Current Psychology
https://doi.org/10.1007/s12144-019-00374-y

Initial validation of the Portuguese version of the Interpersonal Behavior Questionnaire (IBQ & IBQ-Self) in the context of exercise: Measurement invariance and latent mean differences

F. Rodrigues [1,2] · L. Pelletier [3] · H. P. Neiva [1,2] · D. S. Teixeira [4] · L. Cid [2,5] · D. Monteiro [2,5]

Abstract
The aim of the present research is to examine the factor structure of the Interpersonal Behavior Questionnaire (IBQ), and the Interpersonal Behavior Questionnaire Self (IBQ-Self), two scales developed for the purpose of measuring supportive and thwarting interpersonal behaviors. Structural equation modeling was used to examine the psychometric proprieties, the nomological validity with the basic needs' satisfaction and frustration as well as the measurement invariance between gender, and differences across latent means. For the IBQ, 837 Portuguese gym members aged between 18 to 63 years old ($M = 34.58$; $SD = 11.35$) participated in this study. They had been practicing physical exercise for about 43.00 ± 37.00 months. For IBQ-Self, 612 trainers, with a professional experience that ranged from 12 to 492 months (M = 88.54; SD = 77.89), participated in this study. The analysis revealed that both scales had good fit, achieving convergent and discriminant validity. In addition, they show acceptable internal consistency and invariance between gender. Nomological validity displayed projected results, according to theoretical and empirical literature. Regarding analysis of the psychometric proprieties, IBQ and IBQ-Self can be applied to Portuguese exercisers and exercise physiologist to measure perceived behaviors from others and self-reported behaviors, respectively.

Keywords Exercise psychology · Interpersonal behavior · Fitness · Self-determination theory · Multigroup analysis · Measurement invariance · Latent mean differences

Introduction

According to Self-Determination Theory (SDT; Ryan and Deci 2017), motivation orientations in contexts like exercise differ in their quality. When reasons for practicing exercise are more internalized, gym clients experience autonomous motivation and this is shown to results in positive outcomes such as greater interest, increased exercise satisfaction and higher intentions to continue in the future (Rodrigues et al. 2018). When the reasons are less internalized, exercisers experience controlled motivation, which has been shown to lead to negative outcomes like less enjoyment, and drop out (Hagger and Chatzisarantis 2007; Pelletier et al. 2013). However, according to the SDT framework, the social environment has an impact on how one experiences the satisfaction or frustration of basic needs, leading to differentiated behavior regulations when exercising. As shown by Edmunds et al. (2008), exercisers who perceive fitness professionals as supportive tend to experience positive results such as greater exercise participation and commitment. On the other hand, perception of thwarting behaviors has led to negative experiences and higher rates of individuals withdrawing from exercise (Ng et al. 2013). One possible issue regarding previous studies is related with the nature of the instruments used to evaluate interpersonal behaviors, since no contextual validation was made to ensure a feasible and reliable measure of the aforementioned constructs.

Another matter to be considered is the assessment of self-perceived behaviors. Most studies (e.g., Edmunds et al. 2008)

✉ F. Rodrigues
ptfiliperodrigues@gmail.com

[1] Sports Science Department, University of Beira Interior, Rua Marquês de Ávila e Bolama, 6201-001 Covilhã, Portugal

[2] Research Center in Sport, Health and Human Development (CIDESD), Vila Real, Portugal

[3] University of Ottawa, Ottawa, Canada

[4] University of Lusófona, Lisbon, Portugal

[5] Sport Science School of Rio Maior (ESDRM-IPSantarém), Rio Maior, Portugal

Published online: 15 July 2019

have focused solely on how others (e.g., students, athletes, exercisers) perceive persons in key position (e.g., teachers, coach, fitness professionals). Thus, measuring self-perceived behaviors seems crucial since it has been associated with the satisfaction of basic psychological needs (Rocchi and Pelletier 2018), a fundamental "nutrient" for experiencing positive outcomes such as well-being and intrinsic motivation. Therefore, it seems crucial the validation of a scale, assessing not only exercisers perceived behaviors from fitness professionals, but likewise how fitness professionals perceive themselves as supportive and thwarting.

Self-Determination Theory and Basic Psychological Needs

In order to foster the process of internalization, exercisers require the support and satisfaction of three basic needs (autonomy, competence, and relatedness). SDT represents a theoretical framework that explains how the three basic psychological needs (BPN) not only promote differentiated behavioral regulations (for review see Rodrigues et al. 2018) but also are affected by the context (ex. competitive environment) and the people (ex., coaches, trainers or parents) in the exercise context. Over the last 20 years, research guided by SDT has shown that the BPN (autonomy, competence, and relatedness) are important determinants of motivation, well-being, and performance across a wide variety of contextual domains, including physical activity, exercise, and sport (Hagger and Chatzisarantis 2007). More specifically, the need to experience a sense of choice, volition, and psychological freedom (autonomy), the need to feel effective and agency when interaction with one's environment (competence), and the need to relate and feel connected to others (relatedness) play a crucial role in the emergence of autonomous motivation or self-determined goal-directed behaviors. In opposition, the frustration of these three needs is associated with several negative outcomes such as ill-being, controlled motivation, lower levels of performance and persistence, and psychological distress (Ryan and Deci 2017). Specifically, the interpersonal behaviors that are characterized as need supportive versus need thwarting, are critical for the study of motivation in exercise and sport.

Interpersonal Behaviors

SDT proposes that, there are six types of interpersonal behaviors that influence BPN satisfaction or frustration. These interpersonal behaviors are defined as following: (a) Autonomy Support (AS) refers to encouragement of personal choices and volitional decision making (Edmunds et al. 2008); (b) Autonomy Thwarting (AT) behaviors refers to the use of coercion, intimidations and making demands without providing rational or justification (Rocchi et al. 2017) (c) Competence Satisfaction (CS) is related to the provision of positive feedback regarding a specific task and believing in the athlete's capacity to overcome barriers (Puente and Anshel 2010) (d) Competence Frustration (CF) refers to the expression of behavior that emphasizes guilt and doubt (Rocchi et al. 2016); (e) Relatedness Satisfaction (RS) refers to the demonstration of emotional support and the provision of care about one's feelings (Sheldon and Filak 2008); (f) Relatedness Thwarting (RT) behaviors are related to rejections of athletes and low emotional connections with them (Rocchi and Pelletier 2018).

Past research has relied on a variety of distinct tools to assess need supportive and need thwarting behaviors. The majority of previous studies (e.g., Baard et al. 2004; Deci et al. 2006; Gagné 2003; Gillet et al. 2010) have focused mainly on the assessment of autonomy support, thus ignoring the potentially important role of relatedness and competence. Additional studies (e.g., Haerens et al. 2013; Legault et al. 2006) have relied on an assessment of interpersonal behaviors related to all three needs, although remaining focused on either need supportive behaviors or on need thwarting behaviors, rather than the assessment of both types of interpersonal behaviors. Yet a third group of studies (e.g., Haerens et al. 2015; Mabbe et al. 2018; Reeve et al. 2018) have relied on an assessment of need supportive and need thwarting behaviors using a variety of distinct measures that, when taken together, may overlap among themselves and that may lead to a lack of conceptual differences between the different scales, and measurement inconsistencies.

More specifically in the context of physical activity, recent studies have focused on specific types of interpersonal behaviors that could affect BPN satisfaction or frustration. Again, no study has considered all six dimensions of interpersonal behaviors at once in the exercise context. For instance, the majority of scales have only focused on autonomy support (e.g., Edmunds et al. 2008; Klain et al. 2015) and/or competence support (e.g., Puente and Anshel 2010) in the exercise context. In addition, to the best of our knowledge, no studies up to now have ever analyzed thwarting behaviors in this domain. Therefore, the employment of an instrument that could measure all six dimensions of interpersonal behaviors as proposed by SDT and that is adapted specifically to the domain of physical activity and exercise represent an important endeavor (Rodrigues et al. 2018).

In response to these limitations, Rocchi and colleagues (Rocchi et al. 2017; Rocchi et al. 2016) have recently developed the Interpersonal Behavior Questionnaire (IBQ), an integrative questionnaire that measures simultaneously autonomy, relatedness, and competence need supportive and need thwarting behaviors. This questionnaire was created with three specific purposes in mind. The first purpose was to develop a scale that could assess all six dimensions proposed by SDT. The second purpose was to develop a scale that could be

used in different life domains so that researchers could compare participants' perceptions in one life domain to the perceptions of participants in another life domain. The third purpose was to develop a scale that could be used to assess how one perceives the interpersonal behaviors of a specific target (ex., teacher, coach, supervisor), and how the target reports their own interpersonal behaviors (IBQ-Self). The IBQ was developed through a comprehensive series of distinct studies (Rocchi et al. 2016; Rocchi et al. 2017) which supported the a priori six-factor structure of the IBQ when used to assess participants' reports of the need supporting and thwarting behaviors of: (a) people in their lives in general; (b) themselves (IBQ-Self) when interacting with peoples in their lives in general; (c) their coaches in the context of sport practices; and (d) their own coaching behaviors (IBQ-Self). These studies also supported the measurement invariance of IBQ ratings across gender, as well as their criterion-related validity in relation to participants' ratings of need satisfaction and frustration (autonomy, relatedness, and competence), well-being (positive and negative affect, vitality, and life satisfaction), and motivation (autonomous and controlled).

In sum, in agreement with several authors (e.g., Rocchi et al. 2017; Ryan and Deci 2017), the analysis of all six interpersonal behaviors and the way they are related to satisfaction and frustration of BPNs proves to be essential. It is also important to measure invariance between groups with different characteristics (e.g., gender), in order to examine empirically the universality and the generalizability of the different dimensions of interpersonal behavior constructs related to the satisfaction and the frustration of BPN as defined by SDT.

Current Research

The purpose of the present study was to translate the IBQ and IBQ-Self (Rocchi et al. 2017) in Portuguese and to validate both scales in the context of exercise. These scales consist of 24-items, grouped into six factors, three of them representing need supportive behaviors and three representing need thwarting behaviors.

According to Rocchi et al. (2017), the IBQ and IBQ-Self were developed to make the measurement applicable to different social contexts. However, in order to confirm its universality and applicability to multiple social contexts and different cultures, it is imperative to analyze the scales in different contexts. We also intend to analyze the latent mean difference in order to examine factor means between groups. First, the IBQ and IBQ-Self will be translated for the purpose of examining their perceptions of their exercise physiologists' interpersonal behaviors and their own, respectively. Afterwards, we will examine the factorial structure of the scale and its invariance across gender before we examine the nomological validity of the adapted scale by relating the scale to BPN satisfaction and BPN frustration. It is hypothesized that: a) the translated versions of both scales will be a reliable to measure interpersonal behaviors with Portuguese exercisers; b) measurement model will be invariant between gender; c) there will be no differences in latent means between male and female exercisers, and; d) interpersonal behaviors are predictors of BPN satisfaction and frustration, as proposed both in SDT framework (Ryan and Deci 2017) and recent empirical studies (e.g., Rocchi et al. 2018).

Methods

Participants

A total of 837 Portuguese gym exercisers (342 male, 495 female), aged between 18 and 63 years ($M = 34.58$; $SD = 11.35$) completed the Portuguese versions of the IBQ. Their mean exercise experience was approximately 43.00 ± 37.00 months. They were training on average 3.68 ± 1.30 sessions per week and on average, 64.75 ± 17.52 min per session.

A total of 612 Portuguese exercise trainers (282 male; 330 female) completed the Portuguese version of the IBQ-Self; 16.15% were personal trainers, 53.8% gym instructors, and 30.1% group class trainers. Their age varied between 19 and 54 years (M = 31.37; SD = 6.91) and they had between 12 and 492 months (M = 88.54; SD = 77.89) of professional experience. All participant were licensed professionals for exercise prescription: 47,4% had a bachelor's degree, 31.6% a master's degree, 2.4% a doctoral degree, and 18.5% postgraduate studies.

Procedure: Data Collection

Approval from the Ethical Committee before proceeding with the research was obtained. Once approved, researchers got in touch with gym managers to obtain permission to contact their members and exercise physiologists. After obtaining consent, participants were contacted at the reception desk of the different training facilities during different times of the day. They were asked to participate voluntarily in this study. Data were collected before the participants' exercise session. Participants received no monetary reward for their contribution.

Procedure: Translation of the IBQ AND IBQ-SELF

The translation of the IBQ and the IBQ-Self from English to Portuguese was done through the committee approach methodology (see Brislin 1980) as suggested by Banville et al. (2000). The process includes five steps: 1) Preliminary translation: this first step was carried out by the researchers with the help of three translators with higher education in English-Portuguese languages, which resulted in the first version of the questionnaire; 2) First Evaluation Panel: an analysis of the

initial version of the IBQ was done individually by four specialists from different areas, such as English-Portuguese Languages, Psychology, Sports Psychology, and Sports Sciences. Few items were then slightly modified following the modifications proposed by the evaluation panel; 3) Second Evaluation Panel: a revised version of the questionnaire was again submitted for evaluation, this time to a board composed by four other specialists in Psychology, Sports Psychology, and Sports Sciences. This time the board examined all the items together until an agreement between all specialists regarding the new version (third version) could be reached; 4) Pilot Study: a group of 40 exercisers completed the revised version of the IBQ to determine if the items were clear and comprehensible; 5) Final revision: finally, two Portuguese teachers revised the final version of the IBQ for the purpose of identifying the syntax of the items, spelling, and grammar errors. Here are some examples of how the items were adapted to the context of exercise: i) item for autonomy support in its original "*My coach… gives me the freedom to make my own choices*" was adapted to "*My exercise physiologist… gives me options on which exercises to perform*"; ii) item for competence support in its original "*My coach… encourages me to improve my skills*" was adapted to "*My exercise physiologist… provides me with positive feedback when I do the exercise correctly*", and; iii) item for relatedness thwarting in its original "*My coach… does not comfort me when I am feeling low*" was adapted to "*My exercise physiologist… does not care about my feelings when exercising*".

Instruments: Portuguese Exercisers

Interpersonal Behaviors Participants completed the Interpersonal Behavior Questionnaire (IBQ; Rocchi et al. 2016), translated into Portuguese and adapted to the exercise context, measuring the perceptions of their instructor's interpersonal behavior. As described above, this 24-item multidimensional instrument consists of six subscales (4 items per subscale) that measures the use of Autonomy Support (AS; item 1: "*My exercise instructor supports my choices*"), Competence Support, (CT; item 9: "*My exercise instructor encourages me to improve my skills*"), Relatedness Support (RS; item 5: "*My exercise instructor really likes to spend time with me*"), Autonomy Thwarting (AT; item 8: "*My exercise instructor imposes his opinions*"), Competence Thwarting (CT; item 22: "*My exercise instructor questions my ability to overcome challenges*"), and Relatedness Thwarting (RT; item 24: "*My exercise instructor does not build empathy with me*") behaviors. The exercisers indicated their agreement with each statement using a 7-point scale ranging from 1 ("do not agree at all") to 7 ("completely agree"). Previous studies (Rocchi and Pelletier 2018; Rocchi et al. 2017; 2016) support the use of present scale on measuring perceived interpersonal behaviors from others.

Need Satisfaction and Frustration Participants completed the Basic Psychological Need Satisfaction and Frustration Scale in Exercise (BPNSFS; Chen et al. 2015) Portuguese version in exercise context (translated and validated by the authors and currently submitted for publication) to assess their experience of basic needs satisfaction and frustration during the exercise session. The 24-item scale consists of six subscales (4 items each) measuring participants of autonomy (item 1: "*When I exercise I feel a sense of choice and freedom in the exercises I undertake*"), competence (item 5: "*When I exercise I feel confident that I can do exercises well*"), and relatedness (item 9: "*When I exercise I feel connected with others in the gym*") satisfaction, as well as autonomy (item 8: "*When I exercise I feel forced to do training sessions I would not choose to do*"), competence (item 12: "*When I exercise I feel disappointed with my performance*"), and relatedness (item 6: "*When I exercise I feel that the relationships I have at the gym are just superficial*") frustration. Participants responded to each item using a 5-point scale anchored from 1 ("totally disagree") to 5 ("totally agree"). Several studies have shown cultural invariance as well as adjusted internal consistency, convergent and discriminant validity (Chen et al. 2015; Teixeira et al. 2018). In present study, this scale showed acceptable fit to the data (see Table 1) as well as acceptable internal consistency (>.75).

Instruments: Portuguese Exercise Physiologists

Interpersonal Behaviors Participants completed the Interpersonal Behavior Questionnaire Self; Rocchi et al. 2016), translated to Portuguese and adapted to the exercise context measuring their own perceived behaviors when engaging with exercisers. This 24-item multidimensional instrument consists of six subscales (4 items per subscale) that measures the use of AS (item 1: "*When I am with my clients I support their decisions*"), CT (item 9: "*When I am with my clients I provide valuable feedback*"), RS (item 5: "*When I am with my clients I take the time to get to know them*"), AT (item 8: "*When I am with my clients I limit their choices*"), CT (item 22: *"When I am with my clients I question their capacity to improve"*), and RT (item 24: "*When I am with my clients I do not connect with them*") behaviors. Exercise physiologists indicated their agreement with each item using a 7-point scale ranging from 1 ("do not agree at all") to 7 ("completely agree"). Previous studies (Rocchi and Pelletier 2018; Rocchi et al. 2017; 2016) support the use of present scale on measuring self-perceived interpersonal behaviors.

Basic Psychological Need Satisfaction and Frustration Exercise physiologists completed the Basic Psychological Need Satisfaction and Frustration Scale for exercise physiologists (BPNSFS; Rodrigues et al. 2019). This 24-item scale consists of six subscales (4 items each) and was validated specifically for fitness professionals regarding their BPN

Table 1 Measurement fit indexes of the Interpersonal Behavior Questionnaire and Self (including other existing versions), and other scales used in present study

	$\chi 2$	df	$\chi 2$/df	B-S p	CFI	TLI	SRMR	RMSEA	RMSEA 90% CI	AGFI	PCFI
Interpersonal Behavior Questionnaire											
Original version[a]	367.030	237	1.55		.94	.93	.04	.04	.04–.05	–	–
Version in sports[b]	296.230	237	1.25		.95	.95	.05	.05	.04–.06	–	–
Present study	828.906	237	3.95	<.001	.92	.94	.04	.05	.05–.06	.91	.81
Male Sample – Present Study	554.876	237	2.34	<.001	.90	.91	.05	.06	.06–.07	.90	.80
Female Sample – Present Study	589.640	237	2.49	<.001	.93	.94	.04	.05	.05–.06	.92	.84
Interpersonal Behavior Questionnaire - Self											
Original version[a]	342.830	237	1.46		.96	.95	.04	.03	.03–.04	–	–
Version in sports[b]	303.040	237	1.28		.93	.92	.04	.06	.03–.05	–	–
Present study	547.432	237	2.31	<.001	.95	.94	.04	.05	.04–.05	.91	.78
Male Sample – Present Study	451.404	237	1.91	<.001	.93	.92	.05	.06	.05–.07	.90	.80
Female Sample – Present Study	422.858	237	1.78	<.001	.95	.94	.04	.05	.04–.05	.93	.83
Basic psychological need satisfaction and frustration scale											
Exercisers	431.238	237	1.82	<.001	.91	.92	.05	.05	.05–.06	.90	.83
Exercise Physiologists	401.214	237	1.69	<.001	.92	.93	.04	.04	.04–.06	.91	.81

$\chi 2$ = chi-square; *df* = degrees of freedom; $\chi 2/df$ = normative chi-square; B-S p = Bollen-Stine Significance level; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Squared Error of Approximation; 90% CI = Confidence Interval of RSMEA; AGFI = Adjusted Goodness-of-Fit Index; PCFI = Parsimony Comparative Fit Index

[a] Rocchi et al. (2017)

[b] Rocchi et al. (2016)

when prescribing exercise, measuring autonomy (item 7: *"When I prescribe exercise I feel a sense of choice and autonomy"),* competence (item 12: *"When I program exercise trainings I feel confident that I can do them right"*), and relatedness (item 9: *"When I train clients I feel connected with them"*) satisfaction, as well as autonomy (item 2: *"When I train my clients I feel forced to do exercise sessions I would not choose to do"*), competence (item 19: *"When I train clients I feel disappointed with my performance"*), and relatedness (item 6: *"When I prescribe exercise sessions I feel that the relationships I have with gym clients are just superficial"*) frustration. Participants responded to each item using a 5-point scale anchored from 1 ("totally disagree") to 5 ("totally agree"). In present study, this scale showed acceptable fit to the data (see Table 1) as well as acceptable internal consistency (>.73). Previous studies (e.g., Rodrigues et al. 2019), supported the validity and reliability of this scale assessing fitness professionals' BPN satisfaction and frustration.

Statistical Analysis

A two-step Maximum Likelihood approach suggested by Kline (2016) was performed with AMOS 23.0 (Ardbuckle 2014). First, a Confirmatory Factorial Analysis (CFA) was performed to test the psychometric properties of each measurement model. Then, Structural Equation Modeling (SEM) was conducted in order to test the nomological validity across interpersonal behaviors and all six basic psychological needs. For both analyses the recommendations from several authors (Byrne 2010; Hair et al. 2014; Kline 2016; Marsh et al. 2004) were used and the following goodness-of-fit indexes were adopted: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standard Mean Root Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) and its Confidence Interval (90% CI), Adjusted Goodness-of-Fit Index (AGFI), and Parsimonious Comparative Fit Index (PCFI). The following cut-off values were assumed: CFI, TLI, and AGFI ≥0.90, SRMR ≤0.80 and RMSEA ≤0.80 (Byrne 2010; Hair et al. 2014; Kline 2016; Marsh et al. 2004). Additionally, PCFI was performed to compare non-nested models and scores greater than or equal to >0.50 are considered acceptable (Byrne 2016). Raykov's formula (Raykov 1997) was used to analyze internal consistency of each subscale, alpha ≥.70 were considered indicative of good composite reliability. Average Variance Extracted (AVE) was estimated to evaluate convergent validity and values >.50 were considered acceptable. Discriminant validity was achieved when AVE of each construct had values above squared correlations between all factors of the model (Hair et al. 2014). For the SEM analysis, GPower 3.1 (Faul et al. 2009) was used to determine the required sample size. For this analysis, the following parameters were considered: effect size $f^2 = 0.1$; $\alpha = .05$; statistical power = 0.95; and 6 predictors. Results revealed

that the required sample was 215, which was respected for both samples in the present study.

Nomological Validity

Nomological validity between interpersonal behaviors and basic psychological needs satisfaction and frustration was analyzed. The 95% CI values were considered significant when the interval did not include zero (Williams and Mackinnon 2008).

Multigroup Analysis and Latent Mean Differences Analysis

The multigroup analysis was performed to determine if the measurement model was invariant between groups with diverse characteristics (Sass 2011; Byrne 2010; Cheung and Rensvold 2002; Chen 2007). First, we examined whether the measurement model presented a good fit to the data for each group. Second, configural, metric, scalar and residual invariance were performed. The following criteria were used: configural invariance ΔCFI less than .01 (Cheung and Rensvold 2002); metric invariance ΔSRMR less than .030 and ΔRMSEA less than .015 (Chen 2007); scalar invariance ΔSRMR less than .010, and; measurement invariance ΔRMSEA less than .015 (Chen 2007).

Structure analyses of means and covariances were used to test for latent mean differences between samples and gender for each factor. The latent mean values for the male samples were always constrained to zero, while it was freely estimated for the female samples. To determine if there was a statistical significance between the latent means of both sample groups and genders, the z statistic was used. Latent mean differences were only compared after obtaining a strong invariance multi-group model (Kline 2016).

Results

Preliminary Analysis

Missing values (<0.1%) were imputed using the regression procedures in AMOS 23. Descriptive analysis revealed no violations of univariate distribution since Skewness and Kurtosis where contained between - 2 to +2 and − 7 to +7, respectively, and no univariate and multivariate outliers were found. Next, we followed Nevitt and Hancock's (2001) recommendations using Bolle-Stine Bootstrap (2000 samples) since Mardia's coefficient exceeded expected value (>5) for multivariate kurtosis in all samples under analysis. The IBQ and IBQ-Self measurement model (Table 1) demonstrated acceptable fit to the data in all samples and values in the present study are very close to both the original version (Rocchi et al. 2017) as well as the sports version (Rocchi et al. 2016). In addition, all items presented factor loadings equal or greater than cut-off values (0.50) as seen Table 2, explaining at least 25% of variance of the latent factor in mutually scales.

Regarding composite reliability, all subscales demonstrated scores above recommended (CR > .70) for both scales, suggesting that items measure the same construct. IBQ and IBQ-Self revealed no problems of convergent validity presenting scores above 0.70. In addition, discriminant validity was achieved, since squared correlations values were below AVE (see Table 3).

Table 2 Standardized Factor Loadings of the IBQ and IBQ-Self

Constructs	Interpersonal Behavior Questionnaire		Interpersonal Behavior Questionnaire - Self	
	FL	λ^2	FL	λ^2
Autonomy Support				
Item 1	.51	.26	.56	.32
Item 7	.76	.58	.74	.55
Item 13	.73	.53	.79	.62
Item 19	.78	.61	.73	.53
Autonomy Thwarting				
Item 2	.71	.50	.66	.44
Item 8	.74	.54	.76	.57
Item 14	.66	.43	.67	.45
Item 20	.72	.51	.74	.55
Competence Support				
Item 3	.68	.46	.68	.47
Item 9	.84	.71	.83	.69
Item 15	.77	.59	.76	.58
Item 21	.71	.50	.71	.50
Competence Thwarting				
Item 4	.70	.49	.66	.43
Item 10	.80	.63	.79	.62
Item 16	.74	.55	.78	.60
Item 22	.62	.38	.64	.41
Relatedness Support				
Item 5	.76	.52	.73	.53
Item 11	.80	.64	.76	.58
Item 17	.80	.65	.74	.54
Item 23	.68	.46	.69	.47
Relatedness Thwarting				
Item 6	.70	.49	.70	49
Item 12	.69	.48	.72	.51
Item 18	.77	.59	.78	.62
Item 24	.80	.49	.69	.47

FL = Factor Loading; λ^2 = Squared Factor Loadings

Table 3 Descriptive Statistics, composite reliability, convergent and discriminant validity, and correlation matrix

						Correlation Matrix					
	M	SD	CR	AVE		1	2	3	4	5	6
Interpersonal Behavior Questionnaire											
1. Autonomy Support	5.25	.80	.70	.70	r	1					
					r^2						
2. Autonomy Thwarting	3.08	1.23	.78	.71	r	−.58**	1				
					r^2	.34					
3. Competence Support	5.86	.88	.82	.75	r	.67**	−.36**	1			
					r^2	.46	.10				
4. Competence Thwarting	1.92	.92	.79	.72	r	−.43**	.71**	−.38**	1		
					r^2	.19	.50	.15			
5. Relatedness Support	5.15	.95	.80	.76	r	.64**	−.58**	.60**	−.57**	1	
					r^2	.41	.34	.37	.33		
6. Relatedness Thwarting	2.15	1.01	.81	.74	r	−.29**	.66**	−.24**	.67**	−.69**	1
					r^2	.24	.44	.06	.46	.48	
Interpersonal Behavior Questionnaire Self											
1. Autonomy Support	5.25	.93	.77	.71	r	1					
					r^2						
2. Autonomy Thwarting	3.11	1.21	.74	.71	r	−.68**	1				
					r^2	.48					
3. Competence Support	5.90	.86	.85	.75	r	.64**	−.28**	1			
					r^2	.42	.08				
4. Competence Thwarting	1.77	.81	.70	.72	r	−.47**	.69**	−.39**	1		
					r^2	.23	.48	.16			
5. Relatedness Support	5.20	.93	.73	.73	r	.71**	−.58**	.60**	−.59**	1	
					r^2	.50	.34	.36	.34		
6. Relatedness Thwarting	2.14	1.01	.77	.72	r	−.58**	.71**	−.27**	.65**	−.72**	1
					r^2	.34	.50	.07	.42	.52	

M = Mean; SD = Standard Deviations; CR = Composite Reliability; AVE = Average Variance Extracted; r = correlation; r^2 = squared correlation
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Nomological Validity

For the SEM analysis, Variance Inflation Factor (VIF) was conducted to determine the collinearity diagnosis between interpersonal behaviors and basic psychological needs satisfaction and frustration. Results revealed that all values were less than 10 as recommended by Hair et al. (2014), showing conditions for regression analysis. In sum, the results indicated that the conditions were met for the regression models.

Results revealed that the structural model fit the data well, for both the IBQ: [$\chi^2 = 3212.946$ (1014); $\chi^2/df = 3.16$; B-$p < .001$, TLI = .905, CFI = .915, SRMR = .048, RMSEA = .051 (90%CI = .049, .054)] and the IBQ-SELF: [$\chi 2 = 2190.530$ (1014); $\chi 2/df = 2.16$; B-p < .001, TLI = .908, CFI = .918, SRMR = .052, RMSEA = .046 (90%CI = .044, .049)].

These results support the nomological validity of the IBQ and the IBQ-Self.

The direct effects of all six types of interpersonal behaviors on basic needs are shown in Tables 4 and 5 (IBQ and IBQ-self, respectively). Results show that supportive interpersonal behaviors positively predicted basic psychological needs satisfaction and negatively predicted basic psychological needs frustration. However, in IBQ, the effects between autonomy support → competence frustration, autonomy thwarting → relatedness satisfaction and relatedness satisfaction → competence frustration were not significant. In contrast, thwarting interpersonal behaviors positively predicted basic psychological needs frustration and negatively predicted basic psychological needs satisfaction.

Measurement Invariance Latent Mean Differences

Multi-group analysis revealed that both scales were invariant between gender since invariance assumptions adopted in methodology were respected. Specifically results revealed the following: i) the IBQ and IBQ-SELF model fit the data (see Table 1), and; ii) both models displayed configural, metric, scalar, and residual invariance between gender. Furthermore, ΔRMSEA and ΔSRMR showed invariance according to recommendations for measurement invariance, as seen in Table 6. Data revealed no differences between the gender, which means that all interpersonal behaviors are

Table 4 Nomological validity between interpersonal behaviors and basic needs in exercisers

Path	β	CI-95%
Autonomy Support →Autonomy Satisfaction	.27	[.218, .330]
Autonomy Support →Autonomy Frustration	−.17	[−.224, −.105]
Autonomy Support →Competence Satisfaction	.24	[.161, .250]
Autonomy Support →Competence Frustration	−.04	[−.100, .168]
Autonomy Support →Relatedness Satisfaction	.11	[.116, .237]
Autonomy Support →Relatedness Frustration	−.10	[−.120, .102]
Autonomy Thwarting →Autonomy Satisfaction	−.15	[−.197, −.098]
Autonomy Thwarting →Autonomy Frustration	.24	[.214, .311]
Autonomy Thwarting →Competence Satisfaction	−.25	[−.168, −.265]
Autonomy Thwarting →Competence Frustration	.18	[.064, .112]
Autonomy Thwarting →Relatedness Satisfaction	−.03	[−.049, .131]
Autonomy Thwarting →Relatedness Frustration	.10	[.188, .267]
Competence Support →Autonomy Satisfaction	.13	[.078, .184]
Competence Support →Autonomy Frustration	−.09	[−.285, −.038]
Competence Support →Competence Satisfaction	.19	[.130, .208]
Competence Support →Competence Frustration	−.14	[−.191, −.081]
Competence Support →Relatedness Satisfaction	.04	[.039, .125]
Competence Support →Relatedness Frustration	.01	[−.079, .030]
Competence Thwarting →Autonomy Satisfaction	−.14	[−.189,-.044]
Competence Thwarting →Autonomy Frustration	.20	[.144, .235]
Competence Thwarting →Competence Satisfaction	−.16	[−.196, −.096]
Competence Thwarting →Competence Frustration	−.12	[−.123, −.086]
Competence Thwarting →Relatedness Satisfaction	.09	[.029, .242]
Competence Thwarting →Relatedness Frustration	−.05	[−.108, −.002]
Relatedness Support →Autonomy Satisfaction	.13	[.073, .195]
Relatedness Support →Autonomy Frustration	−.06	[−.108,-.007]
Relatedness Support →Competence Satisfaction	.10	[.150, .276]
Relatedness Support →Competence Frustration	.01	[−.072, .032]
Relatedness Support →Relatedness Satisfaction	.18	[.124, .220]
Relatedness Support →Relatedness Frustration	−.10	[−.283, −.154]
Relatedness Thwarting →Autonomy Satisfaction	−.16	[−.224, −.105]
Relatedness Thwarting →Autonomy Frustration	.04	[.045, .184]
Relatedness Thwarting →Competence Satisfaction	−.14	[−.134, −.033]
Relatedness Thwarting →Competence Frustration	.13	[.077, .196]
Relatedness Thwarting →Relatedness Satisfaction	−.15	[−.131, −.045]
Relatedness Thwarting →Relatedness Frustration	.22	[.168, .265]

β = effect; CI-95% = Confidence Interval

perceived equally both in male and female gym exercisers, as well as both male and female fitness instructors (see Table 7).

Discussion

The aim of the present study was to translate the IBQ and the IBQ-Self in Portuguese and then examine the factorial structure and the nomological validity of both versions of the scale. In addition, we examined measurement invariance and latent mean differences in order to examine factor means between groups.

Our results suggest that the original measurement model for the six-factor solution assessing all interpersonal behaviors according to the SDT framework did fit well the Portuguese versions of both the IBQ and the IBQ-Self in both samples of exercisers and exercise physiologists, respectively. Regarding the internal consistency, the results of the present research showed that all factors coefficients for both scales had good levels of internal consistency (Hair et al. 2014), and that these coefficients were similar to the ones found in original studies (Rocchi et al. 2016; Rocchi et al. 2017). All factors displayed adjusted convergent validity (AVE > .50). Also, all factor

Table 5 Nomological validity between interpersonal behaviors and basic needs in fitness professionals

Path	β	CI-95%
Autonomy Support → Autonomy Satisfaction	.46	[.608, .830]
Autonomy Support → Autonomy Frustration	−.22	[−.615, −.296]
Autonomy Support → Competence Satisfaction	.40	[.477, .691]
Autonomy Support → Competence Frustration	−.19	[−.362, −.147]
Autonomy Support → Relatedness Satisfaction	.34	[.416, .653]
Autonomy Support → Relatedness Frustration	−.25	[−.561, −.297]
Autonomy Thwarting → Autonomy Satisfaction	−.26	[−.431, −.236]
Autonomy Thwarting → Autonomy Frustration	.39	[.531, .774]
Autonomy Thwarting → Competence Satisfaction	−.31	[−.497, −.272]
Autonomy Thwarting → Competence Frustration	.44	[.403, .562]
Autonomy Thwarting → Relatedness Satisfaction	−.26	[−.425, −.228]
Autonomy Thwarting → Relatedness Frustration	.36	[.391, .597]
Competence Support → Autonomy Satisfaction	.34	[.341, .536]
Competence Support → Autonomy Frustration	−.22	[−.497, −.232]
Competence Support → Competence Satisfaction	.39	[.377, .556]
Competence Support → Competence Frustration	−.24	[−.360, −.185]
Competence Support → Relatedness Satisfaction	.37	[.379, .573]
Competence Support → Relatedness Frustration	−.27	[−.488, −.270]
Competence Thwarting → Autonomy Satisfaction	−.25	[−.500, −.265]
Competence Thwarting → Autonomy Frustration	.32	[.482, .783]
Competence Thwarting → Competence Satisfaction	−.39	[−.649, −.440]
Competence Thwarting → Competence Frustration	.62	[.742, .907]
Competence Thwarting → Relatedness Satisfaction	−.32	[−.599, −.367]
Competence Thwarting → Relatedness Frustration	.53	[.757, .982]
Relatedness Support → Autonomy Satisfaction	.36	[.479, .734]
Relatedness Support → Autonomy Frustration	−.21	[−.636, −.287]
Relatedness Support → Competence Satisfaction	.20	[.600, .826]
Relatedness Support → Competence Frustration	−.31	[−.569, −.343]
Relatedness Support → Relatedness Satisfaction	.33	[.432, .691]
Relatedness Support → Relatedness Frustration	−.28	[−.661, −.376]
Relatedness Thwarting → Autonomy Satisfaction	−.18	[−.320, −.124]
Relatedness Thwarting → Autonomy Frustration	.27	[.315, .566]
Relatedness Thwarting → Competence Satisfaction	−.27	[−.403, −.224]
Relatedness Thwarting → Competence Frustration	.41	[.370, .528]
Relatedness Thwarting → Relatedness Satisfaction	−.24	[−.399, −.205]
Relatedness Thwarting → Relatedness Frustration	.34	[.335, .559]

β = effect; CI-95% = Confidence Interval

loadings in the 24-item version were significant, they were loading on their respective factor and no cross-loadings were detected, suggesting acceptable convergent validity (e.g., Byrne 2010; Hair et al. 2014). In addition, discriminant validity was achieved since squared correlations among subscales showed scores below AVE. The results of the CFA revealed

Table 6 Measurement invariance analysis between gender

	χ2	df	Δ χ2	Δdf	*p*	CFI	ΔCFI	RMSEA	ΔRMSEA	SRMR	ΔSRMR
Interpersonal Behavior Questionnaire (male-female)											
Configural Invariance	1183.782	474	–	–	–	.923	–	.042	–	.042	–
Metric Invariance	1202.800	492	19.018	18	.391	.923	.000	.042	.000	.041	.001
Structural Invariance	1234.754	513	50.972	39	.095	.922	.001	.041	.001	.040	.002
Residual Invariance	1315.207	537	131.425	63	<.001	.915	.008	.042	.000	.039	.003
Interpersonal Behavior Questionnaire Self (male-female)											
Configural Invariance	853.618	474	–	–	–	.940	–	.040	–	.049	–
Metric Invariance	881.084	492	27.465	18	<.001	.939	.001	.040	.000	.049	.000
Structural Invariance	1003.698	513	150.080	39	<.001	.936	.004	.036	.004	.048	.001
Residual Invariance	1090.865	537	237.247	63	<.001	.931	.009	.035	.005	.047	.002

χ2 = chi-square; df = degrees of freedom; *p* = level of significance; CFI = Comparative Fit Index; ΔCFI = differences in CFI; RMSEA = Root Mean Squared Error of Approximation; ΔRMSEA = differences in RMSEA; SRMR = Standardized Root Mean Square Residual; ΔSRMR = differences in SRMR

Table 7 Latent mean differences on interpersonal behavior constructs between gender

	diference	*z*	*p*
Interpersonal Behavior Questionnaire			
Autonomy Support	−.03	−.82	.42
Autonomy Thwarting	.02	.37	.71
Competence Support	−.01	−.16	.87
Competence Thwarting	−.02	−.41	.68
Relatedness Support	.01	.09	.93
Relatedness Thwarting	.01	.17	.86
Interpersonal Behavior Questionnaire Self			
Autonomy Support	−.01	−.35	.72
Autonomy Thwarting	−.04	−.69	.49
Competence Support	.10	1.96	.07
Competence Thwarting	−.02	−.44	.66
Relatedness Support	−.09	−.195	.06
Relatedness Thwarting	.13	2.18	.06

that the three supporting behaviors were negatively correlated with the three thwarting behaviors. Similarly, covariances among supporting factors as well as covariances among thwarting factors were positive and significant, suggesting that each supporting and each thwarting factors were significantly distinct from each other (Hair et al. 2014). Overall, these results are in agreement with the theoretical framework proposed by SDT, and recent empirical studies on supportive and thwarting interpersonal behaviors (Rocchi et al. 2017).

Nomological Validity

The CFA model exhibited good fit indices for both the IBQ and the IBQ-Self (e.g., Byrne 2010; Hair et al. 2014). In addition, SEM showed good fit to the data and provided support for the nomological validity between interpersonal behaviors constructs and BPN satisfaction and frustration. Significant predictions were found between construct under analysis in both scales. Supporting behaviors displayed positive correlations with BPN satisfaction and negative correlations with BPN frustration. Thwarting behaviors showed positive and significant correlations with BPN frustration and significant negative correlations to satisfaction of BPN. These results are very similar to the ones reported by Rocchi et al. (2017) that showed that the satisfaction and the frustration of BPNs are specifically related to their corresponding perceived interpersonal behaviors.

Measurement Invariance and Latent Mean Differences

The 24-item model was invariant between male and female exercisers, in IBQ and IBQ-Self. All invariance assumptions were met according to several authors (e.g., Byrne 2010; Chen 2007) for measurement invariance between sample groups and gender.

Our study found no significant differences in terms of latent means between samples in the IBQ and IBQ-Self. This means that both genders perceived similar levels of interpersonal behaviors, and that these levels were independent of being exercisers or exercise physiologists. In other words, these results suggest that males and females appear to experience the practice of exercise in a similar manner. In sum, these results support the effectiveness of the IBQ and the IBQ-Self for the assessment of supportive and thwarting interpersonal behaviors with exercisers and exercise physiologists.

Conclusion

Limitations

Despite our research being based on a strong theoretical framework, the present studies have some limitations. First, the present research was the first attempt to translate the IBQ and the IBQ-Self scales into a different language (Portuguese) and to validate the scales in the exercise context. Therefore, our findings cannot be generalized to other countries or to other contexts, as more studies are necessary to establish the validity of the scales in different contexts and with different cultures. However, the original 24-item model exhibited acceptable fit, showing similar results reported by Rocchi et al. (2016, 2017). This means that Portuguese participants have interpreted similarly the meaning of supportive and thwarting interpersonal behaviors when compared to Canadian participants (native English language).

Second, although we found solid relationships between supporting interpersonal behaviors and BPN's satisfaction and thwarting behaviors with BPN's frustration, there are other determinants of interpersonal behaviors that should still be investigated further. For instance, a recent study done with the IBQ and the IBQ-Self has shown that autonomous motivation reported by coaches may lead to more supporting behaviors (e.g., Rocchi and Pelletier 2018). However, this needs to be tested in exercise context.

In addition, in that recent study, Rocchi and Pelletier (2018) examined the relationship between coaches' self-reports of their interpersonal behaviours, and athletes' perceptions of these same behaviours. Specifically, the authors examined whether coaches and athletes were in agreement or disagreement and explored whether having an agreement or disagreement between coaches and athletes had any impact on athletes' need satisfaction and dissatisfaction. Also, this study examined whether there are any coach characteristics that can explain whether coaches are in agreement or not with their athletes. Rocchi and Pelletier (2018) found support for a match in nearly 1/3 of the cases, supporting that for those pairs of coaches and

athletes, the athlete perceives what the coach reports they do. In the cases where there was a match, or where the athlete rated the coach more favourably than the coach rated themselves, this was associated with increased need satisfaction on the need-supportive factors, and decreased need dissatisfaction for the need-thwarting factors. In the instances where coaches rated themselves more positively than their athletes reported them (i.e., more need-supportive and less need-thwarting than perceived by the athletes), this had no impact on athletes' need satisfaction and dissatisfaction. Again, in exploring the factors that lead coaches to inflate their positive behaviour, the authors observed that only coaches' autonomous motivation for coaching predicted that they were less likely to positively inflate their behaviours. We think that these results could have important implications for a context like physical activity and that exercise professionals' self-perception and exercisers perception of their behaviors needs to be examined further to determine the level of agreement between the groups. When compared to exercisers, exercise professionals may overestimate (or underestimate) their supporting behaviors, and this may affect the extent to which this affects the exercisers' motivation (Rocchi and Pelletier 2018).

Practical Implications

In sum, overall our results provide support for the construct validity of the original 24-Item IBQ and IBQ-Self, adding new evidence for the construct distinctiveness of supporting and thwarting interpersonal behaviors. The present work reinforces the importance of assessing exercisers' perceived interpersonal behaviors, since they are predictors of BPN satisfaction and frustration, ultimately forecasting behavioral regulations towards exercising.

The fitness industry should use current scales in gym and health clubs to measure exercisers perception of fitness professionals use of supportive and thwarting behaviors as a way to understand how gym clients feel when exercising. In addition, measuring exercise physiologists self-perceived behaviors is relevant, since self and other-perception of interpersonal behaviors do not always align, as shown in previous literature (Rocchi and Pelletier 2018). Analyzing fitness professionals' behaviors in advance could give club managers the necessary tools to create adequate training programs so exercise physiologist would use more supportive behaviors and hinder thwarting conducts.

Funding This work was supported by the National Funding through the Portuguese Foundation for Science and Technology, I.P., under the project UID/DTP/04045/2019.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (Beira Interior University Ethics Committee, reference number CE-UBI-pJ-2018-044:ID683) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

Ardbuckle, J. (2014). *AMOS (Version 23.0) User's Guide*. Chicago: IBM SPSS.

Baard, P., Deci, E., & Ryan, R. (2004). Intrinsic need satisfaction: A motivational basis of performance and well-being in two work settings. *Journal of Applied Social Psychology, 34*(10), 2045–2068. https://doi.org/10.1111/j.1559-1816.2004.tb02690.x.

Banville, D., Desrosiers, P., & Genet-Volet, Y. (2000). Translating questionnaires and inventories using a cross-cultural translation technique. *Journal of Teaching in Physical Education, 19*(3), 374–387. https://doi.org/10.1123/jtpe.19.3.274.

Brislin, R. (1980). *Translation and content analysis of oral and written material*. IN: *Handbook of cross-cultural psychology: Triandis, H.C. and Brislin R.W., Editors.* Boston: Allyn and Bacon. ISBN: 0205065015.

Byrne, B. (2010). *Structural equation modeling with AMOS. Basic concepts, applications, and programming* (2nd ed.). New York: Taylor & Francis Group, LLC ISBN: 978-0805863734.

Byrne, B. (2016). *Structural equation modeling with AMOS. Basic concepts, applications, and programming* (3rd ed.). New York: Taylor & Francis Group, LLC ISBN: 978-1138797024.

Chen, F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling, 14*(3), 464–504. https://doi.org/10.1080/10705510701318334.

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E., et al. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation & Emotion, 39*(2), 216–236. https://doi.org/10.1007/s11031-014-9450-1.

Cheung, G., & Rensvold, R. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233–255. https://doi.org/10.1207/S15328007SEM0902_5.

Deci, E., La Guardia, J., Moller, A., Scheiner, M., & Ryan, R. (2006). On the Benefits of Giving as Well as Receiving Autonomy Support: Mutuality in Close Friendships. *Personality & Social Psychology Bulletin, 32*(3), 313–327. https://doi.org/10.1177/01467205282148.

Edmunds, J., Ntoumanis, N., & Duda, J. (2008). Testing a self-determination theory-bases teaching style intervention in the exercise domain. *European Journal of Social Psychology, 38*(2), 375–288. https://doi.org/10.1002/ejsp.463.

Gagné, M. (2003). The role of autonomy support and autonomy orientation in prosocial behavior engagement. *Motivation & Emotion, 27*(3), 199–223.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149.

Gillet, N., Vallerand, R., Amoura, S., & Baldes, B. (2010). Influence of coaches' autonomy support on athlete's motivation and sport performance: A test of the hierarchical model and intrinsic and extrinsic motivation. *Psychology of Sport and Exercise, 11*(2), 155.161–155.161. https://doi.org/10.1016/j.psychsport.2009.10.004.

Haerens, L., Aalterman, N., Van den Berghe, L., De Meyer, J., Soenens, B., & Vansteenkiste, M. (2013). Observing physical education teachers' need-supportive interactions in classroom settings. *Journal of Sports and Exercise Psychology, 35*(1), 3–17.

Haerens, L., Aalterman, N., Vansteenkiste, M., Soenens, B., & Van Petegem, S. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and the dark side of motivation. *Psychology of Sport and Exercise, 16*(3), 26–36. https://doi.org/10.1016/j.spychsport.2015.08.013.

Hagger, M. S., & Chatzisarantis, N. L. D. (Eds.). (2007). *Intrinsic motivation and self-determination in exercise and sport*. Champaign: Human Kinetics.

Hair, J., Black, W., Babin, B. & Anderson, R. (2014). Multivariate Data Analysis *(7th ed.)*. New Jersey: Pearson Educational, Inc. ISBN: 978-0138132637.

Klain, I., de Matos, D., Leitão, J., Cid, L., & Moutão, J. (2015). Self-determination and physical exercise adherence in the contexts of fitness academies and personal training. *Journal of Human Kinetics, 46*, 241–249. https://doi.org/10.1515/hukin-2015-0052.

Kline, R. (2016). Principles and practice of structural equation modelling *(3rd ed.)*. New York, The Guildford Press. ISBN: 9781462523344.

Legault, L., Green-Demers, I., & Pelletier, L. (2006). Why do high school students lack motivation in the classroom? Toward an understanding of academic amotivation and the role of social support. *Journal of Educational Psychology, 98*(3), 567–582. https://doi.org/10.1037/0022-0663.98.3.567.

Mabbe, E., Soenens, B., Vansteenkiste, M., Kapp-Deeder, J., & Mouratidis, A. (2018). Day-to-day variation in autonomy-supportive and psychologically controlling parenting: The role of parents' daily experiences of need satisfaction and need frustration. *Parenting-Science and Practice, 18*(2), 86–109. https://doi.org/10.1080/15295192.2018.1444131.

Marsh, H., Hau, K., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling, 11*(3), 320–341. https://doi.org/10.1207/s15328007sem1103_2.

Nevitt, J., & Hancock, G. (2001). Performance of bootstrapping approaches to model test statistics and parameter standard error estimation in Structural Equation Modeling. *Structural Equation Modeling: A Multidisciplinary Journal, 8*(3), 353–377. https://doi.org/10.1207/s15328007sem0803_2

Ng, J., Ntoumanis, N., Thogersen-Ntoumani, C., Stott, K., & Hindle, L. (2013). Predicting psychological needs and well-being of individuals engaging in weight management: The role of important others. *Applied Psychology, 5*(3), 291–310. https://doi.org/10.1111/aphw.1201.

Pelletier, L., Rocchi, M., Vallerand, R., Deci, E., & Ryan, R. (2013). Validation of the revised sport motivation scale (SMS-II). *Psychology of Sport and Exercise, 14*, 329–341. https://doi.org/10.1016/j.psychsport.2012.12.002.

Puente, R., & Anshel, M. (2010). Exercisers' perceptions of their fitness instructor's interacting style, perceived competence, and autonomy as a function on self-determined regulation to exercise, enjoyment, affect, and exercise frequency. *Scandinavian Journal of Psychology, 51*(1), 38–45. https://doi.org/10.1111/j.1467-9450-2009.00723.

Raykov, T. (1997). Estimation of composite reliability for congeneric measures. *Applied Psychological Measurement, 21*(2), 173–184. https://doi.org/10.1177/01466216970212006.

Reeve, J., Jang, H. R., & Jang, H. (2018). Personality-based antecedents of teachers' autonomy-supportive and controlling motivation styles. *Learning and Individual Differences, 62*, 12–22. https://doi.org/10.1016/j.lindif.2018.01.001.

Rocchi, M., & Pelletier, L. (2018). How does coaches reported interpersonal behavior align with athletes' perceptions? Consequences for female athletes' psychological needs in sport. *Sport, Exercise and Performance Psychology*. https://doi.org/10.1037/spy0000116.

Rocchi, M., Pelletier, L., Cheung, S., Baxter, D., & Beaudry, S. (2016). Assessing need-supportive and need-thwarting interpersonal behaviours: The interpersonal Behaviours questionnaire (IBQ). *Personality and Individual Differences, 104*, 423–433. https://doi.org/10.1016/j.paid.2016.08.034.

Rocchi, M., Pelletier, L., & Desmarais, P. (2017). The validity of the interpersonal behaviors questionnaire (IBQ) in sport. *Measurement in Physical Education and Exercise Science, 21*(1), 15–25. https://doi.org/10.1080/1091367X.2016.1242388.

Rodrigues, F., Bento, T., Cid, L., Neiva, H. P., Teixeira, D., Moutão, J., Marinho, D. A., & Monteiro, D. (2018). Can interpersonal behavior influence the persistence and adherence to Phyiscal exercise practice in adults? A systematic review. *Frontiers in Psychology, 9*, 2141. https://doi.org/10.3389/fpsyg.2018.02141.

Rodrigues, F., Neiva, H., Marinho, D.A., Mendes, P.D., Teixeira, D.S., Cid, L., & Monteiro, D. (2019). Assessing need satisfaction and frustration in Portuguese exercise instructors: scale validity, reliability and invariance between gender. *Cuadernos de Psicologia del Deporte, 19*(1), 233–240.

Ryan, R., & Deci, E. (2017). Self-determination theory. In *Basic psychological needs in motivation, development, and wellness*. New York: Guildford Press ISBN: 9781462528769.

Sass, D. (2011). Testing measurement invariance and comparing latent factor means within a confirmatory factor analysis framework. *Journal of Psychoeducational Assessment, 29*(4), 347–363.

Sheldon, K., & Filak, V. (2008). Manipulating autonomy, competence, and relatedness support in a game-learing context: New evidence that all three needs matter. *British Journal of Social Psychology, 47*, 267–283.

Teixeira, D., Silva, M., & Palmeira, A. (2018). How does frustration make you feel? A motivational analysis in exercise context. *Motivation and Emotion, 42*, 1–10. https://doi.org/10.1007/s11031-018-9690-6.

Williams, J., & Mackinnon, D. (2008). Resampling and distribution of the product methods for testing indirect effects in complex models. *Structural Equation Modeling, 15*(1), 23–51. https://doi.org/10.1080/10705510701758166