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Perceived Environmental Supportiveness Scale: Portuguese Translation, Validation and Adaptation to the Physical Education Domain

Diogo S. Teixeira¹, Diogo Monteiro^{2,3}, Frederico Raposo^{1,4}, David Markland⁶,
Marlene N. Silva^{1,5}, António L. Palmeira^{1,5}, Eliana V. Carraça^{1,5}

¹Universidade Lusófona de Humanidades e Tecnologia, ULHT, Faculty of Physical Education and Sport, Lisboa, Portugal; ²Instituto Politecnico de Santarem, Sport Science School of Rio Maior, ESDRM, IPSantarem, Rio Maior, Portugal; ³Research Center in Sport, Health and Human Development, CIDESD; ⁴Universidade Europeia, Lisboa, Portugal; ⁵Universidade de Lisboa, Interdisciplinary Center for the Study of Human Performance, CIPER, Faculty of Human, Kinetics, Lisboa, Portugal; ⁶Bangor University, Bangor, United Kingdom

Abstract — Aim: Grounded on Self-Determination Theory, this study aimed to translate, adapt and validate the Perceived Environmental Supportiveness Scale (PESS) in a sample of Portuguese physical education students. **Methods:** The global sample was comprised of 964 students (518 females), divided in two groups: the calibration (n = 469) and the validation one (n = 483), all of them enrolled in two Physical Education (PE) classes/week. **Results:** The analysis provided support for a one factor and 12 items model, which are in line with the values adopted in the methodology ($\chi^2 = 196.123$, $df = 54$, $p = <.001$, SRMR = .035, NNFI = .943, CFI = .954, RMSEA = .074, 90% CI .063-.085). Results express that the models are invariant in all analysis (i.e., calibration vs. validation, male vs. female, and 3rd vs. secondary cycle; three and single factor models). **Conclusion:** The present study suggests that the PESS with one factor and 12 items has good psychometric properties and can be used to assess perceived need supportive motivational environments provided by PE teachers. Additionally, invariance analysis showed support for the use of the scale in both genders and in the 3rd and secondary cycles.

Keywords: psychological assessment, confirmatory factor analysis, self-determination theory, multi-group analysis, physical education.

Introduction

The understanding of human motivation has been proven useful in the improvement of several contexts of practice^{1,2}. Specifically, Self-Determination Theory (SDT)³ has been a recurrent theoretical approach in order to understand motivation in settings related to the current work: physical activity contexts (e.g., sports, physical education, exercise)^{4,5}. In Physical Education (PE), a better understanding of the possible interaction about teachers' intervention and motivation styles, and students' perceptions, may pose substantial benefits in a wide variety of positive influences (e.g., engagement, learning, self-esteem, enjoyment, intention to future practice), helping teachers' to better develop their work, and to possess a wide array of pedagogical tools to develop their practice⁶⁻⁸.

According to SDT, self-determined behavioral regulation can be obtained through a well-succeeded internalization process, where the person internalizes and integrates the behavior in his/her sense of self, obtaining better cognitive, emotional and behavioral outcomes, as reported empirically in several educational, health and exercise contexts^{9,10}. The

degree of internalization for a given behavior may vary reflecting different motivational regulations: total absence of motivation or intention to initiate/maintain a given activity or task (i.e., amotivation – no internalization whatsoever), extrinsically motivated behaviors (that may reflect external demands and impositions, rewards and/or to avoid some sort of punishment, i.e., external regulation; to address self-esteem related contingencies and internally imposed controls, i.e., introjected regulation; when there is a conscious understanding and acceptance of a behavior personally held as valued, i.e., identified regulation; when behaviors are fully incorporated in the person core values and beliefs, i.e., integrated regulation) and intrinsically regulated behaviors, that encompasses inherent enjoyment and interest (i.e., intrinsic motivation)^{9,11}.

The SDT postulates that Basic Psychological Needs (BPN's) satisfaction plays a key role in the successful internalization of the behavioral regulation⁹. BPN's include the need of autonomy (i.e., experiencing volition and perception of choice in ones' behavior), the need of competence (i.e., feeling of effectiveness producing desired outcomes) and the need of relatedness (i.e., being cared and

respected by significant others), and reflect ones' perception, at a given time and on a specific context, of the satisfaction of each need^{9,12}. Most importantly, social-contextual factors may facilitate or hinder these psychological needs, thus subsequently influencing the extent of the self-determined behavior. In other words, the relation between social-contextual factors and motivational regulations are mediated by the satisfaction of BPN's^{10,13}.

Three dimensions of contextual need support seem to theoretically emerge and are accountable for the facilitation of an adequate social environment: autonomy support, structure (competence support) and involvement (relatedness support)^{10,11}. Autonomy support reflects the provision of choice and meaningful rationale from the coach, fitness instructor or teacher¹⁴. For example, the physical education teacher may behave in an autonomy-supportive manner when trying to analyze the situation from the students' perception, encouraging them to take their own decisions, without imposing his/her choice on them^{15,16}. Structure concerns to the behavior-outcome contingencies, where a clear explanation about expectations and a clear emission of positive feedbacks by the person with authority, may facilitate the receivers' perception of competence^{15,17}. In a particular PE class, the teacher and the students should make the session goals definition in an autonomy-supportive manner, and the teacher should continuously provide positive feedback along activities^{10,11}. Finally, involvement reflects the quality of the relationship between the individual and the person in an authority position, and the willingness to dedicate, for example, time, energy and other psychological resources^{10,15}. In a PE class, this can be shown if the teacher recognizes the students' interest/disinterest, delivered in a supportive manner, where the authority figure provides unconditional positive regard^{10,13}.

The Perceived Environmental Supportiveness Scale (PESS)¹¹ has been created to assess perceptions of need support provided by professionals to exercise referral schemes and adapted to access need support in other contexts, like sport¹⁸ and exercise classes¹⁵. The instrument is composed of 15 items, with three dimensions (autonomy support, structure and involvement). Confirmatory factor analysis of the scale presented a good model adjustment with these three dimensions. However, due to the highly correlated values between factors, a problem of discriminant validity suggests the use of the scale with a unidimensional approach (i.e., need support factor), which also presented in the same confirmatory factor analysis a good model fit¹¹.

To our knowledge, this scale has not been tested and validated to access students' perceptions of teachers need support in PE classes. Considering the aforementioned importance of the PE teachers to be knowledgeable of how to better improve and adapt their teaching styles, and the lack of a proper and validated scale, adapted to this specific context and Portuguese language, the proposed aim of this study was to translate, adapt and validate the Perceived Environmental Supportiveness Scale (PESS) in a sample of Portuguese physical education students.

Method

Participants

For the proposed analysis in this study, we defined two samples of PE students randomly assigned from the global sample. This procedure increases the robustness of the measurement instrument in the subsequent analysis. The global sample was comprised of 964 students (446 males and 518 females). The first group, defined as the calibration sample, consisted of 469 students (219 males and 250 females; 415 of the 3rd cycle (Portuguese educational cycle; ages between 12 and 15 years in general) and 549 of the secondary cycle (last mandatory Portuguese educational cycle; ages between 15 and 18 years in general). The second group, i.e., the validation sample, was composed of 483 students (223 males and 260 females; 212 of the 3rd cycle and 271 of the secondary cycle). All students were enrolled in two PE classes/week, with a total of 135 min/week.

Measures

The Perceived Environmental Supportiveness Scale¹¹ (PESS) consists of 15 items with a five-point bi-polar scale, ranging between 0 ("Not true for me") to 4 ("Very true for me"). This questionnaire encompasses three dimensions in line with the SDT framework⁹ - autonomy support (five items, e.g., 'Provide a range of activities'), structure (five items, e.g., 'Make clear to me what I need to do to get results') and involvement (five items, e.g., 'Care about me'), and was originally built to assess the need support provided by exercise practitioners in exercise referral scheme clients¹¹. A composite variable named 'need support' was also calculated according to the authors' suggestions. This was obtained through the calculation of the mean score for the 15 items following authors' recommendations.

Procedures

Data collection

This study was part of a large cross-sectional study aiming to understand motivational aspects in PE classes. Several Lisbon public schools were selected and invited to participate in this study. Information about the study objectives and participation were sent to the schools' direction boards and legal guardians. After obtaining the required permissions and signed informed consents, date to the application of the instruments was scheduled. PE teachers were debriefed about study characteristics, application particularities and participation requirements. A calm and peaceful place was used to fulfill the questionnaires, in order to read, fill and ask any question about the completion of the instruments. No dropouts were reported. The University

Scientific Board approved the development of this study (n° 1/2014-2015).

Procedures of translation of the PESSp

To ensure an adequate translation and adaptation of the PESS from the original language (English) to Portuguese^{19,20}, the translation/back translation technique, as well as the committee approach methodology²¹ were employed. For this process, five steps were followed: 1) Preliminary Translation; 2) First Committee; 3) Second Committee (this stage was over only when all the specialists agreed with each other and their opinion was unanimous towards the item contents); 4) Pilot Study; 5) Final Review (only syntax aspects). Some contextual changes were made in some items across this methodology, regarding the needed adaptation to the PE context (e.g., the stem, “my instructor...” was changed to “my PE teacher...”).

Data analysis

For data analysis, descriptive statistics were used in both samples for all variables. To develop the confirmatory factor analysis, we used several authors' recommendations²²⁻²⁴ with regard to the use of the estimated method of maximum likelihood (ML), chi-squared (χ^2) testing of the respective degrees of freedom (df), and the level of significance (p). Additionally, the following adjustment goodness-of-fit indexes were used: Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI), Root Mean Square Error of Approximation (RMSEA) and the respective confidence interval (90% CI). Traditionally, NNFI and CFI values $\geq .90$ and RMSEA and SRMR $\leq .08$ have been used as cut-off criteria²³.

To check if the items were related with each of the defined factors, the convergent validity was calculated using the average variance extracted (AVE) and considering the $\geq .50$ as cut-off value²³. The composite reliability (CR) was determined in order to assess the internal consistency of the factors, and the $\geq .70$ defined as reference²³. Finally, to verify the distinction between factors, the discriminant validity was calculated through the square of the correlation between the factors, were variance extracted estimates should be greater than the squared correlation estimate. The analyses were undertaken using AMOS and SPSS 21.0.

Multi-group analysis

To assess if the measurement model structure is equivalent (i.e., invariant), a multi-group analysis is crucial in psychometric instrument validation^{25,26}. For the present study, samples (i.e.,

validation and calibration), gender and age (i.e., grade/cycle of teaching) were submitted to multi-group analysis. As suggested by some authors^{22,25}, invariance criteria needs to be checked for the existence of two criteria: 1) the measurement model is adjusted to each group, and 2) to perform a multi-group analysis, considering the following invariance types: configural invariance (model without constraints), metric invariance (equality of factorial weights), scalar invariance (factorial weights and covariance equals) and residual invariance (factorial weights, covariance and equal measure errors). According with Cheung and Resvold²⁵, differences in values between the models without constraints (free parameters) vs. models with constraints (fixed parameters) should be verified through the difference in the $\Delta\chi^2$ test or by the differences in $\Delta CFI \leq .01$.

Nomological validity

For the relation between constructs based in the same theoretical framework, a bivariate correlation was made between PESS and PLOCQp²⁷, an SDT based instrument, translated and adapted to Portuguese and in the PE context. This instrument is composed of 18 items with five subscales – amotivation, external regulation, introjected regulation, identified regulation and intrinsic motivation. This measurement model presented a good fit to the data ($\chi^2 = 491.473$, $df = 125$, $p = <.001$, SRMR = .062, NNFI = .908, CFI = .924, RMSEA = .067, 90% CI .061-.073), a good internal reliability (composite reliability between 0.67 - 0.82) and a gender and study cycle invariance (i.e., 3rd cycle and secondary cycle).

Results

Preliminary Analysis

Data analysis indicated that there were six multivariate outliers (i.e., four in the calibration sample; two in the validation sample) ($D2 = p1 < .01$; $p2 < .01$). Due to these results, participants were removed from the analysis, as suggested by several authors^{22,23}. When Mardia's coefficient was used to analyze multivariate kurtosis, results in both samples were higher than five (i.e., calibration sample = 40.00; validation sample = 43.41), surpassing expected values for the assumption of multivariate normality²². For this matter, Bollen-Stine bootstrap with 2000 samples was used for subsequent analysis as suggested by Nevitt and Hancock²⁸.

Descriptive analysis of participants' answers showed a normal univariate distribution of the data in both samples, with the tendency to answer near the center of the five-point bi-polar Likert scale (i.e., positions two and three).

Table 1. Descriptive analysis of the answers to the items in the calibration and validation samples of PESS

Item	Min- Max	Calibration		Validation		Calibration		Validation		Calibration		Validation	
		M±SD	M±SD	Skewness	Skewness	z value	z value	Kurtosis	Kurtosis	z value	z value		
Item 1 (Aut. Sup)	0-4	2.74±1.10	2.75±1.07	-.752	-.731	-6.65	-6.559	.082	.012	.364	.055		
Item 2 (Struct. Sup)	0-4	3.10±.91	3.11±0.92	-1.012	-1.045	-8.948	-9.373	.687	.715	3.037	3.209		
Item 3 (Inv. Sup)	0-4	2.74±1.09	2.74±1.07	-.762	-.834	-6.736	-7.486	.314	.496	1.387	2.225		
Item 4 (Aut. Sup)	0-4	2.74±1.12	2.68±1.11	-.855	-.823	-7.559	-7.38	.314	.411	1.386	1.843		
Item 5 (Struct. Sup)	0-4	3.12±0.91	3.04±1.04	-1.054	-.915	-9.317	-8.214	.823	.389	3.640	1.744		
Item 6 (Inv. Sup)	0-4	2.52±1.13	2.45±1.15	-.346	-.354	-3.059	-3.180	-.767	-.661	-3.393	-2.965		
Item 7 (Aut. Sup)	0-4	2.47±1.19	2.50±1.10	-1.144	-1.104	-10.114	-9.904	1.017	.622	4.498	2.791		
Item 8 (Struct. Sup)	0-4	2.83±0.93	2.76±1.02	-.876	-1.017	-7.741	-9.126	.483	.946	2.134	4.242		
Item 9 (Inv. Sup)	0-4	3.04±1.01	2.98±1.02	-.763	-.699	-6.746	-6.272	.027	-.088	.118	-.393		
Item 10 (Aut. Sup)	0-4	3.03±0.99	2.96±1.05	-.663	-.648	-5.861	-5.810	-.298	-.208	-1.316	-.932		
Item 11 (Struct. Sup)	0-4	2.87±0.97	2.86±1.00	-.976	-1.07	-8.632	-9.604	.611	.618	2.703	2.773		
Item 12 (Struct. Sup)	0-4	2.88±1.03	2.83±1.00	-.588	-.495	-5.199	-4.44	-.292	-.509	-1.289	-2.285		
Item 13 (Inv. Sup)	0-4	3.05±0.99	2.96±1.04	-.509	-.547	-4.499	-4.904	-.542	-.313	-2.398	-1.406		
Item 14 (Aut. Sup)	0-4	2.19±1.19	2.24±1.19	-.578	-.741	-5.110	-6.648	.017	.220	.076	.989		
Item 15 (Inv. Sup)	0-4	3.05±1.03	3.11±1.04	-1.129	-.909	-9.985	-8.157	.960	.281	4.244	1.260		

Note. M (Mean); SD (Standard Deviation); Aut. Sup (Autonomy Support); Struct. Sup (Structure Support); Inv. Suport (Involvement Support)

Table 2. Fit indices of the three factor and one factor measurement models of PESSp

Models (three factors)	χ^2	df	B-S p	SRMR	NNFI	CFI	RMSEA	90% CI
Global sample	689.412	87	<.001	.042	.913	.928	.085	.079 - .091
Calibration sample	419.972	87	<.001	.047	.906	.923	.090	.082 - .099
Validation sample	386.753	87	<.001	.043	.913	.928	.085	.076 - .093
Female sample	479.612	87	<.001	.044	.905	.921	.093	.085 - .102
Male sample	349.900	87	<.001	.467	.904	.920	.082	.073 - .092
3 rd cycle	266.723	87	<.001	.358	.942	.952	.071	.061 - .080
Secondary cycle	525.500	87	<.001	.510	.895	.906	.096	.088 - .104
Models (one factor)	χ^2	df	B-S p	SRMR	NNFI	CFI	RMSEA	90% CI
Global sample	785.511	90	<.001	.043	.902	.916	.090	.084 - .095
Calibration sample ¹	468.846	90	<.001	.047	.897	.912	.095	.086 - .103
Validation sample ¹	440.969	90	<.001	.045	.901	.915	.090	.082 - .098
Calibration sample ²	201.003	54	<.001	.036	.944	.954	.076	.065 - .088
Validation sample ²	196.123	54	<.001	.035	.943	.954	.074	.063 - .085
Female sample	255.358	54	<.001	.037	.934	.946	.080	.075 - .096
Male sample	172.638	54	<.001	.038	.940	.951	.070	.059 - .082
3 rd cycle	141.209	54	<.001	.031	.963	.969	.062	.050 - .075
Secondary Cycle	268.943	54	<.001	.041	.923	.937	.080	.075 - .086

Note. χ^2 = chi-squared; df = degrees of freedom; SRMR = Standardized Root Mean Square Residual; NNFI = Non-Normed Fit Index; CFI = Comparative Fit Index; RMSEA = Root Mean Squared Error of Approximation; 90% CI = confidence interval of RMSEA; ¹ (one factor; 15 items); ² (one factor; 12 items)

As seen in table 2, the initial models (i.e., global, calibration, validation, male, female, 3rd cycle and secondary cycle models; three factors and 15 items), presented a reasonable adjustment. However, after the analysis of the residual values between items, the modification indexes and factors covariance's, some fragilities were identified, particularly, due to the high covariance values between the factors (figures 1 and 2). For this matter, and in accordance with the original instrument authors and other recommendations²⁹, a unidimensional model was tested. All models presented, once again, a reasonable model fit. After modification indexes and residual analysis, three items were removed (item 8, structure support; item 14, autonomy support; and item 15; involvement support). All final models (i.e., one factor and 12 items) presented a good model fit and are in line with the values adopted in the methodology (table 2).

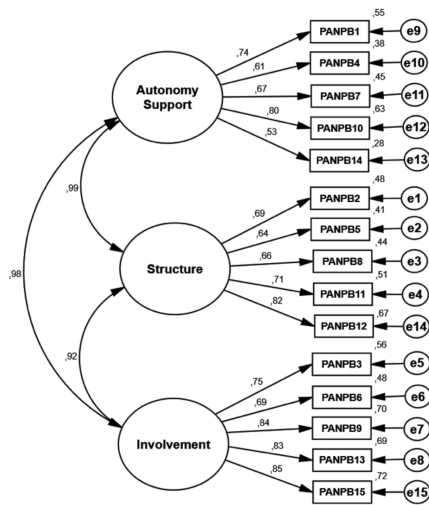


Figure 1. Standardized individual parameters (covariance factors, factorial weights and measurement errors), all of which were significant in the measurement model (PESSp - three factors/15 items) for the Portuguese calibration sample

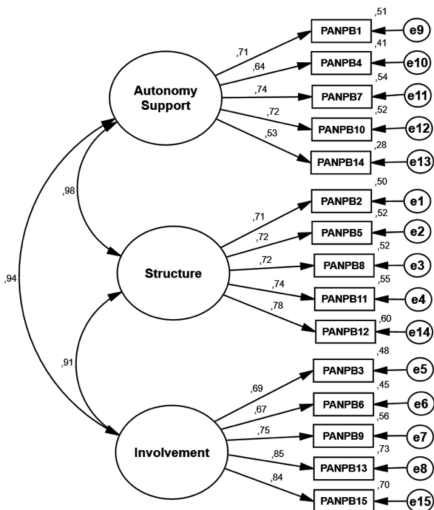


Figure 2. Standardized individual parameters (covariance factors, factorial weights and measurement errors), all of which were significant in the measurement model (PESSp - three factors/15 items) for the Portuguese validation sample

In figures 1 and 2 correlated variables appear to reflect SDT theoretical assumptions, where it is expected that the three BPN should be highly correlated¹¹. In this instrument, in particular, the three factors reflect students' perceptions of the need-support given by teachers in each dimension, which is assumed to follow BPN predicted relations¹⁸. Additionally, these results follow the tendency of the original instrument as reported by Markland and Tobin¹¹. Figure 3 presents the unidimensional model and the standardized individual parameters (factorial weights and measurement errors). All factorial weights presented statistical differences, indicating factorial validity, ranging between .29 and .67. All items explained more than 25% of the variance of the latent factor ($\lambda_{ij}^2 \geq .25$), as recommended by Hair, Black, Babin, Anderson²³. Figure 4 depicts the final model (i.e., 1 factor and 12 items) where factorial weight ranged between .41 and .65 and all items explained more than 25% of the variance of the latent factor.

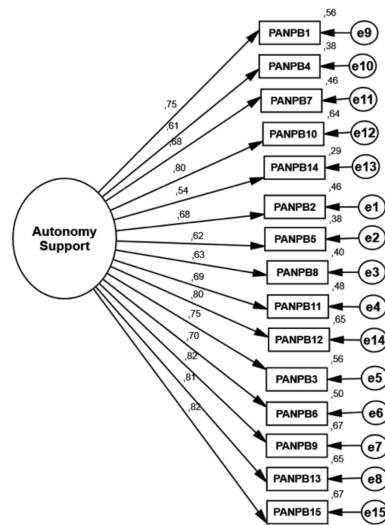


Figure 3. Standardized individual parameters (covariance factors, factorial weights and measurement errors), all of which were significant in the measurement model (PESSp - one factor/15 items) for the Portuguese calibration sample

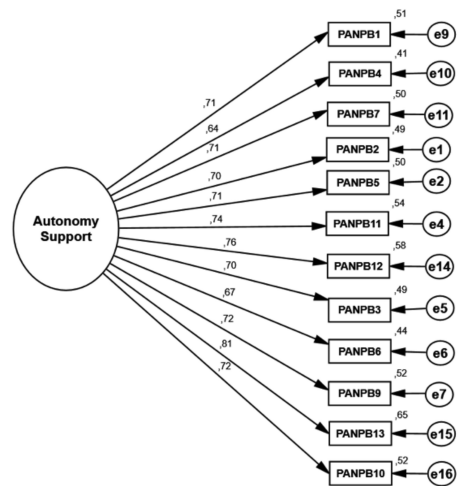


Figure 4. Standardized individual parameters (covariance factors, factorial weights and measurement errors), all of which were significant in the measurement model (PESSp - one factor/12 items) for the Portuguese validation sample

Table 3. Internal reliability, convergent and discriminant validity and average variance extracted – Calibration and Validation samples

Three factors (calibration)	CR	AVE	Aut. Support	Structure	Involvement
Aut. Support	0.81	0.46	1		
Structure	0.83	0.50	0.98	1	
Involvement	0.89	0.63	0.96	0.85	1
Three factors (validation)					
Aut. Support	0.80	0.45	1		
Structure	0.85	0.54	0.96	1	
Involvement	0.87	0.58	0.88	0.83	1
One factor (Calibration)	0.93	0.53	-	-	-
One factor (Validation)	0.93	0.51	-	-	-

Note. Composite Reliability (CR); Average Variance Extracted (AVE).

In table 3 it is possible to observe that composite reliability testing showed values $>.70$, presenting adjusted composite reliability (all models). Regarding convergent validity, the AVE calculated presented minor issues in the autonomy support dimensions, both in the calibration and validation samples (i.e.,

.46 and .45, respectively). However, in the unidimensional model, values of AVE are, in both samples, $>.50$. In the discriminant validity analysis, several problems appeared in the three-factor model and in both samples, where the square of the correlation of the factors was higher than the AVE²³.

Table 4a. Fit indices for the invariance of the measurement model of the PEES in the Portuguese sample across samples, gender and cycles in the three factor model

	χ^2	df	$\Delta\chi^2$	Δ df	p	CFI	Δ CFI
CS - VS							
Configural Invariance	772.979	174	-	-	-	.928	-
Measurement Invariance	791.062	186	18.083	12	.113	.927	.001
Scale Invariance	798.035	192	25.256	18	.118	.927	.001
Residual Invariance	824.508	207	51.529	33	.021	.926	.002
M - F							
Configural Invariance	829.501	174	-	-	-	.921	-
Measurement Invariance	839.428	186	9.927	12	.622	.921	.000
Scale Invariance	874.465	192	44.964	18	<.001	.917	.004
Residual Invariance	913.713	207	84.212	33	<.001	.915	.006
3 rd cycle – secondary cycle							
Configural Invariance	792.179	174	-	-	-	.927	-
Measurement Invariance	898.423	186	26.244	12	.010	.925	.002
Scale Invariance	851.591	192	59.411	18	<.001	.922	.005
Residual Invariance	915.087	207	122.908	33	<.001	.916	.009

Note. χ^2 = chi-squared; df = degrees of freedom; $\Delta\chi^2$ = differences in the value of chi-squared; Δ df = differences in the degrees of freedom; CFI = Comparative Fit Index; Δ CFI = differences in the value of the Comparative Fit Index; CS = calibration sample; VS = validation sample; F = female sample; M = male sample

Invariance testing is presented in table 4. As previously seen in table 2, all final models presented a good adjustment, a condition necessary to invariance testing. Results express that the models are invariant in all analysis (i.e., calibration vs. validation, male vs. female, and 3rd cycle vs. secondary cycle; three and single factor models). These results suggest that the same number of factors were present in each group and associated with the

same group of items (configural invariance), the factor of the PEES had the same understanding between groups (measurement invariance), the latent and observable means are comparable and valid among groups (scale invariance), and that comparison between observable items was supported (residual invariance). An exception exists in the residual invariance in the 3rd cycle vs. secondary cycle (Δ CFI = .012) (table 4b).

Table 4b. Fit indices for the invariance of the measurement model of the PESS in the Portuguese sample across sample, gender and cycles in the one factor model

	χ^2	df	$\Delta\chi^2$	Δ df	p	CFI	Δ CFI
CS - VS							
Configural Invariance	397.977	108	-	-	-	.953	-
Measurement Invariance	413.799	119	15.823	11	.148	.953	.000
Scale Invariance	414.181	120	16.205	12	.182	.953	.000
Residual Invariance	434.574	132	36.598	24	.048	.951	.002
M - F							
Configural Invariance	427.988	108	-	-	-	.948	-
Measurement Invariance	442.669	119	14.688	11	.198	.947	.001
Scale Invariance	460.070	120	32.082	12	.001	.945	.003
Residual Invariance	494.585	132	66.595	24	<.001	.941	.007
3 rd cycle – secondary cycle							
Configural Invariance	410.132	108	-	-	-	.952	-
Measurement Invariance	448.361	119	38.229	11	<.001	.948	.004
Scale Invariance	449.787	120	39.656	12	<.001	.948	.004
Residual Invariance	510.339	132	100.208	24	<.001	.940	.012

Note. χ^2 = chi-squared; df = degrees of freedom; $\Delta\chi^2$ = differences in the value of chi-squared; Δ df = differences in the degrees of freedom; CFI = Comparative Fit Index; Δ CFI = differences in the value of the Comparative Fit Index; CS = calibration sample; VS = validation sample; F = female sample; M = male sample

Table 5. Nomological validity between PESSp and PLOCQp

Variables	Intrinsic	Identified	Introjected	External	Amotivation
Autonomy support	.284**	.248**	.068*	-.092**	-.209**
Structure	.262**	.277**	.081*	-.048	-.209**
Involvement	.239**	.216**	.032	-.091**	-.185**
Need support ¹	.279**	.266**	.066*	-0.80*	-.215**

Note. * p<.05. ** p<.01; ¹ (one factor; twelve items)

The final analysis is presented in table 5, where the nomological validity was tested between the PESSp and another SDT based instrument (PLOCQp). As supported theoretically, the three BPN's were positively associated with more autonomous motivational regulations, and negatively associated with controlled ones. This was also present in the one factor model.

Discussion

The main purpose of this study was to translate, adapt and validate the Perceived Environmental Supportiveness Scale (PESS) in a sample of Portuguese physical education students. This work, seeking to improve the quality of psychological assessments, a never-ending process, as suggested by some authors (e.g., Nunnally & Bernstein³⁰), will also allow better research and practice in the PE domain, and is in line with what Deci and Ryan³¹ call the development of knowledge regarding the universality of SDT variables and, in this case, regarding BPN contextual perceptions.

Preliminary analysis of the PESSp psychometric properties showed that the three factors and 15 items model had a reasonable fit when confronted with the cut-off values defined in the methodology²²⁻²⁴. Some issues with the RMSEA appeared in almost all samples. The predefined methodology values for this test were <.08, which represents a good model fit; according to some authors, values between 0.08 and 0.10 represent a reasonable adjustment^{24,32}. Additionally, and according to Chen³³, the RMSEA value strongly depends of other model parameters, such as the degrees of freedom, sample size and magnitude of correlations, and should not be assumed as a predefined and universal rule for scoring. Thus, in the initial models, it was assumed that some of the covariance values between factors could be influencing this test score. As theoretically assumed, high covariance values (figure 1 and 2) anticipated discriminant validity issues, as posteriorly reported, where the square of all the factors correlation were higher than the AVE (table 3)²⁹.

Due to the previous model fit score and following Markland and Tobin¹¹ recommendation to assume the uni-dimensionality of the PESS (i.e., one total need support factor), the analysis

was conducted to test models fit with this condition (i.e., one factor and 15 items; figure 3). Preliminary analysis showed, once again, a reasonable fit for all models. Inspection of factorial weights and measurement errors presented some issues, and three items were removed (items 8, 14 and 15; one of each of the initial factors) due to high residual values, presenting, in the final analysis (i.e., one factor and 12 items), a good model fit in all samples, and a RMSEA $\leq .08$ (figure 4 and table 2). After semantic and syntax analysis, some similarities between items may justify these issues (e.g., item 13, 'Look after me well' vs. item 15, 'Care about me'), in which some phrasing proximity may have posted some difficulties for students to untangle.

Internal consistency analysis (i.e., composite reliability) presented a good adjustment. CR values in the final model, both in calibration and validation samples, were .93, and in line with previous calculations for the one-factor and 15 items model¹¹ (CR = .97).

Invariance testing procedures (i.e., across samples, gender and cycle of study), followed the procedures recommended by several authors^{19,22}. Invariance testing was conducted in all of the tested models (i.e., three-factors and 15 items, one-factor and 15 items, and one-factor and 12 items), mainly because of the readjustments made to ensure a more parsimoniously final model^{22,29}. In that way, and according with Sass²⁶ and Chen³³, all measurement models that are readjusted need an invariance analysis, in order to demonstrate, independently of the adjustments made, that the measurement models are equivalent in different groups of the same population. Consequently, the invariance measurement in the final models (i.e., one factor and 12 items) showed that all criteria were met (with exception of residual invariance in the 3rd cycle-secondary cycle model), supporting equality in the PESSp in all groups^{22,25}. These results indicate that: i) the unique factor is present in the same data set, regardless of group characteristics (i.e., gender and cycle of study), thus confirming configural invariance; ii) factorial weights are equivalent in both samples (calibration and validation), gender and study cycles, confirming that items have equal importance, supporting metric invariance; iii) the intercepts of items are equivalent in both samples, gender and study cycles, therefore presenting scalar invariance. This last criterion, when verified, ensures that the measurement model is able to properly facilitate comparisons between analyzed groups. Finally, the residual invariance testing was met in the samples and gender analysis, indicating that factorial weights, covariances and errors of measurement operate in the same way across samples. This was not the case of the study cycles samples ($\Delta CFI = .012$). However, Byrne²² and Cheung & Rensvold²⁵ postulate that this criterion could be considered optional in social sciences, mainly because 1) is very difficult to achieve and, 2) does not indicate the presence of an invariant model. To our knowledge, no invariance measurement testing was

made to the original PESS in order to confirm and compare our testing. Nevertheless, taken together, the results suggest that PESSp can be adequately used in both genders and study cycles in the PE context.

Finally, the nomological assessment was made using other SDT based instrument that evaluates a related construct (i.e., behavioral regulations), also adapted to PE contexts (i.e., PLOCQp). SDT posits that a motivational supportive social environment may facilitate BPN's satisfaction and, consequently, facilitate behavioral regulation and internalization^{9,31}. Positive and significant associations were present between perceived need support and autonomous motivational regulations, and negative and significant associations between perceived need support and controlled regulation. These results support the use of PESSp in PE context, and in line with SDT framework⁹.

The present study addresses a gap in the literature regarding the measurement of the perceived need motivational climate. Strong theoretical background and psychometric testing ensure a trustworthy instrument to assess these variables in PE context. Due to intra-class dynamics, inter-individual personality differences, school year transitions, and many other organizational factors, the PE teachers encounter several challenges in order to obtain an adjusted motivational environment that may promote students learning and engagement. Additionally, considering the extensive support of the BPN's satisfaction in motivational outcomes, the acquisition of psychological tools that may allow the improvement of teachers' intervention in these matters is crucial. This may be particularly important in order to prevent undesired student behaviors, poor motivational profiles and engagement issues, lack of in-task and in-class enjoyment, and the necessary teacher interaction adjustment universally supported and required in any pedagogical intervention².

Some reflections and possible limitations should be made to better understand the present results. First, to our knowledge, and besides the original scale, no other psychometric validation was made to this instrument. If the universality of this SDT construct has been shown in several contexts and languages², psychometric testing and validations could help in the identification of possible recurrent issues with the instrument, allowing semantic and contextual adjustments. Additionally, psychometric testing may allow cultural invariance measurements and latent mean analysis, further enhancing gender and study cycle characteristics understanding. Finally, given the social environmental fluctuations across the school year, a longitudinal invariance analysis could provide an increase in the robustness of the instrument.

In conclusion, the present study suggests that the PESSp with one-factor and 12 items have good psychometric properties and can be used to assess perceptions of the need supportive social environment provided by PE teachers.

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Corresponding author

Diogo S. Teixeira,
Universidade Lusófona de Humanidades e Tecnologias, Faculdade de
Educação Física e Desporto
1749-024, Lisboa, Portugal.
Email: diogo.sts.teixeira@gmail.com; diogo.teixeira@ulusofona.pt

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