

Psychometric Properties of the Chinese Version of 20-Item Zimbardo Time Perspective Inventory (C-ZTPI-20) in Chinese Adolescent Population

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Background: This study assesses the psychometric properties of the Chinese version of the Zimbardo Time Perspective Inventory (C-ZTPI-20) in an adolescent population.

Methods: The investigation encompasses a sample of 2634 middle school students from China and aims to evaluate the instrument's reliability, structural validity, measurement invariance, criterion validity, and network structure attributes.

Results: First, descriptive analysis revealed satisfactory reliabilities for four out of five C-ZTPI-20 dimensions, with Present Fatalistic (PF) exhibiting relatively low reliability. Moreover, Confirmatory Factor Analysis (CFA) supported the 5-dimensional structure across all samples and sexes, albeit with a modest Tucker-Lewis Index (TLI) for girls. Furthermore, measurement invariance analysis underscores unbiased assessment across sexes. Sex differences emerge in the Present Hedonistic (PH) dimension, where boys showed higher scores. Furthermore, criteria validity analysis revealed that Past Positive (PP) and Future (F) were positively associated with extraversion, agreeableness, conscientiousness, openness, grit, and mental health, while they were negatively associated with neuroticism. Past Negative (PN) and PF showed inverse trends, while PH perspective demonstrated complex, varied correlations with these psychological traits, underscoring the multifaceted nature of time perspectives. Finally, network analysis revealed positive inter-correlations within dimensions and significant edge differences between sexes, particularly in inter-dimension connections. Despite differing rankings, the most central and marginal items remained consistent between boys and girls in network models.

Conclusion: These findings contribute to understanding the C-ZTPI-20's effectiveness in assessing adolescent time perspectives and inform interventions promoting psychological well-being and coping strategies.

Keywords: time perspective, Zimbardo Time Perspective Inventory, psychometric properties, measurement invariance, network analysis

Introduction

Time perspective is a multifaceted concept that examines how our thoughts and attitudes regarding the past, present, and future influence our functioning as individuals.¹ The relationship between time perspective and adolescents' mental health has been explored through the Zimbardo Time Perspective Inventory (ZTPI).² This tool helps understand how adolescents' views of the past, present, and future influence their behavior and overall well-being. Time perspective plays a significant role in mental health, as it can lead to issues such as regrets, anxiety, or challenges in living in the present. Recognizing this relationship is crucial for developing effective interventions and support systems for adolescents, especially considering the prevalence of psychological disorders among this population, which poses a significant public health challenge. By addressing time perspective in the context of mental health, interventions can be tailored to enhance coping skills and emotional resilience among adolescents.

The ZTPI was developed by Philip Zimbardo and John Boyd in 1999 to comprehensively assess temporal psychology, including cognitive, affective, and behavioral dimensions.² It aimed to address conceptual and measurement challenges prevalent in the field of temporal psychology. Over the years, various literature related to the ZTPI have been employed in academic research. The original ZTPI consists of 56 items, designed to assess five distinct factors related to time perspective: Past Negative (PN), Past Positive (PP), Present Hedonistic (PH), Present Fatalistic (PF), and Future (F). The PN dimension reflects a pessimistic and negative attitude towards the past, while the PP dimension indicates a positive, joyful, and nostalgic outlook on past experiences. The PH dimension suggests a preference for immediate gratification and spontaneity, along with a dislike towards planning. The PF dimension describes a sense of helplessness and a fatalistic attitude towards the future. Lastly, the F dimension portrays a predominance of thoughts about the future and a general orientation towards planning ahead.² These dimensions provide a comprehensive understanding of individuals' time perspectives.

In the context of adolescents, the ZTPI has proven valuable in illuminating their time perspective and how it can significantly influence their mental health and overall well-being.³ The exploration of time perspective in this population contributes to the development of effective interventions and strategies aimed at fostering mental well-being and improving public health outcomes. As psychological disorders in adolescents continue to be a significant public health concern, the insights gained from the ZTPI can play a crucial role in crafting targeted approaches to address these challenges. By recognizing the relationship between time perspective, mental health, and public health, researchers and practitioners can develop evidence-based interventions that promote positive mental health outcomes among adolescents and contribute to overall public health improvement.

Moreover, recent investigations into the constructs of grit and its dimensions have revealed that grit and aspects of F are modestly correlated and contribute uniquely to undergraduate student achievement.⁴ Another study also demonstrated that the association between peer attachment and grit may be moderated by an individual's F.⁵ These studies highlight the potential for F to either bolster or impede the development of grit, depending on whether individuals prioritize short-term or long-term goals. Therefore, incorporating an understanding of grit into the study of time perspective offers a more comprehensive view of the motivational factors that influence adolescent development.

Furthermore, research on the five dimensions of the ZTPI has yielded significant associations with personality traits.⁶⁻⁸ For example, a study found a positive association between PN and the personality traits of neuroticism, while PP time perspective exhibited a positive correlation with conscientiousness. Additionally, PF demonstrated positive associations with neuroticism, and negative relationships with conscientiousness.⁷ Akirmak's study revealed a negative correlation between conscientiousness and both PN and PF, while it was positively correlated with PP and F time perspective. Another study was consistent with these findings, identifying notable correlations between neuroticism and PN, as well as between extraversion and PH, based on an analysis of 265 Caucasian adults.⁸ Regarding research on adolescents, some scholars observed a robust relationship between high extraversion and higher PH, and a strong association between high conscientiousness and higher F time perspective within a sample of 235 Romanian adolescents.⁶

Several studies have shown that distinct time perspectives are predictive of mental health issues such as anxiety and depression in both adult and adolescent cohorts.^{6,9} For instance, a study suggested that PN and PH were negatively associated with self-esteem but positively associated with depression and anxiety, while PP and F were positively associated with self-esteem and life satisfaction, but negatively associated with depression and anxiety in a total sample of 725 adults in South Korea.⁹ Another study demonstrated that PP negatively predicted depression whereas the PF predicted anxiety and depression in a sample of 1281 participants from six countries.¹⁰ As for adolescents, in a study conducted by Chan et al in 2019 on a sample of 8422 Hong Kong Chinese adolescents aged between 12 and 19, a comparison was made between adolescents with low levels of depression and anxiety and those with high levels of depression and anxiety. The findings indicated that the latter group of high depression and high anxiety adolescents exhibited higher PN and PF, while they exhibited lower on the PP, PH, and F time perspectives.¹¹ Adding to this body of evidence, a study by Kuan and Zhang examined 412 secondary school students in Hong Kong. Their results aligned with previous findings, where PP, PH, and F time perspectives predicted higher levels of subjective well-being, whereas PN and PF predicted lower levels.³

The ZTPI has been extensively used in diverse cultural contexts, with versions adapted for several countries and regions.^{10,12} Numerous attempts have been made to modify or shorten the original 56-item ZTPI.¹³⁻¹⁵ Orkibi, for instance, evaluated a 20-item version and found it to maintain the five-dimension structure of the original, displaying high internal

consistency and concurrent validity in 2014.¹³ The 20-item ZTPI strikes a balance between comprehensive assessment and conciseness, retaining the essential dimensions while remaining reasonably brief, unlike the more extensive 56-item versions. Correspondingly, Wang et al conducted a study on diverse ZTPI versions in a Chinese college student population.¹⁶ They translated all 56 items of the full version of the ZTPI and assessed the structural validity of the full version,² two 15-item short versions,^{17,18} and the 20-item short version.¹³ Their findings indicated that the 20-item version proposed by Orkibi exhibited the most favorable model fit indices.¹⁶

However, despite validation of the Chinese version of 20-item ZTPI (C-ZTPI-20), the assessment of the ZTPI in the adolescent population remains limited,⁷ necessitating a reliable and valid tool to measure time perspectives in adolescents. While a study has examined the psychometric properties of the ZTPI in Hong Kong Chinese male adolescents, it focused on a 37-item version rather than the C-ZTPI-20.¹¹ Furthermore, the comprehensive analysis of the psychometric properties of the C-ZTPI-20 in the adolescent population has not been fully documented. Moreover, the exploration of measurement invariance across sex and the internal network structure of the C-ZTPI-20 remain uncharted territories in the existing literature.

The current study further employs network analysis to scrutinize the structural composition of the dimensions encompassed by the C-ZTPI-20 and to assess measurement invariance across sex in the psychometric properties of the C-ZTPI-20 within the adolescent population. This analytical approach facilitates the identification of item clusters with shared characteristics, revealing the underlying structure and distinct clusters of time perspectives. Additionally, centrality indices (eg, strength) aids in determining key items, refining the inventory for more accurate measurements. Moreover, network analysis assesses discriminant validity by ensuring that each time perspective represents a unique construct without overlap.^{19,20} Unlike traditional factor analysis, network analysis uncovers intricate item relationships that may be overlooked. Lastly, an increasing number of studies used network analysis to investigate the psychometric tools.^{21,22} Therefore, the study plans to employ network analysis as a tool for evaluating the psychometric characteristics of the C-ZTPI-20, ensuring it adequately represents time perspectives among Chinese adolescents.

The study is guided by four principal objectives. Primarily, it seeks to assess the reliability and the dimensional structure of the C-ZTPI-20 in the adolescent population. Secondly, the study endeavors to explore the criteria validity of the C-ZTPI-20. Thirdly, the research aims to investigate the measurement invariance across sex in the psychometric attributes of the C-ZTPI-20 among adolescents. Finally, the study aspires to employ network analysis as a tool for evaluating the psychometric characteristics of the C-ZTPI-20.

Methods

Participants and Procedure

The sample for this study consisted of middle school students who were recruited from two educational institutions in China: a martial arts school and a conventional middle school. A total of 2766 students participated in the survey, which was conducted over a span from March 21 to April 21, 2023. In the current study, we excluded 28 participants who did not provide valid answers regarding their sex. Additionally, 104 participants with any missing values on items of the C-ZTPI-20 were also excluded. Consequently, the final sample for further analysis comprised 2634 participants (1429 boys and 1205 girls) with mean age of 14.824 years ($SD = 1.637$).

Ethical Approval Statement

This study was conducted in strict accordance with the ethical guidelines set forth in the Declaration of Helsinki. The study protocol received approval from the respective affiliations of the authors as well as the school boards of participants. Participants were guaranteed anonymity, confidentiality, and the right to withdraw.

Measures

Time Perspective

In this study, we employed the C-ZTPI-20, previously validated by Wang et al among Chinese university students, to assess adolescents' time perspective.¹⁶ This inventory comprises 20 items organized into five distinct time perspective dimensions, with four items per dimension. Participants were requested to assess the extent to which each statement

reflected their personal characteristics using a five-point Likert scale, ranging from 1 (very uncharacteristic) to 5 (very characteristic). Mean scores for each dimension were calculated by averaging the items within it, whereby higher scores denoted a greater association with that particular dimension of time perspective.

Big Five Personality Traits

The assessment of the Big Five personality traits was conducted using the Big Five Inventory–2 (BFI-2),²³ a novel personality inventory consisting of 60 items categorized into five dimensions—extraversion, agreeableness, conscientiousness, neuroticism, and openness—with 15 items for each dimension. The BFI-2 has undergone translation into Chinese and validation among diverse Chinese populations, including adolescents.²⁴ Participants were requested to evaluate the degree to which each statement captured their personal characteristics, employing a five-point Likert scale that ranged from 1 (strongly disagree) to 5 (strongly agree). Mean scores for each dimension were computed using the scoring key established by Soto and John, with higher scores indicating a more pronounced representation of the specific trait.²³

Grit

We employed the short Grit Scale (Grit-S) to measure participants' grit—defined as trait-level perseverance and passion for long-term goals.²⁵ The scale comprises 8 items across two dimensions—perseverance of effort and consistency of interest. The Grit-S has been skillfully translated into Chinese, demonstrating excellent reliabilities and validities when administered to Chinese adolescents.²⁶ Participants were instructed to gauge the extent to which each statement mirrored their personal attributes using a five-point Likert scale, spanning from 1 (very uncharacteristic) to 5 (very characteristic). The mean scores for the Grit-S and each dimension were calculated following the scoring guidelines set forth by Duckworth and Quinn, with higher scores reflecting a stronger manifestation of grit in general or within the specific dimension.²⁷

Mental Health

We employed the Mental Health Continuum–Short Form (MHC-SF) to assess participants' mental health status. The MHC-SF consists of 14 items distributed across three dimensions: emotional well-being (3 items), social well-being (5 items), and psychological well-being (6 items).²⁸ Participants were asked to indicate the extent to which they functioned in a particular manner, using a scale ranging from 1 (none of the time) to 6 (all of the time). The MHC-SF has been translated into Chinese and exhibited excellent reliability and validity in evaluating Chinese adolescents.²⁹ The mean scores for both the MHC-SF total score and each dimension were computed to describe participants' mental health status, with higher scores signifying better mental health overall or within the specific dimension.

Statistical Analysis

In this study, our statistical analysis unfolded across five distinct phases. Firstly, we conducted descriptive analysis to provide an overview of the sample, along with employing Cronbach's alpha to determine the reliabilities of the scales and their respective sub-scales. Additionally, potential sex differences across the 5 dimensions and 20 items of the C-ZTPI-20 were assessed using *t*-tests, with only Cohen's *d* exceeding 0.2 indicating significant distinctions between the two groups.³⁰ Subsequent to this, Confirmatory Factor Analysis (CFA) was undertaken to assess the structural validity of the 5-dimensional architecture within the C-ZTPI-20. We adopted the weighted least squares–mean (WLSM) to make model estimations. Model fit was assessed through several indices: the comparative fit index (CFI, where $\geq 0.95/0.90$ indicates good/acceptable fit), Tucker-Lewis index (TLI, where $\geq 0.95/0.90$ indicates good/acceptable fit), standardized root mean square residual (SRMR, where $\leq 0.06/0.08$ indicates good/acceptable fit), and root mean square error of approximation (RMSEA, where $\leq 0.06/0.08$ indicates good/acceptable fit). The third step encompassed the utilization of the multi-group CFA method to evaluate measurement invariance at the configural, metric, scalar, and strict models, employing the prevalent criterion of a -0.01 alteration in CFI to establish the invariance of nested models, as per Cheung and Rensvold's study.³¹ Additionally, we reported the altered values of RMSEA, TLI, and SRMR. The fourth stage encompassed a correlation analysis designed to examine the criterion validity of the C-ZTPI-20. In line with Cohen's guidance and accounting for our substantial sample size, we considered correlation coefficients reaching a small effect size ($r \geq 0.10$) to be statistically significant.³⁰

In the fifth step of our methodology, we employed the Bayesian Gaussian Graphical Model (BGGM) as outlined by Williams to conduct a psychological network analysis of the 20 items comprising the C-ZTPI-20 in 2021. Within this network framework, nodes represent the variables corresponding to each C-ZTPI-20 item, and edges depict partial correlations between any two variables while accounting for other variables.^{19,20,32} Detailed information regarding the reference numbers of the 20 C-ZTPI-20 items is presented in [Table S1](#) in the [Appendix](#). Readers interested in accessing the original ZTPI-20 statements can refer to the provided anonymous link: [\[https://osf.io/zhucx/?view_only=88c729623f4a403885e26fff4baffe9b\]](https://osf.io/zhucx/?view_only=88c729623f4a403885e26fff4baffe9b). Our network analysis was conducted in a three-step process: Firstly, utilizing BGGM, we estimated separate network models for the entire sample, boys, and girls. Secondly, we performed network comparisons to discern potential nuanced differences between the boy and girl networks. Thirdly, to assess the significance of specific nodes interconnected within a given network,²⁰ we calculated the strength centrality—representing the sum of absolute edge values directed towards a certain node. The prior distribution was set at a scale of 0.5, with 5000 posterior samples employed. We selected estimated edges with a 95% credible interval for the creation of the network visualization. All BGGM analyses were executed using the R software package *BGGM*.³³ Furthermore, all additional statistical analyses were also conducted using the R programming environment.

Results

Descriptive Analysis and Reliability

[Table 1](#) displays the descriptive results for C-ZTPI-20 and the other evaluated scales. While the Cronbach's alpha for PF is relatively low (0.560), the remaining four dimensions of C-ZTPI-20 exhibit satisfactory reliabilities. Item-level reliability testing revealed that the removal of any item from the PF dimension would not improve its Cronbach's alpha (detailed results provided in [Table S2](#) in the [Appendix](#)). Similarly, the other scales and their respective sub-scales also demonstrate acceptable reliabilities.

Table 1 Descriptive Results and Cronbach's Alpha Values of measures Used in the Current Study

	N	(NA ^a)	Mean	SD	Min	Max	Cronbach's Alpha
Five dimensions of C-ZTPI-20							
Past Positive (PP)	2634	–	3.754	0.782	1	5	0.690
Past Negative (PN)	2634	–	2.950	0.939	1	5	0.767
Present Fatalistic (PF)	2634	–	2.685	0.779	1	5	0.560
Present Hedonistic (PH)	2634	–	3.165	0.710	1	5	0.697
Future (F)	2634	–	3.267	0.736	1	5	0.723
Big Five Personality Traits							
Extraversion	2634	–	3.104	0.624	1.083	5	0.791
Agreeableness	2634	–	3.565	0.571	1.417	5	0.798
Conscientiousness	2634	–	3.247	0.623	1	5	0.832
Neuroticism	2634	–	2.977	0.713	1	5	0.837
Openness	2634	–	3.310	0.608	1.333	5	0.784
Grit and its two dimensions							
Grit	2631	3	3.097	0.675	1	5	0.707
Perseverance of Effort	2631	3	3.209	0.814	1	5	0.679
Consistency of interests	2631	3	2.982	0.853	1	5	0.656
Score of MHC-SF and its three dimensions							
Score of MHC-SF	2613	21	3.771	1.192	1	6	0.928
Emotional well-being	2610	24	4.252	1.279	1	6	0.885
Social well-being	2608	26	3.565	1.342	1	6	0.817
Psychological well-being	2603	31	3.705	1.344	1	6	0.890

Note: ^aNA refers to the count of missing responses.

Confirmatory Factor Analysis

As depicted in [Table 2](#), the fit indices lend robust support to the 5-dimensional structure of the C-ZTPI-20 across all samples and among boys. Notably, while the TLI for the 5-dimensional structure of the C-ZTPI-20 among girls is relatively modest (0.899), the remaining three fit indices still affirm the acceptable support of the 5-dimensional structure. Detailed model estimates of CFA (eg, standardized factor loadings) can be referenced in [Tables S3–S5](#) in the [Appendix](#). In light of the Present-Fatalistic domain exhibiting a low Cronbach's alpha, a potential issue for researchers using the sum or mean score of this domain, we suggest employing the factor score approach as a solution.³⁴ A 4-dimensional structural model of the C-ZTPI-20, excluding the Present-Fatalistic domain, demonstrates similar model fit indices when compared to the original five-dimensional structure of the C-ZTPI-20, as shown in [Table S6](#) in the [Appendix](#).

Sex Invariance and Mean Differences

As described in [Table 2](#), all indices strongly support the configural, metric, scalar, and strict invariance of the 5-dimensional structure of the C-ZTPI-20 across sex. The comparative analysis of the 5 dimensions and 20 items of C-ZTPI-20 between boys and girls is presented in [Table 3](#). Evidently, out of the 5 dimensions, only Present Hedonistic (PH) exhibits notable sex differences (Cohen's $d = -0.351$), indicating that boys display a higher level of PH compared to girls. Among the 20 items, significant sex differences (Cohen's $d < -0.2$) are observed in Item 10 and Item 15, both of which belong to the PH dimension, as well as Item 16, a component of the Future (F) dimension.

Table 2 Model Fit Indices for CFA and Invariance Models

	χ^2	df	RMSEA	CFI	TLI	SRMR	Δ RMSEA	Δ CFI	Δ TLI	Δ SRMR
CFA total sample (n = 2634)	2031.257***	160	0.053	0.927	0.914	0.056				
CFA Boys (n = 1429)	1018.693***	160	0.050	0.930	0.917	0.055				
CFA Girls (n = 1205)	1357.483***	160	0.063	0.915	0.899	0.065				
Configural Model	2370.063***	320	0.056	0.922	0.908	0.057				
Metric Model	2315.969***	335	0.056	0.919	0.908	0.059	0.000	-0.003	0.000	0.002
Scalar Model	2518.855***	350	0.057	0.911	0.904	0.061	0.001	-0.007	-0.004	0.002
Strict Model	2622.345***	370	0.057	0.908	0.905	0.062	0.000	-0.004	0.001	0.001

Note: *** $p < 0.001$.

Table 3 Comparison of 5 Dimensions and 20 Items of C-ZTPI-20 Between Boys and Girls

Variables	Boys (n = 1429)		Girls (n = 1205)		t	p	Difference [95% CI]	Cohen's d [95% CI]
	Mean	SD	Mean	SD				
Past Positive (PP)	3.789	0.758	3.712	0.807	-2.526	0.012*	-0.077 [-0.137, -0.017]	-0.099 [-0.175, -0.022]
Past Negative (PN)	2.937	0.922	2.965	0.958	0.759	0.448	0.028 [-0.044, 0.100]	0.030 [-0.047, 0.106]
Present Fatalistic (PF)	2.703	0.807	2.663	0.745	-1.301	0.193	-0.040 [-0.099, 0.020]	-0.051 [-0.128, 0.026]
Present Hedonistic (PH)	3.278	0.700	3.032	0.699	-8.986	< 0.001***	-0.246 [-0.300, -0.192]	-0.351 [-0.428, -0.275]
Future (F)	3.309	0.763	3.216	0.701	-3.240	0.001**	-0.093 [-0.149, -0.037]	-0.127 [-0.203, -0.050]
Item 2 (PP)	4.145	0.947	4.025	1.010	-3.142	0.002**	-0.120 [-0.195, -0.045]	-0.123 [-0.200, -0.046]
Item 7 (PP)	3.768	1.053	3.663	1.016	-2.598	0.009**	-0.105 [-0.185, -0.026]	-0.102 [-0.178, -0.025]
Item 9 (PP)	3.906	1.121	3.709	1.162	-4.431	< 0.001***	-0.198 [-0.285, -0.110]	-0.173 [-0.250, -0.097]
Item 17 (PP)	3.337	1.173	3.451	1.174	2.487	0.013*	0.114 [0.024, 0.204]	0.097 [0.021, 0.174]
Item 6 (PN)	3.059	1.256	3.163	1.227	2.140	0.032*	0.104 [0.009, 0.199]	0.084 [0.007, 0.160]
Item 8 (PN)	2.470	1.206	2.289	1.142	-3.941	< 0.001***	-0.181 [-0.272, -0.091]	-0.154 [-0.231, -0.077]
Item 11 (PN)	3.002	1.263	3.114	1.255	2.266	0.024*	0.112 [0.015, 0.208]	0.089 [0.012, 0.165]
Item 18 (PN)	3.216	1.202	3.293	1.221	1.635	0.102	0.077 [-0.015, 0.170]	0.064 [-0.013, 0.141]

(Continued)

Table 3 (Continued).

Variables	Boys (n = 1429)		Girls (n = 1205)		t	p	Difference [95% CI]	Cohen's d [95% CI]
	Mean	SD	Mean	SD				
Item 1 (PH)	3.740	1.025	3.589	1.003	-3.791	< 0.001***	-0.150 [-0.228, -0.073]	-0.148 [-0.225, -0.072]
Item 10 (PH)	3.184	1.128	2.798	1.112	-8.799	< 0.001***	-0.386 [-0.472, -0.300]	-0.344 [-0.421, -0.267]
Item 15 (PH)	2.916	1.143	2.559	1.026	-8.359	< 0.001***	-0.357 [-0.440, -0.273]	-0.327 [-0.404, -0.250]
Item 20 (PH)	3.271	1.066	3.180	1.063	-2.180	0.029*	-0.091 [-0.172, -0.009]	-0.085 [-0.162, -0.009]
Item 5 (PF)	2.631	1.088	2.509	1.021	-2.961	0.003**	-0.122 [-0.204, -0.041]	-0.116 [-0.192, -0.039]
Item 12 (PF)	3.018	1.139	3.045	1.041	0.621	0.535	0.027 [-0.057, 0.111]	0.024 [-0.052, 0.101]
Item 13 (PF)	2.764	1.102	2.754	1.081	-0.230	0.818	-0.010 [-0.094, 0.074]	-0.009 [-0.086, 0.068]
Item 14 (PF)	2.398	1.100	2.345	1.010	-1.277	0.202	-0.053 [-0.134, 0.028]	-0.050 [-0.127, 0.027]
Item 3 (F)	3.431	1.004	3.251	0.925	-4.764	< 0.001***	-0.180 [-0.255, -0.106]	-0.186 [-0.263, -0.110]
Item 4 (F)	3.171	1.086	3.215	1.001	1.061	0.289	0.043 [-0.037, 0.124]	0.042 [-0.035, 0.118]
Item 16 (F)	3.223	1.041	3.015	0.944	-5.336	< 0.001***	-0.208 [-0.285, -0.132]	-0.209 [-0.285, -0.132]
Item 19 (F)	3.411	0.982	3.384	0.933	-0.726	0.468	-0.027 [-0.101, 0.046]	-0.028 [-0.105, 0.048]

Notes: * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Criterion Validity

Table 4 displays the correlations between the five dimensions of C-ZTPI-20 and other measurement scales. Positive relationships were observed between the PP and extraversion, agreeableness, conscientiousness, openness, as well as grit and its perseverance of effort dimension (all Pearson r coefficients > 0.1). PP also exhibited positive correlations with the scores of MHC-SF and its three dimensions, while showing a negative correlation with neuroticism (all Pearson r coefficients > 0.1). Conversely, both PN and PF were negatively associated with extraversion, agreeableness, conscientiousness, openness, grit, and its two dimensions (all Pearson r coefficients > 0.1). PN and PF also displayed negative correlations with the MHC-SF scores and its three dimensions, but a positive correlation with neuroticism (all Pearson r coefficients > 0.1). The PH and F showed positive correlations with extraversion, agreeableness, conscientiousness, openness, and the perseverance of effort dimension of grit (all Pearson r coefficients > 0.1), while also displaying positive correlations with the MHC-SF scores and its three dimensions, but a negative correlation with neuroticism (all Pearson r coefficients > 0.1).

Table 4 Correlations Between Five Dimensions of C-ZTPI-20 and Other Measures

Variable	Past Positive (PP)	Past Negative (PN)	Present Fatalistic (PF)	Present Hedonistic (PH)	Future (F)
Big Five Personality Traits					
Extraversion	0.339***	-0.283***	-0.316***	0.291***	0.369***
Agreeableness	0.390***	-0.366***	-0.391***	0.150***	0.463***
Conscientiousness	0.296***	-0.320***	-0.399***	0.167***	0.644***
Neuroticism	-0.214***	0.568***	0.373***	-0.114***	-0.409***
Openness	0.239***	-0.115***	-0.235***	0.262***	0.387***
Grit and its two dimensions					
Grit	0.186***	-0.376***	-0.418***	0.065***	0.572***
Perseverance of Effort	0.256***	-0.267***	-0.296***	0.149***	0.582***
Consistency of interests	0.047*	-0.341***	-0.380***	-0.044*	0.347***
Score of MHC-SF and its three dimensions					
Score of MHC-SF	0.435***	-0.351***	-0.324***	0.281***	0.538***
Emotional well-being	0.359***	-0.350***	-0.271***	0.187***	0.344***
Social well-being	0.389***	-0.303***	-0.268***	0.233***	0.473***
Psychological well-being	0.405***	-0.311***	-0.325***	0.297***	0.557***

Notes: * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Network Structure Results

Figure 1 presents the network structure findings encompassing all samples, boys, girls, as well as the network comparison between sex. Comprehensive details regarding edge coefficients for network models and the coefficients of edge differences can be found in [Tables S7–S10](#) in the [Appendix](#).

The inter-correlations among items within the same dimension are predominantly positive in [Figures 1a–d](#) reveals significant edge differences between boy and girl participants—out of the 190 potential edges, 40 displayed statistical differences. Notably, 35 of these edge differences relate to inter-dimension connections.

Figure 2 presents the results of node strengths of network models. Detailed node strength coefficients can be found in [Tables S11–S13](#) in the [Appendix](#). Evidently, while the rankings of node strength differ between boy and girl participants in the network models, the most central and marginal items in both models remain consistent. Specifically, Item 2 of PP (#1 in network models) stands out as the most central item, while Item 8 of PN (#6 in network models) holds the position of the most marginal item.

Discussion

This study delved into multiple pivotal aspects of the C-ZTPI-20 in an adolescent population. The objectives spanned various aspects, including reliability and structural validity, measurement invariance across sex, criterion validity, and network structure attributes. The following discourse critically appraises the outcomes of these analyses, advancing a comprehensive understanding of the utility and robustness of the C-ZTPI-20 in capturing adolescents' time perspectives.

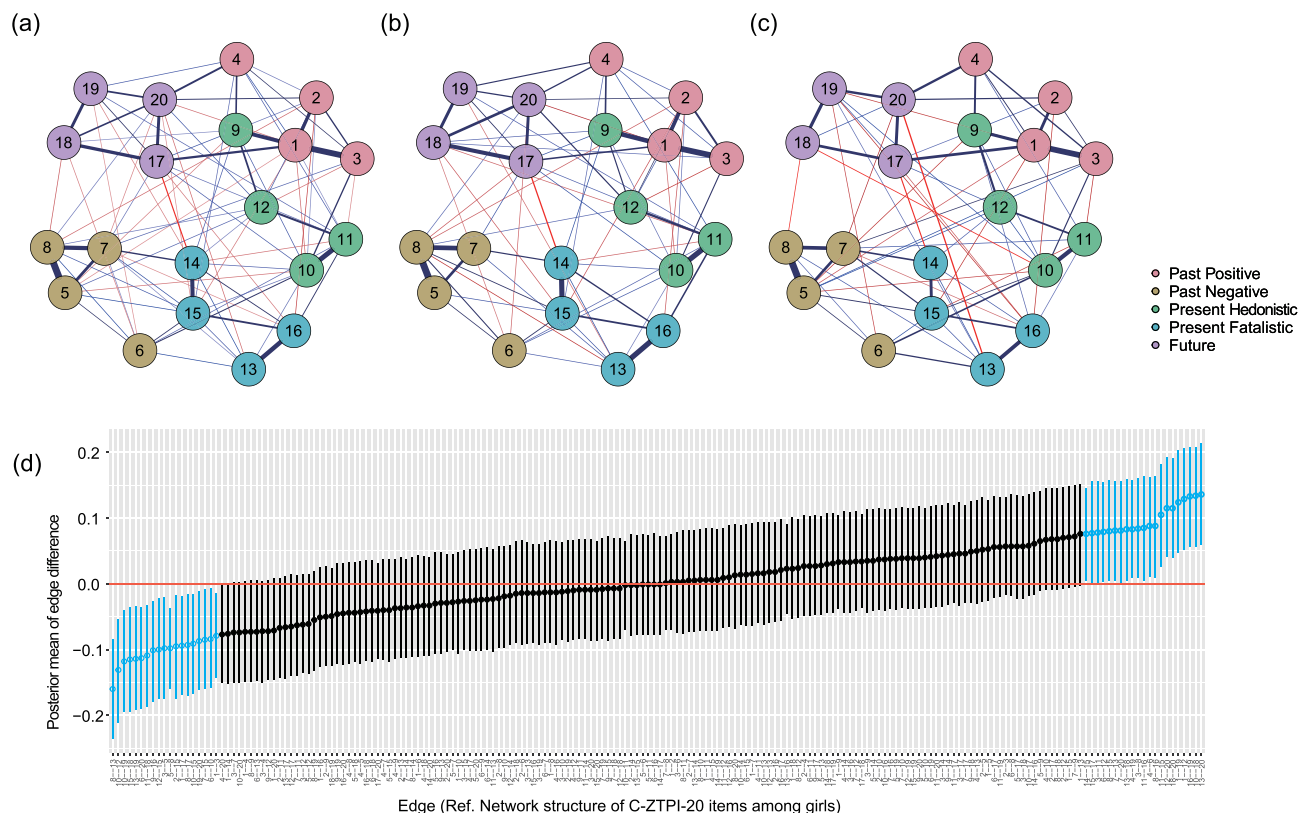


Figure 1 Results of the network models. In (a–c), blue edges represent positive partial correlations, and red edges indicate negative partial correlations, both adjusted for other variables. The thickness of an edge corresponds to the strength of the partial correlation between two nodes, again controlling for other variables. Only partial correlations with 95% credible intervals not encompassing zero are included in the network estimations. (a) illustrates the relations among C-ZTPI-20 items in the total sample ($n = 2634$), while (b and c) depict these relations within the subsets of boys ($n = 1429$) and girls ($n = 1205$), respectively. (d) compares the network structure of C-ZTPI-20 items between boys and girls, with the latter as the reference group. Here, error bars represent 95% credible intervals, and edges highlighted in light blue signify statistically significant differences. For detailed item mapping of the C-ZTPI-20, readers are encouraged to refer to [Table S1](#) in the [Appendix](#), where each item number is linked to its corresponding specific item.

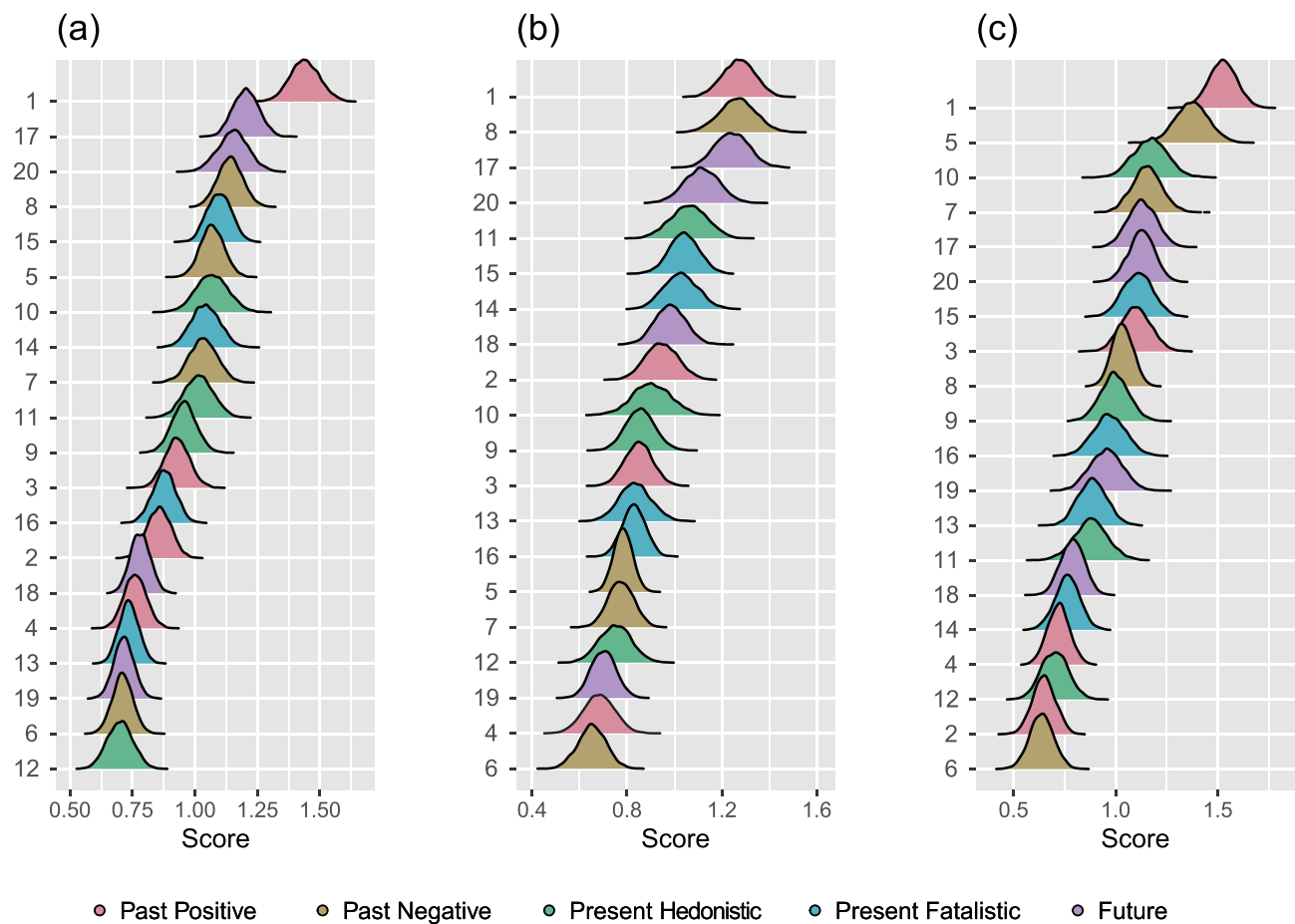


Figure 2 Results for node strength. (a) Node strength for the network structure of C-ZTPI-20 items for the total sample (n = 2634). (b) Node strength for the network structure of C-ZTPI-20 items among boys (n = 1429). (c) Node strength for the network structure of C-ZTPI-20 items among girls (n = 1205). The x-axis scores represent node strength coefficients, and the y-axis numbers correspond to the C-ZTPI-20 item numbers as estimated in the network model. For detailed item mapping of the C-ZTPI-20, readers are encouraged to refer to [Table S1](#) in the [Appendix](#), where each item number is linked to its corresponding specific item.

Firstly, descriptive analysis and reliability assessment unveiled satisfactory reliability for the C-ZTPI-20 dimensions, except for the PF dimension. This observation aligns with the broader landscape of time perspective research where the reliability of the Fatalistic perspective often presents a challenge.³⁵ Nonetheless, the acceptable reliabilities for the other dimensions and scales enhance the credibility of the C-ZTPI-20 as a psychometrically sound instrument. Moreover, the CFA results underscored the robustness of the 5-dimensional structure of the C-ZTPI-20, extending consistent support across various samples and sex groups. While the TLI for girls displayed a relatively modest value, the alignment of other fit indices with the anticipated structure corroborates the reliability of this assessment tool. It is important to note that CFA substantiates the validity of the measurement model by examining the extent to which the data align with the anticipated theoretical structure.³⁶

Third, the assessment of measurement invariance across sex represents a critical endeavor in establishing the universal applicability of the C-ZTPI-20. Notably, all indices supported the configural, metric, scalar, and strict invariance of the 5-dimensional structure across sex groups. This outcome underscores the instrument's robustness and unbiased assessment across different sex, corroborating its potential for unbiased use. Regarding the criterion validity, the pattern of associations among dimensions of time perspectives and external constructs aligns with theoretical expectations and past research, consolidating the convergent and divergent validity of the instrument. These correlations provide valuable insights into the interplay between time perspectives and psychological traits. Specifically, positive correlations were detected between the PP, PH, and F dimensions and traits such as extraversion, agreeableness, conscientiousness, openness, while indicating an inverse relationship with neuroticism. Conversely, both PN and PF dimensions displayed negative links with extraversion, agreeableness, conscientiousness, openness, while a positive correlation with neuroticism. These findings are consistent with prior

research. For instance, the positive relationship between PP and conscientiousness observed in Akirmak's study,³⁷ and the positive correlation between PH and extraversion reported by Diaconu-Gherasim and Mardari in 2022,⁶ all support our results.

Additionally, most dimensions of time perspective showed positive links with emotional well-being, social well-being, and psychological well-being, except for PN and PF. This implies that higher scores in the PN and PF are associated with poor mental health outcomes. The results are consistent with those of a robust study in 2022, which found that PP, PH, and F were positively correlated with enhanced subjective well-being while PN and PF perspectives were negatively correlated, indicating an association with reduced subjective well-being.³ However, given that the current study employed cross-sectional data, future investigations could utilize longitudinal data to further explore the relationships among time perspective, personality trait and mental health.

Finally, the application of network analysis provided an intricate depiction of the inter-item relationships within the C-ZTPI-20. The predominantly positive inter-correlations among items within the same dimension confirm the coherence of the construct measurement. Among the numerous significant differences observed, inter-dimension factors constitute the majority, implying that the variations in relationships between boys and girls are primarily associated with the interconnections among different dimensions of time perspective. This suggests that there are significant differences in the combinations of the five-dimensional models of time perspective between genders, warranting further investigation in future research, particularly for offering new opportunities for theoretical explanations.

In relation to the outcomes of the network analysis, it is worth highlighting that the item "I've taken my share of abuse and rejection in the past", which corresponds to item 8 of the PN dimension, occupies a relatively marginal position. An essential insight gleaned from our network analysis is that the item, currently under scrutiny, seems to exhibit a notable degree of separation from the core conceptual framework. One of the possible reasons is that cultural norms may influence the perception and internalization of past experiences in Chinese adolescents. The cultural emphasis on harmony and face in Chinese society often leads to understated acknowledgments of past abuses, impacting their representation in time perspectives. Moreover, Confucian values prioritizing societal roles and filial piety may cause negative past experiences to be downplayed or reframed within a more harmonious context. Furthermore, the intense academic pressure and the formative stage of adolescence typically shift focus towards immediate academic and social concerns, overshadowing past adversities. The rapid socio-economic changes in China also contribute to this phenomenon, with a growing emphasis on present and future challenges. Additionally, upon reviewing other shortened versions, we observed that the 15-item version omits this item.³⁸ While the 17-item version retains it and demonstrates satisfactory reliability and validity, network analysis has not been utilized to assess its internal structure.¹⁵ Hence, in future discussions centered on the potential simplification of the instrument, the removal of this item could merit contemplation. This identification of items' centrality and marginality serves to enhance the assessment's precision and aids in prioritizing items for potential future refinements.

While the study makes several contributions, it also has certain limitations that could be addressed in future research. For instance, the Cronbach's alpha for PF is relatively low (0.56). In response to this, one possible solution is to adopt the factor score approach to represent this domain. Factor scores, derived from latent variable models, can provide a more accurate understanding of complex psychological constructs. This method can mitigate the negative impact of low alpha values as it involves treating the items of a scale as indicators that reflect different facets of an underlying construct.³⁴ Although four-factor model of the C-ZTPI-20 still shows good fit even after removing the PF domain, but it did not significantly improve over the original five-factor model. This suggests that theoretically, removing the PF domain might result in the loss of an important dimension. Therefore, it might be necessary to consider the importance of the PF domain within the theoretical dimensions of TP when incorporating it into further criteria validity and network analysis. Even with a lower reliability of the PF domain, it might still play a crucial role in understanding the entire construct.

Moreover, given the fact that the current study is to validate C-ZTPI-20, which does not differentiate between two forms of the F Perspective, specifically the Future Negative (FN) dimension. Our measurement was therefore confined to the five conventional dimensions of time perspective, and future research that aims to explore these additional aspects of time perspective should consider employing measurement tools that include these specific constructs. Future research should aim to incorporate a more nuanced assessment of time perspectives, particularly by distinguishing between different forms of F perspective. Such an approach would align with Carelli et al's study, who proposed a differentiation between positive and negative future outlooks and found unique associations with other psychological variables, like

maladaptive coping strategies. This is especially relevant for young and adolescent populations, where the development of time perspective can significantly influence coping mechanisms and overall mental health.³⁹

In general, this comprehensive examination of the C-ZTPI-20's psychometric properties in an adolescent population has significant implications for both research and practice. The validated reliability, structural validity, measurement invariance, and criterion validity of the C-ZTPI-20 underscore its potential for accurately assessing time perspectives in adolescents. This instrument can serve as a valuable tool for researchers studying the relationship between time perspectives and various psychological outcomes, as well as for practitioners aiming to develop interventions targeted at improving adolescents' well-being. Future research could build upon these findings by exploring the dynamic nature of time perspectives in adolescents and how they evolve over time. Longitudinal studies could shed light on the stability and change of time perspectives throughout adolescence, providing a deeper understanding of the developmental trajectories of these constructs. Additionally, investigating the cultural and contextual factors that influence time perspectives among adolescents could enrich our understanding of the complexities of this concept.

In conclusion, the study thoroughly examined the psychometric properties of C-ZTPI-20 in adolescents. The research encompassed diverse analyses, including reliability assessment, confirmatory factor analysis, measurement invariance, criterion validity exploration, and network analysis. The results collectively validate the reliability and validity of the C-ZTPI-20, affirming its effectiveness in assessing time perspectives among adolescents and shedding light on their psychological well-being. The study underscores the potential of incorporating time perspective assessment in research and clinical settings, offering a means to tailor interventions for improved coping mechanisms and emotional resilience.

Ethical Approval

This study protocol received approval from the respective affiliations of the authors as well as the school boards of participants. Participants were guaranteed anonymity, confidentiality, and the right to withdraw.

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Disclosure

The authors declare no conflicts of interest in this work.

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