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The structural invariance of the Temporal Experience of Pleasure Scale across time and culture

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Abstract: The Temporal Experience of Pleasure Scale (TEPS) is a self-report instrument that assesses pleasure experience. Initial scale development and validation in the United States yielded a two-factor solution comprising anticipatory and consummatory pleasure. However, a four-factor model that further parsed anticipatory and consummatory pleasure experience into abstract and contextual components was a better model fit in China. In this study, we tested both models using confirmatory factor analysis in an American and a Chinese sample and examined the configural measurement invariance of both models across culture. We also examined the temporal stability of the four-factor model in the Chinese sample. The results indicated that the four-factor model of the TEPS was a better fit than the two-factor model in the Chinese sample. In contrast, both models fit the American sample, which also included many Asian American participants. The four-factor model fit both the Asian American and Chinese samples equally well. Finally, the four-factor model demonstrated good measurement and structural invariance across culture and time, suggesting that this model may be applicable in both cross-cultural and longitudinal studies.

Keywords: anticipatory and consummatory pleasure; culture; temporal stability

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Pleasure experience can be parsed into anticipatory, or future-oriented, pleasure, and consummatory, or in-the-moment, pleasure (Gard, Gard, Kring, & John, 2006). Animal studies and neuroimaging studies in humans support this distinction and have found different neural correlates for anticipatory and consummatory reward and pleasure (Berridge, 2003; Berridge & Robinson, 1998, 2003; Knutson, Adams, Fong, & Hommer, 2001; Kringelbach & Berridge, 2009). To characterize the difference between anticipatory and consummatory pleasure experience, Gard et al. (2006) developed the Temporal Experience of Pleasure Scale (TEPS). In the United States, the TEPS has a two-factor structure reflecting anticipatory and consummatory pleasure in two American samples. The anticipatory pleasure factor captures the pleasure of forthcoming positive events, such as "I get so excited the night before a major holiday I can hardly sleep," whilst the consummatory pleasure factor captures in-the-moment pleasure, such as "The smell of freshly cut grass is enjoyable to me." The TEPS has subsequently been used in research of pleasure experience in healthy individuals as well as people with psychosis-spectrum disorders (Chan et al., 2012; Favrod, Ernst, Giuliani, & Bonsack, 2009; Gard, Kring, Gard, Horan, & Green, 2007; Mote, Minzenberg, Carter, &

Kring, 2014). The differentiation between anticipatory and consummatory pleasure in the TEPS allows it to capture the two facets of anhedonia. Using the TEPS, conclusive evidence suggests that the anticipatory pleasure experience of patients with schizophrenia is impaired (Gard et al., 2007; Kring & Barch, 2014; Kring & Elis, 2013), while their consummatory pleasure experience appears to be generally preserved. Based on these findings, specific interventions aiming at alleviating anticipatory anhedonia in schizophrenia have been developed (Favrod, Giuliani, Ernst, & Bonsack, 2010). Validating the psychometric properties of the TEPS would facilitate future research in the above areas.

Prior research suggests that the measurement of pleasure experience may vary across cultures (Nozaki & Koyasu, 2016; Ye, Ng, & Lian, 2015), and this is reflected in subsequent research regarding the model fit of the TEPS. For example, while Favrod et al. (2009) found that the original two-factor structure of the TEPS fit well in a French sample, Chan et al. (2012) found that a four-factor structure was a better fit in a Chinese sample. In this solution, Chan et al. have proposed that anticipatory and consummatory pleasure could be further parsed into abstract and contextual components. Hence, the four-factor structure of the TEPS contains abstract anticipatory pleasure, contextual anticipatory pleasure, abstract consummatory pleasure, and contextual consummatory pleasure. The abstract component refers to belief-oriented statements, such as “I look forward to a lot of things in my life,” whereas the contextual component refers to event-oriented statements, such as “A hot cup of coffee or tea on a cold morning is very satisfying to me.” Chan et al. have proposed that Asian cultures tend to emphasize internal and external harmonious conditions (i.e., pleasure) such that individuals have an obligation to maintain internal harmonies (i.e., abstract pleasure) by continually adjusting themselves to the external context (i.e., contextual pleasure). In other words, in Chinese samples, the four-factor solution of the TEPS appears to reflect Asian values, which focus on the interplay between internal and external harmonies (i.e., abstract and contextual pleasure).

Other studies have found support for both the two- and four-factor models across different cultures. For example, Ho, Cooper, Hall, and Smillie (2015) reported that the two-factor model of the TEPS was a better fit than the four-factor model in two medium-sized Australian and British samples, while another study found a good fit for the four-factor model of the TEPS in a sample of Chinese people with schizophrenia spectrum disorders (Li et al., 2015). Taken together, findings from exploratory factor analyses in Western samples indicate that a two-factor model comprising anticipatory and consummatory pleasure may be a better fit, while in Asian samples, a four-factor model comprising abstract and contextual variations of temporal pleasure experience is a better fit.

Another question regarding pleasure experience in any population is how stable this experience is across time. To address this question, instruments with temporal stability are needed for longitudinal studies investigating changes in pleasure experience. Trait anhedonia has been found to be temporally stable in patients with schizophrenia in a 13-year follow-up study (Loas, Monestes, Ingelaere, Noisette, & Herbener, 2009). Furthermore, Buck and Lysaker (2013) found that the two-factor model of the TEPS was stable over 6 months in patients with schizophrenia. However, the variation of pleasure experience over time in healthy people is largely unknown. An additional important question about a measure such as the TEPS is its structural invariance. Ascertaining the measurement invariability of the TEPS across culture could clarify whether the TEPS is an appropriate instrument to assess pleasure experience across cultures.

To the best of our knowledge, however, validation of the structural invariance of the TEPS across culture and time has not been carried out simultaneously in one study. The stability of the structure of a questionnaire is essential in cross-cultural and longitudinal studies. In addition, the clarification of the factor structure of the TEPS could deepen our understanding of pleasure experience in both healthy populations and clinical groups (Li et al., 2015; Strauss, Wilbur, Warren, August, & Gold, 2011). Hence, the aim of this study was to evaluate the goodness-of-fit of the two-factor and four-factor models of the TEPS in American and Chinese samples and to examine the measurement and structural invariance of both models in the two samples. We further examined the stability of the TEPS across time in the Chinese sample. Based on our previous findings, we hypothesized that the four-factor model of the TEPS would be a better fit in the Chinese sample while the two-factor model would be a better fit in the American sample. We also hypothesized that the four-factor model would be temporally stable in the Chinese setting.

Method

Participants

Seven hundred and forty-one undergraduate students were recruited from a large west coast university in the United States, including 325 (44%) Asian Americans, 233 (31%) White Americans, 55 (7%) Hispanic Americans, 12 (2%) Black or African Americans, 14 (2%) Multiracial Americans, 13 (2%) Middle Eastern Americans, and 89 (12%) people who did not report racial information (mean age = 20.83 years, *SD* = 2.82 years). Meanwhile 883 undergraduate students (mean age = 18.84 years, *SD* = 0.83 years) were recruited from two large universities in China (Table 1). Informed consent was obtained from each participant. This study was approved by the Ethics Committees of all participating institutions.

Materials and procedure

Data from the American sample were collected online while data from the Chinese sample were collected on paper during a class. Participants in both samples received partial course credit as compensation. All of the Chinese participants completed the TEPS again after a 6-month interval.

The American participants completed the original version of the TEPS, which contains 18 six-point Likert items (Gard et al., 2006). The Chinese participants completed the Chinese version of the TEPS, which contains 20 six-point Likert items (18 original TEPS items and two additional items; Chan et al., 2012). Both versions of the TEPS measure anticipatory pleasure (10 and 11 items in the original and Chinese versions, respectively) and consummatory pleasure (eight and nine items in the original and Chinese versions, respectively). To examine the structural invariance across cultures, only the original 18-item version was used in the analysis.

Data analysis

We used confirmatory factor analysis (CFA) to investigate the goodness-of-fit for the two- and four-factor models in both the American and Chinese samples. To exclude possible cultural influence on model fitness within the American sample, we also ran separate CFAs on the Asian Americans and White Americans. We did not conduct a CFA on the remaining racial groups within the American sample because the sample sizes were too small. The adopted fitness indices included the comparative fit index (CFI), the Tucker–Lewis index (TLI), the non-normed fit index, the standardized root mean square residual, the Akaike information criterion, the Bayesian information criterion, and the root-mean-square error of approximation (RMSEA).

We then examined the cross-culture invariance of the two models between the American and the Chinese samples and the across-time invariance of both models in the Chinese sample. By manipulating different parameters in the model, we examined the configural invariance, metric invariance, scalar invariance, error variance invariance, factor variance and covariance invariance, and latent mean invariance by constraining each of the above components to be equal between groups in a stepwise fashion. Since the χ^2 statistic is affected by sample size (Milfont & Fischer, 2010), the difference in fitness indices was adopted to estimate model deterioration over time: A difference smaller than .01 indicated no significant difference, a difference between .01 and .02 indicated a medium difference, and a difference larger than .02 indicated a significant difference

Table 1
Descriptive Data of TEPS in American and Chinese Samples

	American sample (N = 741)[a]		Chinese sample (N = 883) 1st time[b]		Chinese sample (N = 883) 2nd time[c]		American vs. Chinese sample			1st vs. 2nd time in Chinese sample		
	Mean	*SD*	Mean	*SD*	Mean	*SD*	*t*	*p*	Cohen's *d*	*t*	*p*	Cohen's *d*
Two-factor model												
ANT	4.57	0.77	4.01	0.65	4.01	0.72	15.838	<.001**	0.78	0.19	.851	0.01
CON	4.66	0.84	4.17	0.77	4.31	0.84	12.167	<.001**	0.60	−3.64	<.001**	−0.17
Four-factor model												
ANT_ABS	4.93	0.92	5.04	0.82	5.01	0.87	−2.602	.009**	−0.13	0.90	.367	0.04
ANT_CONT	4.17	0.91	3.26	0.90	3.29	0.97	20.281	<.001**	1.01	−0.84	.401	−0.04
CON_ABS	4.77	0.89	4.62	0.87	4.74	0.92	3.241	.001**	0.16	−2.65	.008**	−0.13
CON_CONT	4.69	0.91	3.89	0.93	4.00	1.03	17.363	<.001**	0.87	−2.38	.017*	−0.11

Note. TEPS = Temporal Experience of Pleasure Scale; ANT = anticipatory pleasure; CON = consummatory pleasure; ABS = abstract; CONT = contextual.
[a] Cronbach's α = .89. [b] Cronbach's α = .79. [c] Cronbach's α = .84.
*p < .05. **p < .01.

(G. W. Cheung & Rensvold, 2002; Meade, Johnson, & Braddy, 2008). All analyses were performed with Mplus Version 7.4 (Muthén & Muthén, 1998).

Results

Model selection in the American and Chinese samples

Contrary to expectations, in the entire American sample, the four-factor model fit the TEPS data as well as the two-factor model. The CFI and TLI fitness indices of both models were higher than .9, indicating that both models were applicable in the American sample (Table 2). In fact, the fitness indices of the four-factor model had a slight advantage over the two-factor model. However, the American sample included 44% Asian Americans, who may share similar cultural characteristics with the Chinese sample. As such, we re-ran the analyses in the Asian Americans and White Americans separately. These analyses revealed that the CFI and TLI fitness indices of the four-factor and two-factor models among the Asian Americans were somewhat better than the model fit indices of the two models for the White Americans (see Table 2).

Consistent with our hypothesis, in the Chinese sample, the four-factor model fit the TEPS data better than the two-factor model. The CFI and TLI fitness indices of the four-factor model were higher than .9 in the Chinese sample, whereas those of the two-factor model were around .8, which indicated a poorer fit (see Table 2). The standardized factor loadings obtained via CFA of both models in the American and Chinese samples are listed in Table 3.

Model invariance across culture

We examined the measurement invariance of the TEPS between the American and Chinese samples for the two- and four-factor models, respectively. The initial configural invariance of the two-factor model was poor, indicating that there was variance in the basic factor structure and loadings between the American and Chinese samples (see Table 4). Although the model fitness indices were maintained to some extent when the factor loadings were constrained to be equal across groups, the fit of the two-factor model significantly deteriorated when the intercepts were set as invariant, suggesting that this model could not survive the scalar invariance test (ΔCFI > .02, ΔTLI > .02). The model fitness indices of the two-factor model significantly decreased when the error variance, factor covariance, variance invariance, and latent mean invariance were constrained to be equal between groups successively.

For the four-factor model, the fitness indices of configural invariance across groups were adequate, indicating that the factor structure was similar between the American and Chinese samples. Furthermore, the fit of the four-factor model was maintained when the intercept of each item was constrained to be equal, indicating that the TEPS measurement between groups had similar units and reference points (ΔCFI < .01, ΔTLI < .01). Moreover, the fit of the four-factor model did not decrease when the error variance (ΔCFI < .01, ΔTLI < .01) and factor covariance and variance invariance (ΔCFI < .01, ΔTLI < .01) were constrained to be equal. However, constraining the latent mean invariance to be equal decreased the fit of the four-factor model (ΔCFI > .02, ΔTLI > .02; see Table 4).

We re-ran these analyses in the Asian Americans and White Americans and found that the fit of the four-factor model was retained after the factor loading, intercept of each item, error variance, factor covariance, and variance were constrained to be equal in a stepwise manner (Table 5). Then we ran the analysis using the White American and Chinese samples and found similar results (Table 5). These findings

Table 2
Fitness Indicators of Each Model in American and Chinese Samples

Sample	Model	S-Bχ^2	*df*	*p*	CFI	TLI	SRMR	AIC	BIC	RMSEA [90% CI]
American sample (*N* = 741)	2-factor model	450.408	130	<.001	.919	.905	.046	39,180.054	39,451.926	.058 [.052, .064]
	4-factor model	330.454	109	<.001	.942	.927	.041	36,703.826	36,984.914	.052 [.046, .059]
Asian Americans (*N* = 325)	2-factor model	264.309	130	<.001	.916	.901	.054	17,301.343	17,524.588	.056 [.047, .066]
	4-factor model	193.603	109	<.001	.944	.930	.047	16,206.430	16,437.243	.049 [.037, .060]
White Americans (*N* = 233)	2-factor model	264.230	130	<.001	.903	.886	.058	12,084.513	12,288.125	.067 [.055, .078]
	4-factor model	208.920	109	<.001	.924	.906	.056	11,343.072	11,553.585	.063 [.050, .075]
Chinese sample (*N* = 883)	2-factor model	561.691	130	<.001	.821	.790	.057	51,812.587	52,094.803	.061 [.056, .067]
	4-factor model	284.215	109	<.001	.926	.907	.040	48,405.415	48,697.198	.043 [.037, .049]

Note. S-Bχ^2 = Satorra–Bentler χ^2; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root-mean-square error of approximation; CI = confidence interval.

Table 3
Standardized Factor Loadings of Four-Factor and Two-Factor Models of TEPS from Confirmatory Factor Analysis in the American and Chinese Samples

	American sample (N = 741)						Chinese sample (N = 883)					
	Four-factor model				Two-factor model		Four-factor model				Two-factor model	
Item	ANT _ABS	ANT _CONT	CON _ABS	CON _CONT	ANT	CON	ANT _ABS	ANT _CONT	CON _ABS	CON _CONT	ANT	CON
4. I look forward to a lot of things in my life.	.88				.85		.69				.57	
6. Looking forward to a pleasurable experience is in itself pleasurable.	.87				.83		.66				.63	
18. When something exciting is coming up in my life, I really look forward to it.	.77				.76		.73				.63	
1. When I hear about a new movie starring my favorite actor, I can't wait to see it.		.71			.63			.62			.51	
8. When I think of something tasty, like a chocolate chip cookie, I have to have one.		.71			.58			.73			.49	
10. I get so excited the night before a major holiday I can hardly sleep.		.82			.67			.66			.54	
11. When I'm on my way to an amusement park, I can hardly wait to ride the roller coasters.		.69			.58			.77			.56	
5. I love it when people play with my hair.		.61				.65		.58				.57
2. I enjoy taking a deep breath of fresh air when I walk outside.			.86			.85			.60			.56
3. The smell of freshly cut grass is enjoyable to me.			.67			.67			.77			.74
7. A hot cup of coffee or tea on a cold morning is very satisfying to me.			.77			.76			.72			.72
9. I appreciate the beauty of a fresh snowfall.			.81			.80			.68			.66
14. I love the sound of rain on the windows when I'm lying in my warm bed.			.74			.75			.72			.68
12. I really enjoy the feeling of a good yawn.				.72		.68				.54		.46
15. When I think about eating my favorite food, I can almost taste how good it is.				.77	.72					.68	.59	
16. When ordering something off the menu, I imagine how good it will taste.				.74	.69					.77	.69	
17. The sound of crackling wood in the fireplace is very relaxing.				.80		.80				.64		.64
13. I don't look forward to things like eating out at restaurants.					.44						.11	

Note. TEPS = Temporal Experience of Pleasure Scale; ANT = anticipatory pleasure; ABS = abstract; CON = consummatory pleasure; CONT = contextual.

Table 4

Fitness Indicators of Two-Factor and Four-Factor Models Cross-Culture Invariance

Model	S-Bχ^2	*df*	$\Delta\ \chi^2$	Δ *df*	*p*	CFI	TLI	Δ CFI	Δ TLI	SRMR	AIC	BIC	RMSEA [90% CI]
Two-factor													
M1 Configural invariance	1,146.081	261	NA	NA	<.001	.862	.838	NA	NA	.064	91,108.32	91,739.18	.065 [.061, .068]
M2 Metric invariance/weak invariance	1,244.481	277	98.400	16	<.001	.849	.833	−.013	−.005	.067	91,183.38	91,727.97	.066 [.062, .069]
M3 Scalar invariance/strong invariance	1,593.330	286	348.849	9	<.001	.796	.782	−.053	−.051	.082	91,577.48	92,073.55	.075 [.071, .079]
M4 Error variance invariance/strict invariance	2,086.668	304	493.338	18	<.001	.722	.720	−.074	−.062	.099	92,143.33	92,542.34	.085 [.082, .088]
M5 Factor covariance and variance invariance	1,809.664	290	216.334	4	<.001	.763	.750	−.033	−.032	.168	91,825.89	92,300.39	.080 [.077, .084]
M6 Latent mean invariance	1,882.397	291	72.733	1	<.001	.751	.739	−.012	−.011	.114	91,914.00	92,383.10	.082 [.079, .086]
Four-factor													
M1 configural invariance	614.982	218	NA	NA	<.001	.936	.920	NA	NA	.041	85,062.03	85,719.86	.047 [.043, .052]
M2 metric invariance/weak invariance	662.029	231	47.047	13	<.001	.930	.918	−.006	−.002	.046	85,088.16	85,675.89	.048 [.044, .052]
M3 Scalar invariance/strong invariance	685.612	238	23.583	7	<.001	.928	.917	−.002	−.001	.048	85,098.60	85,648.58	.048 [.044, .052]
M4 Error variance invariance/strict invariance	708.829	245	23.217	7	<.001	.925	.917	−.003	.000	.049	85,112.86	85,625.11	.048 [.044, .052]
M5 Factor covariance and variance invariance	738.058	248	52.446	10	<.001	.921	.913	−.007	−.004	.082	85,143.60	85,639.67	.049 [.045, .053]
M6 Latent mean invariance	1,108.055	252	369.997	4	<.001	.861	.850	−.060	−.063	.100	85,578.99	86,053.49	.065 [.061, .069]

Note. S-B$_{\chi 2}$ = Satorra–Bentler χ^2; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root-mean-square error of approximation; CI = confidence interval; NA = not applicable.

suggest structural invariance of the four-factor model between the Chinese and American samples.

Model invariance across time

We also examined the measurement invariance of the two-factor and four-factor models in the Chinese sample over 6 months. The fit of the two-factor model, which did not decrease in the structural invariance examination (ΔCFI < .01, ΔTLI < .01), was poor, similar to our findings in the confirmatory factor analysis (CFI < .9, TLI < .9; Table 6). However, for the four-factor model, both the configural invariance and metric invariance over time were adequate, indicating temporal stability of the four-factor structure in the Chinese sample (Table 6). Although the model deteriorated to a moderate extent when the intercept of each item was set as equal across time (ΔCFI < .02, ΔTLI < .02), the fitness indices were maintained when the error variance, factor covariance, variance invariance, and latent mean invariance were successively constrained to be equal (ΔCFI < .01, ΔTLI < .01). The model fitness indices of each nested model were considerable (Table 6). These findings indicated that the four-factor model of the TEPS was temporally stable in the Chinese sample.

Discussion

This study compared the two-factor and four-factor models of the TEPS using confirmatory factor analyses in American and Chinese samples and examined the measurement and structural invariance of the TEPS across cultures. We also assessed the structural invariance over time in the Chinese sample. We found that the four-factor model fit the Chinese sample better than the two-factor model. In contrast, both models fit the American sample well, although the four-factor and two-factor models were slightly better fits in the Asian American subsample compared with the White American subsample. Furthermore, the four-factor model rather than the two-factor model survived the measurement invariance test across culture, suggesting cross-cultural structural invariance of the four-factor model of the TEPS. Finally, the four-factor model was temporally stable in the Chinese sample, consistent with our expectations.

We found that the four-factor model fit the Chinese sample better than the two-factor model, which is consistent with previous findings (Chan et al., 2012; Li et al., 2015).

Table 5
Fitness Indicators of Four-Factor Models Cross-Culture Invariance in Asian Americans and White Americans, Respectively

Four-factor model	S-Bχ^2	*df*	Δ χ^2	Δ *df*	*p*	CFI	TLI	Δ CFI	Δ TLI	SRMR	AIC	BIC	RMSEA [90% CI]
Asian American													
M1 Configural invariance	472.720	218	NA	NA	<.001	.933	.917	NA	NA	.042	64,611.85	65,233.65	.044 [.039, .049]
M2 Metric invariance/weak invariance	506.035	231	33.315	13	<.001	.928	.915	−.005	−.002	.047	64,621.50	65,177.05	.044 [.039, .050]
M3 Scalar invariance/strong invariance	520.665	238	14.630	7	<.001	.926	.915	−.002	0	.049	64,622.04	65,141.90	.044 [.039, .050]
M4 Error variance invariance/strict invariance	539.076	245	18.411	7	<.001	.923	.914	−.003	−.001	.050	64,631.77	65,115.96	.045 [.039, .050]
M5 Factor covariance and variance invariance	543.019	248	22.354	10	<.001	.923	.915	−.003	0	.066	64,630.01	65,098.91	.044 [.039, .049]
M6 Latent mean invariance	752.994	252	209.975	4	<.001	.869	.858	−.054	−.057	.085	64,875.84	65,324.36	.057 [.053, .062]
White American													
M1 Configural invariance	490.809	218	NA	NA	<.001	.925	.907	NA	NA	.044	59,748.49	60,360.62	.046 [.042, .053]
M2 Metric invariance/weak invariance	517.706	231	26.897	13	<.001	.921	.907	−.004	0	.048	59,751.78	60,298.69	.046 [.042, .053]
M3 Scalar invariance/strong invariance	532.237	238	14.531	7	<.001	.919	.908	−.002	.001	.049	59,752.39	60,264.18	.046 [.042, .052]
M4 Error variance invariance/strict invariance	540.500	245	8.263	7	<.001	.919	.910	0	.002	.049	59,752.81	60,229.48	.047 [.041, .052]
M5 Factor covariance and variance invariance	560.075	248	27.838	10	<.001	.914	.906	−.005	−.002	.069	59,768.48	60,230.10	.046 [.042, .053]
M6 Latent mean invariance	725.345	252	165.270	4	<.001	.870	.860	−.044	−.046	.092	59,956.76	60,398.30	.057 [.053, .063]

Note. S-B$_{\chi 2}$ = Satorra–Bentler χ^2; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root-mean-square error of approximation; CI = confidence interval; NA = not applicable.

Table 6
Fitness Indicators of Two-Factor and Four-Factor Models Cross-Time Invariance in Chinese Sample

Model	S-Bχ^2	*df*	Δ χ^2	Δ *df*	*p*	CFI	TLI	Δ CFI	Δ TLI	SRMR	AIC	BIC	RMSEA [90% CI]
Two-factor													
M1 Configural invariance	1,704.100	563	NA	NA	<.001	.867	.852	NA	NA	.060	99,794.64	100,459.50	.048 [.045, .051]
M2 Metric invariance/weak invariance	1,728.329	579	24.229	16	<.001	.866	.855	−.001	.003	.062	99,788.62	100,377.00	.047 [.045, .050]
M3 Scalar invariance/strong invariance	1,887.978	595	159.649	16	<.001	.850	.841	−.016	−.014	.063	99,935.67	100,447.50	.050 [.047, .052]
M4 Error variance invariance/strict invariance	1,949.940	613	61.962	18	<.001	.845	.840	−.005	−.001	.064	99,968.28	100,394.00	.050 [.047, .052]
M5 Factor covariance and variance invariance	1,961.324	615	73.346	20	<.001	.844	.840	−.006	−.001	.066	99,978.97	100,395.10	.050 [.047, .052]
M6 Latent mean invariance	1,999.606	617	38.282	2	<.001	.839	.836	−.005	−.004	.066	100,018.30	100,424.80	.050 [.048, .053]
Four-factor													
M1 Configural invariance	927.194	474	NA	NA	<.001	.946	.936	NA	NA	.042	92,877.10	93,618.51	.033 [.030, .036]
M2 Metric invariance/weak invariance	942.491	487	15.297	13	<.001	.946	.937	.000	.001	.043	92,868.46	93,547.69	.033 [.029, .036]
M3 Scalar invariance/strong invariance	1,111.100	500	168.609	13	<.001	.927	.918	−.019	−.019	.044	93,035.85	93,652.90	.037 [.034, .040]
M4 Error variance invariance/strict invariance	1,171.773	517	60.673	17	<.001	.922	.915	−.005	−.003	.046	93,071.93	93,607.67	.038 [.035, .041]
M5 Factor covariance and variance invariance	1,184.986	521	73.886	21	<.001	.921	.915	−.006	−.003	.049	93,079.94	93,596.54	.038 [.035, .041]
M6 Latent mean invariance	1,213.697	525	28.711	4	<.001	.918	.912	−.003	−.003	.049	93,103.80	93,601.27	.039 [.036, .041]

Note. S-B$_{\chi 2}$ = Satorra–Bentler χ^2; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root-mean-square error of approximation; CI = confidence interval; NA = not applicable.

However, the fact that both models fit the Asian American sample suggests that the four-factor model may be applicable to Asian culture more broadly, rather than specific to a Chinese context. Our results are different from those of Ho et al. (2015), who found the two-factor model to be a better fit than the four-factor model in European culture. However, it must be noted that 44% of our American sample were Asian Americans, who may share similar cultural backgrounds with the Chinese sample. Furthermore, model fit for Asian Americans was higher than for White Americans. These findings suggest that cultural factors may also play a role in the structure of pleasure experience within the American sample.

It is somewhat surprising that the two-factor model did not exhibit a better fit than the four-factor model in the White American sample. However, it is possible that the American sample may also have cultural heterogeneity, thus affecting the results. Nevertheless, an emerging perspective in cultural psychology describes conventional culture-comparing and indigenous framework (F. M. Cheung, 2012; F. M. Cheung, van de Vijver, & Leong, 2011). On the one hand, the definition, motivation, and predictors of happiness are different between individualistic cultures (which predominate in European–American nations) and collectivistic cultures (which predominate in East Asian countries; Uchida, Norasakkunkit, & Kitayama, 2004). On the other hand, cultural differences are not static but are affected by the salience of individualism and collectivism at a given time (Oyserman & Lee, 2008). Unfortunately, we did not assess individualism and collectivism in this study.

In addition, since half of the participants in the American sample in the present study were Asian Americans, it is not surprising that the four-factor and original two-factor model fit the American sample equally well. The distinctions between abstract and contextual components within both anticipatory and consummatory pleasure may reflect the beliefs and memories highlighted and reflected in different cultures. However, the applicability and measurement invariance of both the two- and four-factor models of TEPS require future examination in other individualistic and collectivistic cultures.

This study was limited by the narrow range of age and education of the samples. Both the American and Chinese samples recruited here were young undergraduate students, and the American sample contained a significant proportion of Asian Americans. Therefore, the present findings might not be generalizable to other populations. Another limitation of this study was the lack of longitudinal data in the American sample. It is uncertain whether the apparent cultural difference was intrinsic and if the two-factor model was more stable than the four-factor model longitudinally in the American sample. Finally, the difference in data-collection methods in the Chinese and American samples in this study should also be taken into consideration. Future studies should collect data in a unified way.

In conclusion, we found that the four-factor model of the TEPS was a better fit than the two-factor model in the Chinese context and among Asian Americans. The four-factor model was also temporally stable. We also found that only the four-factor model of the TEPS possessed structural invariance between the American and Chinese samples. Emotional memory and beliefs may play an important role in determining how individuals respond to the four-factor version of the TEPS across cultures.

Disclosure of conflict of interest

The authors declare that there are no conflicts of interest.

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