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Psychometric properties of the Chinese version of the Zimbardo Time Perspective Inventory

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Abstract

The present study aimed to develop an applicable Chinese version of the Zimbardo Time Perspective Inventory (ZTPI) and to examine its reliability and validity in national samples of China. We first used the samples of undergraduates to revise the original scale into Chinese version, and then examined the psychometric properties of the revised scale in a larger sample (18 to 65 years old). The revised 25-item scale consists of five subscales assessing Past Positive, Past Negative, Present Impulsive, Present Fatalistic, and Future with a similar factor structure to the original instrument, except that “Present Hedonistic” was renamed as “Present Impulsive”. Internal consistency estimates and confirmatory factor analyses showed that the 25-item ZTPI-Chinese version provided good reliability and the revised five-factor structure had acceptable fitness. Subsequent analyses provided support for invariance across gender and age. Overall, the ZTPI-Chinese version provides a reliable and valid instrument for testing time perspective in Chinese population, thereby facilitating both the study of time perspective in China and cross-cultural comparisons.

Keywords Time Perspective · Zimbardo Time Perspective Inventory · ZTPI-Chinese Version · Measurement Invariance · Mainland China

Introduction

Time perspective is a multidimensional construct assessing the influence that cognition and attitude about the past, present, and future have on individual functioning (Worrell et al., 2016). There are various definitions of time perspective, originally defined by Lewin (1951) as “the totality of

the individual’s views of his psychological future and psychological past existing at a given time” (p. 75). Zimbardo and Boyd (1999) defined time perspective as “the often non-conscious process whereby the continual flows of personal and social experiences are assigned to temporal categories, or time frames, which helps to give order, coherence, and meaning to those events.” Time perspective remains one of the most powerful influences on human daily behaviors and thoughts (Zimbardo, 2012). For example, time perspective predicts numerous fundamental life outcomes, including health (Hall et al., 2012), happiness (Boniwell & Zimbardo, 2004; Cunningham et al., 2015), financial and pro-environmental behaviors (Albright & Mcdermott, 2015; Milfont & Demarque, 2015). Time perspective has also proved in general to be a good predictor of students’ learning behavior and academic achievement (Husman & Lens, 1999; Lens et al., 2001). Zhang and Howell (2011) have even shown that time perspective dimensions are better predictors of well-being than any of the Big Five personality traits. And many researchers sought for ways to apply time perspective theory to resolve social problems, including homelessness (Epel et al., 1999), risky driving (Zimbardo et al., 1997), and substance abuse (Keough et al., 1999). Time perspective

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theory also proved useful in other psychological disorders (Kazakina, 2015), as well as in positive interventions among healthy individuals (Boniwell & Osin, 2015).

The Zimbardo Time Perspective Inventory (ZTPI) was designed to evaluate how people conceptualize their past, present and future (Zimbardo & Boyd, 1999). It has 56 items and five moderately correlated factors. The past-positive (PP) dimension represents a positive, joyful, and nostalgic outlook of the past. Past-negative (PN) dimension indicates a pessimistic and negative attitude towards the past. Present-hedonistic (PH) indicates a preference for immediate gratification and spontaneity, and a dislike towards planning. Present-fatalistic (PF) describes a helpless and fatalistic attitude towards the future. Finally, the future (F) dimension describes a predominance of thoughts about the future and a general orientation to plan ahead (Zimbardo & Boyd, 1999). Studies have shown that the five factors of ZTPI are not only associated with personality traits and a range of healthy and risk-taking behaviors but also have effects on positive mental health (subjective well-being) and mental health problems (depression and anxiety) (Drake et al., 2008; Zimbardo & Boyd, 1999). For example, PP is positively related to extraversion, agreeableness, self-esteem, low levels of depression, life satisfaction, and subjective well-being, while PN is positively associated with neuroticism, aggression, depression, and low levels of emotional stability, self-esteem, life satisfaction and subjective well-being (Przepiorka & Blachnio, 2016; van Beek et al., 2011; Zhang & Howell, 2011; Zimbardo & Boyd, 1999). Higher PH is related to risk-taking behaviors, an emphasis on sensation seeking, and increased impulsiveness (Keough et al., 1999; Zimbardo & Boyd, 1999; Zimbardo et al., 1997). PF correlates negatively with self-esteem, life satisfaction and subjective well-being, and positively with aggression, anxiety and depression (Anagnostopoulos & Griva, 2012; Zimbardo & Boyd, 1999). F is correlated strongly and positively with conscientiousness, and negatively with aggression, anxiety and depression, while the future-oriented person are likely to have more self-control and health-promoting behaviors, and tend to have better level of self-esteem, life satisfaction and subjective well-being (Kooij et al., 2018; Zimbardo & Boyd, 1999). Therefore, the Big Five personality traits, self-esteem, well-being, healthy and risk-taking behaviors, depression and anxiety are often used to demonstrate the validity of ZTPI (Anagnostopoulos & Griva, 2012; Milfont et al., 2008; Orkibi, 2015; Zimbardo & Boyd, 1999).

The original version of ZTPI was tested on American samples; the Kaiser–Meyer–Olkin value of the exploratory factor analysis (EFA) was 0.83, the five factors explained 36% of the total variance, and the scale demonstrated good reliability and validity. Globally, the ZTPI has been widely used as a powerful measurement instrument. Researchers have revised the ZTPI in different cultures, including Italy

(D'Alessio et al., 2003), Australia (Horstmanshof & Zimitat, 2007), Brazil (Milfont et al., 2008), Sweden (Carelli et al., 2011), Greece (Anagnostopoulos & Griva, 2012), and Poland (Przepiorka et al., 2016). Collectively, these studies suggest that the ZTPI is an important instrument to test time perspective as it has a stable structure and can be replicated in different countries and cultures. But previous studies on the different versions of the ZTPI also suggested that the number of factors and their content might depend on the nationality of the sample (Przepiorka et al., 2016). Many studies indicate poor reliability of ZTPI, especially for the Present-Fatalistic scale (D'Alessio et al., 2003; Sircova et al., 2014). Regarding dimensionality, replication of the five-factor model has been problematic with poor model fit indices (Anagnostopoulos & Griva, 2012; Davis & Ortiz, 2017). For example, Anagnostopoulos and Griva (2012) reported less desirable fit indices for the five-factor model (CFA = 0.85, RMSEA = 0.19) on a sample of Greek young adults. In sum, additional evidence is required to support the generalizability and replicability of ZTPI, as a widely used cross-cultural measurement tool in the field of time perspective research.

While there is growing interest in time perspective in China, only a few measurement tools are currently available. For example, the 28-item Future Time Perspective Inventory developed by Lyu and Huang (2016) has been used to assess attitudes, feelings and behavioral tendencies towards the future for Chinese adolescents. Another 53-item Past Time Perspective Inventory designed by Lyu and Huang (2007) evaluates how undergraduates conceptualize their past in Chinese context. However, it can be seen that these instruments only focus on future or past time perspective, and cannot depict the whole picture of time perspective, which is not conducive to the studies of time perspective in China. To fully understand time perspective in Chinese samples, it is necessary to revise ZTPI and assess its psychometric properties in mainland China. The original scale of ZTPI was developed and tested in individualistic cultures and its relevancy to societies that emphasize more on collectivistic values and interdependence is yet to be well established. Evaluations of ZTPI's psychometric properties in diverse samples especially for adults in mainland China and measurement invariance across gender and age need to be conducted.

The Current Research

This article consists of two studies. The aim of study 1 was to develop a Chinese version of Zimbardo Time Perspective Inventory (ZTPI-C) capturing all five dimensions of time perspective. In study 1, we first used the samples of undergraduates to revise the original ZTPI into Chinese version on the basis of exploratory factor analyses. Next, we conducted

confirmatory factor analyses in another independent sample of undergraduates to confirm the factor structure. Finally, we investigated validity of the Chinese version of ZTPI in a third independent sample of undergraduates by correlating it with big-five personality dimensions, aggression, impulsiveness, self-esteem, and depression. In study 2, we examined the psychometric properties of the revised ZTPI in a larger sample (18 to 65 years old). Based on internal consistency and confirmatory factor analyses, we replicated the findings of reliability and validity. And the validity of ZTPI-C was tested by the associations between subscales of ZTPI-C and subjective well-being and life satisfaction, because many studies claimed that time perspective was fundamental to well-being and positive functioning (Boniwell et al., 2010; Cunningham et al., 2015). Moreover, we tested the measurement invariance for gender and age group to explore whether the revised scale could be used in different samples in mainland China.

Study 1: Revising ZTPI into Chinese Version and Assessing its Psychometric Properties

Method

Participants and Procedure

Participants in study 1 were recruited from Chinese universities including Southwest University, Chongqing University, and Henan University. We recruited three independent samples in study 1. Sample 1 consisted of 519 participants (67.8% females; mean age = 20.30, $SD = 1.08$), sample 2 consisted of 819 participants (72.5% females; mean age = 20.08, $SD = 1.44$) and sample 3 consisted of 908 participants (47.0% females; mean age = 19.51, $SD = 0.94$). We deleted the data with missing values and obviously random responding (17, 23, and 51 subjects were eliminated from samples 1–3, respectively), and the sample sizes mentioned above in all three group participants were valid samples for subsequent data analysis. Participants from sample 1 completed the original ZTPI and participants from sample 2 administered the ZTPI-C. Participants in Sample 3 completed the ZTPI-C, Depression, Big Five Personality, Aggression, Self-Esteem, and Impulsiveness scales. A total of 156 participants from sample 3 completed the ZTPI-C twice at two weeks apart for examining test–retest reliability.

Based on convenience sampling methods, the university students in all three samples were enrolled in the psychology and education courses. All students were in their first to fourth year in the universities and consented to attend the study after being informed about purpose and procedures of the study. Instructions were listed at the beginning of the inventory, and the data were collected through paper–pencil

based in classrooms, taking at most 10–20 min. Students who participated in the study received partial course credit. The written informed consent was obtained from all participants. The study protocol was approved by the local ethics committee.

Measures

Zimbardo Time Perspective Inventory (ZTPI)

A translated version of 56-item ZTPI was used to measure time perspective. The 56-item inventory consists of five dimensions: Past-Negative, Present-Hedonistic, Future, Past-Positive, Present-Fatalistic. Each item was rated on a 5-point Likert scale, with 1 denoting “very uncharacteristic or untrue, strongly disagree,” 2 denoting “uncharacteristic,” 3 denoting “neutral,” 4 denoting “characteristic,” and 5 denoting “very characteristic or true, strongly agree”. With the permission of original author, the ZTPI items were translated into Chinese by a bilingual psychological researcher using the back-translation method. Then, two experienced psychological researchers reviewed the translated items and provided feedback. Twelve Chinese-speaking undergraduates completed the Chinese version of ZTPI to test the meaning and readability of the items. The translated version was modified until it was comparable to the original English version.

Chinese Version of Zimbardo Time Perspective Inventory (ZTPI-C)

After item analysis and exploratory factor analysis, we removed some items which were not fit the data well and obtained a short Chinese version of the ZTPI. The ZTPI-Chinese version contains 25 items with a similar factor structure to original scale. The English and Chinese items are presented in the [supplementary materials](#). The corresponding items and factor structure are shown in the analysis section below (see Table 1).

Barratt Impulsiveness Scale

The Barratt Impulsiveness Scale (Patton et al., 1995) assessed participants’ impulsive tendency. It is a 30-item measure including three subscales for attentional impulsiveness, motor impulsiveness, and non-planning impulsiveness. Each item was rated on a 5-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) Higher total scores reflecting higher levels of Impulsiveness. The Cronbach’s α of three subscales and the whole scale in this study were 0.81, 0.83, 0.73, and 0.85, respectively.

Table 1 Results of the Exploratory Factor Analysis ($N=559$)

Items	Factor loadings				
	1	2	3	4	5
50 I think about the bad things that have happened to me in the past	0.77	-0.13	-0.08	0.09	0.04
16 Painful past experiences keep being replayed in my mind	0.76	-0.14	0.07	0.03	0.02
34 It's hard for me to forget unpleasant images of my youth	0.73	-0.19	-0.04	0.07	0.10
54 I think about the good things that I have missed out on in my life	0.56	0.19	-0.19	0.02	0.20
25 The past has too many unpleasant memories that I prefer not to think about	0.54	0.27	-0.10	-0.18	-0.17
27 I've made mistakes in the past that I wish I could undo	0.50	0.19	-0.02	0.16	0.01
33 Things rarely work out as I expected	0.45	-0.13	0.01	0.06	0.39
20 Happy memories of good times spring readily to mind	-0.01	0.72	0.13	0.03	0.07
15 I enjoy stories about how things used to be in the "good old times"	0.17	0.70	0.00	0.02	0.00
29 I get nostalgic about my childhood	-0.04	0.67	0.02	0.06	-0.10
7 It gives me pleasure to think about my past	-0.12	0.60	0.12	-0.03	0.05
2 Familiar childhood sights, sounds, smells often bring back a flood of wonderful memories	-0.17	0.54	0.10	0.03	0.05
11 On balance, there is much more good to recall than bad in my past	-0.34	0.51	0.27	0.00	-0.07
40 I complete projects on time by making steady progress	-0.02	0.06	0.75	-0.06	0.01
13 Meeting tomorrow's deadlines and doing other necessary work comes before tonight's play	0.02	-0.02	0.70	-0.05	0.09
10 When I want to achieve something, I set goals and consider specific means for reaching those goals	-0.04	0.15	0.64	0.07	-0.13
51 I keep working at difficult, uninteresting tasks if they will help me get ahead	0.07	0.08	0.55	-0.11	-0.22
21 I meet my obligations to friends and authorities on time	-0.15	0.21	0.51	-0.05	-0.03
8 I do things impulsively	-0.09	-0.02	-0.01	0.76	0.01
23 I make decisions on the spur of the moment	0.15	-0.10	-0.05	0.70	0.17
46 I find myself getting swept up in the excitement of the moment	0.13	0.12	0.02	0.67	-0.01
44 I often follow my heart more than my head	0.01	0.11	-0.25	0.54	0.26
39 It doesn't make sense to worry about the future, since there is nothing that I can do about it anyway	0.07	0.00	-0.01	0.12	0.72
37 You can't really plan for the future because things change so much	0.11	0.06	-0.19	0.01	0.70
38 My life path is controlled by forces I cannot influence	0.19	0.02	-0.03	0.14	0.70

Note: Factor loadings > 0.40 are displayed in the table. Factor 1: Past Negative, Factor 2: Past Positive, Factor 3: Future, Factor 4: Present Impulse, Factor 5: Present Fatalistic.

Big Five Inventory

The Big Five Inventory developed by John et al. (1991) has five dimensions: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. When answering the 44-item Big Five Inventory, participants indicate how much they agree with specific phrases that describe personality characteristics on a five-point scale (1 = disagree strongly, 2 = disagree a little, 3 = neither agree nor disagree, 4 = agree a little, 5 = agree Strongly). Higher subscale scores reflecting higher extraversion ($\alpha=0.75$), agreeableness ($\alpha=0.77$), conscientiousness ($\alpha=0.77$), neuroticism ($\alpha=0.69$), and openness ($\alpha=0.60$).

Beck Depression Inventory

The Chinese version of Beck Depression Inventory (Zhang et al., 1990), wherein participants report the degree of depression they experienced in the week prior to testing,

was used in this study. This scale consists of 21 items and participants were asked to choose the one statement out of four that was most characteristic of them for each item from 0 to 3. The option "0" means that the symptom was not experienced in the past week, and ratings of 1 to 3 imply mild, moderate, and severe levels of symptoms, respectively. Higher total scores reflect increased depressive affect ($\alpha=0.82$).

Self-Esteem Scale

The Rosenberg Self-Esteem Scale (Rosenberg, 1965) is a 10-item scale that measures self-esteem of participants. A four-point Likert scale was used to score the participants' responses regarding self-esteem, with 1 denoting "strongly disagree," 2 denoting "disagree," 3 denoting "agree," and 4 denoting "strongly disagree". Higher total scores reflecting higher levels of self-esteem ($\alpha=0.78$).

Aggression

Aggression Questionnaire (Buss & Perry, 1992) was used to measure aggressive behavior tendency. The scale includes 30 items and four dimensions: Physical Aggression, Verbal Aggression, Anger and Hostility. Response options range from 1 to 5, with 1 denoting “extremely uncharacteristic of me,” 2 denoting “somewhat uncharacteristic of me,” 3 denoting “neither uncharacteristic nor characteristic of me,” 4 denoting “somewhat characteristic of me,” and 5 denoting “extremely characteristic of me”. In the present study, we used the total score of all items to reflect the level of aggression of participants, and higher total scores indicate increased aggression tendency. The Cronbach’s α of four subscales and the whole scale in this study were 0.78, 0.83, 0.77, 0.75, and 0.92, respectively.

Data Analysis

Item analysis and exploratory factor analysis were used to delete the items and determine the factor structure with data from sample 1. Confirmatory factor analysis (CFA) was used to test the structural validity of the revised scale with data from sample 2, and the data from sample 3 was used to test the reliability and validity of the Chinese version of ZTPI. All descriptive analyses were completed using SPSS 22, and the CFAs were performed using Amos 21.0. Scores of most items showed no appreciable skewness or kurtosis in the EFA and CFA samples, but the data used in the present samples was not a completely normal distribution. Thus the parameter estimates for confirmatory factor analysis were obtained using the maximum likelihood Method (MLM).

Results

Item Analysis

First, we used item analysis to examine the items of original ZTPI. Items 9, 24, 25, 41, and 56 were reverse-coded, and total scores of all items were calculated. Then scores were grouped into two groups: the highest and lowest 27% of scores were defined as high- and low-score groups, respectively. Items 9, 24, and 41 were removed because the independent samples *t*-tests showed that those items did not demonstrate differentiability.

Exploratory Factor Analysis

Subsequently, exploratory factor analysis (EFA) was conducted with principal component method and varimax rotation to find the best interpretable clusters of factors using the data from sample 1. The results show that the Kaiser–Meyer–Olkin value was 0.80 far exceeded the

minimum standard of 0.60 (Kaiser, 1974) and Bartlett’s test of Sphericity was statistically significant ($\chi^2 = 2,988.95$, $p < 0.001$; Bartlett, 1954), indicating that the ZTPI-C correlation matrix was not random. Initial communality estimates ranged from 0.32 to 0.60. Therefore, the correlation matrix was deemed appropriate for factor analysis. The scree plot and the eigenvalues > 1 criterion all suggested that five factors were deemed appropriate (see Table 1). The five factors explained 47.89% of the total variance (Factor 1, 17.10%; Factor 2, 10.97%; Factor 3, 8.58%; Factor 4, 5.84%; Factor 5, 5.37%).

The resulting 25-item ZTPI-C comprised five dimensions: (1) Past Negative (7 items), a tendency to dislike the past and hold pessimistic and negative attitudes towards it; (2) Present Impulsive (4 items), a tendency to act and make decisions impulsively, without considering the consequences. The name of this dimension was revised from original “Present Hedonistic” to “Present Impulsive,” as four items primarily assess impulsivity rather than hedonism and enjoyment (see Table 1); (3) Future (5 items), a tendency to plan for the future and work towards achieving goals; (4) Past positive (6 items), a tendency to be nostalgic and perceive the past as delightful and positive; and (5) Present Fatalistic (3 items), a tendency to have a hopeless, fatalistic, and helpless attitude, and perceive the future as predestined and unchangeable, regardless of effort. The structure of the ZTPI-C was very similar to the original scale, with the exception that one dimension’s name was revised.

Confirmatory Factor Analysis

Confirmatory factor analysis was used to test the measurement model of the ZTPI-C and the data came from an independent sample 2 ($N = 819$). The CFI (≥ 0.95 for good, ≥ 0.90 for acceptable), TLI (≥ 0.95 for good, ≥ 0.90 for acceptable), and RMSEA (≤ 0.06 for good, ≤ 0.08 for acceptable) were used to evaluate overall global model fit (Hu & Bentler, 1999). To validate the hypothesized five-factor structure of ZTPI-C, we specified two alternative models assuming one-factor and three-factor structures. The one-factor model assumed a single latent factor representing the overall time perspective. The three-factor model was focused on three time zones (past, present and future) as common traits measured by different methods. The one-factor model resulted in very poor fit ($\chi^2/df = 9.633$, RMSEA = 0.103, CFI = 0.460, TLI = 0.410), and the three-factor model yielded a better fit, but also fell well short of an acceptable fit ($\chi^2/df = 6.95$, RMSEA = 0.085, CFI = 0.632, TLI = 0.594). The five-factor model of ZTPI-C generally had satisfactory fit indices: $\chi^2/df = 1.18$, RMSEA = 0.015, CFI = 0.992, TLI = 0.988. All loadings of items on factors in the five-factor model were significant, suggesting that the five-factor model of ZTPI-C

is a relatively consistent structure, and very similar to the structure of the original scale (Zimbardo & Boyd, 1999).

We further evaluated the convergent and discriminant validity of ZTPI-C during the confirmatory factor analysis by checking the values of composite reliability coefficients (CR), average variance extracted (AVE), maximum shared variance (MSV), and average shared variance (ASV) (Hair et al., 2010). To establish convergent validity, CR should be greater than AVE and AVE should be greater than 0.50. To confirm discriminant validity, ASV should be less than MSV and MSV should be less than AVE (Hair et al., 2010). Table 2 shows the construct validity for all five dimensions of ZTPI-C. Each CR score of the five factors was greater than its AVE score, but the AVE values of all factors were less than 0.50. These results partially supported the convergent validity of ZTPI-C. This is not surprising because ZTPI measures multiple distinguishing constructs including positive and negative attitude towards past, hedonism, and planning for future (Worrell et al., 2016). Each AVE score of the five factors was greater than MSV and ASV, and MSV scores of all five factors were greater than ASV. These results supported the discriminant validity of ZTPI-C.

Reliability

We further tested the reliability and criterion-related validity of ZTPI-C with sample 3. We assessed reliability with Cronbach's alpha using the commonly reported cutoff values of 0.70 and 0.80 (Nunnally, 1978). Cronbach's alpha coefficients for each ZTPI-C subscale are shown in Table 3, ranging from 0.57 to 0.77, in which Cronbach's alpha coefficients of present fatalistic ($\alpha=0.57$) and future subscale ($\alpha=0.67$) were relatively lower than 0.70. Given that there

are only 3 items of present fatalistic and 5 items of future subscale, these values are considered adequate for measures of psychological constructs (Hair et al., 2014).

Test-retest reliabilities of five subscales of ZTPI-C were established with 156 college students over a 2-week interval. The mean test-retest reliability for ZTPI-C is 0.70 (ranged 0.56 to 0.76), the highest test-retest reliability coefficient was for F subscale.

Criterion-Related Validity

Having established the factor structure of the ZTPI-C, we turn to examine its criterion-related validity. Effect sizes were evaluated according to Cohen's (1988) benchmarks: correlations of $r=0.10$ to 0.30 were considered small, 0.30 to 0.50 were considered medium, and over 0.50 were considered large. The criterion-related validity of ZTPI-C was evaluated by the association with depression, big-five personality dimensions, aggression, self-esteem, and impulsiveness. Based on the notion of each subscale of ZTPI-C and results of previous studies mentioned in the preface, we made the following predictions about the relationship between ZTPI-C and the selected measures. Past Negative was predicted to be associated positively with depression, aggression, and neuroticism and negatively with self-esteem, extraversion, and agreeableness (Przepiorka & Blachnio, 2016; van Beek et al., 2011; Zhang & Howell, 2011; Zimbardo & Boyd, 1999), while Past Positive was predicted to have the opposite relationship pattern compared to Past Negative. Future was predicted to be positively related with self-esteem and conscientiousness, and negatively with depression, aggression, and impulsiveness (Kooij et al., 2018; Lyu et al., 2019; Zimbardo & Boyd, 1999). Present Impulsive is characterized by impulsivity and disregard for consequences. Thus high scorers on this factor were predicted to be high in impulsiveness and aggression, but low in self-esteem and conscientiousness. Finally, we hypothesized that Present Fatalistic would be associated positively with depression, neuroticism, and aggression, and negatively with self-esteem, extraversion, agreeableness, openness, and conscientiousness (Keough et al., 1999; van Beek et al., 2011; Zimbardo & Boyd, 1999). Findings supporting these predictions would provide evidence for criterion-related validity.

Table 2 Convergent and discriminant validity of measurement models

	CR	AVE	MSV	ASV
Past-Negative	0.80	0.38	0.36	0.16
Past-Positive	0.78	0.37	0.14	0.06
Present-Impulsive	0.71	0.39	0.20	0.12
Present-Fatalistic	0.69	0.41	0.36	0.18
Future	0.67	0.29	0.14	0.09

Table 3 Internal consistency and test-retest reliability of the ZTPI-C subscales

	Past-Negative	Past-Positive	Present-Impulsive	Future	Present-Fatalistic
Cronbach's α	0.75	0.77	0.70	0.67	0.57
Test-retest reliability	0.75	0.74	0.69	0.76	0.57

Note: $n=908$; Test-retest reliability coefficients were significant at $p<0.01$.

Table 4 shows the correlation coefficients between the subscales of ZTPI-C and other constructs. Consistent with predictions, Past Negative had moderate correlations with depression, aggression, neuroticism, impulsiveness, and low level of self-esteem. Past Positive had moderate correlations with agreeableness and low level of depression, and had a small to medium correlations with high self-esteem and low impulsiveness.

We found high correlations between Future and conscientiousness, and moderate correlations between Future and self-esteem, low level of impulsiveness, and neuroticism. It was also found that Future subscale had small-moderate correlations with agreeableness and openness.

Present Impulsive had high correlations with impulsiveness, and moderate correlations with aggression (positive direction) and conscientiousness (negative direction). Present Impulsive was also correlated positively with neuroticism and negatively with agreeableness and self-esteem.

Present Fatalistic had positive correlation with aggression and negative correlation with aggression and self-esteem. There were small but significant correlations between Present Fatalistic and depression, impulsiveness, neuroticism, and low conscientiousness.

We revised the ZTPI into a Chinese version using a sample of college students in Study 1. The results indicate that the ZTPI-C has acceptable reliability and validity. However, study 1 only used the sample of college students, whether it is applicable to the sample of a wider age range is unknown. In addition, previous studies consistently show gender and age differences in ZTPI scores (Mello & Worrell, 2015; Milfont et al., 2008). Without establishing measurement invariance, gender and age differences in ZTPI may not be due to true gender and age differences in subscale scores (Carr et al., 2018). Thus we intend to reexamine the psychometric properties and test the measurement invariance of ZTPI-C in young, middle, and older adults in study 2.

Study 2: Replicability of factor structure of the ZTPI-Chinese version in a larger sample

The objective of Study 2 was to evaluate the validity and reliability of the ZTPI-C in a larger sample and test its measurement invariance across gender and age groups.

Method

Participants and Procedure

A total of 4168 respondents completed an anonymous survey containing self-report measures. Data of 209 participants were excluded due to missing responses and obviously random responding. Thus, data of 3959 participants were included in current study. The age of samples ranged from 18 to 65 years old ($M = 34.73$, $SD = 9.74$), 57.3% were female. Based on convenience sampling methods, well-trained experimenters were recruited from different regions to distribute the questionnaires to community residents. Participants were given the inventories if they were over 18 years of age and were able to read and understand the questions. All participants consented to attend the study after being informed about purpose and procedures of the study. Participants were given a packet of questionnaires that included demographics, ZTPI-C, subjective well-being, and life satisfaction. The data were collected through paper–pencil based. It took about 10–20 min to complete several self-report questionnaires. No direct compensation was provided for study participation.

A sample of American adolescents from Worrell et al. (2016) was used to test measurement invariance between China and America in the present study. This American sample contained 815 adolescents aged 11–18 years old ($M = 14.40$, $SD = 1.41$), including 380 males (46.6%) and 435 females (53.4%). All of these adolescents completed the full version of ZTPI including 56 items. And we selected

Table 4 Convergent and discriminant validity of the ZTPI-C (sample 3)

Scale	Past Negative	Present Impulsive	Future	Past Positive	Present Fatalistic
Impulsiveness	0.31**	0.60**	-0.45**	-0.22*	0.27**
Depression	0.45**	0.17	-0.17	-0.32**	0.29**
Self-Esteem	-0.40**	-0.27**	0.37**	0.21**	-0.41**
Extraversion	-0.10	0.11	0.02	0.15	-0.12
Neuroticism	0.37**	0.26**	-0.32**	-0.10	0.18*
Openness	-0.13	-0.12	0.22*	0.16	-0.17
Agreeableness	-0.26**	-0.29**	0.27**	0.33**	-0.05
Conscientiousness	-0.16	-0.45**	0.62**	0.07	-0.22*
Aggression	0.45**	0.43**	-0.14	-0.07	0.43**

Note: * $p < 0.05$, ** $p < 0.01$.

data of 25 items consistent with ZTPI-C for further measurement invariance analysis.

Measures

Chinese Version of Zimbardo Time Perspective Inventory (ZTPI-C)

All participants filled in the ZTPI-C revised in study 1. In the present sample, Cronbach's alpha was $\alpha=0.75$ for Past Negative, $\alpha=0.73$ for Past Positive, $\alpha=0.67$ for Future, $\alpha=0.69$ for Present Impulsive, and $\alpha=0.62$ for Present Fatalistic.

Subjective Well-Being

A Chinese version of Index of well-being scale (Campbell et al., 1976) was used to measure subjective well-being. The scale consists of two parts: Index of General Affect (8 items) and Life Satisfaction (1 item). Ratings were given on a 7-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neither agree nor disagree, 5 = slightly agree, 6 = agree, 7 = strongly agree). When calculating the total score of subjective well-being, the average score of the Index of General Affect was added to the score of the life satisfaction. Higher scores indicate increased subjective well-being ($\alpha=0.78$).

Life Satisfaction

Life satisfaction scale (Diener et al., 1985) consists of 5 items that were to be answered on a 1–7 Likert scale (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neither agree nor disagree, 5 = slightly agree, 6 = agree, 7 = strongly agree), where higher scores indicate higher levels of Life satisfaction ($\alpha=0.77$).

Data Analyses

We first used confirmatory factor analysis (CFA) to examine the model fit and robustness of the hypothesized five-factor structure in the total samples, gender group samples, and age group samples. Several indices of fit mentioned in study 1 were used to evaluate the goodness of model fit, including TLI, CFI, and RMSEA. Next, correlational analyses were used to test the relationship between subscales of ZTPI-C and subjective well-being to provide support for validity. Finally, invariance analyses were conducted. A sequence of steps was taken to examine measurement invariance across age and gender from the least restrictive to most restrictive levels: Configural (no parameter constraints imposed), metric (factor loadings constrained to be equal across groups), and scalar invariance (factor

loadings and intercepts constrained to be equal across groups). Change in fit statistics, including CFI and RMSEA, from each invariance level to the next was used to evaluate whether a specific level of invariance was reached. Specifically, a decrease in $CFI \leq 0.01$ (Cheung & Rensvold, 2002) and an increase in $RMSEA \leq 0.015$ (Chen, 2007) indicated that the more restrictive level of invariance was established.

Results

The Structure of ZTPI-C

The goodness-of fit indices from the confirmatory factor analysis are reported in Table 5. Almost all fit indices indicated poor fit of the one-factor model to the data, suggesting that items are not direct indicators of an overarching time perspective factor. The hypothesized five-factor model in the total samples had acceptable fitness, $RMSEA=0.042$, $CFI=0.906$, $TLI=0.911$. In male and female samples, the five-factor model fitted equally at an acceptable level, with $RMSEA$ of 0.042 and 0.037 respectively. We divided the samples in study 2 into three age groups (younger group: 18–25 years old, $n=813$, 68.8% were female; middle group: 25–45 years old, $n=2341$, 57.2% were female; older group: 45–65 years old, $n=805$, 46.7% were female) to test the structural validity of ZTPI-C. In the samples of young and middle groups, the five-factor model fitted well at an acceptable level, with $RMSEA$ of 0.041 and 0.040 respectively. However, in the elder samples, the five factor model fit not so well, with CFI and TLI values < 0.90 . American sample was also used to test the model fit of ZTPI-C and results of the CFA revealed a poor fit for the data (TLI values less than 0.80), indicating that ZTPI-C could not suitable for American adolescents.

Table 5 Confirmatory factor analysis results for ZTPI-C

Fitness	χ^2/df	RMSEA	RMR	TLI	CFI
single-factor	38.48	0.095	0.107	0.453	0.499
five-factor in total sample	6.83	0.038	0.047	0.911	0.922
five-factor for					
male	3.92	0.042	0.054	0.899	0.911
female	4.15	0.037	0.046	0.914	0.925
younger	2.39	0.041	0.052	0.901	0.912
middle	4.65	0.040	0.051	0.906	0.918
older	2.92	0.049	0.059	0.864	0.881
American sample	3.73	0.058	0.089	0.798	0.823

Criterion-Related Validity

Studies have shown that a person was high in past positive and future orientation, as well as low in Past Negative and Present Fatalistic tended to have better subjective well-being and life satisfaction (Boniwell et al., 2010; Cunningham et al., 2015). Thus, we predicted that Past Positive and Future were positively associated with subjective well-being and life satisfaction, and that Past Negative and Present Fatalistic were negatively associated with subjective well-being and life satisfaction. Present Impulsive is a new factor in ZTPI-C and characterized by carelessness and disregard for consequences. Such individuals should score low on measures of subjective well-being, life satisfaction.

In the present study, the criterion-related validity of ZTPI-C was tested by the associations between subscales of ZTPI-C and subjective well-being and life satisfaction. According to expectations, we found that Past Negative had small but significantly correlations with subjective well-being ($r=0.18$, $p < 0.001$) and life satisfaction ($r=0.07$, $p < 0.01$) in the negative direction. Still the small size of the positive link between Past Positive and subjective well-being ($r=0.20$, $p < 0.001$) and life satisfaction ($r=0.17$, $p < 0.001$) were found in the present study. We found that Present Impulsive had negative correlation with subjective well-being ($r=0.10$, $p < 0.01$) but no correlation with life satisfaction. Present Fatalistic had negative correlation with subjective well-being ($r=0.21$, $p < 0.01$) and life satisfaction ($r=0.08$, $p < 0.01$). And we found a positive, moderate correlation between Future and subjective well-being ($r=0.25$, $p < 0.001$) and life satisfaction ($r=0.24$, $p < 0.001$). Taken together, these findings provided support for the criterion-related validity of ZTPI-C.

Measurement Invariance

In order to explore the measurement invariance of ZTPI-C in different genders and age groups, Mplus7.0 was adopted to test the invariance of different groups in configural, metric, and scalar measurement invariance. As shown in Table 6, all models for gender and age had acceptable fit. All differences in CFI value and RMSEA value from each invariance level to the next were less than 0.01, indicating that more restrictive models are equivalent to the configural model. This suggests that the factor structure and the meaning of the items are equivalent for gender and age groups. In addition, we examined the measurement invariance of ZTPI-C between Chinese and American samples. Since we only obtained the ZTPI data of American adolescents (11–18 years old, $n=815$, 53.4% were female), the younger group (18–25 years old, $n=813$, 68.8% were female) in the sample of present study was used to compare to American adolescents. Results of measurement invariance for different countries showed that CFI values from each invariance level to the next were well above 0.01, indicating that factor loadings and intercepts of ZTPI-C were unequal between Chinese and American samples.

Factor loadings and intercepts constrained to be equal across groups.

Discussion

The present study aims to develop the Chinese version of Zimbardo Time Perspective Inventory that can be applied to younger, middle, and older samples. We first revised the original ZTPI into Chinese version with samples of undergraduates in study 1. The EFA yielded 25 items and five dimensions—past negative, present impulsive, future, past positive, and present fatalistic—that explained 47.89% of the total variance. Different from the original scale (Zimbardo

Table 6 Invariance analyses (maximum-likelihood robust) for ZTPI-C scores

Models	S-B χ^2	df	TLI	CFI	RMSEA	Δ CFI
Invariance across gender						
Configural invariance	1996.34	530	0.897	0.909	0.037	-
Metric invariance	2027.15	550	0.900	0.909	0.036	0.000
Scalar invariance	2079.37	570	0.902	0.907	0.036	-0.002
Invariance across age						
Configural invariance	2454.14	835	0.891	0.899	0.038	-
Metric invariance	2482.95	855	0.893	0.899	0.038	0.000
Scalar invariance	2545.91	875	0.893	0.896	0.038	-0.003
Invariance across country						
Configural invariance	1431.02	530	0.849	0.867	0.046	-
Metric invariance	1647.41	550	0.823	0.838	0.050	0.029
Scalar invariance	2374.494	570	0.719	0.733	0.062	0.105

& Boyd, 1999), however, we renamed “Present Hedonistic” to “Present Impulsive”, as the revised dimension did not contain items that reflected hedonism. Previous studies have duplicated the factor structure of ZTPI and most of them used samples from individualistic societies (Anagnostopoulos & Griva, 2012; Davis & Ortiz, 2017; Orkibi, 2015). Chan et al. (2019) identified a six-factor structure of ZTPI in Hong Kong adolescents, and they separated a present impulsivity dimension from the Present Hedonistic subscale. These results indicate that the factor structure of ZTPI may not be applicable in different cultural contexts. In the present study, confirmatory factor analysis suggests that the five-factor model of ZTPI-C fit the data well in the samples of undergraduates. Regarding internal consistency reliability, Cronbach’s alpha for four factors ranged 0.67–0.77, while Cronbach’s alpha for Present Fatalistic was 0.57. Similarly, for test–retest reliability, the coefficients ranged 0.69–0.76, while that of Present Fatalistic was 0.57. The low coefficients for Present Fatalistic may be attributed to the small number of items (Worrell et al., 2016). Alternatively, this may also be due to the demographics characteristics of samples, given that the participants were undergraduates, who were likely to believe that their efforts could influence their future. Moreover, as young adults, they may have been more hopeful for the future, especially for most of them, higher education would create a promising future for them. Similarly, low Present Fatalistic coefficients have been found when revising inventories in other countries and cultures (McKay et al., 2015; Milfont et al., 2008; Sircova et al., 2014). For example, Milfont et al. (2008) found that Cronbach’s alpha for Present Fatalistic of the Brazilian version was 0.46. Sircova et al. (2014) observed that the lowest internal consistency reliability estimates were for Present Fatalistic ($\alpha = 0.53$). The reason behind these results may be that items of Present Fatalistic dimension are intended to measure inconsistent constructs including hopelessness about the future and fatalism (Worrell et al., 2016). Therefore, future studies may attempt to refine the items of Present Fatalistic subscale.

The correlations with depression, big five personality, aggression, self-esteem, life satisfaction, and impulsiveness further indicate validity of five dimensions as captured by ZTPI-Chinese version. In line with previous studies (Anagnostopoulos & Griva, 2012; van Beek et al., 2011; Zimbardo & Boyd, 1999), we found that Past Negative was positively associated with aggression and depression, and negatively associated with self-esteem and agreeableness, whereas Past Positive was positively correlated with self-esteem and agreeableness. We also found that individuals with high scores on Past Negative were more likely to have impulsiveness, and individuals with high scores on Past Positive tended to be agreeable and have high levels of self-esteem. Future is characterized by future planning

and working towards goal achievement, which is positively correlated with multiple adaptive behaviors (Albright et al., 2015; Hall et al., 2012; Lyu et al., 2019). In the present study, we found that Future was negatively associated with impulsiveness and neuroticism, and positively associated with self-esteem, agreeableness, openness, and conscientiousness, all of which contribute to success. Different from original scale (Zimbardo & Boyd, 1999), we renamed “present hedonistic” as “present impulsive,” regarding it as the characteristics of impulsivity, carelessness, and disregard for consequences. Present Impulsive was negatively associated with self-esteem, agreeableness, and conscientiousness, and positively associated with impulsiveness, neuroticism, and aggression. And Present Fatalistic was negatively associated with self-esteem, neuroticism, and conscientiousness, which is consistent with previous studies (Anagnostopoulos & Griva, 2012; van Beek et al., 2011; Zimbardo & Boyd, 1999). The correlations of the ZTPI subscales with other variables support the criterion-related validity of ZTPI-Chinese version.

The aim of study 2 was to examine the reliability and validity of the ZTPI-Chinese version in a more diverse sample and to test the measurement invariance of ZTPI-C across gender and age groups. Reliability estimates indicated good internal consistency for each of five subscales including Present Fatalistic, which was not good enough in study 1, and the alpha estimates ranged from 0.62 to 0.75. Correlation analysis was used to test validity of ZTPI-C by examining the relationship between each dimension of ZTPI-C with subjective well-being and life satisfaction. Consistent with previous studies (Boniwell et al., 2010), we found that all subscales of ZTPI-C had small to medium correlations with subjective well-being, and that all subscales of ZTPI-C, except Present Impulsive, had small to medium correlations with life satisfaction. Again, these findings suggest that the ZTPI-C has good concurrent validity. Confirmatory factor analyses were used to compare models including one single factor and theorized five-factor in the total samples and found that the theorized five-factor structure of the ZTPI-C fit the data better in the acceptable range. We examined CFI, TLI, and RMSEA fit indices for each gender and age group and found that all groups had acceptable fit except for the elder group with CFI below 0.9.

Developmental theory suggests that time perspective differs across the life-span (Mello & Worrell, 2015), and previous studies also have found gender differences in time perspective (Milfont et al., 2008; Zimbardo & Boyd, 1999). Therefore, it was necessary to examine the gender and age equivalence of the revised scale with a larger sample. We conducted invariance analyses to determine if ZTPI-C subscales and items could be interpreted similarly across three age groups and two gender groups in study 2. It was found that factor structure and the meaning of

ZTPI-C items are equivalent for gender. This is important because it shows that previous findings identifying mean-level differences of ZTPI scores across gender (Milfont et al., 2008) likely reflect true gender effects and not scale properties. Our results of measurement invariance analyses also revealed that the scale is scalar invariant across age groups. This suggests that the structure of five-factor model and the meaning of time perspective were consistent across young, middle, and older adult groups. Given that national culture plays a top-down role in time perspective (Andre et al., 2018; Mohammed & Marhefka, 2019), we also tested the measurement invariance between Chinese and American samples. Our results revealed that the factor structure and the meaning of the items of ZTPI-C were not equivalent for Chinese and American samples. Such results may suggest that Chinese and Americans have inconsistent perceptions of time.

Despite these findings, the study has a few limitations. Firstly, considering the adaptability of cultural factors, many items of the original ZTPI were deleted, we only obtained a 25-item scale, which may have lost some information that the original ZTPI wanted to measure. Currently, there are only three items in the Present Fatalistic dimension, which may lead to a low coefficient of internal consistency. Secondly, because we used samples of university students to determine the factor structure of ZTPI-C in study 1, the results may not applicable in adolescents and old adults. Although we examined the psychometric properties of ZTPI-C in an adults sample in Study 2, we did not test the applicability of the revised ZTPI-C in adolescents. Adolescence is a critical period for the development of present and future time frame (Husman & Shell, 2008), and adolescents' temporal frame has substantial influences on their identity formation, thus additional evidence is required to support the utility of ZTPI-C for adolescents. Thirdly, additional efforts are needed to improve psychometrics of ZTPI, especially the length the scale. Researchers have suggested that a future-negative perspective should be included in ZTPI (Carelli et al., 2011), because some mental health problems, such as depressive and anxiety symptoms, are characterized by negative future views. Fourthly, different age ranges of Chinese and American samples may limit the results of cross-cultural measurement invariance. Additional efforts are also needed to focus on the test of cross-cultural measurement invariance of ZTPI, which will facilitate the work to compare the time perspectives of samples from individualistic cultures with samples from non-Western cultures. Finally, time perspective changes across life span (Mello & Worrell, 2015), and milestones, such as having children and retirement, may alter individuals' perceptions of time perspective (Andre et al., 2018), thus more longitudinal studies to test causal relationships and processes over time is especially critical for time perspective.

Conclusions

Two studies in this article provided a comprehensive evaluation of the psychometric properties of ZTPI-C with Chinese college students and adults. The findings suggest that the ZTPI-C scores demonstrate modest to sufficient reliability, validity, and measurement invariance, and appear appropriate for application in Chinese young, middle and older adults. The five subscale of ZTPI-C were associated with a host of external criteria including personality traits, self-esteem, aggression, and well-being related variables. Additional evidence required supporting the utility of ZTPI-C for adolescents and more longitudinal studies to test causal relationships and processes over time are called for.

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Author Contributions Lyu Houchao, Li Xiaobao and Wang Chen designed the study idea and research framework. Material preparation, data collection and analysis were performed by Li Xiaobao and Wang Chen. The first draft of the manuscript was written by Li Xiaobao and Wang Chen. Lyu Houchao contributed to manuscript writing and modification. Data collection of American sample were performed by Frank C. Worrell and Zena R. Mello. All authors read and approved the final manuscript.

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Data Availability The datasets generated for this study are available on request to the corresponding author.

Declarations

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest. The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval This study was approved by the ethics committee of the corresponding author's university.

Informed Consent Written informed consent was obtained from each participant before data collection.

Ethics Statement This study was approved by the ethics committee of Faculty of Psychology at Southwest University. The participants signed an informed consent form stating the aim of the study and explaining that they could withdraw from the study, and the data would be anonymous.

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