Chinese-translated Behavioral Regulation in Exercise Questionnaire-2

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Original article

Chinese-translated Behavioral Regulation in Exercise Questionnaire-2: Evidence from university students in Mainland China and Hong Kong.

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Abstract

Purpose: The purpose of the study was to examine the psychometric properties of the Chinese-translated Behavioral Regulation in Exercise Questionnaire-2 (C-BREQ-2) among Chinese university students from the Mainland and Hong Kong of China.

Methods: University students from Mainland China ($n = 191$) and Hong Kong ($n = 194$) of China participated in this study. Factorial validity, discriminant validity, nomological validity, internal reliability, and measurement invariance across sample of the C-BREQ-2 were examined.

Results: Confirmatory factor analysis provided support for the factorial validity of the 18-item, 5-factor structure C-BREQ-2. Examination of the 95% confidence interval of the inter-factor correlations suggested that the C-BREQ-2 assesses related but distinct constructs, which provided support for its discriminant validity. The internal consistency reliability of the C-BREQ-2 was found acceptable. Examination of the pattern of inter-factor correlations between different regulations suggested that a simplex-like pattern was displayed, which provided evidence for the nomological validity of C-BREQ-2. The results from multi-group confirmatory factor analysis suggested that the factor loadings and factor variances/covariances of the C-BREQ-2 measurement model were invariant across the Chinese University students in Mainland China and Hong Kong.

Conclusion: The current study provided further psychometric evidence for the C-BREQ-2, which makes the further application and research of self-determination theory (SDT) based motivation in relation to exercise and physical activity in the Mainland Chinese context possible.

Keywords: Behavioral regulation; Chinese; Motivation; Reliability; Validity

1. Introduction

The health benefits of regular exercise participation have been well documented; however, the prevalence of physical inactivity is still widely reported. Numerous studies have been conducted to investigate the factors that influence an individuals' exercise behavior, and motivation studies have become one of the heated research topics. Recently, self-determination theory (SDT) [1, 2] has been employed to explain human behavior and motivation within the sport and exercise field. One of the reasons is that SDT differentiates motivation by types, which is different from many traditional theories of motivation that have treated motivation primarily as a unitary concept, and focused on the overall amount of motivation that people have for particular behaviors or activities. SDT assumes that the type or quality of a person's motivation will be more important than the total amount of motivation for predicting important outcomes (e.g., psychological health and well-being, effective performance) and this idea has been confirmed by many studies.[3, 4]

According to SDT, human behaviors could be characterized by three general types of motivation, namely, amotivation (AM), extrinsic motivation (EM), and intrinsic motivation (IM). These three types of motivation are believed to be located along a self-determination continuum from non-self-determined to high self-determination. AM is considered a non-self-determined state which reflects no intention to engage in a behavior. IM is considered the most self-determined form of motivation, and refers to performing a behavior for its own sake because it is inherently satisfying, of interest, or enjoyable. EM is located between AM and IM, and occurs when individuals are extrinsically motivated to behave and obtain separable outcomes. EM is further characterized by four types of regulatory styles, namely, external, introjected, identified, and integrated regulations. External regulation occurs when behaviors are performed to fulfill an external demand, achieve a reward, or to avoid punishment. Introjected regulation occurs when behaviors are performed to avoid feelings such as guilt or shame, or to enhance ego and feelings of self-worth. Identified regulation exists when an individual values and judges the separable

outcomes of a behavior as being personally important. If an individual views a behavior not only as personally important but also as in congruence with deeply-held values and his or her sense of self, then it is a form of regulation known as integrated regulation. External and introjected regulations are considered controlled motivations, whereas identified and integrated regulations together with IM are considered autonomous motivation. Less self-determined forms of motivation could be internalized to be more self-determined forms of motivation by satisfying the individuals' basic psychological needs, which are presumed to be universal aspects of human beings across developmental and cross-cultural settings. Many studies across domains have been conducted to estimate the correlates and consequences of autonomous and controlled motivation. Consistently, autonomous motivation has been correlated with greater persistence, a more positive affect, enhanced performance, and greater psychological well-being.[5]

To examine the exercise motivation within the SDT framework, a number of behavioral regulation measures have been developed e.g., the Behavioral Regulation in Exercise Questionnaire (BREQ),[6] the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2),[7] the Exercise Motivation Scale (EMS),[8] and the Perceived Locus of Causality (PLOC).[9] The most widely used one is the BREQ-2, which is a revised version of the 15-item BREQ by adding an amotivation subscale (4 items) and renamed as the BREQ-2.[7] The BREQ-2 is a self-report measure assessing amotivation, plus external, introjected, identified, and intrinsic regulations. In common with some other behavioral regulation instruments for different contexts,[10] it does not attempt to distinguish between integrated regulation and intrinsic regulation because it is thought that these two forms of regulation are easy to distinguish theoretically but difficult to distinguish empirically.[6] Therefore, the BREQ-2 is a five correlated factor, 19-item measure. Previous studies have provided strong empirical evidence for the validity [6,7,11-13] and reliability [7,14,15] of the scores derived from the BREQ/BREQ-2. Furthermore, the factor loadings and factor variance and covariance of the structure of the instrument were found to be invariant across gender.[6] All of these findings suggest that the instrument (BREQ/BREQ-2) is psychometrically strong and

appropriate for research in the exercise setting.

The translation of relevant instruments to other languages is thought to be a method for extending the application of theories and models across cultures and nations.[11] The BREQ-2 has been translated into several languages, such as Spanish, Greek, and Chinese, and the psychometric properties of the BREQ-2 in different languages have been examined.[11,12,16] The factor structure hypothesized in the original scale was replicated, and the internal reliabilities of the subscales were also found to be acceptable. However, one identified regulation item (I get restless if I don't exercise regularly) was found problematic, and was finally removed from the final translated versions of the BREQ-2 (e.g., the Spanish version BREQ-2,[12] the Greek version BREQ-2,[11] the Chinese version BREQ-2[16]). Some researchers also found that the factor structure of the BREQ-2/BREQ was invariant across gender.[6,12] All of these findings suggested that the BREQ-2 translated into different languages could be used within different cultural contexts.

Although the psychometric properties of the Chinese BREQ-2 (C-BREQ-2) have been reported in a previous study[16] among Chinese university students in Hong Kong, the applicability of the C-BREQ-2 among Chinese university students from Mainland China should be investigated. Although both Hong Kong and Mainland Chinese societies are thought to be within Chinese culture overall, there are still some typical different characteristics between the two societies. For example, in writing, the traditional Chinese characters are used in Hong Kong, whereas the simplified Chinese characters are used in Mainland China. The language spoken in Hong Kong is mainly Cantonese, whereas the language spoken in Mainland China is mainly Putonghua. This will require researchers to consider whether the different forms of the Chinese language will affect the people's understanding of the C-BREQ-2 items. Furthermore, different from most of the cities in Mainland China, Hong Kong has a history of being colonized for more than 150 years by Western societies. Whether this colonial history will influence the perceptions of individuals living in Hong Kong should be kept in mind. Therefore, researchers should not assume that these two Chinese cultural societies are equivalent without any examination or investigation.

The purpose of the current study was to examine the psychometric properties of scores derived from the C-BREQ-2 in a sample of Chinese university students from Mainland China. The objectives of the study were: (1) to investigate the scale's factorial validity by examining whether the data derived from the C-BREQ-2 would fit a five correlated but distinct factor model; (2) to investigate the discriminant validity of the scale by examining whether the 95% confidence intervals (95% CI) ($\pm 1.96 \times$ SE) of the inter-factor correlations include the value ± 1.0; (3) to investigate the internal consistency reliability of the scale by examining whether for each C-BREQ-2 subscale, the Cronbach's α coefficient and the composite reliability values would be greater than 0.70; (4) to investigate the nomological validity by examining whether the correlations among different regulations would confirm a simplex-like pattern with stronger positive correlations between those factors adjacent on the self-determination continuum than between more distal factors; (5) to further investigate the nomological validity by examining the correlations among regulations with theoretically-related motivational consequences, such as self-reported positive and negative affects and subjective vitality, as well as exercise behaviors; and (6) to examine whether the measurement model (factor loadings, factor variances, and covariances) of the C-BREQ-2 would be invariant across the Chinese university students from Mainland China versus those from Hong Kong once the 5-factor structure of the C-BREQ-2 could be replicated among Chinese university students in Mainland China.

2. Methods

2.1. Participants and procedures

A total of 401 Chinese undergraduate students (no majors in physical education) were invited to take part in this study by answering a set of questionnaires. A total of 385 students returned the questionnaires (191 students from a public university in Mainland China, 94.5% response; 194 students from a public university in Hong Kong, 97.5% response). The mean age of the participants from Mainland China was 22.32 years old (range 18-24; 111 females and 80 males). The mean age of the participants from Hong Kong was 21.09 years old (range 17-23; 118 females

and 76 males).

Ethical approval was obtained from the human and animal research ethics committee of the researchers' university. Teachers of the general education classes were contacted to obtain their permission to approach the students in class for participation in the study. Written informed consent forms were obtained from the students prior to data collection, and confidentiality was ensured. All participants volunteered to participate in the study. The questionnaires were completed prior to the classes. It took approximately 10 min to finish the questionnaires.

2.2. Measures

2.2.1. Behavioral regulation in exercise

The C-BREQ-2[16] comprises 18 items with ratings on a 5-point Likert scale ranging from 0 (not true for me) to 4 (very true for me). It measures amotivated (e.g., "I think exercising is a waste of time"), external (e.g., "I exercise because other people say I should"), introjected (e.g., "I feel guilty when I don't exercise"), identified (e.g., "it's important to me to exercise regularly"), and intrinsic (e.g., "I find exercise a pleasurable activity") regulations of exercise behavior. The C-BREQ-2 was transformed from traditional Chinese characters into simplified Chinese characters. The deleted item (item 17 in original English BREQ-2) in Chinese was also included in the current study to further examine the performance of that item among Mainland participants. Seven native Chinese university students from Mainland of China were invited to complete the simplified Chinese characters version. They reported that the instructions and items of the simplified Chinese characters version were easy to understand.

2.2.2. Positive and negative affect

The International Positive and Negative Affect Schedule Short Form (I-PANAS-SF[17]) was used to measure positive and negative affect. The I-PANAS-SF is a short form of the PANAS including a 10-item scale with 5-item positive affect (PA) and negative affect (NA) subscales scored on a 5-point Likert scale ranging from 1 (never) to 5 (always). The scale demonstrated satisfactory internal consistency reliability in previous research among Chinese populations[18] and

in the current study (the Cronbach's α for PA and NA subscales were 0.78 and 0.72, respectively).

2.2.3. Subjective vitality

The Subjective Vitality Scale (SVS[19]) was employed to measure the participants' psychological well-being because subjective vitality was considered a primary component of psychological well-being.[2] The SVS is a 7-item instrument. An example item is, "I feel alive and full of vitality." The reponses were provided on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The reversed scored item (item 2) was reported to be problematic in a previous study[20] and therefore was not included in this study. The 6-item scale demonstrated satisfactory internal consistency reliability in previous research among Chinese populations[21] and in the current study (Cronbach's α = 0.86).

2.2.4. Leisure time exercise behavior

Self-reported exercise behavior was assessed via the Godin Leisure Time Exercise Questionnaire (GLTEQ),[22] which has been found to be reliable and valid when compared to objective measures of physical activity.[23,24] The respondents indicated the frequency of mild, moderate, and strenuous exercise they engage in for at least 15 min during a typical week. These scores were weighted by the approximate metabolic equivalents for the different levels of activity (3, 5, and 9, respectively).[18,25]

2.5. Data analysis

First, the descriptive statistics of the C-BREQ-2 items were computed. Second, confirmatory factor analysis (CFA) using AMOS 19.0[26] was performed to examine the hypothesized 5-factor structure of the C-BREQ-2. Third, due to the documented shortcomings of the Cronbach's α,[27-29] the composite reliability and Cronbach's α were calculated to examine the internal consistency reliabilities of the C-BREQ-2 subscales. Forth, the correlations between the C-BREQ-2 subscales and the theoretically related variables were computed to examine the discriminant validity and nomological validity of the C-BREQ-2. Finally, multiple-group CFA was performed to examine

the measurement invarince (e.g., factor-loadings and factor covariances and variances) of the C-BREQ-2 across university students in Mainland China versus Hong Kong.

The overall model fit was evaluated using multiple goodness-of-fit indices including the Chi-square value, Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA) accompanied by its 90% confidence interval (90%CI), and the Standardized Root Mean Square Residual (SRMR). The commonly-accepted thresholds of CFI >0.90, SRMR close to (or less than) 0.08[30] and RMSEA less than 0.08,[31] respectively, were used as criteria indicative of an acceptable model fit. CFI > 0.95,[30,32] SRMR less than 0.08, and RMSEA less than 0.06,[31] respectively, were used as criteria indicative of a good model fit. In addition, the modification indices and standardized residuals were analyzed to screen for mis-specified items. In line with previous works,[33] items that displayed large standardized residuals (> │ 2.00 │) were considered for removal.

3. Results

3.1. Factorial validity, discriminant validity and reliability

Examination of Mardia's[34] normalized estimate of multivariate kurtosis indicated that the data departed from multivariate normality (71.74, critical ratio = 17.55). To be in line with the recommendations of Byrne,[35] all subsequent CFAs were performed using the maximum likelihood estimation coupled with a bootstrapping procedure, which is a useful approach to handle the presence of multivariate non-normal data. To be in line with the recommendation of Preacher and Hayes,[36] in the present study, 5000 bootstrap replication samples were drawn with replacement from the data sets.

The results of the CFA among Mainland Chinese students suggested that the 5-factor, 19-item simplified C-BREQ-2 model displayed a poor fit to the data (χ^2 (142) = 334.44, p < 0.001; CFI = 0.801; SRMR = 0.094; RMSEA = 0.084 (0.073-0.096)). The standardized factor loadings ranged from 0.39 to 0.80. Inspection of the modification indices and standardized residual matrix suggested that item 17 ("I get restless if I don't exercise regularly"), which is in identified

regulation subscale, displayed cross-loadings on multiple factors and was associated with multiple standardized residuals. Therefore, removing this item from the model would considerably improve the model fit. Thus, the item was removed from further analysis, and removal of item 17 greatly improved the fit of the 5-factor C-BREQ-2 model (18-item) to the data (χ^2 (125) = 209.76, $p < 0.001$; CFI = 0.900; SRMR = 0.069; RMSEA = 0.060 (0.045-0.074)). The fully-standardized item loadings ranged from 0.56 to 0.80. Further examination of the modification indices and standardized residuals of this solution revealed no further factorially complex items. Table 1 displays the item means ± SD, standardized factor loadings, squared multiple correlations, and bootstrap standard errors for the solution.

The discriminant validity of the 18-item C-BREQ-2 was supported by the results that none of the 95% CI of inter-factor correlations (Table 2) including the value ± 1.0. This finding suggested that the C-BREQ-2 assesses distinct constructs.

3.2. Nomological validity

An examination of the inter-factor correlations revealed that the scores from the regulations that were predicted to be closer together on the proposed self-determination continuum were generally more strongly-correlated than those predicted to be more distal (Table 2). For example, intrinsic motivation had a positive correlation with identified regulation (0.62), a positive correlation with introjected regulation (0.48), and a negative correlation with external regulation (-0.22) and amotivation (-0.39); however, not all hypotheses were supported. For example, the relationship between amotivation and identified regulation (-0.91) was stronger than that between amotivation and intrinsic motivation (-0.39). These findings provide partial support for the nomological validity of the C-BREQ-2.

An examination of the correlations among different regulations with theoretically-related motivational consequences suggested that amotivation correlated negatively with subjective vitality, and correlated positively with negative affect. External regulation correlated positively with negative affect, but was not correlated with other affective and behavioral variables.

Introjected regulation was found to be positively correlated with positive affect, subjective

vitality, and strenuous exercise, which is consistent with previous findings.[16] Identified regulation

and intrinsic motivations were found to be positively correlated with positive affect, subjective

vitality, and strenuous exercise (Table 3). These findings are consistent with previous studies,[11,16]

and provide further evidence for the nomological validity of the C-BREQ-2.

3.3. Measurement invariance analysis

A sequential model testing approach was employed via multiple-group CFA to examine

whether the measurement model was invariant across the Mainland Chinese and Hong Kong

university students. A baseline model was established first, and then two increasingly constrained

models specific to the measurement (factor loadings) and structural parameters (i.e., factor

variances and covariances) of the C-BREQ-2 were tested for equality across Mainland Chinese

and Hong Kong samples.[35] Traditionally, invariance testing has relied on the χ^2 test statistic as an

indicator of equality across groups. However, since this test is influenced by the sample size, the

CFI difference approach recommended by Cheung and Rensvold[37] was adopted in this study.

Accordingly, the change in CFI values between increasingly more constrained models smaller

than 0.01 was considered to be indicative of invariance. Independent CFA models specific for the

university students in Mainland and Hong Kong of China(Table 4) and the unconstrained model

(M1: no parameters were constrained to be equal across groups) displayed an acceptable fit to the

data (Table 5). When the factor loadings (M2: factor loadings were constrained) were constrained

to be equal across the two samples, then the model yielded satisfactory fit to the data (Table 5).

Comparing M2 with M1, no substantial change in the CFI (0.920 *vs.* 0.919) was observed, which

revealed an invariance of the factor loadings across Chinese Mainland and Hong Kong university

students. When the factor variances and covariances were further constrained, the final model (M3:

factor loadings, factor variances and covariances were constrained) also demonstrated an

acceptable fit to the data (Table 5). When comparing M3 against M2, the change in the CFI (0.919

vs. 0.910) was less than 0.01, which provided support for the invariance of the factor variances and

covariances across the two samples. Taken collectively, these results suggested that the factor loadings and factor variances and covariances of the 18-item 5-factor C- BREQ-2 measurement model was invariant across the Mainland Chinese and Hong Kong university students.

4. Discussion

The current study was designed to further examine the psychometric properties of the C-BREQ-2 among a sample of Chinese university students from Mainland of China. The factor structure of the C-BREQ-2 was identified and replicated in this study. Item 17 ("I get restless if I don't exercise regularly"), which has been found problematic in previous studies[11,12] was also found to be problematic in this study, which is consistent with the findings from a sample of Hong Kong university students.[16] Therefore, item 17 was removed from the final version of the C-BREQ-2. The discriminant validity and internal consistency reliability of the C-BREQ-2 was also supported in the current study.

The correlations of the C-BREQ-2 subscales generally show a simplex-like pattern, which are consistent with previous findings,[16] which provided support for the nomological validity of the C-BREQ-2. As expected, amotivation was negatively correlated with subjective vitality and introjected regulation, whereas identified regulation and intrinsic motivation were positively correlated with subjective vitality. The autonomous regulations and introjected regulation were found to be positively correlated with positive affective and strenuous exercise behavior, whereas amotivation and external regulation were found to be positively correlated with a negative affect only in this study. All of these findings provided further support for the nomological validity of the C-BREQ-2. However, some of the correlations between the variables in this study were different from the findings in a previous study.[16] For example, amotivation was found to be positively correlated with negative affect and negatively correlated with strenuous exercise behavior, whereas autonomous regulations were negatively correlated with negative affect in a previous study. Unexpectedly, all of these correlations were not statistically significant in this study. These inconsistent results may suggest that the application of different regulations in

predicting the affective outcomes of university students in Mainland and Hong Kong of China should be interpreted with caution in future practical service or studies. Future studies are encouraged to investigate the potential reasons for this discrepancy.

Measurement invariance analysis revealed that the factor loadings and factor variances and covariances of the C-BREQ-2 measurement model were invariant across Mainland Chinese and Hong Kong university students. These results suggest that the C-BREQ-2 measures the same structure, and the items could be interpreted in the same way among the university students in Mainland China and Hong Kong.

The findings of the current study provided further psychometric evidence for the C-BREQ-2, which make the further application and research of SDT based motivation in relation to exercise and physical activity in the Chinese Mainland context possible. Several future research directions emanate from the findings of this current study. First, all participants in the current study were university students (from Mainland and Hong Kong of China), and thus the conclusion may not be generalized to other Chinese populations. Future study is encouraged to examine the applicability of the C-BREQ-2 among various Chinese populations, such as adolescents, working adults, as well as the elderly. Second, the expected negative correlations between controlled motivation (e.g., amotivation and external regulation) and positive affect, and the negative correlations between autonomous motivation (e.g., identified regulation and intrinsic motivation) and negative affect were not observed in this study. These findings suggest that, for the Chinese Mainland university students, controlled motivation may not inevitably lead to a negative effect on their positive affect. Future study is encouraged to investigate these abovementioned relationships among Chinese populations. Furthermore, previous studies conducted among Chinese university students in Hong Kong[16,18] found that the correlation between introjected regulation and amotivation was not significant, which is inconsistent with the findings from studies using Western participants.[7,11] In this study, this non-significant relationship is also identified among Mainland Chinese university students. The measurement invariance analysis suggested that the

factor covariances of the measurement model were invariant across university students in Mainland and Hong Kong of China. These results suggest that the university students in Mainland and Hong Kong of China share the same pattern for the relationship between introjected regulation and amotivation, but are different from that among Western participants. Cross-cultural studies (e.g., Chinese *vs.* British) are encouraged to further investigate this research question. Finally, introjected regulation was found to be positively correlated with a positive affect and subjective vitality, as well as strenuous exercise, which is similar to the relationships between autonomous motivation and affective outcomes. This result implies that, for university students in the Mainland of China, introjected regulation may also be treated as one of the potential exercise promotion motivational styles, like identified regulation and intrinsic motivation, which do not seem to compromise the affective outcomes.

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Table 1. Summary of the CFA factor loadings, item means, standard deviation, standard error, squared multiple correlation, composite reliability, and Cronbach's α coefficients.

BREQ-2 subscale and item	Mean ± SD	FL	SE	SMC	CR	α
Amotivation					0.80	0.80
5. I don't see why I should have to exercise	0.65 ± 1.06	0.73	0.03	0.53		
9. I can't see why I should bother exercising	0.72 ± 1.06	0.71	0.04	0.50		
12. I don't see the point in exercising	0.37 ± 0.88	0.66	0.05	0.43		
19. I think that exercising is a waste of time	0.45 ± 0.86	0.74	0.03	0.54		
External regulation					0.73	0.73
1. I exercise because other people say I should	1.04 ± 1.05	0.61	0.05	0.37		
6. I take part in exercise because my friends/family/spouse say I should	1.37 ± 1.12	0.56	0.06	0.31		
11. I exercise because others will not be pleased with me if I don't	0.30 ± 0.69	0.76	0.03	0.57		
16. I feel under pressure from my friends/family to exercise	1.06 ± 1.11	0.62	0.04	0.38		
Introjected regulation						

2. I feel guilty when I don't exercise	0.84 ± 1.02	0.69	0.04	0.47	
7. I feel ashamed when I miss an exercise session	0.93 ± 1.11	0.63	0.05	0.39	
13. I feel like a failure when I haven't exercised in a while	1.23 ± 1.20	0.71	0.03	0.50	
Identified regulation				0.72	0.72
3. I value the benefits of exercise	3.54 ± 0.96	0.68	0.05	0.46	
8. It's important to me to exercise regularly	2.39 ± 1.30	0.70	0.03	0.49	
14. I think it is important to make the effort to exercise regularly	3.30 ± 1.07	0.66	0.04	0.43	
Intrinsic motivation				0.83	0.83
4. I exercise because it's fun	1.93 ± 1.23	0.63	0.06	0.39	
10. I enjoy my exercise sessions	2.31 ± 1.17	0.79	0.04	0.63	
15. I find exercise a pleasurable activity	2.64 ± 1.12	0.77	0.04	0.59	
18. I get pleasure and satisfaction from participating in exercise	2.52 ± 1.12	0.80	0.03	0.64	

Note: Numbers to the left of each item represent the item's position in the English version of the BREQ-2. $n = 191$.

Abbreviations: FL=factor loading; CFA = confirmatory factor analysis; SE = standard error; SMC = squared multiple correlation; CR =

composite reliability.

All factor loadings were statistically significant ($p < 0.05$).

Table 2. Summary of the mean subscale scores, standard deviation, standard error, and factor correlations

Subscale	Mean ± SD	AM	EX	IJ	ID
Amotivation (AM)	0.55 ± 0.68	—	—	—	—
External regulation (EX)	0.94 ± 0.68	0.62 (0.08)	—	—	—
Introjected regulation (IJ)	1.00 ± 0.83	**0.01** (0.09)	0.35 (0.06)	—	—
Identified regulation (ID)	3.08 ± 0.82	-0.91 (0.08)	**-0.08** (0.10)	0.35 (0.08)	—
Intrinsic motivation (IM)	2.35 ± 0.94	-0.39 (0.04)	-0.22 (0.09)	0.48 (0.04)	0.62 (0.09)

Note: $n = 191$. The factor correlations with standard errors in parentheses are displayed below the diagonal. All correlation coefficients were from the confirmatory factor analysis of the 18-item factor structure model. The bold correlations were not statistically significant. All other correlations were significant at $p < 0.05$ level. The regulations were measured on a 5-point scale.

Table 3. Correlations between the scores derived from measures of the Chinese Behavioral Regulation in Exercise Questionnaire-2 (C-BREQ-2)

and affective and behavioral outcomes.

	Positive affect	Negative affect	Subjective vitality	Mild exercise	Moderate exercise	Strenuous exercise
Amotivation	**-0.04**	0.12	-0.20	**0.01**	**-0.01**	**-0.01**
External regulation	**0.05**	0.23	**-0.02**	**-0.01**	**-0.03**	**-0.06**
Introjected regulation	0.16	**0.06**	0.22	**-0.06**	**-0.02**	0.21
Identified regulation	0.19	**0.01**	0.32	**0.03**	**0.09**	0.13
Intrinsic motivation	0.14	**-0.01**	0.36	**0.02**	**0.11**	0.30

Note: $n = 191$. The bold correlations were not statistically significant. All other correlations were significant at $p < 0.05$ level

Table 4. Goodness-of-fit index for the measurement models

Model	Sample	χ^2	*df*	CFI	RMSEA (90%CI)	SRMR
19-item model	Mainland China	334.44	142	0.801	0.084 (0.073-0.096)	0.094
18-item model	Mainland China	209.76	125	0.900	0.060 (0.045-0.074)	0.069
	Hong Kong	222.02	125	0.932	0.063 (0.050-0.077)	0.062

Note: $n_{\text{Mainland China}}$ = 191; $n_{\text{Hong Kong}}$ = 194.

Abbreviations: CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Table 5. Goodness-of-fit index for the measurement   invariance analysis models.

18-item CBREQ-2 models	χ^2	df	CFI	RMSEA (90%CI)	SRMR	Model Comparison	ΔCFI
M1	431.79	250	0.920	0.044 (0.037-0.05)	0.069	-	
M2	446.54	263	0.919	0.043(0.036-0.049)	0.070	M2 *vs.* M1	0.001
M3	484.02	278	0.910	0.044 (0.037-0.050)	0.077	M3 *vs.* M2	0.009

Note: $n_{\text{Mainland China}}$ = 191; $n_{\text{Hong Kong}}$ = 194.

Abbreviations: M1 = no parameters were constrained to be equal across groups; M2 = factor loadings were constrained to be equal across groups; M3 = factor loadings, factor variances and covariances were constrained to be equal across groups; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.