Hellenic Journal of Psychology, Vol. 9 (2012), pp. 1-17

MEASUREMENT EQUIVALENCE OF THE BEHAVIORAL REGULATION IN EXERCISE QUESTIONNAIRE – 2 ACROSS GREEK MEN AND WOMEN EXERCISE PARTICIPANTS

Symeon P. Vlachopoulos
Aristotle University of Thessaloniki, Greece

***Abstract*:** The present study examined the extent of measurement invariance of the Behavioral Regulation in Exercise Questionnaire – 2 (BREQ-2) scores across Greek men and women exercise participants. Data were analyzed from 330 men and 403 women exercise participants aged between 18 and 64 years. After obtaining a sound factor structure via confirmatory factor analysis and strong internal consistency of the Greek BREQ-2 responses for men and women separately, measurement invariance analyses provided support for configural and full metric, full strong, and partial strict factorial invariance across gender. Overall, the present findings point to equivalent interpretation of the BREQ-2 items across Greek men and women exercise participants.

***Key words*:** Self-determination theory, Measurement invariance, Exercise motives

INTRODUCTION

Given the widespread recognition of the fundamental role that regular exercise and physical activity participation can play in improving physical and psychological health (Miles, 2007), it becomes of utmost importance to understand how to reverse the physical inactivity trends identified in large percentages of both the U.S. (Pleis & Lethbridge-Hejku, 2006) and European populations (Cavill, Kahlmeier, & Racioppi, 2006). As physical activity can be motivated by a number of reasons

***Διεύθυνση*:** Symeon Vlachopoulos, Laboratory of Social Research on Physical Activity, Department of Physical Educationand Sport Science at Serres, Aristotle University of Thessaloniki, Aghios Ioannis, 621 10 Serres, Greece. Phone: +30 2310 991045. Fax: +30 23210 64806. E-mail: vlachop@phed-sr.auth.gr

(Ingledew & Markland, 2008), self-determination theory (SDT: Deci & Ryan, 1985; Ryan & Deci, 2002) is considered a theory useful in better understanding the "why" of motivated behavior. SDT has been consistently studied in sport and physical activity (Ryan & Deci, 2007; Ryan, Williams, Patrick, & Deci, 2009). Six types of behavioral regulation have been proposed by Deci and Ryan that differ qualitatively in the way behavior is regulated.

In SDT it is proposed that these behaviors lie along a continuum that ranges from completely non self-determined to completely self-determined regulation. These types of regulation are amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation. *Amotivation* reflects a lack of intention to perform the behavior. *External regulation* reflects behavior enacted to gain a reward or to avoid punishment; under *introjected* regulation behavior is enacted to avoid feelings of guilt or anxiety or to maintain self-esteem; under *identified* regulation individuals enact the behavior because they consciously accept the behavior as important to them; under *integrated* regulation, behavior is enacted because it is felt as part of the individuals' identity and it is in congruence with other aspects of one's self and values. External regulation, introjected regulation, identified regulation, and integrated regulation are subtypes of extrinsically motivated behavior, that is, behavior enacted to gain something separable from the enjoyment of being involved in the behavioral process. Intrinsically motivated behaviors are enacted out of pleasure and fun inherent in the behavior itself. These types of regulations are assumed to be located on a self-determination continuum with more self-determined forms of motivation to be correlated with more positive outcomes of a cognitive, affective, and behavioral nature. In the exercise domain, research has provided ample support for these assumptions (Vallerand, 2007; Wilson, Mack, & Grattan, 2008).

The main instrument used to measure these types of regulation in exercise has been the Behavioral Regulation in Exercise Questionnaire (BREQ: Mullan, Markland, & Ingledew, 1997) that measures external, introjected, identified and intrinsic exercise regulations followed by the development of the BREQ-2 that included an assessment of amotivation (Markland & Tobin, 2004). Various aspects of the psychometric qualities of the original and the revised instrument have been supported in the literature. The BREQ-2 has also been translated into Spanish (Murcia, Gimeno, & Camacho, 2007) and Greek (Moustaka, Vlachopoulos, Kaperoni, Vazou, & Markland, 2010; see Appendix for items) to facilitate exercise motivation research in non English-speaking populations with evidence in support of their psychometric qualities.

Past SDT research has revealed gender differences in the types of regulation of

motivated behavior in various behavioral domains such as sport (Fortier, Vallerand, Briere, & Provencher, 1995; Pelletier, Fortier, Vallerand, Tuson, Briere, & Blais, 1995), the academic domain (Vallerand et al., 1992), among the elderly (Vallerand & O'Connor, 1989), and the exercise domain (Mullan & Markland, 1997; Rose, Markland, & Parfitt, 2001; Rose, Parfitt, & Williams, 2005) highlighting the role of gender differences in the motivational processes posited within SDT. For instance, while Mullan and Markland (1997) found that it was the male exercise participants in the maintenance exercise stage of change who reported levels of autonomous behavior higher than the female participants, Rose et al. (2005) demonstrated that it was the female exercisers in the maintenance exercise stage of change who reported greater levels of autonomous motivation than their male counterparts. Such inconsistencies in the findings may be attributed to a number of reasons including the differential functioning of the measure across groups. Therefore, performing meaningful gender comparisons requires evidence of measurement invariance between gender groups.

Measurement invariance shows the extent to which scale responses retain their meaning across groups (Millsap & Kwok, 2004). The parameters investigated for invariance are the same pattern of free and fixed factor loadings (configural invariance), the item loadings (metric invariance), item intercepts (strong invariance) and item residuals (strict invariance) (Gregorich, 2006; Vlachopoulos, 2010). When measurement invariance does not hold, meaningful comparisons between groups cannot be performed given potential confounding and misinterpretation of group differences (Hoyle & Smith, 1994).

The present study

As culture and ethnicity may be important explanatory variables in psychological theories of cognition, affect, and behavior in the sport/exercise domain, lack of research in populations other than English-speaking populations may result in theoretical frameworks that are likely to be misleading in their presumed generalizability (Duda & Allison, 1990). Given that the majority of the SDT exercise-related research has been conducted with English-speaking populations, the availability of the Greek BREQ-2 provides an opportunity to test SDT tenets on behavioral regulations among Greek-speaking exercise participants. Despite that Moustaka et al. (2010) provided support for a number of psychometric qualities of the Greek BREQ-2 scores among a sample of exercise participants, the extent of measurement invariance of the BREQ-2 responses across Greek men and women exercise participants has not been investigated. Given observed inconsistencies in the broader

SDT literature with regard to the role of gender in behavioral regulation in various behavioral domains including the exercise domain, the purpose of the present study was to examine the extent of measurement invariance of the Greek BREQ-2 responses between Greek men and women exercise participants. The specific objectives of the study were to examine the extent of configural invariance, metric invariance, strong invariance, and strict invariance of BREQ-2 responses. The study hypotheses were that the data would support (a) configural invariance of the BREQ-2 responses across men and women exercise participants; (b) metric invariance; (c) strong invariance; and (d) strict measurement invariance.

METHOD

Participants

The data represent part of a larger project on understanding motivation for exercise participation among Greek exercise participants (e.g., see Moustaka et al., 2010) and comprise 330 men (45%) and 403 women (55%) aged between 18 and 64 years. For men, there were 44.7% participants aged 18-25, 18.5% aged 25-30, 14% aged 30-35, 10% aged 35-40 and 12.8% aged 40-64 yrs. The self-reported length of exercise participation was between a few months and 37 years (M = 6.79 yrs, SD = 7.26) while the self-reported weekly frequency was between 0 and 7 times per week (M = 3.68, SD = 1.28); they also reported that they spent between 30 min and 4hrs in the fitness center (M = 88.65, SD = 30.63) per visit to the center. The participants' body mass index (BMI) was calculated based on self-reported weight and height values separately for men (range = 18.99 – 35.53, M_{BMI} = 24.91 Kg / m^2, SD = 2.62) and women (range = 16.33 – 34.89, M_{BMI} = 22.03 Kg / m^2, SD = 3.02). In terms of BMI classification (Health Canada, 2003) for men, zero (0%) men belonged in the underweight category (< 18.5), 175 men (53%) were characterized as having a normal BMI (18.5 – 24.9), 131 (39.7%) as belonging in the overweight category (25 – 29.9), and 13 (4%) as belonging in the obese category (>30) with 11 men (3.3%) not reporting anthropometric data. In terms of activities, men were involved in both group-type and individual aerobic activities and resistance training activities.

Among women there were 36% participants aged 18-25, 15.1% aged 25-30, 10.4% aged 30-35, 10% aged 35-40 and 28.5% aged 40-64 yrs. The self-reported length of exercise involvement was between a few months and 37 years (M = 6.90 yrs, SD = 7.45) while the weekly frequency was between 0 and 8 times per week (M = 3.15, SD = 1.05); they reported spending between 30 min and 3hrs in the fitness

center (M = 74.62, SD = 29.83). In terms of BMI classification for women, 38 women (9.5%) belonged in the underweight category (< 18.5), 291 women (72.2%) were characterized as having a normal BMI (18.5 – 24.9), 66 (16.4%) as belonging in the overweight category (25 – 29.9), and 5 (1.2%) as belonging in the obese category (>30) while 3 (0.7%) women did not report anthropometric data. In terms of activities, women were involved in both group-type and individual aerobic activities and resistance training activities.

Measures

Behavioral Regulation in Exercise Questionnaire – 2. Behavioral regulations in exercise were measured via the Behavioral Regulation in Exercise Questionnaire – 2 (BREQ-2: Markland & Tobin, 2004). The BREQ-2 measures five types of regulations to exercise, that is, amotivation (4 items: e.g., "I don't see why I should have to exercise"), external regulation (4 items: e.g., "I exercise because other people say I should"), introjected regulation (3 items: e.g., "I feel guilty when I don't exercise"), identified regulation (4 items: e.g., "I value the benefits of exercise") and intrinsic motivation (4 items: e.g., "I exercise because it's fun"). Responses follow the stem "why do you exercise?" and are provided on a 5-point Likert scale ranging from 0 ("*definitely no*") to 4 ("*definitely yes*"). The identified regulation item #4 ("I get restless if I don't exercise regularly") is not used given low inter-item correlations with the remaining subscale items (Moustaka et al., 2010). Based on the 18-item BREQ-2 model (after removing the identified regulation #4 item) a number of psychometric qualities of the scale including factor structure, internal consistency, scale dimensionality, discriminant validity, simplex structure, and nomological validity have been supported using a sample of Greek exercise participants (Moustaka et al. 2010).

Procedure

Data were collected in fitness centers after having secured the verbal permission of the center directors. Exercise participants were requested to fill in the questionnaires before initiation of that day's exercise program. Data were collected all days of the week. The participants completed the questionnaires after being informed about the general purpose of the study and after receiving assurance about the confidentiality and anonymity of their responses. All participants provided written informed consent for participating in the study. In the end, participants were thanked for their participation.

Data analysis

Initially, confirmatory factor analyses (CFA) were performed on the BREQ-2 responses for each gender separately to examine the factor structure of the scale along with computing the internal consistency coefficient using Cronbach's alpha (Cronbach, 1951) for each subscale. Then, measurement invariance analyses were performed to examine the extent of measurement invariance of the BREQ-2 responses across Greek men and women exercise participants. The measurement invariance models tested in line with the hypotheses were (a) the configural invariance model with no equality constraints imposed; (b) the metric invariance model with equality constraints imposed on the item loadings; (c) the strong invariance model with equality constraints imposed on the item intercepts of those items found to have invariant item loadings in the metric invariance model; and (d) the strict invariance model where equality constraints were imposed on the item residuals of those items found to have invariant both item loadings and item intercepts concurrently in the strong invariance model (Gregorich, 2006). That is, given a good fit of the configural multi-group confirmatory factor analysis (MGCFA) model, subsequent models were tested that were increasingly more constrained. The goodness of fit indexes used were the chi-square value (χ^2), the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA) accompanied by its 90% confidence interval (90% CI).

Because of the sensitivity of the χ^2 to sample size (Byrne, 2006), assessment of model fit was mainly based on the CFI and the RMSEA. CFI values close to .95 indicate an excellent fit to the data (Hu & Bentler, 1999) whereas values of .90 or greater indicate a reasonable fit. A RMSEA value less than .05 indicates a good model fit (Hu & Bentler, 1999), while values between .08 and .10 represent an adequate fit (Browne & Cudeck, 1993) (Byrne, 2000). Further, according to Cheung and Rensvold (2002) comparison of MGCFA may be based on the difference of the CFI values (ΔCFI) between the less constrained (e.g., metric invariance model) and the more constrained (e.g., strong invariance) MGCFA model with a ΔCFI value greater than 0.01 indicating meaningful difference between the two MGCFA models. A ΔCFI difference greater than 0.01 means that the equality constraints imposed on the more constrained model are not tenable and further investigation is required using the Lagrange Multiplier test (in the context of the EQS software; Bentler, 2003) to examine which equality constraints are responsible for model fit deterioration.

RESULTS

Confirmatory factor analysis of the BREQ-2 for men and women

Confirmatory factor analysis was performed on the BREQ-2 data separately for Greek men and women exercise participants. Given multivariate non-normality of the male data (normalized estimate of Mardia's multivariate kurtosis = 39.35) (a normalized value greater than 5.0 indicates multivariate non-normality: Byrne, 2006) the ML robust method of estimation was employed using the EQSWIN software (Bentler, 2003). This method provides indexes corrected for non-normality (called robust estimates) such as the Satorra-Bentler χ^2 value (S-B χ^2), CFI, RMSEA and its 90% CI. The CFA results supported the fit of the correlated 5-factor BREQ-2 model to the data: S-B scaled $\chi^2 = 213.73$, $df = 125$, $p < .001$, Robust CFI = .954, Robust RMSEA = .046 (90% CI = .036 - .057). Standardized item loadings ranged between .50 and .88 (Table 1). For women, the data were also multivariately non-normal (normalized estimate of Mardia's multivariate kurtosis = 46.90). The CFA results supported the fit of the correlated 5-factor BREQ-2 model to the data: S-B scaled $\chi^2 = 183.37$, $df = 125$, $p < .001$, Robust CFI = .975, Robust RMSEA = .034 (90% CI = .022 - .044). Standardized item loadings ranged between .64 and .91 (Table 2).

Estimates of internal consistency of the BREQ-2 for men and women

The Cronbach's alpha values were greater than .70 for both males and females. For men, the alphas were .82 for amotivation, .84 for external regulation, .78 for introjection, .78 for identified regulation (3 items) and .85 for intrinsic motivation. For women, the alphas were .91 for amotivation, .84 for external regulation, .76 for introjected regulation, .85 for identified regulation (3 items) and .91 for intrinsic motivation.

Multi-sample confirmatory factor analyses over gender

The BREQ-2 configural invariance model (Model 1) had a good fit to the data (Table 3) allowing the comparison of more constrained MGCFA models. Examination of the metric invariance model (Model 2) with equality constraints imposed on the BREQ-2 item loadings showed a good fit of the model to the data and based on the ΔCFI value that it did not differ from the configural invariance model (Table 3). These findings provided support for the tenability of the item

Table 1. Correlated 5-factor CFA Model Parameter Estimates for the Translated-into-Greek BREQ-2 Scores for Men

Scale items	*M*	*SD*	Skewness	Kurtosis	Item loadings	Item uniquenesses
Amotivation						
Amotivation 1 – I don't see why I should have to exercise	0.39	0.64	2.05	6.13	.613	.790
Amotivation 2 – I can't see why I should bother exercising	0.34	0.52	1.16	0.30	.851	.525
Amotivation 3 – I don't see the point in exercising	0.32	0.53	1.60	2.99	.881	.474
Amotivation 4 – I think exercising is a waste of time	0.30	0.52	1.97	6.83	.603	.798
External regulation						
External 1 – I exercise because other people say I should	0.51	0.74	1.66	3.17	.774	.634
External 2 – I take part in exercise because my friends/family/partner say I should	0.50	0.76	1.79	3.70	.864	.503
External 3 – I exercise because others will not be pleased with me if I don't	0.54	0.79	1.61	2.52	.633	.774
External 4 – I feel under pressure from my friends/family to exercise	0.48	0.68	1.65	3.60	.773	.634
Introjected regulation						
Introjected 1 – I feel guilty when I don't exercise	2.24	1.26	-0.31	-1.10	.689	.725
Introjected 2 – I feel ashamed when I miss an exercise session	2.48	1.13	-0.54	-0.60	.791	.612
Introjected 3 – I feel like a failure when I haven't exercised in a while	2.32	1.24	-0.41	-0.97	.751	.660
Identified regulation						
Identified 1 – I value the benefits of exercise	3.51	0.56	-0.62	-0.64	.668	.745
Identified 2 – It's important for me to exercise regularly	3.25	0.80	-1.08	1.08	.775	.632
Identified 3 – I think it's important to make the effort to exercise regularly	3.24	0.67	-1.05	3.06	.772	.636
Intrinsic motivation						
Intrinsic 1 – I exercise because it's fun	2.66	1.02	-0.63	-0.21	.505	.835
Intrinsic 2 – I enjoy my exercise sessions	3.06	0.79	-0.91	1.07	.808	.589
Intrinsic 3 – I find exercise a pleasurable activity	3.13	0.81	-1.26	2.54	.888	.461
Intrinsic 4 – I get pleasure and satisfaction from participating in exercise	3.19	0.74	-0.99	1.52	.838	.545

Note: $N = 330$; CFA = Confirmatory Factor Analysis; All factor loadings and item uniquenesses are completely standardized and statistically significant at $p < .05$. Item uniqueness represents the item variability not explained by the latent factor (item error variance). Identified Regulation #4 item has not been presented.

Table 2. Correlated 5-factor CFA Model Parameter Estimates for the Translated-into-Greek BREQ-2 Scores for Women

Scale items	*M*	*SD*	Skewness	Kurtosis	Item loadings	Item uniquenesses
Amotivation						
Amotivation 1 – I don't see why I should have to exercise	0.30	0.55	2.00	4.72	.834	.552
Amotivation 2 – I can't see why I should bother exercising	0.33	0.59	2.17	6.44	.802	.597
Amotivation 3 – I don't see the point in exercising	0.28	0.56	2.36	6.75	.908	.419
Amotivation 4 – I think exercising is a waste of time	0.29	0.58	2.55	8.46	.849	.528
External regulation						
External 1 – I exercise because other people say I should	0.73	0.93	1.43	1.55	.739	.674
External 2 – I take part in exercise because my friends/family/partner say I should	0.63	0.92	1.74	2.81	.754	.657
External 3 – I exercise because others will not be pleased with me if I don't	0.50	0.73	1.65	2.98	.781	.625
External 4 – I feel under pressure from my friends/family to exercise	0.52	0.72	1.49	2.54	.765	.644
Introjected regulation						
Introjected 1 – I feel guilty when I don't exercise	2.49	1.10	-0.57	-0.59	.751	.660
Introjected 2 – I feel ashamed when I miss an exercise session	2.46	1.07	-0.40	-0.78	.771	.637
Introjected 3 – I feel like a failure when I haven't exercised in a while	2.29	1.16	-0.33	-0.91	.646	.764
Identified regulation						
Identified 1 – I value the benefits of exercise	3.50	0.67	-1.24	1.26	.765	.645
Identified 2 – It's important for me to exercise regularly	3.19	0.84	-0.97	0.50	.867	.499
Identified 3 – I think it's important to make the effort to exercise regularly	3.23	0.77	-1.04	1.07	.831	.556
Intrinsic motivation						
Intrinsic 1 – I exercise because it's fun	2.66	1.03	-0.59	-0.46	.690	.724
Intrinsic 2 – I enjoy my exercise sessions	3.05	0.83	-0.93	0.76	.881	.473
Intrinsic 3 – I find exercise a pleasurable activity	3.14	0.93	-1.19	1.10	.911	.412
Intrinsic 4 – I get pleasure and satisfaction from participating in exercise	3.14	0.93	-1.17	1.01	.917	.400

Note: $N = 403$; CFA = Confirmatory Factor Analysis; All factor loadings and item uniquenesses are completely standardized and statistically significant at $p < .05$. Item uniqueness represents the item variability not explained by the latent factor (item error variance). Identified Regulation #4 item has not been presented.

loading constraints leading to the conclusion that in the present data, all of the BREQ-2 item loadings are invariant across Greek men and women exercise participants. Examination of the strong invariance model (Model 3) showed that it fitted the data well (Table 3). Also, inspection of the ΔCFI value in regard to the comparison between the metric invariance model (Model 2) and the strong invariance model (Model 3) led to the conclusion that the two models did not differ and that all of the item intercept equality constraints were correctly imposed (Table 3). These findings indicated that in the present data, all of the item intercepts of the BREQ-2 items were invariant across Greek men and women exercise participants. Further, the strict invariance model (Model 4) also had a good fit to the data (Table 3). However, inspection of the ΔCFI value in relation to the comparison between the strong invariance model (Model 3) and the strict invariance model (Model 4) led to the conclusion that the two models did differ with the strict invariance model (Model 4) being worse than the strong invariance model (Model 3) (Table 3). These findings indicated that in the present data, not all item residual equality constraints were tenable. Therefore, the results of the Lagrange Multiplier Test (LM test) were inspected in relation to item residual equality constraints to detect the BREQ-2 item residuals with the untenable equality constraints. The results of the LM test indicated that the items with the untenable item residual equality constraints were the amotivation #4 and the identified regulation #2 items (Table 3).

Table 3. Goodness-of-Fit Indexes for the Cross-Gender BREQ-2 Measurement Invariance Models in Greek Exercise Participants

BREQ-2 Multi-group CFA models	χ^2	Satorra-Bentler Scaled χ^2	*df*	Robust CFI	ΔCFI	Robust RMSEA	Robust RMSEA 90% CI
Model 1: Configural invariance	438.18	394.27	250	.967	-	.028	.023 - .033
Model 2: Full metric invariance	496.41	442.44	268	.960	.007	.030	.025 - .035
Model 3: Full strong invariance	549.18	496.53	286	.960	.000	.032	.027 - .036
Model 4: Full strict invariance	764.16	601.61	304	.938	.022[a]	.037	.032 - .041
Model 4a: Partial strict invariance (omitting amotivation #4 item)	743.27	600.82	303	.939	.021[a]	.037	.032 - .041
Model 4b: Partial strict invariance (omitting Amotivation #4 and Identified Regulation #2 items)	743.31	595.54	302	.940	.020[a]	.036	.032 - .041

Note: CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; Model 2 is compared to Model 1; Model 3 is compared to Model 2; Models 4, 4a and 4b are compared to Model 3. [a] indicates model difference based on the ΔCFI value (Cheung & Rensvold, 2002).

DISCUSSION

A number of instances have been observed in the SDT literature where inconsistencies in the findings related to behavioral regulations and gender have been noted in various behavioral domains such as the sport domain, the academic domain, older individuals, and the exercise domain. Given the possibility that such inconsistencies may be attributed to differential functioning of the scale across populations (e.g., gender groups) (Gregorich, 2006), the need is evident to ascertain whether the instrument of interest functions differentially across populations. Given inconsistencies in findings related to exercise behavioral regulations measured via the Behavioral Regulation in Exercise Questionnaire and gender in the broader exercise motivation literature, and the need to study the role of these exercise regulations among Greek-speaking individuals, the present study examined the extent to which Greek-speaking men and women exercise participants interpret the BREQ-2 items in a similar manner. This aim was accomplished using measurement invariance analyses within a CFA framework.

Because it is necessary for the measure of interest to have a good factor structure within each of the populations to be compared, the factor structure of the BREQ-2 was initially examined within Greek men and women exercise participants, separately. The findings showed that the BREQ-2 responses were in agreement with an a priori correlated 5-factor BREQ-2 model for both men and women separately. The good factor structure for each gender was also accompanied by strong internal consistency coefficients for both men and women, supporting the internal coherence of each of the five BREQ-2 subscales.

Measurement equivalence of the Greek BREQ-2

Measurement invariance analyses in general provided support for the equivalence of the BREQ-2 item parameter estimates of item loadings, item intercepts and item residuals across Greek men and women exercise participants. This is important because substantive group comparisons necessitate that the constructs assessed have the same meaning across groups (Gregorich, 2006). Support for the configural invariance model means that men and women associated the same items with the same constructs or put differently, the constructs were conceptualized in the same way by the two groups (Cheung & Rensvold, 2002). Thus, it may be concluded that based on the present data, gender category does not influence participants' perceptions of the constructs assessed by the BREQ-2. The findings of the invariant item loadings across men and women in relation to the metric invariance model provided

even stronger evidence that the five BREQ-2 factors have the same meaning across gender groups (Gregorich, 2006).

According to Bollen (1989) invariance of item loadings is the minimum prerequisite for meaningful cross-group comparison and allows for valid group comparisons of latent factor variances, covariances (i.e., controlling for measurement error), and of structural regression coefficients (i.e., between latent variables) (Gregorich, 2006). Further, the present findings supported the strong invariance model of the BREQ-2 which means concurrent equivalence of both item intercepts and item loadings across men and women. Such invariance is a prerequisite for latent means and observed means comparison (Gregorich, 2006). Instruments that do not demonstrate strong invariance may be counterproductive in comparative research (Gregorich, 2006) because lack of such an invariance means that variables not related to the common factors of interest may result into higher or lower item responses in one group compared to the others (Gregorich, 2006). That is, support for strong factorial invariance means that cross-group differences in observed means are held to be unbiased estimates of group differences in the corresponding latent factor means (Gregorich, 2006). Strict factorial invariance is important when the aim is the valid cross-group comparison of observed variance and covariance estimates because such comparisons should entirely reflect cross-group differences in common factor variation and not be contaminated by group differences in residual variation. For this reason, item residual invariance is a prerequisite for meaningful group comparisons of item or composite score variance estimates (Gregorich, 2006)— for instance, when one needs to compare the magnitude of the variance of an item or the variance of an observed subscale composite score across men and women. In the present data the Amotivation #4 item and the Identified Regulation #2 item did not display strict factorial invariance. Thus, for the present data, these two items should not be involved in gender comparison of observed item variance or composite score variance estimates for the amotivation and identified regulation subscales.

It should be noted that such invariance results are sample specific. Hence, before researchers decide on the usefulness of a particular scale item in terms of group comparisons, evidence should first be collected from a number of studies examining the various types of invariance for the particular item in order to reach valid and trustworthy conclusions as to the general utility of the particular item in further comparative research. An important point is that in the present data, the findings supported full metric and full strong factorial invariance while partial strict invariance emerged for the BREQ-2 item residuals.

Overall, the Greek BREQ-2 may be used for valid cross-gender comparisons of latent factor variances, covariances, and/or regression coefficients between latent

factors (metric invariance); latent factor means and/or observed means (strong invariance); and observed variance and covariance estimates (strict invariance) across Greek men and women exercise participants taking into account the Amotivation #4 and the Identified Regulation #2 items that appeared non-invariant in the strict invariance analyses in the present data.

Limitations and future directions

The present findings apply to healthy adult Greek men and women exercise participants but not to other populations for which regular exercise participation may also provide health benefits such as older individuals and individuals with chronic disease. Future research may test behavioral regulation predictions derived from SDT within Greek men and women exercise participants separately as well as the extent to which such predictions hold equally across men and women. Given the increasingly accumulated validity evidence for the Greek BREQ-2 scores and the need to use the measure in future experimental research on the effects of exercise instructing style interventions on changes in self-determined motivation for exercise, future studies should also examine the temporal stability of the Greek BREQ-2 responses over short and longer time intervals. Overall, the present data support the usefulness of the Greek BREQ-2 for continued SDT research within and across gender in exercise and contribute to a better understanding of the role of gender in motivation for exercise participation and adherence.

REFERENCES

Bentler, P. M. (2003). *EQS 6.1 for windows* [Computer software]. Encino, CA: Multivariate Software.

Bollen, K. A. (1989). *Structural equations with latent variables.* New York: Wiley.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & S. J. Long (Eds.), *Testing structural equation models* (pp. 445-455). Newbury Park, CA: Sage.

Byrne, B. M. (2000). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Mahwah, NJ: Erlbaum.

Byrne, B. M. (2006). *Structural equation modeling with EQS: Basic concepts, application, and programming (2nd ed.).* Mahwah, NJ: Erlbaum.

Cavill, N., Kahlmeier, S., & Racioppi, F. (Eds.). (2006). *Physical activity and health in Europe: Evidence for action.* Copenhagen, Denmark: World Health Organization Regional Office for Europe. Retrieved January 6, 2010 from: *http://www.euro.who.int/document/e89490.pdf*

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indices for testing measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal, 9,* 233-255.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Plenum .

Duda, J. L., & Allison, M. T. (1990). Cross-cultural analysis in exercise and sport psychology: A void in the field. *Journal of Sport and Exercise Psychology, 12*, 114-131.

Fortier, M. S., Vallerand, R. J., Briere, N. M., & Provencher, P. (1995). Competitive and recreational sport structures and gender: A test of their relationship with sport motivation. *International Journal of Sport Psychology, 26*, 24-39.

Gregorich, S. E. (2006). Do self-report instruments allow meaningful comparisons across diverse population groups? Testing measurement invariance using the confirmatory factor analysis framework. *Medical Care, 44*, S78-S94.

Health Canada. (2003). *Canadian guidelines for body weight classification in adults.* Ottawa: Minister of Public Works and Government Services, Canada.

Hoyle, R. H., & Smith, G. T. (1994). Formulating clinical research hypotheses as structural equation models: A conceptual overview. *Journal of Consulting and Clinical Psychology, 62*, 429-440.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1-55.

Ingledew, D. K., & Markland, D. (2008). The role of motives in exercise participation. *Psychology and Health, 23*, 807-828.

Markland, D., & Tobin, V. (2004). A modification to the Behavioural Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology, 26,* 191–196.

Miles, L. (2007). Physical activity and health. *Nutrition Bulletin, 32,* 314-363.

Millsap, R. E., & Kwok, O. (2004). Evaluating the impact of partial factorial invariance on selection in two populations. *Psychological Methods, 9*, 93-115.

Moustaka, F. C., Vlachopoulos, S. P., Kaperoni, M., Vazou, S., & Markland, D. A. (2010). Initial validity evidence for the Behavioral Regulation in Exercise Questionnaire-2 among Greek exercise participants. *European Journal of Psychological Assessment, 26,* 269-276.

Mullan, E., & Markland, D. (1997). Variations in self-determination across the stages of change for exercise in adults. *Motivation and Emotion, 21*, 349–362.

Mullan, E., Markland, D., & Ingledew, D. K. (1997). A graded conceptualisation of self-determination in the regulation of exercise behaviour: Development of a measure using confirmatory factor analytic procedures. *Personality and Individual Differences, 23,* 745–752.

Murcia, J. A. M., Gimeno, A. C., & Camacho, A. M. (2007). Measuring self determination motivation in a physical fitness setting: Validation of the Behavioral Regulation in

Exercise Questionnaire – 2 (BREQ-2) in a Spanish sample. *Journal of Sports Medicine and Physical Fitness, 47*, 366-374.

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., Tuson, K. M., Briere, N. M., & Blais, M. R. (1995). Toward a measure of intrinsic motivation, extrinsic motivation and amotivation in sports: The Sport Motivation Scale (SMS). *Journal of Sport and Exercise Psychology, 17,* 35–53.

Pleis, J. R., & Lethbridge-Hejku, M. (2006). Summary health statistics for U.S. adults: National health interview survey, 2005. National Center for Health Statistics. *Vital & Health Statistics, 10,* 232.

Rose, E. A., Markland, D. A., & Parfitt, G. (2001). The development and initial validation of the Exercise Causality Orientations Scale. *Journal of Sports Sciences, 19,* 445–462.

Rose, E. A., Parfitt, G., & Williams, S. (2005). Exercise causality orientations, behavioural regulations for exercise and stages of change for exercise: Exploring their relationships. *Psychology of Sport and Exercise, 6,* 399–414.

Ryan, R. M., & Deci, E. L. (2002). An overview of Self-determination Theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3-33). Rochester, NY: The University of Rochester Press.

Ryan, R. M., & Deci, E. L. (2007). Active human nature: Self-determination theory and the promotion and maintenance of sport, exercise, and health. In M. S. Hagger & N. L. D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 1-19). Champaign, IL: Human Kinetics.

Ryan, R. M., Williams, G. C., Patrick, H., & Deci, E. L. (2009). Self-determination theory and physical activity: The dynamics of motivation in development and wellness. *Hellenic Journal of Psychology, 6*, 107-124.

Vallerand, R. J. (2007). Intrinsic and extrinsic motivation in sport and physical activity: A review and a look at the future. In G. Tenebaum & R. C. Eklund (Eds.), *Handbook of sport psychology* (3rd. ed., pp. 59-83). Hoboken, NJ: Wiley.

Vallerand, R. J., & O'Connor, B. P. (1989). Motivation in the elderly: A theoretical framework and some promising findings. *Canadian Psychology, 30*, 539–550.

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Briere, N. M., Senecal, C., & Vallieres, E. F. (1992). The Academic Motivation Scale: A measure of intrinsic, extrinsic, and amotivation in education. *Educational and Psychological Measurement, 52*, 1003-1019.

Vlachopoulos, S . P. (2010). Measurement invariance in comparative psychological research. In A. Brouzos (Series Ed.) & P. Metallidou, P. Roussi, A. Brouzos, & A. Efklides (Vol. Eds.), *Scientific annals of the Psychological Society of Northern Greece: Vol. 8. New methodological approaches in psychological research – applications* (pp. 37-67). Athens: Pedio.

Wilson, P. M., Mack, D. E., & Grattan, K. P. (2008). Understanding motivation for exercise: A self-determination theory perspective. *Canadian Psychology, 49,* 250-256.

APPENDIX

Το Ερωτηματολόγιο Ρύθμισης της Συμπεριφοράς στην Άσκηση - 2
[Behavioral Regulation in Exercise Questionnaire -2 (BREQ-2)]
(Moustaka, Vlachopoulos, Kaperoni, Vazou, & Markland, 2010).

Οδηγίες. Τα παρακάτω είναι λόγοι για τους όποιους συνήθως τα άτομα ασκούνται. Θα θέλαμε να ξέρουμε κατά πόσο οι παρακάτω λόγοι αληθεύουν για σας. Χρησιμοποιώντας την κλίμακα που ακολουθεί κάθε λόγο, σας παρακαλούμε υποδείξτε πόσο κάθε λόγος αληθεύει για σας με το να βάλετε σε κύκλο τον κατάλληλο αριθμό.

Γιατί ασκείστε;	**Σίγουρα όχι**	**Όχι**	**Δεν είμαι σίγουρος/η**	**Ναι**	**Σίγουρα ναι**
1. Ασκούμαι γιατί οι άλλοι λένε πως πρέπει.	0	1	2	3	4
2. Αισθάνομαι ενοχές όταν δεν ασκούμαι.	0	1	2	3	4
3. Εκτιμώ τα οφέλη της άσκησης.	0	1	2	3	4
4. Ασκούμαι γιατί είναι διασκεδαστικό	0	1	2	3	4
5. Δεν βλέπω γιατί πρέπει να ασκούμαι.	0	1	2	3	4
6. Ασκούμαι γιατί οι φίλοι/η οικογένεια/ο-η σύντροφος λένε πως πρέπει.	0	1	2	3	4
7. Αισθάνομαι άσχημα όταν χάνω ένα πρόγραμμα άσκησης.	0	1	2	3	4
8. Είναι σημαντικό για μένα να ασκούμαι συστηματικά.	0	1	2	3	4
9. Δεν βλέπω τον λόγο γιατί θα πρέπει να μπαίνω στον κόπο να ασκούμαι.	0	1	2	3	4
10. Ευχαριστιέμαι τα προγράμματα άσκησης στα οποία συμμετέχω.	0	1	2	3	4
11. Ασκούμαι γιατί οι άλλοι δεν θα ήταν	0	1	2	3	4
ευχαριστημένοι μαζί μου εάν δεν το έκανα	0	1	2	3	4
12. Δεν βρίσκω νόημα στο να ασκούμαι					
13. Αισθάνομαι σαν αποτυχία όταν δεν έχω ασκηθεί για κάποιο διάστημα	0	1	2	3	4
14. Είναι σημαντικό για μένα να κάνω την προσπάθεια να ασκούμαι τακτικά	0	1	2	3	4
15. Θεωρώ ότι η άσκηση είναι μία ευχάριστη δραστηριότητα	0	1	2	3	4
16. Αισθάνομαι πίεση από τους φίλους/την οικογένειά μου να ασκούμαι	0	1	2	3	4
17. Αντλώ ευχαρίστηση και ικανοποίηση από την άσκηση.	0	1	2	3	4
18. Νομίζω πως η άσκηση είναι χάσιμο χρόνου.	0	1	2	3	4

Κλειδί απαντήσεων: Απουσία κινήτρων (amotivation): 5, 9, 12, 18. Εξωτερική ρύθμιση (external regulation): 1, 6, 11, 16. Ενδοπροβαλλόμενη ρύθμιση (introjected regulation): 2, 7, 13. Ταυτιζόμενη ρύθμιση (identified regulation): 3, 8, 14. Εσωτερικά κίνητρα (intrinsic motivation): 4, 10, 15, 17. Το θέμα 'ταυτιζόμενη ρύθμιση' #4 ("I get restless if I don't exercise regularly") έχει αφαιρεθεί από το ερωτηματολόγιο.