicates that Chinese self involves collective self related to nation and ethnicity (Luo & Huang, 2011; Hamamura et al., 2021), and that Chinese people show group reference effects under national identity reference conditions, whereas Americans do not (Yang & Huang, 2007). This suggests that Chinese people possess interdependent self-construal, with collective self playing an important role in Chinese self-structure (Markus & Kitayama, 1991; Heine, 2001; Liu & Zou, 2007; Yang & Huang, 2007). Therefore, the results of this study indicate that in social comparison contexts, Chinese people can perceive similarity and connectedness with their groups (Cross et al., 2011) with stability across time, potentially providing temporal perspective support for the interdependent self-construal view among Chinese people.

## 4.3 Limitations and Future Directions

First, this study primarily selected college students as participants. However, given that college students have not yet entered society, their temporal self-evaluation differs from that of middle-aged and older adults, requiring caution when extending these results to other age groups. Second, although this study examined individual and collective temporal selves among Chinese college students, it did not include Western participants for cross-cultural comparison. Therefore, the findings cannot provide fully sufficient direct evidence for interdependent self-construal theory among Chinese people. Future research could simultaneously select Chinese and American participants for cross-cultural studies to further validate the conclusions of this study.

## Conclusion

Under the conditions of this study, Chinese college student participants exhibited positive bias in both individual temporal self-evaluation and collective temporal self-evaluation, with consistency across time. Moreover, both individual and collective temporal self-evaluation showed emotional negativity bias effects at the neurophysiological level. Therefore, collective temporal self-evaluation shares similar cognitive-neural characteristics with individual temporal self-evaluation among Chinese college students, providing supporting evidence for interdependent self-construal theory to some extent.

## References

- Albert, S. (1977). Temporal comparison theory. *Psychological Review*, 84(6), 485–503.
- Boldry, J. G., & Gaertner, L. (2006). Separating status from power as an antecedent of intergroup perception. *Group Processes and Intergroup Relations*, 9(3), 377–400.
- Boylan, B. M., McBeath, J., & Wang, B. (2021). US-China relations: Nationalism, the trade war, and COVID-19. *Fudan Journal of the Humanities and Social Sciences*, 14, 23–40.
- Brewer, M. B., & Gardner, W. (1996). Who is this “We”? Levels of collective identity and self representations. *Journal of personality and social psychology*, 71(1), 83–93.
- Brown, R. A. (2006). Self-esteem, modest responding, sandbagging, fear of negative evaluation, and self concept clarity in Japan. *Information & Communication Studies*, 33, 15–21.
- Cai, H., Brown, J. D., Deng, C., & Oakes, M. A. (2007). Self-esteem and culture: Differences in cognitive self-evaluations or affective self-regard? *Asian Journal of Social Psychology*, 10(3), 162–170.
- Cai, H., Sedikides, C., Gaertner, L., Wang, C., Carvallo, M., Xu, Y., ... & Jackson, L. E. (2011). Tactical self-enhancement in China: Is modesty at the service of self-enhancement in East Asian culture? *Social Psychological and Personality Science*, 2(1), 59–64.
- Chiao, J. Y., Harada, T., Komeda, H., Li, Z., Mano, Y., Saito, D., Parrish, T. B., ... Iidaka, T. (2009). Neural basis of individualistic and collectivistic views of self. *Human Brain Mapping*, 30(9), 2813–2820.
- Cross, S. E., Hardin, E. E., & Gercek-Swing, B. (2011). The what, how, why, and where of self-construal. *Personality and Social Psychology Review*, 15(2), 142–179.
- Ellemers, N. (2012). The group self. *Science*, 336(6083), 848–852.

- Fan, W., Chen, J., Wang, X. Y., Cai, R. H., Tan, Q. B., Chen, Y., ... Zhong, Y. P. (2013). Electrophysiological correlation of the degree of self-reference effect. *PLoS One*, 8(12), e80289.
- Fan, W., Zhong, Y. P., Yang, Z. L., Lai, J., Ouyang, Y., Cai, R. H., ... Fu, X. L. (2016). The degree of self-reference effect of extroversion individuals. *Acta Psychologica Sinica*, 48(8), 1002–1012.
- Fan, W., Zhang, Y., Wang, X., Wang, X., Zhang, X., & Zhong, Y. (2011). The temporal features of self-referential processing evoked by national flag. *Neuroscience letters*, 505(3), 233–237.
- Festinger, L. (1954). A theory of social comparison processes. *Human relations*, 7(2), 117–140.
- Gao, F., & Wang P. (2017). The relationship among the individual self, the relational self and the collective self: Based on the motivational and cognitive perspectives. *Advances in Psychological Science*, 25(7), 1208–1217.
- Gorodnichenko, Y., & Roland, G. (2012). Understanding the individualism-collectivism cleavage and its effects: Lessons from cultural psychology. In M. Aoki, T. Kuran, & G. Roland (eds.), *Institutions and comparative economic development* (pp. 213–236). London: Palgrave Macmillan.
- Gray, H. M., Ambady, N., Lowenthal, W. T., & Deldin, P. (2004). P300 as an index of attention to self-relevant stimuli. *Journal of experimental social psychology*, 40(2), 216–224.
- Greenhouse, S. W., & Geisser, S. (1959). On methods in the analysis of profile data. *Psychometrika*, 24(2), 95–112.
- Grundy, J. G., Benarroch, M. F., Lebar, A. N., & Shedden, J. M. (2015). Electrophysiological correlates of implicit valenced self-processing in high vs. low self-esteem individuals. *Social neuroscience*, 10(1), 100–112.
- Guo, Q. Q. (2020). Emotional cognitive bias of individual future thought and collective future thought: The influence of temporal distance and imagined groups (Unpublished master's thesis). Southwest University.
- Herbert, C., Junghofer, M., & Kissler, J. (2008). Event related potentials to emotional adjectives during reading. *Psychophysiology*, 45(3), 487–498.
- Hu, J. S., & Huang, X. T. (2009). Preliminary study on self-modesty: One significant behavioral style of Chinese. *Acta Psychologica Sinica*, 41(9), 842–852.
- Huang, X. T., & Xia, L. X. (2004). On the ego in personality. *Journal of Shaanxi Normal University (Philosophy and Social Sciences Edition)*, 33(2), 108–111.
- Huang, X. T., & Yin, T. Z. (2012). On cultural differences in zi zun (self-esteem). *Journal of Psychological Science*, 35(1), 2–8.

- Huang, X. T., & Zhang, S. L. (1992). Desirability, meaningfulness, and familiarity ratings of 562 personality-trait adjectives. *Journal of Psychological Science*, (5), 19–24.
- Huang, Y. X., & Luo, Y. J. (2006). Temporal course of emotional negativity bias: An ERP study. *Neuroscience Letters*, 398(1-2), 91–96.
- Huang, Y. X., & Luo, Y. J. (2009). Can negative stimuli always have the processing superiority? *Acta Psychologica Sinica*, 41(9), 822–831.
- Kong, F., Zhang, Y., & Chen, H. (2012). ERP differences between processing of physical characteristics and personality attributes. *Behavioral and Brain Functions*, 8(1), 1–10.
- Kraus, B., & Kitayama, S. (2019). Interdependent self-construal predicts emotion suppression in Asian Americans: An electro-cortical investigation. *Biological Psychology*, 146, Article 107733.
- Lemay, E. P., Jr., & Ryan, J. E. (2021). Common ingroup identity, perceived similarity, and communal interracial relationships. *Personality and Social Psychology Bulletin*, 47(6), 985–1003.
- Lewis, P. A., Critchley, H. D., Rotshtein, P., & Dolan, R. J. (2007). Neural correlates of processing valence and arousal in affective words. *Cerebral cortex*, 17(3), 742–748.
- Liu, C. X., Liu, L. Z., Wang, D., & Chen, W. F. (2022). The mechanism of collective ritual promoting group emotional contagion. *Advances in Psychological Science*, 30(8), 1870–1882.
- Liu, J. H., Paez, D., Slawuta, P., Cabecinhas, R., Techio, E., Kokdemir, D., ... & Zlobina, A. (2009). Representing world history in the 21st century: The impact of 9/11, the Iraq war, and the nation-state on dynamics of collective remembering. *Journal of Cross-Cultural Psychology*, 40(4), 667–692.
- Liu, Y., & Zou, H. (2007). A review of self-construal theories. *Journal of Psychological Science*, 30(5), 1272–1275.
- Luck, S. J., & Kappenman, E. S. (Eds.). (2011). *The Oxford handbook of event-related potential components*. Oxford University Press.
- Luo, Y. M. (2011). Explicit and implicit measurements of temporal self-attitudes (Unpublished master's thesis). Southwest University.
- Luo, Y. M., & Huang, X. T. (2011). The properties of temporal self-evaluations. *Journal of southwest university (Social Sciences Edition)*, 37(6), 1–6.
- Luo, Y., Huang, X., Chen, Y., Jackson, T., & Wei, D. (2010). Negativity bias of the self across time: An event-related potentials study. *Neuroscience Letters*, 475(2), 69–73.
- Luo, Y., Jackson, T., Wang, X., & Huang, X. (2013). Neural correlates of self-appraisals in the near and distant future: An event-related potential study.

*PloS One*, 8(12), e84332.

Ma, W. J., & Feng, R. (2012). Self-construal, self-serving attributional bias, and self-enhancement in Chinese college students. *Journal of Psychological Science*, 35(6), 1398–1403.

Mandel, N. (2003). Shifting selves and decision making: The effects of self-construal priming on consumer risk-taking. *Journal of Consumer Research*, 30(1), 30–40.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological review*, 98(2), 224–253.

Mert, N., Hou, Y., & Wang, Q. (2023). What lies ahead of us? Collective future thinking in Turkish, Chinese, and American adults. *Memory & cognition*, 51(3), 773–790.

Ross, M., & Wilson, A. E. (2002). It feels like yesterday: Self-esteem, valence of personal past experiences, and judgments of subjective distance. *Journal of personality and social psychology*, 82(5), 792–803.

Ross, M., & Wilson, A. E. (2003). Autobiographical memory and conceptions of self: Getting better all the time. *Current Directions in Psychological Science*, 12(2), 66–69.

Sharot, T., Riccardi, A. M., Raio, C. M., & Phelps, E. A. (2007). Neural mechanisms mediating optimism bias. *Nature*, 450(7166), 102–105.

Shrikanth, S., & Szpunar, K. K. (2021). The good old days and the bad old days: Evidence for a valence-based dissociation between personal and public memory. *Memory*, 29(2), 180–192.

Shrikanth, S., Szpunar, P. M., & Szpunar, K. K. (2018). Staying positive in a dystopian future: A novel dissociation between personal and collective cognition. *Journal of Experimental Psychology: General*, 147(8), 1200–1210.

Spencer-Rodgers, J., Peng, K., Wang, L., & Hou, Y. (2004). Dialectical self-esteem and East-West differences in psychological well-being. *Personality and Social Psychology Bulletin*, 30(11), 1416–1432.

Tacikowski, P., & Nowicka, A. (2010). Allocation of attention to self-name and self-face: An ERP study. *Biological psychology*, 84(2), 318–324.

Topcu, M. N., & Hirst, W. (2020). Remembering a nation's past to imagine its future: The role of event specificity, phenomenology, valence, and perceived agency. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 46(3), 563–579.

Trafimow, D., Triandis, H. C., & Goto, S. G. (1991). Some tests of the distinction between the private self and the collective self. *Journal of Personality and Social Psychology*, 60(5), 649–655.

- Vaish, A., Grossmann, T., & Woodward, A. (2008). Not all emotions are created equal: The negativity bias in social-emotional development. *Psychological bulletin*, 134(3), 383–403.
- Verplanken, B., Trafimow, D., Khusid, I. K., Holland, R. W., & Steentjes, G. M. (2009). Different selves, different values: Effects of self-construals on value activation and use. *European Journal of Social Psychology*, 39(6), 1070–1080.
- Wang, P., Jin, Z. Y., & Gao, F. (2022). The motivational hierarchy of the triple self: The perspective of self-positive bias. *Chinese Journal of Clinical Psychology*, 30(1), 1–7.
- Wang, W. C., Zhao, Y. F., Xiao, Z. L., & Chen, B. (2022). The influence of self-construal on group reference effects. *Journal of Psychological Science*, 45(6), 1407–1413.
- Wilson, A. E., & Ross, M. (2000). The frequency of temporal-self and social comparisons in people's personal appraisals. *Journal of personality and social psychology*, 78(5), 928–942.
- Wilson, A. E., & Ross, M. (2001). From chump to champ: People's appraisals of their earlier and present selves. *Journal of personality and social psychology*, 80(4), 572–584.
- Wu, L., Hou, C. N., & Liu, Z. J. (2013). Study on the past years' development and future research path of group-reference effect. *Journal of Huazhong Normal University (Humanities and Social Sciences)*, 52(4), 168–176.
- Yamashiro, J. K., & Roediger III, H. L. (2019). How we have fallen: Implicit trajectories in collective temporal thought. *Memory*, 27(8), 1158–1166.
- Yang, H. S., & Huang, X. T. (2007). Group-reference effect in Chinese. *Acta Psychologica Sinica*, 39(2), 235–241.
- Yao, G. J., & Zhang, F. (2013). The effect of self-esteem level, event valence and temporal distance on temporal distance estimation of past events. *Psychological Development and Education*, 29(1), 18–22.
- Zang, X., Jin, K., & Zhang, F. (2021). A difference of past self-evaluation between college students with low and high socioeconomic status: Evidence from event-related potentials. *Frontiers in Psychology*, 12, 629283.
- Zeng, H., & Guo, S. P. (2012). “Le”: The Chinese subject well-being and the view of happiness in China tradition culture. *Acta Psychologica Sinica*, 44(7), 986–994.
- Zhang, F., Jin, K. G., & Zhu, Y. M. (2021). Review on temporal self research. *Psychological Research*, 14(3), 209–215.
- Zheng, Y. C., Xiao, Z. L., Chen, H., Huang, X. Y., & Zhou, X. (2018). The hierarchical relationship between relational self and collective self in self-construal. *Journal of Psychological Science*, 41(6), 1403–1409.

Zhang, L., Zhou, T. G., Zhang, J., Liu, Z. X., Fan, J., & Zhu, Y. (2005). In search of the Chinese self: An fMRI study. *Science in China Series C*, 35(5), 472–478.

Zhu, Y., & Zhang, L. (2001). Experiment study of self-reference effect. *Science in China Series C*, 31(6), 537–543.

Zhu, Y., Zhang, L., Fan, J., & Han, S. H. (2007). Neural basis of cultural influence on self-representation. *NeuroImage*, 34(3), 1310–1316.

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

*Source: ChinaXiv — Machine translation. Verify with original.*