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Psychometric Properties of the Coach-Created Empowering and Disempowering Motivational Climate Questionnaire (EDMCQ-C) in a Brazilian Sample of Athletes: An ESEM Approach

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Abstract: The objectives of this study were to assess the psychometric properties of the Coach-created Empowering and Disempowering Motivational Climate Questionnaire (EDMCQ-C) by testing four different hypotheses. A procedure of translation and adaptation of the instrument between different languages and cultures was carried out. A total of 350 national level Brazilian athletes (aged between 15 and 17 years; mean = 17.0, SD = 1.7) completed the questionnaire. Confirmatory Factor Analysis (CFA) and Exploratory Structural Equation Modelling (ESEM) were performed. Consistent with previous work on the EDMCQ-C, all solutions failed to achieve suitable levels of fit for a hierarchical model represented by five climate dimensions (autonomy-supportive, controlling, task-involving, ego-involving, and socially-supportive) and two global dimensions (empowering and disempowering). The 2-ESEM solution provided a satisfactory fit for the first-order model with two global factors supported. The 2-ESEM version of the questionnaire showed adequate predictive and discriminant validity, good internal consistency, and invariance across gender. Such results suggest that the EDMCQ-C is a promising scale to assess Brazilian athletes' perception of the over-arching empowering and disempowering features of the coach-created motivational climate.

Keywords: motivational climate; empowering coaching; disempowering coach behaviors; self-determination theory; achievement goal theory; basic psychological needs

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1. Introduction

Extensive research indicates that the behaviors of coaches contribute to variability in athletes' cognitions, affect and behavior [1]. Variations in the psychological environment (or motivational climate) created by the coach have an impact on the motivational processes of athletes, their well-being, the quality of their sports engagement, and whether athletes are more or less likely to drop out or maintain participation [2,3].

Among the theories that identify features of the coach-created motivational climate and describe the implications of the dimensions of the climate are Achievement Goal Theory (AGT) [4,5] and Self-Determination Theory (SDT) [6]. AGT holds that the meaning people assign to their involvement in activities, such as practicing sports, influences their motivational patterns in and responses to the activity [4]. This theory emphasizes that the main objective when engaged in sport is to feel capable or competent and, thus, to feel successful. The term achievement goal refers to the motivational core of the action

and reflects differences in how success is interpreted or construed in a given context [7]. AGT assumes that there are two major achievement goals, namely a task goal in which perceptions of competence are self-referenced. One tends to feel successful when centered on a task goal if acting masterfully, learning, developing his/her skills, and/or improving task performance [1]. When emphasizing an ego goal, perceptions of competence are normatively based and the concern is to demonstrate that one is better than others (or not worse). In regard to important features of the motivational climate, AGT considers the degree to which the psychological environment created by the coach is more or less task-involving (promotive of a focus on task goals via the coach's emphasis on trying hard, cooperation, and responding to mistakes with constructive feedback) and ego-involving (facilitating an ego goal emphasis via the coach promoting inter-team member rivalry, responding to mistakes in a punitive manner, and emphasizing differential ability levels amongst his or her athletes [8].

SDT centers on the 'why' of behavior and the differential determinants and consequences of autonomous motivation, controlled motivation and amotivation [9]. According to this theory, a psychological environment (motivational climate) can promote, not satisfy and even frustrate what are considered to be three Basic Psychological Needs (BPNs; i.e., the needs for autonomy, relatedness, and competence). The BPNs are considered essential for the promotion of autonomous motivation, optimal functioning, skill development, and well-being. In regard to the features of the motivational climate, SDT considers the degree to which a coach is autonomy-supportive [10] (e.g., provides his or her athletes choice, solicits their input, considers the athlete's perspective) and socially-supportive [7] (e.g., the coach cares about the athlete, separates the athlete from his or her performance, and has created a respectful relationship marked by mutual trust). SDT-grounded work also suggests that coaches can engage in controlling behaviors [11]. In this case, the coach imposes orders and gives instructions without justifying them. Controlling coaches try to impact athletes' behaviors via pressure, punishment, intimidation, and/or excessive personal interference [12–14].

Building upon AGT and SDT, Duda [7] proposed a hierarchical conceptualization of the coach-created motivational climate that integrates the major social environmental dimensions emphasized within the two theories. According to Duda, the coach-created motivational climate should be considered multidimensional in nature and can be more or less 'empowering' and 'disempowering'. An empowering motivational climate would be one that is more task-involving, autonomy-supportive, and socially-supportive/involvement-centered. A disempowering motivational climate is marked by ego-involving and controlling-coach attitudes and behaviors.

The need for an instrument to assess athletes' perceptions of the characteristics of empowering and disempowering coach-created motivational climates led to the development of Coach-created Empowering and Disempowering Motivational Climate Questionnaire (EDMCQ-C) [15]. Appleton and colleagues conducted a series of studies with young sports participants from England and tested a number of alternative models of the scale's structure. The results confirmed that an empowering climate is marked by task-involving, autonomy-supportive, and socially-supportive features, and a disempowering climate is characterized by ego-involving and controlling. A hierarchical structure of the measure was not supported by the data.

Previous studies have analyzed the psychometric properties of the EDMCQ-C with athletes from Iran [16], Korea [17], Lithuania [18], Mexico [19], France, Greece, Norway, Spain, and England [20]. To date, no research has tested the EDMCQ-C when administered to Brazilian athletes. Based on the initial work of Duda and colleagues [15,21], this study aimed to examine the psychometric properties of the EDMCQ-C that captured Brazilian athletes' perceptions of the empowering and disempowering features of the coach-created climate. After adaptation to the Portuguese language spoken in Brazil, an in-depth analysis of the factor structure of the original scale was conducted, including alternative analyzes of validity and reliability, to detect unsuitable items and improve the instrument's oper-

ationalization. Testing of the predictive validity of the EDMCQ-C was then conducted, examining the theoretically expected relationships between an empowering and disempowering climate dimension and the three basic psychological needs of competence, relatedness, and autonomy [22]. Discriminant validity was tested to verify whether the dimensions of the EDMCQ-C are independent from one another [23]. Finally, extending the work of Appleton and colleagues [20] but drawing also on research by Milton and colleagues [24] who validated the EDMCQ in regard to students' perceptions of their physical education teacher, we examined whether there was gender invariance in responses to the Brazilian version of the EDMCQ-C.

The objectives of this study were to assess psychometric properties of the Coach-created Empowering and Disempowering Motivational Climate Questionnaire by testing four different hypotheses.

Hypothesis 1. *The Brazilian version would be consistent with the structure of the EDMCQ-C as supported in previous research [20]. Namely, we tested the hierarchical structure originally proposed by Duda [21], but expected that an over-arching empowering climate dimension (marked by task-involving, autonomy-supportive, and socially-supportive features), and a disempowering climate dimension (characterized by ego-involving and controlling features) would be supported;*

Hypothesis 2. *The empowering climate is expected to be significantly and positively correlated with the three BPNs (the needs for autonomy, relatedness, and competence) and a disempowering climate correlated negatively with each BPN [7,22].*

Hypothesis 3. *Empowering and disempowering climates are expected to be independent from one another; indicative of discriminant validity [25].*

Hypothesis 4. *The measurement model will be invariant (or equivalent) across gender, in the sense that the same construct is measured equally in different groups of males and females [20].*

2. Methods

2.1. Participants and Recruitment

A total of 350 athletes (110 girls and 240 boys) participated in the study, with a mean age of 17.0 years (SD = 1.7). The young athletes participated in basketball (n = 147), volleyball (n = 166) or indoor soccer (n = 37). All participants were competitive at the national level. On average, their training lasted for duration of 3 h (SD = 0.9) and they engaged in training 4 times a week (SD = 1.0). The athletes had an average of 4 years of experience participating in their sport (SD = 2.3). Data collection took place in sports clubs and training centers located in the cities of São Paulo and Belo Horizonte. The current study's procedures respected ethical requirements inherent to scientific research, and the Ethics Council of the São Judas Tadeu University approved this study.

2.2. Instruments

(1) Demographic data of participants, namely age, gender, type of sport, and years of experience in the sport, weekly frequency and duration of training sessions were reported.

(2) Coach-created Empowering and Disempowering Motivational Climate Questionnaire: The EDMCQ-C has 32 items capturing two second-order variables (i.e., over-arching empowering and disempowering climates). The empowering climate is characterized by three first-order latent variables: Task-Involving (TI) which is comprised of 9 items (e.g., "My coach encouraged athletes to try new skills"), Autonomy-Supportive (AS) comprised of 5 items (e.g., "My coach gave athletes choices and options"), and Socially-Supportive (SS) which consists of 3 items (e.g., "My coach really appreciated athletes as people, not just as sport participants"). Disempowering is characterized by two first-order latent variables: Ego-Involving (EI) consisting of 10 items (e.g., "My coach yelled at athletes for messing

up") and Controlling coach behaviors (CO) comprised of 5 items (e.g., "My coach paid less attention to athletes if they displeased him or her").

(3) Basic Needs Satisfaction Sport Scale (BNSSS): The BNSSS [26,27] consists of 12 items, four tapping competence need satisfaction (e.g., "I have the ability to perform well in my sport"), four satisfaction of the need for autonomy (e.g., "In my sport, I can take part in the decision-making process"), and four assessing relatedness need satisfaction (e.g., "In my sport, I feel close to other people"). In responding to the EDMCQ-C and BNSSS, the athletes responded to the items on 5-point Likert scales ranging from (1) strongly disagree to (5) strongly agree.

2.3. Cross-Cultural and Lingual Adaptation of the EDMCQ-C

Permission was requested from the original instrument's authors for translation, adaptation, and validation of the EDMCQ-C for Brazilian athletes. After authorization, the translation from the original language (English) was performed into Brazilian Portuguese, through independent bilingual translators, in order to remedy any linguistic, psychological, cultural, or understanding biases. With the two translations in hand, comparisons were made between them to identify discrepancies and arrive at a single, agreed version. This version was evaluated by the authors regarding the semantic equivalence of language and concepts captured between the Brazilian version of the EDMCQ-C and the original instrument. After this stage, the last version of the instrument was evaluated by sports coaches, who checked issues (such as clarity of instrument instructions and wording of items) to ensure greater suitability for athletes from different regions and the targeted audiences. It was not necessary to make any changes. Then, the resulting version from this process was presented to six athletes, aged between 15 and 16 years, who were requested to respond to the questionnaire and then were interviewed to confirm if they understood the items and instructions properly. Based on their responses, there was no need to further revise the wording of the questionnaire. Thus, the final version used in this research was reached. All steps described above are proposed by Borsa [28] and Pasquali [29] for adapting psychological instruments across cultures/different languages. After this careful procedure, it was verified that the Portuguese version reflected the original version.

2.4. Data Analyses

We used Exploratory Structural Equation Modeling (ESEM) and Confirmatory Factor Analyses (CFA) solutions to assess the parameters of the constructs and the measurement models adopted. We tested four models with each of the solutions. The five-factor model (5-CFA and 5-ESEM) and the alternative two-factor model (2-CFA and 2-ESEM) were first order, with correlated latent variables. The next models tested were hierarchical (H-CFA and H-ESEM) and bi-factorial (BI-CFA and BI-ESEM).

The 5-CFA and 5-ESEM models included the latent variables TI, AS, SS, EI and CO; the 2-CFA and 2-ESEM models included two global latent variables, namely, empowering and disempowering [30]. The H-CFA and H-ESEM models included five first-order latent variables (TI, AS, SS, EI and CO) and two correlated second-order latent variables (empowering and disempowering). In hierarchical models, second-order factors are measured by two or more first-order factors. Hierarchical models serve to assess whether there are one or more higher dimensions that explain latent factors and the frequent high correlations between factors [31].

The bi-factorial models BI-CFA and BI-ESEM, allow estimates of direct relationships between items and the specific and global factors. Thus, it is possible to separate the variation attributed to specific factors, from that attributed to the general factor [32]. More precisely, bi-factorial models assume that the covariance between a set of items can be explained by a set of orthogonal factors, including a Global-factor (G-factor) and Specific-factor (S-factor). In the bi-factorial structure (BI-CFA), the G-factor and S-factor were specified as orthogonal to ensure that the interpretability of the solution was in line with the premises of the bi-factorial models. The main difference between BI-ESEM and BI-CFA

is that, in the CFA, first-order factorial loads can only load on a specific factor. The recent development of bi-factorial rotation for exploratory factor analyses has made it possible to incorporate bi-factorial modelling into the ESEM framework. In BI-ESEM, the G-factor was specified separately, outside the rotation process [31,33,34].

CFAs have been very restrictive in limiting each item to load on the desired factor and restricting cross loads on unintended factors to zero. This can be a problem on multidimensional scales because the items of these instruments are related and are generally associated with unintended factors [35,36]. For the ESEM models, a rotation was used in which all cross loads were specified as close to zero and the main loads were freely estimated [37,38]. A total of 8 models were then tested, 4 with the CFA solution (5-CFA, 2-CFA, H-CFA, BI-CFA) and 4 with the ESEM solution (5-ESEM, 2-ESEM, H- ESEM and BI-ESEM). The adequacy of the models was assessed using the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI) adjustment indexes. According to the literature [38], RMSEA values must be less than 0.08, CFI and TLI values must be above 0.90, or preferably, 0.95, for the fit of the data to the model to be considered adequate.

Mardia's coefficient was 9.67 with a critical ratio of 4.76 ($p < 0.001$) indicating significant deviations of the data from multivariate normality. Considering the ordinal nature of the data, the asymptotic covariance matrix of the polychoric correlation and threshold estimates was used for data analysis in a mean- and variance-adjusted weighted least squares (WLSMV) estimator to obtain the parameter estimates, standard errors, and chi-square goodness of fit statistic [38]. There were no missing values in the data set.

The final model to be tested for validity and reliability was chosen based on a good data-model fit and a theoretically interpretable factor structure. We follow the recommendations of Fornell and Larcker [39] to calculate the Composite Reliability (CR), in which it is recommended that the values be accepted when they are equal to or greater than 0.07. For the discriminant validity, we compared the square roots of the Average Variance Extracted (AVE) values of each construct with the correlations between the latent variables. The square roots of the AVEs should be greater than the correlations between latent variables [25,40]. We also tested external measures: the relationships between the measure of a perceived empowering and disempowering climate as assumed in the Brazilian EDCMQ-C measurement model and the measures of the three BPNs. The empowering climate is expected to be significantly and positively correlated with each of the BPNs and a disempowering climate correlated negatively with the three BPNs [22].

Finally, to test for measurement invariance of the EDMCQ-C across gender, we performed a Multi-group Confirmatory Factor Analysis (MGCFA). When comparing the fit of structural models and models nested in the invariance process, it is advisable that competing models provide a degree of fit similar to the data and the difference in CFI and RMSEA is less than 0.01 and 0.015, respectively [41]. The psychometric procedures were performed on Mplus version 8.4 [42].

3. Results

Participants reported higher scores on the empowering climate items than on the disempowering climate items. Most items showed low values of skewness and kurtosis (Table 1).

3.1. Goodness-of-Fit

Among the four CFA models tested, only the bi-factorial model (BI-CFA) achieved an acceptable fit, though borderline. Except for items AS32 ($\lambda = 0.84$), AS27 ($\lambda = 0.84$), CO24 ($\lambda = 0.77$), and EI10 ($\lambda = 0.72$), which showed higher levels of association with the S-factor, all other items showed low levels of specificity in the S-factors and a weak association with the G-factor. To achieve satisfactory adjustments in the other models, after analyzing the modification indices, the removal of items with low factorial loads and/or crossed loads was tested. Even after extensive modifications, it was not possible to achieve suitable

adjustment rates in the 5-CFA, 2-CFA, and H-CFA models. Table 2 presents the results of the goodness-of-fit indices for the various models tested.

Besides consulting the adjustment indices, it is recommended that the ESEM model be adopted over the CFA model when the estimated factor correlations are substantially reduced in ESEM [23,31,37]. In this study, 5-ESEM resulted in lower factor correlations than 5-CFA; 2-ESEM presented lower factor correlations than 2-CFA providing additional support for the use of ESEM (Table 3).

Table 1. Item means, standard deviations, skewness, and kurtosis in the sample.

EDMCQ-C Subscale and Item	M	SD	Sk	Ku
Task-involving				
T1. My coach encouraged players to try new skills	3.89	0.97	−0.77	0.37
T4. My coach tried to make sure players felt good when they tried their best	4.14	0.96	−1.03	0.64
T11. My coach made sure players felt successful when they improved	4.11	0.83	−0.91	1.21
T13. My coach acknowledged players who tried hard	4.05	0.99	−1.08	0.91
T18. My coach made sure that each player contributed in some important way	4.19	1.00	−1.34	1.44
T23. My coach made sure everyone had an important role on the team	4.19	1.02	−1.38	1.59
T28. My coach let us know that all the players are part of the team's success	3.94	1.05	−0.83	0.03
T30. My coach encouraged players to help each other learn	4.12	0.93	−0.96	0.63
T15. My coach encouraged players to really work together as a team	4.47	0.88	−2.08	4.52
Autonomy-supportive				
AS3. My coach gave players choices and options	3.61	0.97	−0.33	−0.38
AS6. My coach thought that it is important that players participate in this sport because the players really want to	3.95	0.98	−0.85	0.55
AS16. My coach answered players' questions fully and carefully	4.13	0.90	−0.79	0.13
AS22. When my coach asked players to do something, he or she tried to explain why this would be good to do so	4.14	0.91	−0.96	0.66
AS32. My coach thought that it is important for players to play this sport because they (the players) enjoy it	4.01	0.96	−0.85	0.52
Socially-supportive				
SS8. My coach could really be counted on to care, no matter what happened	4.03	1.09	−0.98	0.15
SS14. My coach really appreciated players as people, not just as athletes	3.84	1.01	−0.54	−0.35
SS27. My coach listened openly and did not judge players' personal feelings	3.22	1.06	−0.07	−0.37
Ego-involving				
EI5. My coach substituted players when they made a mistake	3.27	1.11	−0.25	−0.66
EI9. My coach gave most attention to the best players	2.85	1.27	0.13	−0.98
EI10. My coach yelled at players for messing up	3.43	1.20	−0.27	−0.84
EI19. My coach had his or her favorite players	3.18	1.32	−0.14	−1.00
EI21. My coach only praised players who performed the best during a match	2.81	1.18	0.19	−0.79
EI25. My coach thought that only the best players should play in a match	2.79	1.18	0.16	−0.77
EI20. My coach favored some players more than others	2.76	1.24	0.11	−0.94
Controlling coaching				
CO2. My coach was less friendly with players if they didn't make the effort to see things his/her way	2.47	1.26	0.44	−0.84
CO7. My coach was less supportive of players when they were not training and/or playing well	2.47	1.11	0.32	−0.67
CO12. My coach paid less attention to players if they displeased him or her	2.41	1.06	0.59	−0.09
CO17. My coach was less accepting of players if they disappointed him or her	2.47	1.05	0.36	−0.34
CO24. My coach shouts at players in front of others to make them do certain things	3.34	1.23	−0.42	−0.71
CO26. My coach threatened to punish players to keep them in line during training	2.29	1.28	0.64	−0.72
CO29. The coach mainly used rewards/ praise to make players complete all the tasks he/she sets during training	2.45	1.12	0.41	−0.50
CO31. My coach tried to interfere in aspects of players' lives outside of this sport	2.38	1.29	0.59	−0.78

M = Mean; SD = Standard Deviation; Sk = Skewness; Ku = Kurtosis.

Table 2. Goodness-of-Fit Indices for CFA and ESEM solution.

Model	χ^2	df	RMSEA	90%CI	SRMR	CFI	TLI
5-CFA	1258.82 *	454	0.072	0.067 0.076	0.082	0.862	0.849
H-CFA	1296.58 *	458	0.073	0.068 0.077	0.084	0.856	0.844
BI-CFA	902.59 *	421	0.057	0.052 0.062	0.055	0.919	0.905
2-CFA	1341.48 *	463	0.074	0.069 0.079	0.086	0.849	0.838
5-ESEM	642.62 *	346	0.050	0.044 0.056	0.044	0.949	0.928
H-ESEM	6017.35 *	450	0.049	0.046 0.064	0.044	0.950	0.929
BI-ESEM	549.51 *	319	0.045	0.039 0.052	0.055	0.961	0.940
2-ESEM	1136.59 *	433	0.069	0.064 0.073	0.068	0.880	0.863

* $p < 0.01$; CFA: confirmatory factor analysis; ESEM: exploratory structural equation modelling; 5-CFA and 5-ESEM: models with five first-order factor solutions (task-involving, ego-involving, autonomy-supportive, socially-supportive and controlling-coach-behaviors); 2-CFA and 2-ESEM: models with two first-order factor solutions (empowering and disempowering); H-CFA and H-ESEM: hierarchical models with task-involving/autonomy-supportive/socially-supportive specified as related to a higher-order empowering factor and ego-involving/controlling coach-behaviors specified as related to a second higher-order disempowering factor; BI-CFA and BI-ESEM: bifactor solution including two G-factors (empowering and disempowering) and five S-factors (task-involving, ego-involving, autonomy-supportive, socially-supportive and controlling coach behaviors); χ^2: chi-square test of exact fit; df: degrees of freedom; CFI: comparative fit index; TLI: Tucker–Lewis index; RMSEA: root mean square error of approximation; 90% CI: 90% confidence interval of the RMSEA; SRMR: standardized root mean square residual.

Table 3. Latent Factor Correlations from the CFA and ESEM solutions.

ESEM CFA	1	2	3	4	5	6	7
1. Task-involving		*0.407*	*−0.074*	*−0.418*	*−0.129*		
2. Autonomy-supportive	**0.809**		*0.004*	*−0.061*	*−0.117*		
3. Socially-supportive	**0.823**	**0.817**		*0.458*	*0.133*		
4. Ego-involving	**−0.405**	**−0.317**	**−0.602**		*0.264*		
5. Controlling coaching	**−0.496**	**−0.352**	**−0.580**	**0.878**			
6. Empowering							*−0.419*
7. Disempowering						**−0.498**	

Correlations 5-CFA/2-CFA are in bold; Correlations 5-ESEM/2-ESEM are in italics.

In addition to using information about model fit to guide the choice of the best model, Morin and colleagues [35] proposed that after a detailed analysis of parameter estimates, the researcher should compare the CFA and ESEM models before comparing BI-ESEM with the other ESEM models [36]. The goodness-of-fit index was better in the 5-ESEM-related model when compared to the 5-CFA (as shown in Table 2). However, when analyzing the estimates of the 5-ESEM parameters we noticed a problem in defining the factors in the latent variables. The majority of items failed to load significantly on their intended factor and demonstrated elevated and significant factor loadings on their non-intended climate dimension. Specifically, only nine items (6-TI, 2-AS, and 1-EI) loaded significantly onto their intended factor (Table 4; target factor loadings are in bold). Regarding the hierarchical models, H-ESEM provided better fit indices compared to the H-CFA. An examination of the parameters, however, showed that none of the first-order factors loaded significantly onto their respective second-order factors (Table 5).

The BI-ESEM goodness-of-fit indices are suitable and better than 5-ESEM and H-ESEM (Table 2), although the G-factors were not well defined by strong and significant target loadings (Table 4). Of the items involving disempowering coach behaviors, seven showed high levels of specificity associated with the S-factor, and two (EI25, CO29) failed to demonstrate significant loadings. Six (CO31, CO24, CO7, EI21, EI9, EI5) presented significant loadings, but were weak on the respective S-factors (varying from 0.288 to 0.459). Of the items related to empowering coach behaviors, all TI items loaded significantly on their intended S-factor. On the other hand, SS and AS items were very poorly defined and presented a weak association with the G-factor. None of the SS and AS items loaded significantly on their intended factor (AS3, AS6, AS16, and SS27 items demonstrated elevated factor loadings on the TI).

Table 4. Standardized Parameter Estimates from the five-Factor and bifactor ESEM Solutions including five S-factors and two G-factors.

	5-ESEM						BI-ESEM						
							S-Factor					G-Factor	
	TI	**AS**	**SS**	**EI**	**CO**	**δ**	**TI**	**AS**	**SS**	**EI**	**CO**	**EMP**	**δ**
TI1	**−0.026**	0.503 *	−0.058	−0.298	−0.017	0.633	**0.438 ***	−0.227	0.314	−0.169	−0.048	−0.159	0.602
TI4	**0.079**	0.303 *	0.089	−0.571 *	0.045	0.551	**0.506 ***	−0.139	0.245	0.010	−0.359	−0.040	0.534
TI11	**0.283 ***	0.322 *	0.065	−0.385 *	0.018	0.515	**0.631 ***	−0.064	0.226	−0.008	−0.196	−0.024	0.508
TI13	**0.379 ***	0.214 *	0.064	−0.074	0.065	0.724	**0.488 ***	0.111	0.145	0.110 *	−0.012	−0.034	0.715
TI18	**0.749 ***	−0.058	0.057	−0.136	0.072	0.391	**0.730 ***	0.131	−0.049	0.048	−0.097	0.199	0.397
TI23	**0.791 ***	−0.018	−0.089	−0.134	0.052	0.261	**0.809 ***	0.105	0.022	−0.106	−0.104	0.256	0.247
TI28	**0.722 ***	−0.014	−0.173 *	0.012	0.012	0.450	**0.694 ***	0.104	0.061	−0.196	0.025	0.314 *	0.366
TI30	**0.644 ***	0.030	0.015	−0.101	−0.200 *	0.421	**0.718 ***	0.135	−0.053	−0.102	−0.118	0.031	0.439
TI15	**0.703 ***	0.053	−0.037	−0.028	−0.178 *	0.378	**0.755 ***	0.168	−0.061	−0.132	−0.058	0.007	0.377
AS3	0.012	**0.535 ***	−0.009	−0.163	0.011	0.670	0.409 *	**−0.153**	0.318	−0.068	0.066	−0.206 *	0.657
AS6	0.100	**0.359 ***	0.189 *	0.035	−0.407 *	0.613	0.354 *	**0.036**	−0.111	−0.025	0.059	−0.567 *	0.535
AS16	0.312 *	**0.201 ***	−0.080	−0.210	−0.176 *	0.606	0.536 *	**0.092**	0.094	−0.150	−0.234	−0.143 *	0.597
AS22	0.515 *	**0.083**	−0.092	−0.056	−0.029	0.638	0.531 *	**0.331 ***	0.126	0.017	−0.201	−0.004	0.552
AS32	0.393 *	**0.326 ***	0.084	0.211	−0.327 *	0.528	0.506 *	**0.287 ***	−0.070	−0.002	0.138	−0.488 *	0.40
SS8	−0.007	0.563 *	**−0.076**	−0.511 *	0.000	0.351	0.582 *	−0.249	**0.365 ***	−0.210	−0.230	−0.185	0.334
SS14	0.122	0.318 *	**−0.219 ***	−0.171	−0.044	0.701	0.354 *	0.143	**0.339 ***	−0.140	−0.239	−0.142	0.642
SS27	0.380 *	0.312 *	**−0.237 ***	0.111	−0.157 *	0.592	0.527 *	0.129	**0.157**	−0.260	0.065	−0.157	0.585
												DIS	
EI5	−0.004	0.325 *	−0.016	**0.154**	0.452 *	0.674	−0.019	0.096	0.413	**0.301 ***	0.265 *	−0.117	0.646
EI9	−0.138 *	−0.011	0.456 *	**0.347 ***	−0.005	0.458	−0.316	0.011	−0.118	**0.430 ***	0.379 *	0.343 *	0.440
EI10	0.17	0.018	0.432 *	**0.071**	0.594 *	0.348	0.017	0.102	0.031	**0.714 ***	0.323 *	−0.306	0.281
EI19	−0.022	−0.167 *	0.758 *	**0.101**	−0.057	0.322	−0.174	0.006	−0.325	**0.633 ***	0.185 *	0.396 *	0.273
EI21	−0.090	0.273 *	0.160 *	**0.017**	0.318 *	0.802	−0.021	−0.019	0.258	**0.322 ***	0.190 *	−0.019	0.792
EI25	0.144	0.009	0.016	**0.593 ***	−0.042	0.700	−0.157	0.298	−0.015	**0.151**	0.390 *	0.199 *	0.672
EI20	−0.256 *	0.036	0.844 *	**−0.036**	−0.072	0.245	−0.183	−0.247	−0.226	**0.603 ***	0.232 *	0.467 *	0.219
CO													
CO2	0.143 *	−0.037	0.282 *	0.493 *	**0.064**	0.571	−0.131	0.079	−0.147	0.325	**0.508 ***	0.146	0.570
CO7	−0.042	−0.014	0.034	0.601 *	**0.118**	0.540	−0.384	0.213	0.024	0.242	**0.459 ***	0.105	0.526
CO12	−0.167 *	0.238	−0.021	0.574 *	**0.087**	0.533	−0.316	0.047	0.208	0.116	**0.528 ***	0.242 *	0.503
CO17	−0.027	0.158	0.081	0.757 *	**0.032**	0.326	−0.283	0.055	0.023	0.152	**0.739 ***	0.262 *	0.278
CO24	0.197	0.000	0.560 *	0.002	**0.416 ***	0.448	0.085	−0.008	−0.130	0.660	**0.307 ***	−0.185	0.411
CO26	−0.036	0.031	0.382 *	0.185 *	**0.126**	0.706	−0.063	−0.307	−0.220	0.247	**0.540 ***	−0.051	0.498
CO29	0.076	0.101	0.104	−0.048	**0.021**	0.967	0.168	−0.100	0.011	0.036	**0.085**	0.029	0.952
CO31	0.015	−0.006	0.371 *	−0.010	**0.078**	0.853	0.051	−0.286	−0.211	0.210	**0.288 ***	−0.006	0.744

Target factor loadings are in bold (* $p < 0.05$). δ: uniquenesses; TI: task-involving; EI: ego-involving; AS: autonomy-supportive; SS: socially-supportive; CO: controlling-coach-behaviors; ESEM: exploratory structural equation modelling; 5-ESEM: models with five first-order factor solutions (TI, AS, SS, EI, CO); BI-ESEM: bifactor solution including two G-factors (empowering and disempowering) and five S-factors (TI, AS, SS, EI, CO); G-factor: global factor estimated as part of a bifactor model; S-factor: specific factor estimated as part of a bifactor model.

The 2-ESEM model with two-factors first-order (empowering and disempowering) failed on suitable fit indices, but an investigation of the parameter estimates revealed that most of the items loaded significantly ($p < 0.001$) onto their intended factor. Besides that, the parameter estimates revealed a well-defined factor for the empowering climate dimension due to substantial target factor loadings ($|\lambda| = 0.37$ to 0.83). For the disempowering climate dimension, the majority of target factor loadings were consistent with the underlying conceptual model with the exception of three items, which loaded more strongly onto the empowering factor.

In short, the ESEM-related models provided a better fit to the data than the CFA. The 5-ESEM and H-ESEM models showed slightly weaker adjustments compared to the BI-ESEM model; although the three models provided acceptable adjustments, an examination on the parameters suggests the three solutions are problematic and they fail to align with the theory underpinning this model. The 2-ESEM was the only model in which all items loaded heavily on the respective factor; however, it failed to achieve adequate goodness-of-fit indices.

Table 5. Standardized Factor Loadings for CFA Solutions.

	5-CFA		2-CFA		H-CFA		BI-CFA		
		δ		δ		δ	S-Factor	G-Factor	δ
TI					**0.891**	**0.205**		**EMP**	
TI1	0.520	0.729	0.511	0.739	0.522	0.728	0.100	0.516	0.724
TI4	0.620	0.616	0.604	0.636	0.619	0.617	0.086	0.639	0.585
TI11	0.686	0.529	0.665	0.557	0.686	0.53	0.293	0.615	0.537
TI13	0.452	0.796	0.438	0.826	0.451	0.796	0.463	0.283	0.705
TI18	0.707	0.5	0.691	0.523	0.706	0.501	0.579	0.484	0.431
TI23	0.834	0.305	0.817	0.333	0.835	0.303	0.553	0.638	0.287
TI28	0.692	0.521	0.677	0.542	0.693	0.519	0.472	0.535	0.490
TI30	0.728	0.471	0.708	0.498	0.726	0.473	0.488	0.564	0.444
TI15	0.774	0.401	0.757	0.427	0.773	0.402	0.556	0.558	0.380
AS					**0.841**	**0.292**			
AS3	0.480	0.769	0.417	0.611	0.474	0.775	0.271	0.353	0.802
AS6	0.399	0.841	0.332	0.731	0.391	0.847	0.518	0.138	0.712
AS16	0.715	0.489	0.623	0.667	0.728	0.47	0.256	0.607	0.566
AS22	0.660	0.564	0.577	0.488	0.663	0.56	0.332	0.517	0.623
AS32	0.522	0.727	0.438	0.68	0.510	0.74	0.843	0.159	0.265
SS					**0.985**	**0.03**			
SS8	0.762	0.42	0.716	0.808	0.760	0.423	0.157	0.743	0.423
SS14	0.551	0.697	0.519	0.89	0.549	0.699	0.222	0.508	0.693
SS27	0.589	0.653	0.565	0.808	0.593	0.648	0.839	0.395	0.139
EI					**0.888**	**0.212**		**DIS**	
EI5	0.242	0.941	0.231	0.623	0.241	0.942	0.294	0.143	0.893
EI9	0.781	0.389	0.755	0.43	0.785	0.384	0.201	0.724	0.435
EI10	0.543	0.705	0.517	0.732	0.540	0.709	0.720	0.289	0.397
EI19	0.761	0.421	0.731	0.466	0.760	0.423	0.439	0.613	0.432
EI21	0.266	0.929	0.255	0.57	0.266	0.929	0.298	0.162	0.885
EI25	0.471	0.778	0.450	0.797	0.469	0.78	0.079	0.438	0.802
EI20	0.763	0.417	0.736	0.458	0.763	0.417	0.412	0.630	0.433
CO					**0.989**	**0.022**			
CO2	0.626	0.608	0.614	0.634	0.626	0.608	0.275	0.571	0.598
CO7	0.674	0.546	0.656	0.447	0.672	0.548	−0.010	0.689	0.526
CO12	0.617	0.619	0.605	0.745	0.619	0.617	−0.037	0.623	0.610
CO17	0.293	0.416	0.290	0.73	0.294	0.416	0.073	0.748	0.436
CO24	0.531	0.739	0.520	0.947	0.532	0.741	0.765	0.301	0.324
CO26	−0.027	0.718	−0.025	0.935	−0.028	0.717	0.298	0.467	0.693
CO29	0.764	0.999	0.744	0.999	0.764	0.999	0.186	−0.082	0.959
CO31	0.510	0.914	0.505	0.916	0.509	0.913	0.286	0.233	0.864

δ: uniquenesses; TI: task-involving; EI: ego-involving; AS: autonomy-supportive; SS: socially-supportive; CO: controlling-coach-behaviors; CFA: confirmatory factor analysis; 5-CFA: models with five first-order factor solutions (TI, AS, SS, EI, CO); 2-CFA: models with two first-order factor solutions (empowering and disempowering); H-CFA: TI, AS and SS specified as related to a higher-order empowering factor and EI and CO specified as related to a second higher-order disempowering factor; BI-CFA: bifactor solution including two G-factors (empowering and disempowering) and five S-factors (TI, AS, SS, EI, CO); G-factor: global factor estimated as part of a bifactor model; S-factor: specific factor estimated as part of a bifactor model.

To improve the fit indices of the 2-ESEM, three items were removed (CO29: $\lambda = 0.11$, $\delta = 0.97$; CO31: $\lambda = 0.35$, $\delta = 0.90$ and EI21: $\lambda = 0.34$, $\delta = 0.90$) but suitable fit indices were not achieved. When analysing the modification indices, we observed an error correlation between EI10 and CO24 and between AS32 and AS6. In the first case, the suggestion was accepted because there was a content overlap between the items. In the second case, considering statistical compliance and theoretical relevance, it was decided to exclude item AS6. After the changes, the adjustments proved to be acceptable ($\chi 2 = 839.30$; df = 322; RMSEA = 0.068; SRMR = 0.056; CFI = 0.910; TLI = 0.900; GFI = 0.939) and the parameter estimates theoretically relevant and therefore, the model was accepted. Figure 1 shows

the final version of the EDMCQ-C and the standardized parameter estimates related to 2-ESEM solutions are reported in Table 6.

The figure shows only the target factor loadings for better visualization. All the factor loadings are reported in Table 6.

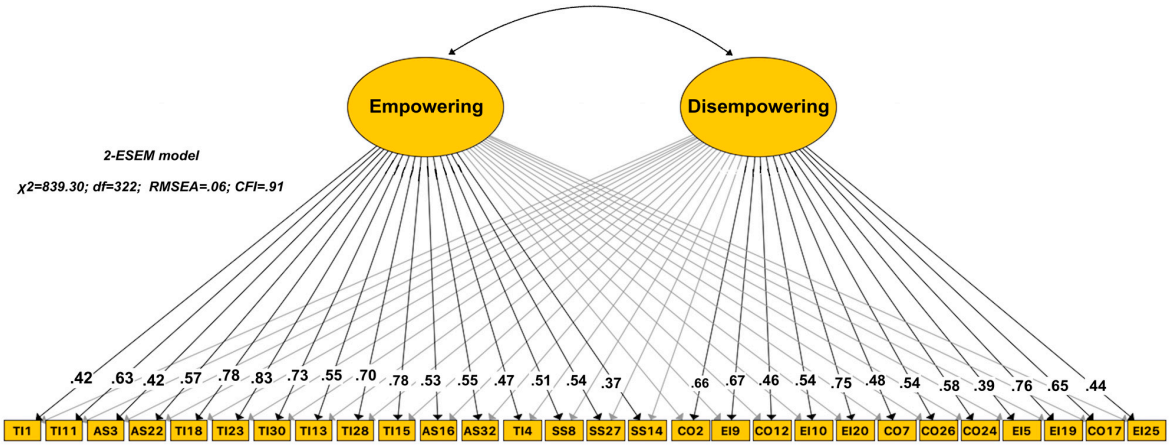

Figure 1. The Final Measurement Structure of the EDMCQ-C.

Table 6. Standardized Parameter Estimates from the 2-ESEM solutions.

Empowering				Disempowering			
Item	**EMP**	**DIS**	**δ**	**Item**	**EMP**	**DIS**	**δ**
TI1	0.416	−0.148	0.756	EI9	−0.143	0.666	0.461
TI4	0.469	−0.224	0.647	EI10	0.128	0.539	0.747
TI11	0.630	−0.087	0.553	EI19	0.013	0.762	0.427
TI13	0.551	0.139	0.737	EI25	−0.023	0.444	0.795
TI18	0.777	0.113	0.453	EI20	−0.012	0.753	0.426
TI23	0.830	−0.007	0.307	EI5	0.091	0.389	0.768
TI28	0.698	−0.008	0.508	CO7	−0.242	0.481	0619
TI30	0.733	0.007	0.467	CO12	−0.183	0.456	0.693
TI15	0.785	0.043	0.409	CO17	−0.132	0.651	0.491
AS3	0.424	0.004	0.822	CO24	0.182	0.581	0.712
AS16	0.526	−0.171	0.623	CO26	−0.007	0.538	0.707
AS22	0.570	−0.040	0.656	CO2	0.029	0.663	0.575
AS32	0.553	0.209	0.741				
SS8	0.514	−0.300	0.525				
SS14	0.370	−0.247	0.739				
SS27	0.538	−0.054	0.685				

EMP: empowering; DIS: disempowering; TI: task-involving; AS: autonomy-supportive; SS: socially-supportive; EI: ego-involving; CO: controlling coaching; δ: uniquenesses. Target factor loadings are in black.

3.2. Reliability and Validity of the 2-ESEM Model of the EDMCQ-C

The Composite Reliability was 0.77 for empowering and 0.85 for disempowering. Thus both scales were marked by good internal consistency. Predictive validity was assessed via examining correlations between the empowering/disempowering climate dimensions and the three BPNs. Empowering climate was significantly and positively correlated with autonomy (r = 0.456; $p < 0.01$), relatedness (r = 0.495; $p < 0.01$), and competence (r = 0.102; $p = 0.02$). A disempowering climate was negatively and significantly correlated with autonomy (r = −0.289; $p < 0.01$) and relatedness (r = −0.380; $p < 0.01$), but not significantly associated with competence (r = −0.065; $p = 0.11$). Regarding discriminant validity, when comparing the AVEs square root ($\sqrt{}$AVE = 0.55/0.65) and the correlation between the factors (r = −0.39), the higher values of the AVE roots suggest that the model has discriminant validity [41].

3.3. Measurement Invariance across Gender of the 2-ESEM Model of the EDMCQ-C

A MGCFA was implemented to assess the invariance of the measure by gender. Through the CFI and RMSEA difference tests, the configural, metric (ΔCFI = 0.006; ΔRMSEA = 0.000), and scalar (ΔCFI = 0.004; ΔRMSEA = 0.001) invariance was supported, indicating that there are no response differences across gender. Thus, the evidence demonstrates that the Brazilian version of the EDMCQ-C can be administered to both boys and girls, allowing for an adequate comparison [41,43].

4. Discussion

The purpose of this study was to make a cross-cultural and cross-lingual adaptation and examine the psychometric properties of the EDMCQ-C when administered to a sample of Brazilian athletes. The cross-cultural adaptation included translation, back-translation and testing the clarity and comprehensibility of instructions and items in the views of coaches. We explored the scale's global and specific factor structure using CFA and ESEM solutions. The ESEM solutions provided a better fit, confirming previous studies that evidenced the superiority of ESEM when analyzing the factor structure of a complex and multidimensional scale [15,30,36].

From a theoretical perspective, there may be considerable overlap among items related to task-involving, autonomy-supportive, and socially-supportive behaviors [1]. The three factors, TI, AS, and SS, were designed to capture the subtle albeit related differences in behaviors marking an empowering climate as proffered by the theories that guided the development of this instrument (namely, AGT and SDT). The same occurs with the factors EI and CO, which evaluate controlling and ego-oriented behaviors; both were designed to capture the slight differences in coach behaviors which contribute to a disempowering climate [8]. Allowing items to be loaded crosswise on an unintended factor, it is expected that items will load significantly and more strongly on the desired factor. The 5-ESEM, H-ESEM and BI-ESEM models did not accurately represent the concept of motivational climate elaborated by Duda [21]. Such results supporting this conceptualization were observed only in the 2-ESEM. The 2-ESEM model results confirmed that the empowering climate is marked by task-involving, autonomy-supportive, and socially-supportive features, and the disempowering climate is characterized by ego-involving and controlling, corroborating the first hypothesis of this current research [18,20,21,24].

Although the items have significantly loaded on the intended factors, the 2-ESEM presented an inadequate fit. Thus, it was necessary to make some modifications to the model to make it useful. Item AS6 was excluded because data showed that respondents in this study were unable to differentiate AS6 from another nearly identical item. Items EI21, CO29, and CO31, which were not interpreted as disempowering according to the results, were also excluded. The reason why this occurred is not clear; however, a possible explanation for item CO31 is that the coach may have been someone who cares about the athlete's well-being outside the sporting context. If "to interfere" may have been perceived as "trying to understand what happens in the athlete's personal life" or as the coach's sincere concern, this would be more empowering than disempowering coach behaviors. Item EI21 may not have made sense to athletes because, on the one hand, it is desirable to receive "praise" from the coach; on the other hand, it is not expected to receive praise (even if it is from an empowering coach) for a mediocre performance. Item CO29 was originally included in the EDMCQ-C to capture the use of rewards that can control behavior [24]. According to SDT, when coaches use awards and compliments in a controlling manner, just so that athletes will fulfill what has been established, it is likely that athletes will have their feelings of autonomy and intrinsic motivation compromised [6]. However, the participants in this study did not interpret these strategies as controlling or negative. Future research should determine the extent to which the use of praise/rewards as stipulated in items EI21 and CO29 are empowering over the short and long term. For example, qualitative research with athletes may reveal the extent to which the use of rewards is task-involving and competence promoting. We recommend that until future research clarifies whether

(and why) these controlling strategies are empowering, items EI21, CO29, and CO31 should not be included in the EDMCQ-C for Brazilian athletes.

After the modifications, the adjustments were acceptable to support a reduced 28-item two-factor model (2-ESEM) representing the Brazilian version of EDMCQ-C. By correlating the empowering and disempowering climate scale scores with the subscales of a validated instrument that assessing the BPNs [44], correlations of moderate to high magnitude emerged which aligned with our theoretically-based hypothesis (hypothesis 2). The only exception was the association between a disempowering climate and competence, which was negative (as expected) but not significant [7,22]. In general, the EDMCQ-C (BR) showed good internal consistency, discriminant, and predictive validity (hypothesis 3). Further, tests of invariance indicated that the questionnaire is suitable for administration to males and females. These latter findings support hypothesis 4 and are aligned with the findings of Milton and colleagues [24] in their work on the EDMCQ-PE.

Thus, the EDMCQ-C (BR) is expected to contribute significantly to future research and intervention regarding the motivational climate created by the coach with the aim to promote more positive and adaptable sports environments for Brazilian athletes. The adoption of the EDMCQ-C as a measure is advantageous because it recognizes the broad spectrum of climate dimensions central to AGT and SDT simultaneously and their implications for athletes' motivation, well-being [18,45], and sustained engagement in sports [3,46]. From a practical perspective, the EDMCQ-C (BR) could be used by coaches and researchers to establish the empowering and disempowering climate being created in training sessions and competition. The scale could be employed, for example, to determine the extent to which coaches (based on self-report and/or athletes' perceptions) are (or are not) utilizing motivational strategies that are known to foster or hinder athletes' autonomous motivation, engagement, and psychological health. Moreover, the administration and sharing of findings from the EDMCQ-C could enhance coaches' understanding of the motivational climate they create (in the eyes of their athletes) and potentially provide further insight into specific empowering and disempowering strategies impacting their athletes [47]. The questionnaire could be administered as part of the *Empowering Coaching*™ [7,21] workshop in this regard and/or utilized to determine whether this training facilitates the creation of more empowering and less disempowering motivational climates.

Study Limitations and Future Research Directions

The main limitation of the study was the small sample size. Due to the limited sample, it was not possible to carry out an invariance test between different sports, regions in the country, and/or sports clubs. As Brazil is a continental country, the ideal would be to evaluate the cross-cultural equivalence of the scale between athletes from different Brazilian states, but the current study was limited to young national-level athletes from the cities of São Paulo and Belo Horizonte.

Another limitation of the study was that the multilevel nature of the data (i.e., athletes nested within teams) was not considered. That is, we did not take into account the limited number of teams per parameters with the more complex models. Although it is not possible to perform a multilevel analysis in ESEM, it is possible to account for 'clusters'. Future research should try to recruit athletes from a larger number of teams and subsequently consider clustering effects when examining the factorial structure of the EDMCQ-C.

Given the challenge regarding social desirability bias [48], it is essential to highlight that this study relied solely on athletes' self-reports. Therefore, future work utilizing the EDMCQ-C (BR) assessing self-perceptions of young sports athletes might consider incorporating a psychometrically sound measure of social desirability. Moreover, in subsequent research with this instrument, it would be interesting to have Brazilian coaches also complete the EDMCQ-C (BR) [14].

5. Conclusions

The purpose of the current study was to examine the initial psychometric properties of the EDMCQ-C when translated into Portuguese and completed by Brazilian sports athletes. The evidence from this study is aligned with the findings of previous research (e.g., [18,20,24]) that supports a two-factor model. Moreover, the research provides additional evidence regarding indicators of validity and reliability of the scale. This evidence suggests that the EDMCQ-C (BR) can be used in future research to examine the antecedents and consequences of athletes' perceptions of empowering and disempowering features of the coach-created motivational climate in Brazilian sport.

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Institutional Review Board Statement: The study was conducted in accordance with international guidelines for ethical principles of scientific research with human beings, and approved by the Ethics Committee of the São Judas Tadeu University (protocol code: 02887318.1.0000.0089, date of approval: June 2019) for studies involving humans.

Informed Consent Statement: Written informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest in the results.

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