ARTICLE

Validation of the Chinese Version of the Affective Exercise Experiences Questionnaire (AFFEXX-C)

Ting Wang[1], Boris Cheval[2,3], Silvio Maltagliati[4], Zachary Zenko[5], Fabian Herold[6], Sebastian Ludyga[7], Markus Gerber[7], Yan Luo[8], Layan Fessler[4], Notger G. Müller[6] and Liye Zou[1,*]

[1]Body-Brain-Mind Laboratory, School of Psychology, Shenzhen University, Shenzhen, 518060, China

[2]Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland

[3]Department of Psychology, Laboratory for the Study of Emotion Elicitation and Expression (E3Lab), University of Geneva, Geneva, Switzerland

[4]University Grenoble Alpes, SENS, Grenoble, F-38000, France

[5]Department of Kinesiology, California State University Bakersfield, Bakersfield, CA, USA

[6]Research Group Degenerative and Chronic Diseases, Movement, Faculty of Health Sciences Brandenburg, University of Potsdam, Potsdam, Germany

[7]Department of Sport, Exercise & Health, University of Basel, Basel, Switzerland

[8]Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Illinois, 61801, USA

*Corresponding Author: Liye Zou. Email: liyezou123@gmail.com

ABSTRACT

Despite the well-established benefits of regular physical activity (PA) on health, a large proportion of the world population does not achieve the recommended level of regular PA. Although affective experiences toward PA may play a key role to foster a sustained engagement in PA, they have been largely overlooked and crudely measured in the existing studies. To address this shortcoming, the Affective Exercise Experiences (AFFEXX) questionnaire has been developed to measure such experiences. Specifically, this questionnaire was developed to assess the following three domains: antecedent appraisals (e.g., liking *vs.* disliking exercise in groups), core affective exercise experiences (i.e., pleasure *vs.* displeasure, energy *vs.* tiredness, and calmness *vs.* tension), and exercise motivation (i.e., attraction *vs.* antipathy toward exercise). The current study aimed to validate a Chinese version of the AFFEXX questionnaire (AFFEXX-C). In study 1, 722 Chinese college students provided data for analyses of factorial, convergent, discriminant, criterion validity, and test-retest reliability of the AFFEXX-C. In addition, 1,300 college students were recruited in study 2 to further validate its structural model. Results showed that the AFFEXX-C demonstrates a good fit and reliability. Additionally, results further supported the hypothesized model based on previous research: antecedent appraisals predicted core affective exercise experiences, which in turn predicted attraction-antipathy toward physical exercise. The AFFEXX-C was found to be a reliable and valid measure of affective exercise experiences in a population of Chinese college students.

KEYWORDS

Affective exercise experiences; questionnaires; reliability; validity; college students; Chinese translation

Introduction

The World Health Organization (WHO) has recommended that adults should perform at least 150 min/week of moderate-intensity physical activity (PA) or 75 min/week of vigorous-intensity PA—at best accompanied by at least two sessions of strength training per week—to maintain and promote general health [1,2]. However, the proportion of adults who fail to meet these PA guidelines remains relatively high. For example, recent estimates suggest that nearly 80% of people fail to achieve the aerobic and muscle-strengthening guidelines [3]. Among the populations at particular risk for physical inactivity are college students. For example, 41.4% of college students can be classified as physically inactive, ranging from 21.9 % in Kyrgyzstan to 80.6% in Pakistan [4,5]. This high prevalence of physical inactivity has severe consequences as it contributes to the increased risk of premature mortality [6,7] and a variety of chronic diseases [8,9], including hypertension, coronary heart disease, cognitive decline [10–12], depressive symptoms [13], type II diabetes mellitus, and cancers [14]. Moreover, the economic burden due to physical inactivity is substantial. Latest data from WHO suggests that health consequences related to physical inactivity cause healthcare costs of nearly 520 billion USD by 2030 worldwide, while physical inactivity-related productivity loss reaches 47.6 billion USD per year [15]. Against this background, global efforts to promote regular PA (e.g., in structured and planned forms also referred to as physical exercises) are urgently required.

Although numerous efforts have been made to better understand why many individuals intending to be physically active fail to turn these intentions into action, our ability to understand this so-called intention-behavior gap is, so far, relatively limited. Recently, affective mechanisms have taken a prominent place in recent theories aiming to explain individuals' engagement in PA [16–18], to the point that these mechanisms could be considered as pivotal constructs to explain the gap between intention and action. Experimental studies in line with these theories have shown that experiencing a positive affective response during physical activity increases the probability of re-engaging in this behavior in the future [19–22]. Despite these promising results, studies investigating the role of affective mechanisms are still relatively limited due to at least one main reason: the lack of validated scales to accurately measure the affective constructs and mechanisms.

To fill this gap, Ekkekakis and colleagues proposed a construct, namely affective exercise experiences, which was defined as a "summary valanced designation, ranging from pleasant to unpleasant, that reflects the history of associations between exercise over the life course of an individual and the attendant affective responses" [23]. Anchored within the affective-reflective theory [24], Ekkekakis et al. have developed a new questionnaire to assess such affective exercise experiences, namely the Affective Exercise Experiences (AFFEXX) questionnaire. The authors proposed a conceptual model of the AFFEXX questionnaire (see Fig. 1), which relied on a three-tiered causal chain—antecedent appraisals influencing core affective experiences, which in turn influence attraction-antipathy toward exercise [23]. In a validation study, the AFFEXX questionnaire showed good reliability and validity to assess the impact of affective constructs on exercise motivation in a sample of US college students [23].

Despite the importance of the affective mechanisms to foster engagement in PA, a validated Chinese version of the scale is lacking at the time of writing. The first aim of the study was thus to validate a Chinese version of the AFFEXX questionnaire (AFFEXX-C). Moreover, evidence suggests that affect-related processes are culturally patterned [25]. Accordingly, the structure of the AFFEXX questionnaire could differ between different cultures, especially between western, individualism relative to eastern, collectivist countries [26]. The second aim of the study was therefore to examine the cross-cultural validity of the AFFEXX-C in a
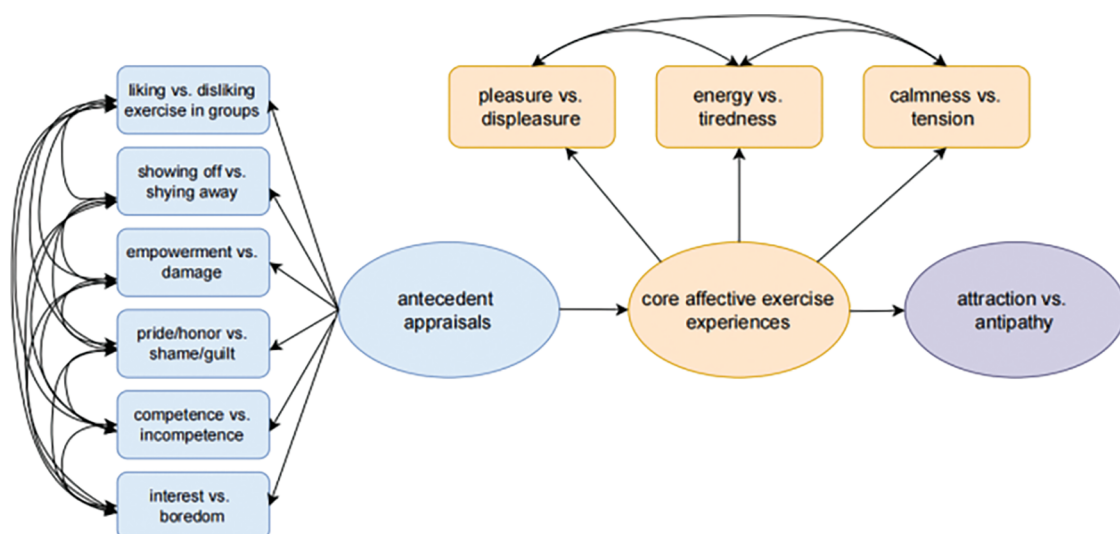

FIGURE 1. Illustration of the structural model of the AFFEXX questionnaire (36 items).

Chinese sample to assess to which extent the hypothesized model proposed in previous western research is maintained or differed in an eastern country. Moreover, at the conceptual level, it is essential to test the hypothesized model proposed in previous research [23] (i.e., antecedent appraisals → core affective exercise experiences → attraction-antipathy toward exercise) to further verify the role of the first two structures in exercise motivation.

Methods

In this research, college students were invited to complete a questionnaire on the online Questionnaire-Star platform. Specifically, a scan code was sent to colleagues of the leading author across China. Those colleagues agreed to help distribute the code to their students via WeChat. Only students who were willing to participate in this study got access to the questionnaire. In study 1, the survey included the AFFEXX-C and other instruments designed to assess the convergent validity (i.e., affective attitudes), discriminant validity (i.e., instrumental attitudes, behavioral intention, exercise self-efficacy and situated decisions to exercise), and criterion validity (self-reported PA behaviors). Reliability assessment was also conducted in the first survey and test-retest analysis was additionally performed on participants (referring to a portion of the sample size in study 1) who responded to the same survey about three weeks later. In study 2, another independent sample of college students was recruited with the same procedure described above to validate the conceptual model of the AFFEXX-C (see Fig. 1). This protocol was approved by the ethics committee of Shenzhen University (PN-202200026) and all study procedures were in accordance with the latest version of the Declaration of Helsinki. All individuals who were interested in participating in this study provided informed consent before any data collection.

AFFEXX questionnaire and scale translation
The AFFEXX questionnaire was originally developed by Ekkekakis and colleagues [23] and consists of 36 items and 10 factors assessing three structures (i.e., antecedent appraisals, core affective exercise experiences, and attraction-antipathy; more details can be found in Supplementary data). Each response was made on a 7-point Likert scale ranging from 1 ("if the statement on the left perfectly matches what you would say") to 7 ("if the statement on the right perfectly matches what you would say"). A higher mean score of each factor (i.e., the average scores of the entries items of each factor) indicates a more positive level of antecedent appraisals, core affective exercise experiences, or greater attraction (*vs.* antipathy) towards physical exercise. Previous research reported good validity and reliability in an English-speaking US sample, with all Cronbach's coefficients being higher than 0.80 [23]. A Chinese-language version of the AFFEXX questionnaire (AFFEXX-C) was developed to capture the above three structures.

Researchers from the Body-Brain-Mind Laboratory contacted the authors who developed the original AFFEXX questionnaire and communicated with them for the project

about translating and validating this instrument among the Chinese population. Two English-Chinese bilingual researchers who specialized in psychology translated the original questionnaire into Chinese. Subsequently, the translated version was sent to four Chinese exercise psychologists with good bilingual skills (Chinese and English) who reviewed and provided feedback on this version. Based on their feedback, this newly translated version was revised and then sent to two individuals fluent in English and Chinese and invited to independently perform back-translation. Meanwhile, a discussion meeting was scheduled with one of the original authors of the AFFEXX questionnaire to confirm whether the translations adequately captured the original three structures. As a result, the 36-item AFFEXX-C was built.

Participants
We recruited Chinese-speaking college students for the current study who met the following inclusion criteria: (i) healthy, without any self-reported psychiatric or neurological disorders, other chronic diseases, or contraindications to PA, and (ii) aged between 17 and 29 years. In addition, we excluded participants who responded with an unreasonable duration to complete the questionnaires (i.e., less than 3 minutes, as determined as minimum duration by the researcher team during a pilot testing), participants with implausible responses (e.g., time spent on exercise participation of >16 h), or those who failed to pass the polygraph questions (i.e., Please select "I'm sure I can do it" for this question). In total, 722 eligible participants (excluding 86 participants) were included for the final data analysis in study 1 (408 female, 314 male, age = 19.92 ± 1.45 years, Body Mass Index = 21.13 ± 4.54 kg/m^2), with 197 who completed the questionnaire a second time 3 weeks later for test-retest reliability. In study 2, 1,300 college students (700 female, 600 male, age = 19.84 ± 1.45 years, Body Mass Index = 20.55 ± 2.82 kg/m^2) were included according to the same criteria mentioned above, after excluding 53 participants with implausible responses.

Measures
To examine convergent and discriminant validity, three constructs from the theory of planned behavior (TPB) were assessed [27]. Specifically, instrumental attitudes (including five items following the stem "For me, exercising on at least 5 of the next 7 days for recreation, leisure, exercise or sport would", e.g., "be useless" or "be useful"), affective attitudes (including six items following the same stem, e.g., "feel satisfying" or "feel unsatisfying") and behavioral intention (including three items, e.g., "I plan on exercising on at least 5 of the next 7 days for recreation, leisure, exercise, or sport", responded by "definitely no" or "definitely yes") were measured using a 7-point bipolar scale, ranging from 1 ("if the statement on the left perfectly matches what you would say") to 7 ("if the statement on the right perfectly matches what you would say"), with higher scores representing more positive attitudes and stronger behavioral intention. In the present study, Cronbach's alpha of the three constructs of the TPB were 0.86, 0.94, and 0.90, respectively. As in the original study [23], affective attitudes were used to assess

convergent validity, and instrumental attitudes and behavioral intentions were measured to determine discriminant validity.

The Exercise Self-Efficacy Questionnaire (ESE), developed by Wu et al. [28], was used to measure participants' beliefs in their ability to perform physical exercises. This single-dimension questionnaire contained 12 items in total and each item was scored on a 3-point rating scale ranging from 1 (*I can't do it*) to 3 (*I'm sure I can do it*), with a higher score representing a greater exercise self-efficacy. In the present study, Cronbach's alpha of this construct was 0.91. The ESE served as another indicator for testing the discriminant-validation criterion.

The Situated Decisions to Exercise Questionnaire (SDEQ) was used to assess individual tendencies to decide whether to exercise or not in situations in which individuals are faced with behavioral alternatives [29]. This questionnaire includes eight items describing eight prototypical situations (e.g., "You're finishing your classes and you are just about to go to the gym. Now you hear that your classmates plan to go for a drink. They invite you"). In each situation, participants were asked to indicate whether they would likely exercise now or refrain from it. Answers ranged from 1 (*definitely yes*) to 5 (*absolutely no*). The lower the mean score of the eight items, the more likely individuals would decide to exercise when faced with other choices. The English version of this questionnaire has a good internal consistency indicated by a Cronbach's alpha of 0.79 [29], which is supported by the present study, with a Cronbach's alpha of 0.81. The SDEQ served as another indicator for testing the discriminant-validation criterion.

To evaluate predictive validity, the level of usual PA was assessed by the International Physical Activity Questionnaire-Short Form (IPAQ-SF). Participants were asked to reflect on how many days, and how many minutes they engaged in PA in the last seven days, namely vigorous PA (VPA), moderate PA (MPA), and walking leisure (i.e., not used for transportation). The level of regular PA was quantified by weighting each type of activity following the energy requirements defined in METs (referred to as metabolic equivalent) and expressed as MET-min per week (MET level*minutes of activity*events per week) [30]. The total level of PA (expressed in MET-min/week) was the sum of the three kinds of PA levels. Additionally, the level of moderate-to-vigorous PA (MVPA, calculated by the sum of the VPA and MPA) was also used as an indicator of the overall level of PA. A study on the Chinese version of IPAQ-SF reported good test-retest reliability with coefficients of 0.75 to 0.93 for the different levels of PA [31].

Statistical analysis
Data analyses were carried out in IBM SPSS 24.0 (Armonk, NY, USA) and Mplus 8 (Los Angeles, CA, USA). In study 1, demographic information (e.g., age and sex) was first visually inspected, and means (*M*) and standard deviations (*SD*) for continuous variables and numbers and percentage for categorical variables were calculated. Secondly, 722 college students were randomly divided into two samples (sample 1 and sample 2). Based on sample 1 (n = 339), i) Kaiser-Meyer-Olkin (KMO) and Bartlett's test were

conducted as exploratory factor analysis (EFA). We used the principal axis method of factor extraction followed by oblimin rotations to account for the assumption of intercorrelations between the factors of the AFFEXX-C. According to the guidelines [32–34], items with factor loadings ≥ 0.50 and cross-loadings ≤ 0.25 were included. Based on sample 2 (n = 383), ii) internal consistency was tested with Cronbach's alpha, and iii) three confirmatory factor analyses (CFAs) of antecedent appraisals, core affective exercise experiences, and attraction-antipathy were conducted. To measure the fit of these models, the Tucker-Lewis Index (TLI) and other parameters were considered, including the Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA), with a 90% Confidence Interval (CI). According to Hu and Bentler [35], the recommended acceptable values for these indices were as followed: CFI and TLI ≥ 0.95; SRMR and RMSEA ≤ 0.06. Finally, iv) to test convergent, discriminant, and predictive validity, the relationships between the factors of the AFFEXX-C and other variables (e.g., level of regular PA and exercise self-efficacy) were tested by partial correlation analyses in the total sample (N = 722). The correlation coefficient was rated as follows: <0.19; low correlation: 0.20 to 0.39; moderate correlation: 0.40 to 0.59; moderately high correlation: 0.60 to 0.79; high correlation: ≥0.80 [36]. Additionally, a total of 197 participants volunteered to carry out the re-test three weeks later and their data was used to determine the test-retest reliability. ICC values were rated by the following criterion [37]: <0.40 as poor, from 0.40 to 0.59 as fair, from 0.60 to 0.74 as good, and ≥0.75 as excellent. Finally, to confirm the validity of the conceptual model of the AFFEXX-C, structural modeling analyses were carried out in study 2 (N = 1,300). A p-value of 0.05 was considered statistically significant for all two-tailed tests.

Results

Descriptive statistics in study 1
Descriptive statistics for the total sample in study 1 (N = 722) are presented in Table 1. The means and standard deviations of the AFFEXX-C are shown on all items in Table 2.

Exploratory factor analysis (EFA)
The EFA of the items developed to represent antecedent appraisals, core affective exercise experiences, and attraction *vs.* antipathy (KMO = 0.891 > 0.80, p < 0.001; KMO = 0.930 > 0.90, p < 0.001; KMO = 0.854 > 0.80, p < 0.001) were computed in sample 1 (n = 339). According to the criterion [32–34], six items (11, 20, 23, 26, 31, 34) were removed in EFA. The modified model with 30 items tapping into three different domains is shown in Table 3 and was used for subsequent analyses.

Confirmatory factor analysis (CFA)
Fit statistics of the CFA from sample 2 are presented in Table 4. Good model fit indices were indicated in the analysis of antecedent appraisals (χ^2 = 218.36, df = 90,

TABLE 1

Participant demographic characteristics and targeted variables for the total sample

Variables	All (*N* = 722)		Male (*n* = 314)		Female (*n* = 408)			
	M	**SD**	**M**	**SD**	**M**	**SD**	***t***	***p***
Age	19.92	1.45	19.98	1.46	19.88	1.45	0.88	0.381
BMI (kg/m²)	21.13	4.54	22.08	4.76	20.40	4.23	4.95	<0.001
Interest *vs.* Boredom	4.86	1.23	5.16	1.19	4.63	1.21	5.77	<0.001
Pride/Honor *vs.* Shame/Guilt	4.55	1.36	4.88	1.33	4.30	1.33	5.88	<0.001
Empowerment *vs.* Damage	5.38	1.04	5.62	1.00	5.19	1.03	5.70	<0.001
Showing off *vs.* Shying away	3.01	1.28	3.33	1.32	2.77	1.20	5.94	<0.001
Liking *vs.* Disliking exercise in groups	4.44	1.33	4.54	1.30	4.36	1.35	1.83	0.067
Competence *vs.* Incompetence	5.11	0.94	5.25	0.91	5.00	0.94	3.67	<0.001
Pleasure *vs.* Displeasure	5.20	1.01	5.34	0.98	5.09	1.01	3.37	<0.001
Energy *vs.* Tiredness	4.51	1.31	4.65	1.25	4.40	1.35	2.55	0.011
Calmness *vs.* Tension	5.00	1.05	5.13	1.08	4.91	1.02	2.91	0.004
Attraction *vs.* Antipathy	4.31	1.16	4.67	1.06	4.04	1.17	7.43	<0.001
Instrumental attitudes	5.73	0.99	5.85	0.96	5.63	1.01	2.91	0.004
Affective attitudes	5.16	1.22	5.39	1.18	4.98	1.22	4.54	<0.001
Behavioral intention	4.15	1.50	4.42	1.52	3.94	1.45	4.32	<0.001
Exercise self-efficacy	21.21	5.83	22.62	5.96	20.13	5.50	5.80	<0.001
Situated decisions to exercise	3.02	0.72	2.90	0.76	3.11	0.68	−3.90	<0.001
Walking (MET-min/week)	1577.42	1068.42	1585.65	1051.40	1571.08	1082.58	0.18	0.856
MPA (MET-min/week)	656.94	649.42	779.34	721.88	562.74	570.89	4.37	<0.001
VPA (MET-min/week)	1261.31	1120.37	1483.75	1110.21	1090.12	1099.17	4.75	<0.001
MVPA (MET-min/week)	1918.24	1416.46	2263.08	1424.43	1652.85	1353.34	5.87	<0.001
Total PA (MET-min/week)	3495.66	1781.75	3848.73	1721.08	3223.94	1782.04	4.74	<0.001

Note: M = mean; SD = standard deviation; BMI = body mass index; MPA = moderate-intensity physical activity; MET = metabolic equivalent; VPA = vigorous-intensity physical activity; MVPA = moderate-to-vigorous-intensity physical activity; PA = physical activity. 10 factors from Interest *vs.* Boredom to Attraction *vs.* Antipathy belong to the original version of the AFFEXX questionnaire.

TABLE 2

Descriptive analysis of all items of the AFFEXX-C (36 items)

Factor	Item	All (*N* = 722)		Male (*n* = 314)		Female (*n* = 408)	
		M	**SD**	**M**	**SD**	**M**	**SD**
Interest *vs.* Boredom	1	4.76	1.46	5.16	1.41	4.44	1.43
	4	4.72	1.46	5.03	1.49	4.49	1.40
	23	5.11	1.25	5.28	1.23	4.97	1.25
Pride/Honor *vs.* Shame/Guilt	2	4.49	1.74	5.00	1.61	4.09	1.74
	21	4.34	1.63	4.68	1.63	4.07	1.57
	34	4.83	1.50	4.96	1.52	4.73	1.48
Empowerment *vs.* Damage	5	5.10	1.28	5.47	1.22	4.82	1.26
	7	5.32	1.25	5.60	1.15	5.11	1.29
	26	5.70	1.21	5.80	1.19	5.62	1.22
Showing off *vs.* Shying away	8	2.84	1.51	3.11	1.56	2.63	1.45
	24	3.27	1.50	3.60	1.56	3.01	1.40
	27	2.93	1.39	3.28	1.46	2.65	1.28
Liking *vs.* Disliking exercise in groups	9	4.38	1.58	4.48	1.53	4.30	1.61

(Continued)

Table 2 (continued)

Factor	Item	All (N = 722)		Male (n = 314)		Female (n = 408)	
		M	SD	M	SD	M	SD
	10	4.27	1.57	4.39	1.57	4.17	1.57
	33	4.67	1.53	4.76	1.51	4.61	1.55
Competence *vs.* Incompetence	15	5.26	1.08	5.39	1.08	5.16	1.07
	16	5.25	1.22	5.41	1.19	5.13	1.23
	28	5.01	1.12	5.17	1.16	4.89	1.06
	36	4.91	1.16	5.04	1.17	4.81	1.14
Pleasure *vs.* Displeasure	11	5.24	1.30	5.45	1.30	5.08	1.29
	30	5.06	1.12	5.21	1.09	4.94	1.13
	32	5.28	1.07	5.39	1.03	5.18	1.10
	35	5.26	1.15	5.42	1.14	5.14	1.14
Energy *vs.* Tiredness	12	4.71	1.52	4.93	1.46	4.53	1.55
	13	4.30	1.50	4.37	1.47	4.25	1.53
	18	4.52	1.40	4.65	1.40	4.42	1.40
	20	4.78	1.33	5.00	1.29	4.61	1.34
Calmness *vs.* Tension	17	4.76	1.43	4.99	1.40	4.59	1.43
	19	5.12	1.15	5.20	1.19	5.06	1.12
	22	5.13	1.14	5.21	1.19	5.07	1.10
	31	5.04	1.14	5.14	1.13	4.96	1.15
Attraction *vs.* Antipathy	3	4.76	1.50	5.19	1.36	4.43	1.52
	6	4.94	1.38	5.27	1.25	4.69	1.43
	14	3.83	1.48	4.25	1.47	3.51	1.41
	25	4.18	1.23	4.47	1.14	3.95	1.24
	29	3.85	1.45	4.15	1.43	3.63	1.43

Note: M = mean; SD = standard deviation.

TABLE 3

Factor loadings of items for antecedent appraisals (four factors), core affective exercise experiences (three factors), and attraction-antipathy items (one factor)

No.	Items	Factors			
		F1	F2	F3	F4
Antecedent appraisals (KMO = 0.89; Cumulative variance 58.0%)					
Identification *vs.* disidentification					
1.	Exercise is stimulating–Exercise is boring	0.710			
2.	When my doctor asks if I exercise, I can answer with my head held high–When my doctor asks if I exercise, I bow my head in shame	0.794			
4.	Exercise is very exciting–Exercise is very dull	0.572			
5.	I love that exercise makes me feel stronger–I hate that exercise may injure me	0.808			
7.	I feel good to be getting all the great benefits from exercise–I feel horrible because I feel like I may get hurt from exercise	0.668			
21.	Exercise is something everyone ought to be doing and I am happy to say that I do–Exercise is something everyone ought to be doing but I am sorry to say that I do not	0.615			
Competence *vs.* incompetence					
15.	After exercise, I feel encouraged–After exercise, I feel discouraged		0.778		
16.	Exercise gives me a sense of accomplishment–Exercise gives me a sense of failure		0.757		

(Continued)

Table 3 (continued)

No.	Items	F1	F2	F3	F4
28.	Exercise boosts my ego–Exercise deflates my ego		0.598		
36.	Exercise makes me feel like I could do anything–Exercise makes me feel incompetent		0.773		
Showing off *vs.* shying away					
8.	When I exercise, I love showing off–When I exercise, I'd rather be invisible			0.751	
24.	When others look at me when I exercise, it makes me feel great–When others look at me when I exercise, it makes me feel terrible			0.764	
27.	I love when others watch me as I exercise–I hate it when others watch me as I exercise			0.802	
Liking *vs.* disliking group exercise					
9.	I feel great exercising in a group–I feel intimidated exercising in a group				0.875
10.	Exercise is enjoyable in a group–Exercise is not enjoyable in a group				0.948
33.	I love exercising with others–I hate exercising with others				0.513
Core affective experiences (KMO = 0.93; Cumulative variance 63.1%)					
Energy *vs.* tiredness					
12.	Exercise leaves me feeling energized–Exercise leaves me feeling exhausted	0.754			
13.	I feel revitalized after exercise–I feel drained after exercise	0.799			
18.	Exercise is very invigorating–Exercise is very tiring	0.729			
Pleasure *vs.* displeasure					
30.	The feeling I get from exercise is fantastic–The feeling I get from exercise is awful		0.819		
32.	Exercise improves my mood–Exercise worsens my mood		0.753		
35.	Exercise feels wonderful–Exercise feels terrible		0.786		
Calmness *vs.* tension					
17.	For me, exercise is a relaxing activity–For me, exercise is a stressful activity			0.746	
19.	Exercise gives me serenity–Exercise stresses me out			0.678	
22.	Exercise soothes me–Exercise makes me feel tense			0.606	
Attraction *vs.* antipathy (KMO = 0.85; Cumulative variance 60.7%)					
3.	Exercise is something I look forward to–Exercise is something I dread	0.785			
6.	Exercise is a tempting activity–Exercise is an uninviting activity	0.736			
14.	I would choose exercise over most other activities–I would choose most other activities over exercise	0.721			
25.	Exercise is near the top of the list of things I like–Exercise is near the bottom of things I like	0.789			
29.	Exercise is high on my priority list–Exercise is low on my priority list	0.768			

Note: F1 = Factor 1, F2 = Factor 2, F3 = Factor 3, F4 = Factor 4, KMO = Kaiser-Meyer-Olkin.

TABLE 4

Fit indices for each CFA model in sample 2 ($n = 383$)

	Factors	χ^2	*df*	TLI	CFI	SRMR	RMSEA (90% CI)
Antecedent appraisals	4	218.36	90	0.952	0.964	0.042	0.061 (0.051, 0.071)
Core affective experiences	3	42.69	20	0.977	0.987	0.022	0.054 (0.032, 0.077)
Attraction-antipathy	1	11.23	5	0.976	0.988	0.021	0.057 (0.006, 0.102)
Structural model	8	687.25	344	0.947	0.958	0.042	0.051 (0.045, 0.057)

Note: χ^2 = Chi-Square Test of Model Fit; *df* = Degrees of Freedom, TLI = Tucker-Lewis Index, CFI = Comparative Fit Index, SRMR = Standardized Root Mean Square Residual, RMSEA = Root Mean Square Error of Approximation, 90% CI = lower level and upper level of the bias-corrected 90% bootstrap confidence interval.

TLI = 0.95, CFI = 0.96, RMSEA = 0.06 [0.05, 0.07], SRMR = 0.04), core affective exercise experiences (χ^2 = 42.69, *df* = 20, TLI = 0.98, CFI = 0.99, RMSEA = 0.05 [0.03, 0.08], SRMR = 0.02), and attraction-antipathy (χ^2 = 11.23, *df* = 5, TLI = 0.98, CFI = 0.99, RMSEA = 0.06 [0.01, 0.10], SRMR = 0.02). The test of all eight factors in this 30-item framework

TABLE 5

Coefficients of internal consistency from sample 2 (n = 383)

	Items	Cronbach's alpha
Antecedent appraisals		
Identification *vs.* Disidentification	6	0.90
Competence *vs.* Incompetence	4	0.83
Showing off *vs.* Shying away	3	0.84
Liking *vs.* Disliking group exercise	3	0.80
Core affective experiences		
Energy *vs.* Tiredness	3	0.87
Pleasure *vs.* Displeasure	4	0.88
Calmness *vs.* Tension	3	0.81
Attraction *vs.* Antipathy	5	0.89

also indicated a reasonable fit to the data (χ^2 = 687.25, df = 344, TLI = 0.95, CFI = 0.96, RMSEA = 0.05 [0.05, 0.06], SRMR = 0.02). Thus, a 30-item AFFEXX-C was established.

Internal consistency and inter-correlations among the factors of the AFFEXX-C

As shown in Table 5, in sample 2 (n = 383), Cronbach's alpha coefficients ranged from 0.80 to 0.90, which indicates a good internal consistency of the AFFEXX-C among Chinese college students.

Convergent and discriminant validity

The relationships between the scales of the AFFEXX-C, instrumental attitudes, affective attitudes, behavioral intention, exercise self-efficacy, and situated decisions to exercise are presented in Table 6 for the total sample

(N = 722). All variables were significantly correlated with each other (p < 0.05) in Pearson correlation analyses. For further analyses, we used cocor R package documentation to conduct statistical comparisons between these correlations [38]. In terms of convergent validity, the relationships between affective attitudes and core affective exercise experiences were observed. Specifically, scores on core affective exercise experiences (i.e., pleasure-displeasure, energy-tiredness, and calmness-tension) exhibited slightly and descriptively higher correlations with affective attitudes (r = 0.61, 0.63, and 0.57, respectively) than with instrumental attitudes (r = 0.37, 0.52 and 0.44, respectively), which was supported by the comparison of these correlations (all p < 0.001, for more details please see Appendix A). Attraction-antipathy was moderately to strongly correlated with affective attitudes (r = 0.67, p < 0.001), and mostly moderately with behavioral intention (r = 0.57, p < 0.001), exercise self-efficacy (r = 0.62, p < 0.001) and situated decisions to exercise (r = −0.51, p < 0.001). Most of the variance between attraction-antipathy and exercise self-efficacy and situated decisions to exercise was not shared (i.e., 64%–77% unique variance).

Criterion validity

To examine criterion validity, correlations between the three structures of the AFFEXX-C and the self-reported habitual level of PA were conducted. As shown in Table 7, our results indicated that the correlations of all AFFEXX-C constructs were non-significant and near-zero with walking. MPA was weakly related to most variables (e.g., r = 0.10 to 0.16 for antecedent appraisal, r = 0.11 to 0.13 for core affective experiences, r = 0.17 for attraction-antipathy). VPA and MVPA were significantly correlated with attraction-antipathy, with correlations ranging between 0.47 and 0.45 (p < 0.001).

TABLE 6

Analysis of bivariate correlations between the scales of the AFFEXX-C, attitudes, behavioral intention, exercise self-efficacy, and situated decisions to exercise

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Identification *vs.* Disidentification													
2. Competence *vs.* Incompetence	0.68												
3. Showing off *vs.* Shying away	0.44	0.29											
4. Liking *vs.* Disliking group exercise	0.36	0.32	0.42										
5. Energy *vs.* Tiredness	0.68	0.67	0.31	0.30									
6. Pleasure *vs.* Displeasure	0.70	0.82	0.28	0.34	0.66								
7. Calmness *vs.* Tension	0.68	0.67	0.26	0.35	0.64	0.73							
8. Attraction *vs.* Antipathy	0.88	0.68	0.49	0.36	0.70	0.70	0.69						
9. Instrumental attitude	0.39	0.52	0.10	0.25	0.37	0.52	0.44	0.35					
10. Affective attitude	0.66	0.62	0.30	0.29	0.61	0.63	0.57	0.67	0.60				
11. Behavioral intention	0.58	0.43	0.25	0.20	0.44	0.42	0.42	0.57	0.39	0.64			
12. Exercise self-efficacy	0.61	0.45	0.36	0.22	0.47	0.46	0.42	0.62	0.29	0.50	0.54		
13. Situated decisions to exercise	−0.52	−0.41	−0.24	−0.20	−0.42	−0.43	−0.39	−0.51	−0.30	−0.43	−0.47	−0.63	

Note: Except for the relationship between "showing off *vs.* shying away" and instrumental attitude (p = 0.016 < 0.05), all other correlations were significant at the 0.001 level.

TABLE 7

Analysis of correlations between the scales of the AFFEXX-C, attitudes, behavioral intention, exercise self-efficacy, and situated decisions to exercise with self-reported physical activity

	Walking	MPA	VPA	MVPA	Total PA
Identification *vs.* disidentification	−0.03	0.16***	0.48***	0.45***	0.34***
Competence *vs.* incompetence	−0.05	0.10*	0.30***	0.28***	0.20***
Showing off *vs.* shying away	0.02	0.13***	0.34***	0.33***	0.27***
Liking *vs.* disliking group exercise	−0.01	0.12**	0.24***	0.25***	0.19***
Energy *vs.* tiredness	−0.02	0.13**	0.26***	0.26***	0.20***
Pleasure *vs.* displeasure	−0.05	0.11**	0.30***	0.29***	0.20***
Calmness *vs.* tension	−0.02	0.11**	0.30***	0.29***	0.22***
Attraction *vs.* antipathy	−0.01	0.17***	0.47***	0.45***	0.35***
Instrumental attitude	−0.09*	0.06	0.18***	0.17***	0.08*
Affective attitude	−0.02	0.12*	0.33***	0.32***	0.24***
Behavioral intention	−0.05	0.12**	0.40***	0.38***	0.27***
Exercise self-efficacy	−0.04	0.20***	0.45***	0.45***	0.33***
Situated decisions to exercise	0.05	−0.09*	−0.33***	−0.30***	−0.21***

Note: MPA = moderate-intensity physical activity, VPA = vigorous-intensity physical activity, MVPA = moderate-to-vigorous physical activity, PA = physical activity, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Test-retest reliability
Test-retest reliability of the AFFEXX-C was evaluated using intraclass correlation coefficients (ICC). In the current study, we observed ICC ranging from good ($r = 0.69$, $p < 0.001$) for the liking-disliking group exercise to excellent ($r = 0.87$, $p < 0.001$) for identification-disidentification (for more details please see Appendix A).

Validation of the structural model in study 2
In study 2 ($N = 1,300$), the internal consistency of the AFFEXX-C was good, with Cronbach's alpha coefficients ranging from 0.85 to 0.91 (more details can be found in Appendix A). Three different structural models were tested based on the hypothesized conceptual model (see Fig. 1). According to fit indices [35], results indicated acceptable fits of the three different structural models (shown in Table 8), of which model 3 had the best fit and was the most theoretically relevant (Fig. 2). In this model, both direct effect (antecedent appraisal - > attraction-antipathy) and indirect effect (antecedent appraisal - > core affective experiences - > attraction-antipathy) are significant. Furthermore, the four factors within "antecedent appraisals" were correlated with each other while correlations between every two factors within "core affective exercise experiences" were also observed.

Discussion

Based on two independent studies conducted in a large sample of Chinese college students, we developed and validated a Chinese version of the AFFEXX questionnaire (AFFEXX-C) to assess the key affective mechanisms involved in the regulation of PA, namely antecedent appraisals, core affective exercise experiences, and exercise motivation. Our results showed that the AFFEXX-C was valid for measuring the affective experiences toward PA in Chinese college

students. Concerning the reliability of the instruments, analogous factor structures were obtained with the Chinese version of the scale relative to the original, English version of the scale. Furthermore, Cronbach's alpha of the AFFEXX-C was good and almost identical to that in the original version (0.81 to 0.92 in the English *vs.* 0.80 to 0.90 in the Chinese version). Finally, the hypothesized model found in the western sample (i.e., US adults), was also partially observed in our eastern sample. Hence, in sum, our study provides evidence of the reliability and (partial) cross-cultural validity of the AFFEXX-C.

Different from the original scale of the AFFEXX questionnaire, the Chinese version involves a 30-item structure (*vs.* 36-item in the original version). Specifically, six items (11, 20, 23, 26, 31, 34 of the original scale) were removed due to insufficient factor loadings (<0.50) and high cross-loadings (>0.25) in the EFA. Based on these results, the dimensions of antecedent appraisals decreased from 6 to 3. Specifically, three domains (i.e., physical empowerment *vs.* bodily damage, pride/honor *vs.* shame/guilt, and interest *vs.* boredom) were removed. Cultural differences may explain why it makes sense to remove these three domains in a Chinese sample. For instance, Chinese college students perceive physical exercise as a part of a healthy lifestyle rather than something to be proud of, and the idea of "exercise is glorious" is not very popular among this population [39,40]. In addition, whether physical exercise is interesting or boring and physically healthy or harmful maybe not as important for Chinese as for Western individuals. Instead, most of them would not place physical exercise as a higher priority and tend to choose other activities in time conflicts and are likely to attribute it to lack of time for physical exercise [41].

The remaining items (1, 2, 4, 5, 7, 21 of the original scale) of the above domains were gathered to create a new dimension, named "identification *vs.* disidentification". For

TABLE 8

Fit indices of three structural models of the AFFEXX-C

	Factors	χ^2	df	TLI	CFI	SRMR	RMSEA (90% CI)
Model 1	8	1822.40	380	0.927	0.936	0.041	0.054 (0.052, 0.057)
Model 2	8	1812.31	377	0.927	0.936	0.041	0.054 (0.052, 0.057)
Model 3	8	2035.24	381	0.916	0.927	0.042	0.058 (0.055, 0.060)

Note: χ^2 = Chi-Square Test of Model Fit; df = Degrees of Freedom, TLI = Tucker-Lewis Index, CFI = Comparative Fit Index, SRMR = Standardized Root Mean Square Residual, RMSEA = Root Mean Square Error of Approximation, 90% CI = lower level and upper level of the bias-corrected 90% bootstrap confidence interval. Model 1: 1) antecedent appraisals → core affective exercise experiences → attraction-antipathy (four factors within "antecedent appraisals" are significantly correlated with each other), 2) antecedent appraisals → attraction-antipathy; Model 2: 1) antecedent appraisals → core affective exercise experiences → attraction-antipathy (four factors within "antecedent appraisals" are significantly correlated with each other while significant correlations between every two factors within "core affective exercise experiences" are observed), 2) antecedent appraisal → attraction-antipathy; Model 3: 1) antecedent appraisal → core affective exercise experiences → attraction-antipathy (four factors within "antecedent appraisals" are significantly correlated with each other while significant correlations between every two factors within "core affective exercise experiences" are observed).
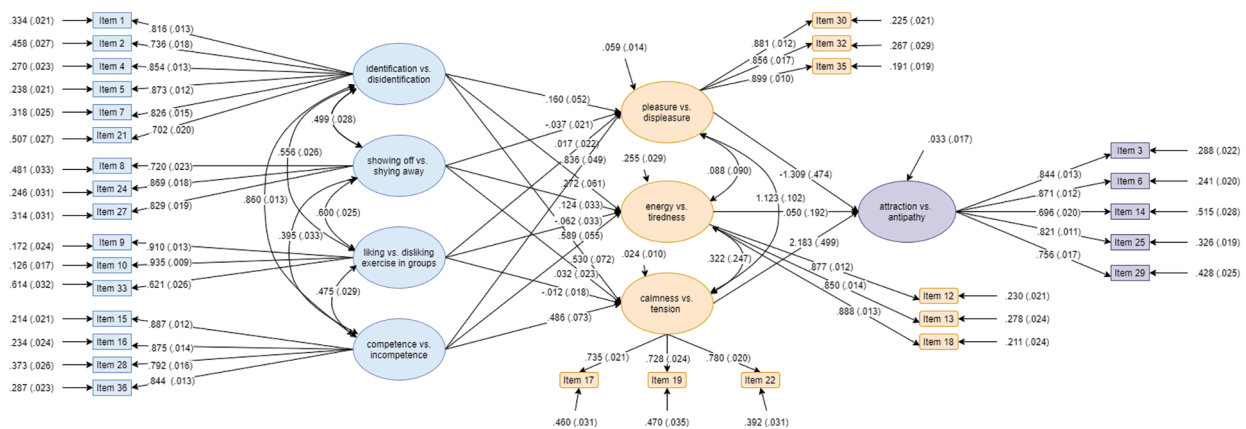

FIGURE 2. Statistical diagram of the structural model of the AFFEXX-C (Model 3).
Note: Standardized path coefficients were presented in this model.

example, item 21 (i.e., "Exercise is something everyone ought to be doing and I am happy to say that I do" *vs.* "Exercise is something everyone ought to be doing but I am sorry to say that I do not") reflects that physical exercise corresponds to something that individuals are supposed to do, which may result from a consensus among the society on the necessity of physical exercise. In contrast to item 1 (i.e., "Exercise is stimulating" *vs.* "Exercise is boring") and 4 (i.e., "Exercise is very exciting" *vs.* "Exercise is very dull"), this dimension relates to a conception about physical exercise that is influenced by a popular belief in Chinese culture, rather than to sheer personal attitudes. This new dimension may thus reflect the impact of social desirability or shared social-cultural attitudes on an individual's affective exercise experiences. In other words, cultural differences may directly influence individuals' antecedent appraisals to exercise to have an indirect impact on affective exercise experiences.

Despite these cross-cultural differences, the AFFEXX-C maintains a degree of consistency with the original version [23]. To be specific, three dimensions of the core affective experiences (i.e., pleasure-displeasure, energy-tiredness, calmness-tension), and attraction-antipathy were retained. Of them, this three-dimension structure (i.e., core affective

experiences) aligns with the conceptualization of core affects suggested by Ekkekakis and colleagues investigating core affective responses to physical exercise from a dimensional perspective [42]. It is worth noting that core affective responses emphasize a core affect emanating directly from somatic sensations, whereas core affective exercise experiences are impacted by an antecedent cognitive appraisal. In other words, the affective responses to physical exercise are expanded from the core affective responses of somatic sensation (e.g., physical pain or excitement) to the complex emotions under the cultural framework (e.g., chasing or pursuit of physical exercise) [23], which implied that the affective mechanisms towards PA should not be discussed in isolation from cultural influences. Despite cultural differences between the original version and the AFFEXX-C, the similarity of core affective exercise experiences may be rooted in the general understanding of this structure. These findings might be explained by the fact that affective associations of feeling energized, pleasant, and calm might be more culturally universal than affective associations that are influenced to a greater extent by specific cognitive appraisals (i.e., antecedent appraisals) [43]. Uncertainly, whether cultural differences change the structure of the core affective exercise experiences is still up

for discussion. The lack of the score of the three dimensions of this structure in the original version may impede the cross-cultural comparison. In general, as affective exercise experiences have so far been measured in only two versions, whether there is cross-cultural consistency needs to be further verified in other cultures. Future studies should provide more empirical evidence to further explore them in cross-cultural studies.

In addition, attraction-antipathy is also retained and highly related to factors of the other two structures, which is similar to the original version (0.43 to 0.82 in the English version *vs.* 0.36 to 0.88 in the Chinese version) [23]. This indicates that pleasant exercise experiences or positive cognitive appraisals may not alone determine an individual's tendency to feel the attraction of exercise and trigger the desire to exercise. Consistently, researchers also assumed that combining either hedonic or reflective motivation to reflect individuals' motivation towards physical exercise is reasonable [17]. Indeed, individuals' responses to "attraction-antipathy" toward exercise may reflect whether an individual wants to perform physical exercise based on a combination of both reflective and automatically activated processes [23].

With respect to validity, the significant correlations that we observed between the AFFEXX-C and other variables mirror previous findings [23]. Regarding convergent validity, positive affective exercise experiences were associated with positive affective attitudes. Similar to affective attitude, a cognitive construct with the affective label, affective exercise experiences are also strongly associated with PA behavior but emphasize the individuals' history of association with exercise. This supports the inter-individual differences in affective exercise experiences. With respect to discriminant validity, compared with affective attitudes (r = 0.57 to 0.61), affective exercise experiences were less relevant to other variables (e.g., instrumental attitudes and situated decisions to exercise). Then, the results of the criterion validity indicated that the associations between the core affective experience of the AFFEXX-C and the level of VPA and MVPA (r = 0.26 to 0.30) were almost as strong as the relationships between the latter and affective attitudes (r = 0.32 to 0.33). Additionally, we observed that the attraction-antipathy variable (as a proxy for exercise motivation) was significantly related to MVPA and VPA (r = 0.45 to 0.47), which exhibited descriptively higher correlations than these of behavioral intention (r = 0.38 to 0.40) and situated decisions to exercise (r = 0.30 to 0.33). Actually, these findings to some extent illustrate the vital role of attraction-antipathy in this complex model of decision-making to PA behavior. Overall, in line with the original version, these findings supported the good convergent, discriminant, and criterion validity of the AFFEXX-C.

Finally, the current study tested and refined the conceptual model proposed by previous research in a large sample [23]. Specifically, our findings supported the following model: antecedent appraisal → core affective exercise experiences → attraction-antipathy. In this mediating model, 4 factors of antecedent appraisals and 3 factors of core affective exercise experiences are intra-correlated with each other. Given that the original version of the AFFEXX-C only proposed a conceptual model without validation, we verified this model in the context of Chinese culture and reported the applicability of the model, which has a reduction in factors of antecedent appraisal and core affective exercise experiences compared with the hypothesis model. Our findings indicated that model 3 with an acceptable fit index was in line with the hypothesized model, which emphasized core affective exercise experiences as the central construct within a three-tiered system. Based on the conceptualization combining the level of activation and pleasure [42], this core structure forms three bipolar dimensions, namely (a) pleasure *vs.* displeasure associated with a moderate level of perceived activation, (b) high-activation pleasure *vs.* low-activation displeasure (i.e., energy *vs.* tiredness), and (c) low-activation pleasure *vs.* high-activation displeasure (i.e., calmness *vs.* tension). Upstream, these core affective exercise experiences are expected to be predicted by relevant cognitive appraisals of exercise, including (i) evaluating oneself whether to identify/recognize exercise, (ii) judging oneself as competent or incompetent, (iii) perceiving for oneself whether like exercising in groups, and (iv) noticing oneself tends to show off or shy away. Ultimately, affective exercise experiences shape the motivational tendency to be attracted to or feel antipathy towards physical exercise. Accordingly, this three-structure and eight-factor hypothesis model was validated, for the first time, within the Chinese cultural background.

Strengths and limitations

In the current study, we adopted a multi-stage design to develop and validate the AFFEXX-C in two independent and large samples of Chinese students, which is, in its final format, slightly different from the original version of the questionnaire [23]. In addition, the hypothesis model proposed by Ekkekakis and colleagues was verified in the present study, thereby confirming its cross-cultural validity. Nevertheless, some limitations have to be acknowledged. First, the sample selection is based on convenience sampling which is less representative than random sampling and therefore limits the generalization of the current results to healthy college students. Thus, further studies in other populations are necessary to test the generalizability of our findings (e.g., non-college student emerging adults [44,45] and in older adults). Thirdly, self-reported measurement of PA was used in the current research, which is subject to social desirability bias (e.g., overestimation of PA levels). Therefore, future research could incorporate device-based measures of PA (e.g., accelerometer) to further strengthen the predictive validity of the AFFEXX-C in the Chinese population.

Conclusion

The modified 30-item AFFEXX-C has sound psychometric properties and thus is well-suited to assess affective exercise experiences in samples of college students. By translating and validating the AFFEXX-C, our study paves the way for future research aiming to examine the role of affective

mechanisms in the regulation of PA behaviors in Chinese-speaking samples.

Author Contributions: The authors confirm contribution to the paper as follows: Ting Wang, Conceptualization, Methodology, Data Curation, Formal Analysis, Writing-Original Draft, Writing-Review & Editing, Visualization; Boris Cheval, Writing-Review & Editing, Formal Analysis; Silvio Maltagliati, Writing-Review & Editing; Zachary Zenko, Methodology, Writing-Original Draft, Writing-Review & Editing, Visualization; Fabian Herold, Formal Analysis, Writing-Review & Editing; Sebatian Ludyga, Formal Analysis; Markus Gerber, Writing-Review & Editing; Yan Luo, Methodology, Formal Analysis; Layan Fessler, Writing-Review & Editing, Formal Analysis; Notger G. Müller, Writing-Review & Editing; Liye Zou, Conceptualization, Methodology, Data Curation, Formal Analysis, Writing-Original Draft, Writing-Review & Editing, Visualization, Supervision, Project Administration, Funding Acquisition. All authors reviewed the results and approved the final version of the manuscript.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

References

1. Rollo S, Antsygina O, Tremblay MS. The whole day matters: Understanding 24-hour movement guideline adherence and relationships with health indicators across the lifespan. J Sport Health Sci [Internet]. 2020;9(6):493–510. doi:10.1016/j.jshs.2020.07.004.

2. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med [Internet]. 2020;54(24):1451–62. doi:10.1136/bjsports-2020-102955.

3. Bennie JA, de Cocker K, Teychenne MJ, Brown WJ, Biddle SJH. The epidemiology of aerobic physical activity and muscle-strengthening activity guideline adherence among 383,928 U.S. adults. Int J Behav Nutr Phy [Internet]. 2019;16(1):34. doi:10.1186/s12966-019-0797-2.

4. Pengpid S, Peltzer K, Kassean HK, Tsala Tsala JP, Sychareun V, et al. Physical inactivity and associated factors among university students in 23 low-, middle- and high-income countries. Int J Public Health [Internet]. 2015;60(5):539–49. doi:10.1007/s00038-015-0680-0.

5. Keating XD, Guan J, Piñero JC, Bridges DM. A meta-analysis of college students' physical activity behaviors. J Am Coll Health [Internet]. 2005;54(2):116–25. doi:10.3200/JACH.54.2.116-126.

6. Kohl HW, Craig CL, Lambert EV, Inoue S, Alkandari JR, et al. The pandemic of physical inactivity: Global action for public health. The Lancet [Internet]. 2012;380(9838):294–305. doi:10.1016/S0140-6736(12)60898-8.

7. Liu W, Leong DP, Hu B, AhTse L, Rangarajan S, et al. The association of grip strength with cardiovascular diseases and all-cause mortality in people with hypertension: Findings from the Prospective Urban Rural Epidemiology China Study. J Sport Health Sci [Internet]. 2021;10(6):629–36. doi:10.1016/j.jshs.2020.10.005.

8. Ezzatvar Y, Izquierdo M, Núñez J, Calatayud J, Ramírez-Vélez R, et al. Cardiorespiratory fitness measured with cardiopulmonary exercise testing and mortality in patients with cardiovascular disease: A systematic review and meta-analysis. J Sport Health Sci [Internet]. 2021;10(6):609–19. doi:10.1016/j.jshs.2021.06.004.

9. Sheng M, Yang J, Bao M, Chen T, Cai R, et al. The relationships between step count and all-cause mortality and cardiovascular events: A dose-response meta-analysis. J Sport Health Sci [Internet]. 2021;10(6):620–28. doi:10.1016/j.jshs.2021.09.004.

10. Yu Q, Herold F, Ludyga S, Cheval B, Zhang Z, et al. Neurobehavioral mechanisms underlying the effects of physical exercise break on episodic memory during prolonged sitting. Complement Ther Clin [Internet]. 2022;48(1):101553. doi:10.1016/j.ctcp.2022.101553.

11. Li J, Herold F, Ludyga S, Yu Q, Zhang X, et al. The acute effects of physical exercise breaks on cognitive function during prolonged sitting: The first quantitative evidence. Complement Ther Clin [Internet]. 2022;48(2):101594. doi:10.1016/j.ctcp.2022.101594.

12. Jung M, Zou L, Yu JJ, Ryu S, Kong Z, et al. Does exercise have a protective effect on cognitive function under hypoxia? A systematic review with meta-analysis. J Sport Health Sci [Internet]. 2020;9(6):562–77. doi:10.1016/j.jshs.2020.04.004.

13. Rodriguez-Ayllon M, Acosta-Manzano P, Coll-Risco I, Romero-Gallardo L, Borges-Cosic M, et al. Associations of physical activity, sedentary time, and physical fitness with mental health during pregnancy: The GESTAFIT project. J Sport Health Sci [Internet]. 2021;10(3):379–86. doi:10.1016/j.jshs.2019.04.003.

14. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, et al. Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. The Lancet [Internet]. 2012;380(9838):219–29. doi:10.1016/S0140-6736(12)61031-9.

15. Costa Santos A, Juana, Meheus F, Ilbaw A, Bull FC. The cost of inaction on physical onactivity to healthcare systems [Internet]. 2022.

16. Conroy DE, Berry TR. Automatic affective evaluations of physical activity. Exercise and Sport Sciences Reviews [Internet]. 2017;45(4):230–37. doi:10.1249/JES.0000000000000120.

17. Williams DM, Bohlen LC. Motivation for exercise: Reflective desire versus hedonic dread. APA handbook of sport and exercise psychology. In: Exercise psychology, APA handbooks in psychology series [Internet]. Washington DC, US: American Psychological Association; 2019. p. 363–85.

18. Cheval B, Boisgontier MP. The theory of effort minimization in physical activity. Exerc Sport Sci Rev [Internet]. 2021;49(3):168–78. doi:10.1249/JES.0000000000000252.

19. Kwan BM, Bryan A. In-task and post-task affective response to exercise: Translating exercise intentions into behaviour. Br J Health Psychol [Internet]. 2010;15: 115–31. doi:10.1348/135910709X433267.

20. Rhodes RE, Kates A. Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of published evidence. Ann Behav Med [Internet]. 2015;49(5):715–31. doi:10.1007/s12160-015-9704-5.

21. Schneider M, Dunn A, Cooper D. Affect, exercise, and physical activity among healthy adolescents. J Sport Exerc Psychol [Internet]. 2009;31(6):706–23. doi:10.1123/jsep.31.6.706.

22. Williams DM, Dunsiger S, Jennings EG, Marcus BH. Does affective valence during and immediately following a 10-min walk predict concurrent and future physical activity? Ann Behav Med [Internet]. 2012;44(1):43–51. doi:10.1007/s12160-012-9362-9.

23. Ekkekakis P, Zenko Z, Vazou S. Do you find exercise pleasant or unpleasant? The affective exercise experiences (AFFEXX) questionnaire. Psychol Sport Exerc [Internet]. 2021;55(10):101930. doi:10.1016/j.psychsport.2021.101930.

24. Brand R, Ekkekakis P. Affective-Reflective Theory of physical inactivity and exercise. Ger J Exerc Sport Res [Internet]. 2017;48(1):48–58. doi:10.1007/s12662-017-0477-9.

25. Lindquist KA, Jackson JC, Leshin J, Satpute AB, Gendron M. The cultural evolution of emotion. Nat Rev Psychol [Internet]. 2022; 1:669–681. doi:10.1038/s44159-022-00105-4.

26. Huang WY, Wong SH. Cross-cultural validation. In: Michalos AC, Encyclopedia of quality of life and well-being research [Internet]. Dordrecht: Springer Netherlands; 2014. p. 1369–71.

27. Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process [Internet]. 1991;50(2):179–211. doi:10.1016/0749-5978(91)90020-T.

28. Wu TY, Ronis DL, Pender N, Jwo JL. Development of questionnaires to measure physical activity cognitions among taiwanese adolescents. Preventive Medicine [Internet]. 2002;35(1):54–64. doi:10.1006/pmed.2002.1049.

29. Brand R, Schweizer G. Going to the gym or to the movies?: Situated decisions as a functional link connecting automatic and reflective evaluations of exercise with exercising behavior. J Sport Exerc Psychol [Internet]. 2015;37(1):63–73. doi:10.1123/jsep.2014-0018.

30. Sjostrom M, Ainsworth BE, Bauman A, Bull FC, Hamilton-Craig CR. Guidelines for data processing analysis of the international physical activity questionnaire (IPAQ)-short and long forms [Internet]. IPAQ Research Committee; 2015.

31. Macfarlane DJ, Lee CCY, Ho EYK, Chan KL, Chan DTS. Reliability and validity of the Chinese version of IPAQ (short, last 7 days). J Sci Med Sport [Internet]. 2007;10(1):45–51. doi:10.1016/j.jsams.2006.05.003.

32. Tabachnick B, Fidell L. Using mulivariate statistics [Internet]. 2012.

33. Mertler C, Reinhart R. Advanced and multivariate statistical methods: Practical application and interpretation [Internet]. 6th edition. 2016. p. 1–374.

34. Kahn JH. Factor analysis in counseling psychology research, training, and practice. Couns Psychol [Internet]. 2006;34(5):684–718. doi:10.1177/0011000006286347.

35. Lt Hu, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct Equ Modeling: Multidiscip J [Internet]. 1999;6(1):1–55. doi:10.1080/10705519909540118.

36. Cohen J. Statistical power analysis for the behavioral sciences. [Internet]. 1988.

37. Guidelines Cicchetti D. Criteria, and rules of thumb for evaluating normed and standardized assessment instrument in psychology. Psychol Assess [Internet]. 1994;6(4):284–90. doi:10.1037/1040-3590.6.4.284.

38. Diedenhofen B, Musch J. cocor: A comprehensive solution for the statistical comparison of correlations. PLoS One [Internet]. 2015;10(3):e0121945. doi:10.1371/journal.pone.0121945.

39. Wang D, Ou CQ, Chen MY, Duan N. Health-promoting lifestyles of university students in Mainland China. BMC Public Health [Internet]. 2009;9(1):379. doi:10.1186/1471-2458-9-379.

40. Wang D, Xing XH, Wu XB. Healthy lifestyles of university students in China and influential factors. Sci World J [Internet]. 2013(6):412950–10. doi:10.1155/2013/412950.

41. Survey on fitness beliefs and exercise habits in China. Available from: https://daxueconsulting.com/exercise-habits-in-china/. [Accessed 2021].

42. Ekkekakis P, Zenko Z. 12-measurement of affective responses to exercise: From affectless arousal to the most well-characterized relationship between the body and affect. In: Meiselman HL, editor. Emotion measurement [Internet]. Woodhead Publishing; 2016. p. 299–321.

43. Jamieson JP, Hangen EJ, Lee HY, Yeager DS. Capitalizing on appraisal processes to improve affective responses to social stress. Emot Rev [Internet]. 2018;10(1):30–9. doi:10.1177/1754073917693085.

44. Kuang J, Zhong J, Yang P, Bai X, Liang Y, et al. Psychometric evaluation of the inventory of dimensions of emerging adulthood (IDEA) in China. Int J Clin Hlth Psyc [Internet]. 2023;23(1):100331. doi:10.1016/j.ijchp.2022.100331.

45. Kuang J, Zhong J, Arnett JJ, Hall DL, Chen E, et al. Conceptions of adulthood among Chinese emerging adults. J Adult Dev [Internet]. 2022. doi:10.1007/s10804-023-09449-4.

Appendix A

The Chinese version of the AFFEXX questionnaire (AFFEXX-C)

中文版情感锻炼经验问卷AFFEXX-C-30

下面是描述关于锻炼经历的观点、态度等一系列陈述. 这些陈述以一对相反的形式呈现(例如,"锻炼是我害怕的事情"和"锻炼是我期待的事情"),以7级进行评分. 如果左边的陈述更接近您的情况, 则选择1(完全符合)、2(比较符合)或3(有点符合). 反之, 如果右边的陈述更接近您的情况, 则选择7(完全符合)、6(比较符合)或5(有点符合). 如果您的情况介于这两个对立的陈述之间, 请选择中间点4(不确定).

序号	条目	评分	条目
1	锻炼挺刺激的	1 2 3 4 5 6 7	锻炼挺无聊的
2	当医生/别人问我是否锻炼时, 我可以自信地给出肯定的回答	1 2 3 4 5 6 7	当医生/别人问我是否锻炼时, 我羞愧地给出否定的回答
3	锻炼是我害怕的事情	1 2 3 4 5 6 7	锻炼是我期待的事情
4	锻炼让人感到很枯燥	1 2 3 4 5 6 7	锻炼让人感到很兴奋
5	我喜欢锻炼, 因为它使我变得更强壮	1 2 3 4 5 6 7	我讨厌锻炼, 因为它可能会使我受伤
6	锻炼是没什么意思的活动	1 2 3 4 5 6 7	锻炼是吸引人的活动
7	从锻炼中能够获益很多让我感觉很棒	1 2 3 4 5 6 7	锻炼可能会使我受伤让我感觉很糟糕
8	我不希望锻炼时别人注意到我	1 2 3 4 5 6 7	我锻炼时喜欢表现自己
9	集体锻炼让我感觉很好	1 2 3 4 5 6 7	集体锻炼让我感到害怕
10	集体锻炼是一种享受	1 2 3 4 5 6 7	集体锻炼不是一种享受
11	锻炼让我感到筋疲力尽/虚脱	1 2 3 4 5 6 7	锻炼让我感到充满能量
12	锻炼后我感到耗竭/无力	1 2 3 4 5 6 7	锻炼后我感到恢复了活力
13	我会选择锻炼而不是大多数的其他活动	1 2 3 4 5 6 7	我会选择大多数的其他活动而不是锻炼
14	锻炼后, 我感到沮丧	1 2 3 4 5 6 7	锻炼后, 我感觉备受鼓舞
15	锻炼给了我挫败感	1 2 3 4 5 6 7	锻炼给了我成就感
16	对我来说, 锻炼是一种放松的活动	1 2 3 4 5 6 7	对我来说, 锻炼是一种有压力的活动
17	锻炼使人非常疲惫	1 2 3 4 5 6 7	锻炼令人精力充沛
18	锻炼使我平静	1 2 3 4 5 6 7	锻炼使我压力增大
19	锻炼是每个人都应该做的事情, 但我很惭愧我没锻炼	1 2 3 4 5 6 7	锻炼是每个人都应该做的事情, 而且我很高兴我锻炼了
20	锻炼使我放松	1 2 3 4 5 6 7	锻炼让我感到紧张
21	别人在我锻炼时看着我, 会让我感觉很棒	1 2 3 4 5 6 7	别人在我锻炼时看着我, 会让我感觉很糟糕
22	锻炼几乎是我最喜欢的事	1 2 3 4 5 6 7	锻炼几乎是我最不喜欢的事
23	我锻炼时喜欢别人看着我	1 2 3 4 5 6 7	我锻炼时讨厌别人看着我
24	锻炼降低了我的自尊	1 2 3 4 5 6 7	锻炼提升了我的自尊
25	锻炼不是我优先考虑的事情	1 2 3 4 5 6 7	锻炼是我优先考虑的事情
26	我从锻炼中得到的感觉很不舒服	1 2 3 4 5 6 7	我从锻炼中得到的感觉非常好
27	锻炼让我的情绪更糟糕	1 2 3 4 5 6 7	锻炼改善了我的情绪
28	我喜欢和别人一起锻炼	1 2 3 4 5 6 7	我讨厌和别人一起锻炼
29	锻炼让我感到不高兴	1 2 3 4 5 6 7	锻炼让我感觉很棒
30	锻炼让我感到自己没用	1 2 3 4 5 6 7	锻炼让我觉得我可以做到任何事情