

# Initial validation of the teacher-created Empowering and Disempowering Motivational Climate Questionnaire in PE (EDMCQ-PE)

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DOI:  
[10.1123/jtpe.2018-0119](https://doi.org/10.1123/jtpe.2018-0119)

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Document Version  
Peer reviewed version

Citation for published version (Harvard):  
Milton, D, Appleton, P, Duda, J & Bryant, A 2018, 'Initial validation of the teacher-created Empowering and Disempowering Motivational Climate Questionnaire in PE (EDMCQ-PE)', *Journal of Teaching in Physical Education*, vol. 37, no. 4, pp. 340-351. <https://doi.org/10.1123/jtpe.2018-0119>

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Article as accepted for publication.

Final version of record appeared in: *Journal of Teaching in Physical Education* 10.1123/jtpe.2018-0119

Checked 7.9.18, amended 5/12/18

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**Initial validation of the teacher-created Empowering and  
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(EDMCQ-PE)**

Journal:	<i>Journal of Teaching in Physical Education</i>
Manuscript ID	JTPE.2018-0119.R2
Manuscript Type:	Article
Keywords:	achievement goal theory, self-determination theory, ESEM

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## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE - PE 2

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**Abstract**

2

Purpose: Guided by Duda's (2013) hierarchical conceptualization of the motivational climate that draws from self-determination and achievement goal theories, this study provides initial evidence of the psychometric properties of the Empowering and Disempowering Motivational Climate Questionnaire-PE (EDMCQ-PE).

6

Method: Questionnaire-based with two samples of Welsh secondary school pupils.

7

Results: Exploratory structural equation modelling (ESEM) provided a better fit of the data to the hypothesised model than confirmatory factor analysis. Moreover, a two factor composite (i.e., empowering and disempowering) lower-order model provided an acceptable fit and clear parameter estimates. This two factor model also demonstrated scalar gender measurement invariance.

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Discussion: The evidence from this study suggests the EDMCQ-PE is a promising scale for the assessment of secondary school pupils' perceptions of the empowering and disempowering features of the motivational climate created by their physical education (PE) teachers. Moving forward, the statistical approach employed in this paper can inform future studies that develop questionnaire methodology in physical education (PE) and from an applied perspective, the EDMCQ-PE can be used by researchers and teachers to assess the motivational climate in PE and help inform the pedagogy underpinning teachers' classes.

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**Acknowledgments:** The research forming the basis of this paper was a Sport Wales funded Empowering Physical Education project.

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## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE - PE 3

1 Despite the many benefits of Physical Education (PE), not all pupils have an  
2 empowering experience in PE. For example, 35% of Welsh children do not enjoy school sport  
3 and PE (Sport Wales, 2015). Over 20 years of research confirms that a key determinant of the  
4 quality of a pupil's experience in PE is the teacher-created motivational climate (Duda,  
5 Papaioannou, Appleton, Quested & Krommidas, 2014). Recently, Duda (2013; Duda &  
6 Appleton, 2016) suggested a hierarchical and multidimensional conceptualization of the  
7 coach-created motivational climate that integrates the major social environmental dimensions  
8 emphasized within achievement goal theory (AGT; Ames, 1992; Nicholls, 1989) and self-  
9 determination theory (SDT; Deci & Ryan, 1985, 2000). Duda's conceptualization suggests the  
10 motivational climate created is multidimensional and can be more or less 'empowering' and  
11 'disempowering.' Given the motivational climate created by teachers in PE has received  
12 considerable attention in previous research from an AGT or SDT perspective, and holds  
13 important pedagogical implications for students' motivation (Braithwaite, Spray &  
14 Warburton, 2011), the quality and quantity of their engagement and learning (Reeve, 2012),  
15 levels of moderate-to-vigorous physical activity, and psychological responses in PE (Van den  
16 Berghe, Vansteenkiste, Cardon, Kirk, & Haerens, 2014), future research on the PE teacher-  
17 created motivational climate may benefit from adopting Duda's theoretically integrated  
18 model.

19 In order to examine the PE teacher created motivational climate as conceptualised  
20 within Duda's model, an initial step is the development of a valid and reliable questionnaire.  
21 Therefore, the primary aim of this study was to provide an initial examination of the  
22 psychometric properties of the Empowering and Disempowering Motivational Climate  
23 Questionnaire-PE (EDMCQ-PE). Establishing the EDMCQ-PE as a psychometrically sound  
24 measure would make a significant contribution to the PE literature by: (a) providing  
25 researchers with a valid and reliable questionnaire that captures empowering and  
26 disempowering strategies employed by PE teachers, (b) allowing for an examination of the

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1 correlates and antecedents of these motivation-related teaching climates, and (c) evaluating  
2 interventions that seek to change the motivational strategies employed by PE teachers.  
3 Moreover, from a pedagogical perspective, establishing the EDMCQ-PE as a valid and  
4 reliable questionnaire will enable teachers to determine the extent to which their own  
5 communication and behaviors (using self-report data and student's perceptions) in class are  
6 more or less empowering and disempowering.

**7 AGT: Task- and Ego-involving Motivational Climates**

8 AGT proposes that the motivational climate is the social environment surrounding  
9 pupils and is a function of what teachers say and do, how they organise, communicate, try to  
10 motivate, and use praise and feedback following desirable performance or mistakes (Duda,  
11 2001). A main assumption of AGT is that the teacher-created motivational climate can shape  
12 pupils' perceptions of competence in PE by emphasizing a task- and/or ego-involving criteria  
13 (Ames, 1992). A task-involving criteria of competence centres on personal progress, effort,  
14 task mastery and learning new skills. In contrast, ego-involving criteria revolves around the  
15 demonstration of superior, comparative ability with minimal effort (Nicholls, 1989). A task-  
16 involved conception of competence is promoted within an environment where the teacher  
17 values hard work, effort, skill development and pupils working together (i.e., a task-involving  
18 climate; Ames, 1992). An ego-involved conception of competence is assumed to be more  
19 likely to emerge when a teacher criticises pupil mistakes and recognises and rewards only the  
20 most able performers (i.e., an ego-involving climate; Ames, 1992). Research (for a summary  
21 see Liu, Xiang, Lee & Li, 2017) shows that pupil perceptions of a task-involving climate  
22 predicts more adaptive motivational processes and outcomes in PE, whereas an ego-involving  
23 climate in PE predicts maladaptive motivational processes and negative outcomes in pupils.  
24 Although the literature that has adopted AGT to examine the motivational climate created by  
25 PE teachers has been psychological in nature, Morgan (2017) recently explained that the

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1 achievement-related structures inherent to task- and ego-involving climate can also be  
2 understood from a pedagogical perspective which holds direct implications for how PE  
3 teachers teach.

**4 SDT: Autonomy Supportive, Socially Supportive, and Controlling Environments**

5 SDT is concerned with the study of human motivation and personality (Deci & Ryan,  
6 2000) and predicts that the satisfaction of three psychological needs (i.e., autonomy,  
7 competence and relatedness) will promote more autonomous motivation (e.g., participating in  
8 PE because one enjoys it and/or values the benefits) resulting in sustained behavior, quality  
9 engagement, and well-being. Conversely, unsatisfied and/or thwarting of the three  
10 psychological needs leads to controlled motivation (e.g., participating in PE out of fear, guilt  
11 or pressure, or to receive rewards/ praise). In this case, student disengagement, undesirable  
12 behaviors and ill-being are expected outcomes (Deci & Ryan 1985, 2000). Key motivational  
13 climate dimensions within SDT are autonomy support, social support, and controlling  
14 teaching. An autonomy-supportive PE teacher recognises pupils' preferences and provides  
15 meaningful choices. Decisions made about learning and mastery are pupil-centred, and a  
16 rationale is provided with requests (Cheon & Reeve, 2013). Within a socially-supportive  
17 environment every pupil matters, feels valued and cared for as a student and person (Mageau  
18 & Vallerand, 2003). In contrast, controlling teachers pressure pupils to behave, think and feel  
19 in a specific way (Reeve & Jang, 2006). Research evidence (for a summary, see Sun, Li &  
20 Shen, 2017) supports a positive relationship between autonomy- and socially-supportive  
21 climates in PE with the satisfaction of pupils' psychological needs, autonomous motivation,  
22 well-being, and effective functioning. In contrast, controlling climates positively predict  
23 students' unsatisfied and thwarted psychological needs, controlled motivation, ill-being and  
24 disengagement in PE. This evidence suggests that, as per AGT, the motivational climate  
25 according to SDT holds significant pedagogical implications for teachers that allow pupils to  
26 thrive (or not) in PE (Curran & Standage, 2017).

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**1 Integrating SDT and AGT: Empowering and Disempowering Motivational Climates**

2 Building upon research concerning the motivational climate from a SDT or AGT  
3 perspective, Duda (2013) proposed that it is possible to simultaneously examine an  
4 interconnected array of facets of the social environment proposed in both theories.  
5 Specifically, based on the tenets of SDT and AGT and previous research, Duda suggests there  
6 are more empowering (i.e., those which are more task-involving, autonomy- and socially-  
7 supportive) and disempowering (i.e., they are more ego-involving and controlling/relatedness  
8 thwarting) climates. In integrating the climate dimensions from AGT and SDT, Duda's  
9 (2013) framework highlights that each climate dimension is important in predicting basic  
10 psychological need satisfaction and thwarting, motivation regulations and outcomes (see  
11 Duda & Appleton, 2016). That is, although there is theoretical (and often statistical) overlap  
12 between the climate dimensions proposed by AGT and SDT, no dimension is redundant  
13 within Duda's perspective (Appleton, Ntoumanis, Quested, Viladrich & Duda, 2016). To  
14 date, Duda's (2013) framework has informed an examination of the motivational climate and  
15 its correlates in youth sport. Smith et al. (2016), for example, reported that athletes who  
16 perceived the environment to be more empowering reported more autonomous motivation.  
17 Conversely, a perceived disempowering environment was associated with higher scores on  
18 controlled motivation and amotivation.

19 Although it is important to recognise that young people may have different reasons for  
20 participating in youth sport (i.e., where participation is generally voluntary) compared to PE  
21 (i.e., where participation is generally compulsory for all students), creating an empowering  
22 learning environment (and reducing disempowering environments) in both contexts are  
23 equally important (Mayorga-Vega, & Viciano, 2014). Regardless of the young person's  
24 achievement level in sport or PE, research concerning the motivational climate suggests that  
25 teachers and coaches who are more empowering will foster enjoyment, commitment,  
26 persistence and increase intrinsic motivation in all young people (Duda et al., 2014).



## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE - PE 7

1 Conversely, teachers and coaches who adopt more disempowering strategies increase the  
2 extent to which young people experience anxiety, drop out, avoidance and decreases in effort  
3 (Duda et al., 2014) in sport or PE. Thus, Duda's (2013) model seems to offer equal potential  
4 for investigating the motivational climate in both youth sport and PE. Adopting Duda's model  
5 in PE is also advantageous because, in contrast to previous research on the teacher-created  
6 motivational climate in PE which has generally adopted AGT or SDT, it integrates and  
7 considers in a more comprehensive way the features of the motivational climate (based on  
8 AGT and SDT) which have pedagogical significance.

9         Given the prominence of SDT and AGT research to an understanding of the nature  
10 and implications of the PE teacher-created motivational climate, it seems reasonable to  
11 suggest that Duda's (2013) integrated framework could also inform future research in PE.  
12 However, such work requires a valid and reliable measure of the degree to which PE teacher-  
13 created motivational climates are empowering and disempowering. Soini et al.'s (2014)  
14 Motivational Climate in Physical Education Scale (MCPES) is one measure which evaluates  
15 task- and ego-involving, and autonomy and socially supportive climates as created by PE  
16 teachers. However, the MCPES does not capture controlling teaching and the items for the  
17 MCPES were derived from scales based purely within AGT. Thus, it is possible that the SDT-  
18 based climate dimensions are not accurately defined nor sufficiently captured in the MCPES.

19         Recently, Appleton et al. (2016) adopted Duda's framework to inform the  
20 development and initial validation of the EDMCQ; a scale that draws from AGT and SDT to  
21 capture empowering and disempowering motivational climates. An initial study by Appleton  
22 et al. (2016) suggested that Exploratory Structural Equation Model (ESEM) (compared to  
23 confirmatory factor analyses; CFA) solutions of the EDMCQ multidimensional, higher-order  
24 structure provided a best fit in multiple groups of youth athletes. However, inspection of the  
25 factor loadings revealed that many autonomy-supportive and some controlling and socially-  
26 supportive items failed to load significantly on their intended factor and demonstrated

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1 elevated and significant factor loadings on non-intended dimensions (i.e., autonomy- and  
2 socially-support items loaded onto the task-involving dimension; controlling items loaded  
3 onto the ego-involving dimension). Appleton et al's (2016) findings suggest that, rather than a  
4 hierarchical structure representing five lower-order and two higher-order factors, the EDMCQ  
5 in its current format may be best represented by two composite factors whereby task-  
6 involving, autonomy- and socially-supportive items load onto an empowering factor, and ego-  
7 involving and controlling items load onto a disempowering factor. However, Appleton et al.  
8 (2016) did not test the fit of the two factor model nor compare its fit against a hierarchical  
9 model.

### 10 Present Study

11 Guided by Duda's framework (2013), the aim of this study was to examine the  
12 psychometric properties of an adapted EDMCQ that captured secondary school students'  
13 perceptions of the empowering and disempowering features of the PE teacher-created  
14 motivational climate (EDMCQ-PE). Aligned with Appleton et al. (2016), the current study  
15 sought to identify the best approach to modeling the factor structure of the EDMCQ-PE and  
16 establish the internal reliability of pupils' scores. Consistent with Appleton et al., ESEM  
17 (compared to CFA) models were expected to provide the best approach to modeling the  
18 scale's factor structure. A two factor composite model was also expected to provide the best  
19 modeling approach. Extending the analyses of Appleton et al., and to further establish the  
20 psychometrics of the scale, gender measurement invariance was also tested.

### 21 Methods

#### 22 Participants

23 A total of 1662, 12-15 year old ( $M = 13.74$ ;  $SD = 0.81$ ) Welsh pupils participated in  
24 this study. Group one ( $N = 826$ ) comprised 50.12% males ( $M$  age = 13.77 years;  $SD = 0.95$   
25 years) who received 2.5 to 4 hours of PE lessons per week. Group two ( $N = 836$ ) comprised

## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE - PE 9

1 53.71% males ( $M$  age = 13.72 years;  $SD$  = 0.66 years) who received 3 to 4 hours PE per  
2 week.

### 3 **Climate Measures**

4 After at least 12 weeks of PE lessons, pupils completed the EDMCQ-PE. The 34  
5 items from the EDMCQ-C were adapted from sport to a PE context (e.g., “my coach  
6 encouraged players to try new skills” adapted to “my teacher encouraged pupils to try new  
7 skills”). The terminology in each item that made reference to the theoretical concepts was not  
8 changed. Responses were provided on a 5-point scale (i.e., 1 = “strongly disagree” to 5 =  
9 “strongly agree”). The average Flesch-Kincaid reading level was 6.0, suggesting items were  
10 suitable for the target age group.

11 The EDMCQ-C includes 16 items from the Perceived Motivational Climate in Sport  
12 Questionnaire-2 (Newton, Duda & Yin, 2000) which capture task- (nine items) and ego-  
13 (seven items) involving climate features. These features included cooperative learning (e.g.,  
14 “My teacher encouraged pupils to really work together in class”), important role (e.g., “My  
15 teacher made sure everyone had an important role in the class”), effort improvement (e.g.,  
16 “My teacher encouraged pupils to try new skills”), punishment for mistakes (e.g., “My  
17 teacher yelled at pupils for messing up”) and unequal recognition (e.g., “My teacher had his  
18 or her favourite pupils”).

19 Pupils’ perceptions of autonomy-support were assessed using five items (e.g., “My  
20 teacher gave pupils choice and options”) taken from Reinboth, Duda and Ntoumanis’s (2004)  
21 adapted version of the Health Care Climate Questionnaire (Williams, Grow, Freedman, Ryan,  
22 & Deci, 1996) and Reeves (2006) proposals on autonomy supportive climates emphasizing  
23 participating for intrinsic reasons (e.g., “My teacher thought it important for students to  
24 participate in PE because the pupils enjoy PE”).

25 Pupils’ perceptions of their teachers’ controlling behaviors were measured via 10

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1 items, including eight items from the Controlling Coaching Behaviors Scale (Bartholomew,  
2 Ntoumanis, & Thøgersen-Ntoumani, 2010) which tapped teachers' controlling use of rewards  
3 (e.g., "My teacher mainly used rewards/praise to make pupils complete all the tasks he or she  
4 set during class"), negative conditional regard (e.g., "My teacher paid less attention to pupils  
5 if they displeased him or her"), intimidation (e.g., "My teacher shouted at pupils in front of  
6 others to make them do certain things"), and excessive personal control (e.g., "My teacher  
7 tried to control aspects of pupil's lives outside of PE"). Two further items were included in  
8 the EDMCQ-C measuring controlling use of rewards (e.g., "My teacher only allowed us to do  
9 something we like to do at the end of class if we had done well during class").

10 Pupils' perceptions of their teachers' social support were measured using three items  
11 (e.g., My teacher could really be counted on to care, no matter what happened) originally  
12 presented in the Social Support Questionnaire-6 (Sarason, Sarason, Shearin, & Pierce, 1987)  
13 and modified for use with coaches by Reinboth et al. (2004).

14 **Procedures.** An ethics committee of the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> authors' University approved  
15 the project. The first author subsequently made contact with head teachers to introduce the  
16 project. Information letters describing the project purpose and procedures were then  
17 distributed to parents who could opt-out their child from the project. The project was also  
18 explained verbally and in writing to the pupils. Pupils who agreed to participate completed  
19 consent forms followed by an inventory which included the EDMCQ-PE. Data collection  
20 took place at 11 schools, a small team of data collectors led by the 1<sup>st</sup> author administered the  
21 questionnaires and pupils completed the inventory without discussing answers with  
22 classmates or teachers. The inventory took 20-40 minutes to complete.

### 23 Data Analysis

24 **Testing alternative models.** Structural equation modelling analyses were performed  
25 in Mplus 8.0 (Muthén & Muthén, 2017) using the procedures outlined by Morin, Arens and  
26 Marsh (2016) for CFA and ESEM. CFA and ESEM are statistical approaches to testing the

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1 factor structure of a scale. Marsh et al.'s (2004) suggested that in preliminary analyses of a  
2 scale's factor structure, researchers should compare the findings (i.e., model fit, standardized  
3 factor loadings and factor correlations) using CFA and ESEM. CFA utilises the Independent  
4 Cluster Model where first-order factors are allowed to correlate, observed variables load only  
5 onto their intended factor, and cross loadings on non-intended factors are restricted to zero. In  
6 contrast, ESEM integrates the principles of exploratory factor analysis (EFA) within the CFA  
7 framework (Asparouhov & Muthen, 2009), items cross load onto non-intended factors which  
8 is reported to better represent (and evaluate) the factor structure of complex multidimensional  
9 structures such as the EDMCQ-PE (Asparouhov & Muthen, 2009) where factors overlap.  
10 Previous research generally supports the use of ESEM over CFA as the most appropriate  
11 approach to modeling multidimensional scale's factor structure (Marsh, Nagengast & Morin,  
12 2013)

13 A higher-order ESEM model (H-ESEM), tested via an approach where lower-order  
14 factors are defined within an ESEM and CFA estimates the higher-order factors (Marsh et al.,  
15 2013), and a bi-factor (Holzinger & Swineford, 1937) ESEM model can also be tested when  
16 determining the best fitting measurement model. In a bi-factor model, the covariances among  
17 item answers can be described by a pattern matrix in which each item loads onto a general (or  
18 global) factor (e.g., empowering climate) and a group (or specific) factor (e.g., task-involving  
19 climate). Furthermore, all correlations are constrained to be zero among the group-factors and  
20 the global-factors. Although researchers have relied on an approach (B-CFA) in which items  
21 load on a global factor and only one group factor, it is now possible to test a bi-factor  
22 structure within ESEM (B-ESEM; Morin et al., 2016) where items are permitted to load on  
23 multiple factors.

24 In this study, we initially examined the fit of the original model tested by Appleton et  
25 al. (2016) which included the targeted five lower-order climate dimension factors via CFA  
26 and ESEM. The approach associated with the best fit (i.e., CFA or ESEM) informed the

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1 testing of higher-order and bi-factor models. Finally, the best fitting model was compared to  
2 the fit of a simpler two factor composite (i.e., “empowering” and “disempowering”) lower-  
3 order model. Models were tested based on the robust Weighted least square (WLSMV)  
4 estimator. For the ESEM, target rotation was used where all cross loadings were specified to  
5 be close to zero and the main loadings were freely estimated (Morin et al., 2016).

6 **Invariance.** Millsap and Yun-Tein’s (2004) recommendations for invariance testing  
7 with categorical variables were adopted. First, we combined the samples and the findings  
8 from the “tests of alternative models” informed the model tested. The validity of the model in  
9 boys and girls was then tested via a multiple group analysis without any equality constraint  
10 (configural invariance). Measurement invariance of factor loadings and thresholds (scalar  
11 invariance; Muthén & Muthén, 2012) was then tested. Total or partial scalar invariance  
12 ensures meaningful latent mean comparisons across gender (Marsh et al., 2013).

13 **Assessment of Model Fit.** Goodness of fit was evaluated using the Comparative Fit  
14 Index (CFI), the Tucker Lewis index (TLI) and Root Mean Square of Approximation  
15 (RMSEA) with its 90% confidence interval. Hu and Bentler (1999) proposed the following  
16 cut off criteria: CFI and TLI  $>.90$  and  $>.95$  and RMSEA values  $<.08$  and  $<.06$ , which are  
17 considered as indicators of acceptable and excellent fit, respectively. To allow a degree of  
18 flexibility in the cut-off criteria, the parameter estimates, statistical conformity and theoretical  
19 relevance were also consulted when evaluating and comparing model fit (Marsh, Hau, &  
20 Wen, 2004).

21 When comparing the fit of the structural models and nested models in the invariance  
22 process, it is advised that competing models provide a similar degree of fit to the data and the  
23 change in CFI is  $< 0.1$  and increases in RMSEA are  $< 0.15$ . In particular, Marsh and  
24 colleagues (2009; 2010) suggested that fit indices that correct for parsimony (e.g., RMSEA)  
25 are particularly important in ESEM given the large number of estimated parameters. For this  
26 study, we also examined the WRMR when comparing the alternative models. While not

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1 describing the fit of the models, lower WRMR values reflect better fit.

2 Internal reliability was tested using Cronbach's Alpha. An alpha above .80 constitutes  
3 a reliable measure (Clark & Watson, 1995), while .70 and .60 are generally agreed as the  
4 lower limits for scales with 10 or more and less than 10 items, respectively (Hair et al., 2010).

## 5 Results

### 6 Testing Alternative Models in Group One

7 **CFA versus ESEM.** CFA provided a poor fit, and the ESEM an excellent fit, to the  
8 data for the five-factor lower-order model, respectively (see Table 1). ESEM also resulted in  
9 lower factor correlations ( $|r| = -0.448$  to  $|r| = .506$ ) than the CFA ( $|r| = -.699$  to  $|r| = .939$ ),  
10 providing further support for the use of ESEM over CFA (see Table 2; Marsh et al., 2009).

11 ESEM parameter estimates (see Table 3) revealed well defined factors for task-  
12 involving and controlling dimensions due to substantial target factor loadings (task involving  
13  $|\lambda| = .207$  to  $.783$ ; controlling  $|\lambda| = .222$  to  $.475$ ). Autonomy support ( $|\lambda| = .357$  to  $.680$ ) and  
14 ego-involving ( $|\lambda| = .350$  to  $.923$ ) factors were fairly well defined, although both factors had  
15 two items which did not load as intended (autonomy support item 16  $|\lambda| = -.001$ , item 22  $|\lambda| =$   
16  $.098$ ; ego-involving item 5  $|\lambda| = -.130$ , item 10  $|\lambda| = .033$ ). Finally, the social support items did  
17 not load on their intended factor ( $|\lambda| = .040$  to  $.132$ ). In total, four items did not load  
18 significantly onto their intended factor and a number of items cross-loaded (and in some cases  
19 had higher loadings) onto non-intended factors. Two task-involving items (Item 1  $|\lambda| = .476$ ;  
20 Item 4  $|\lambda| = .349$ ) cross loaded on the autonomy support factor, and two autonomy support  
21 items (Item 16  $|\lambda| = .502$ ; Item 22  $|\lambda| = .463$ ) and three social support items (Item 8  $|\lambda| = .339$ ;  
22 Item 14  $|\lambda| = .421$ ; Item 27  $|\lambda| = .476$ ) cross loaded on the task-involving factor. Likewise, two  
23 ego-involving items (Item 5  $|\lambda| = .426$ ; Item 10  $|\lambda| = .489$ ) loaded onto the controlling factor.  
24 Overall, although the results supported the ESEM solution, social support items did not load  
25 onto their intended factor and cross-loaded onto the task-involving factor, and a number of  
26 other items loaded onto non-intended factors.

## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE - PE 14

1 **ESEM versus H-ESEM and B-ESEM.** The H-ESEM solution provided an excellent  
2 fit (see Table 1). The higher-order factors had a significant negative correlation of  $|r| = -.913$ ;  
3 however, none of the lower-order factors had significant ( $p < 0.05$ ) factor loadings on the  
4 higher order factors (TI:  $|\lambda| .404$ ; AS:  $|\lambda| .479$ ; SS:  $|\lambda| -.934$ ; CO:  $|\lambda| .695$ ; EI:  $|\lambda| .765$ ). For the  
5 B-ESEM, an orthogonal bi-factor target was employed when estimating the model (Reise et  
6 al., 2011). The B-ESEM model provided an excellent fit (see Table 1) that was superior to all  
7 the other models. Results from the B-ESEM solution (see Table 3) revealed a well-defined  
8 empowering G-factor with significant loadings on all 17 items ( $|\lambda| = .213$  to  $.539$ ). In contrast,  
9 the disempowering G-factor was less well defined with five significant factor loadings (three  
10 ego-involving and two controlling;  $|\lambda| = -.122$  to  $.590$ ). Over and above the G factors, three of  
11 the items (two empowering; AS: item 16 and 22; one disempowering EI: item 5) failed to  
12 demonstrate significant target factor loadings on their S factors, and the parameter estimates  
13 also revealed multiple non-target cross loadings. Three autonomy-supportive, three socially  
14 supportive and two ego-involving items had significant factor loadings on non-intended S  
15 factors (**all  $> .30$** . See Table 3). This suggests the task-involving, controlling and to a lesser  
16 extent ego-involving S factors tap into relevant specificity and add information to the G  
17 factors. The autonomy and social support S factors, however, appear to be less well defined.

18 In sum, ESEM models best fit the data in group one and although all three ESEM  
19 model provide an excellent fit, the B-ESEM had the best fit. However, parameter estimates  
20 revealed that the ESEM solutions failed to align to the theory underpinning the model.

21 **Re-testing the ESEM-related Models in Group Two**

22 All three ESEM models provided an excellent fit to the data (see Table 1) in  
23 group two, with the B-ESEM providing the best fit. The ESEM produced correlations in  
24 keeping with the theoretical assumptions of the model ( $|r| = .47$  to  $.43$ , see Table 2). The  
25 lower-order empowering factors correlated with each other positively but were negatively  
26 associated with the disempowering factors. The lower-order disempowering factors correlated



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1 with each other positively but negatively with the empowering lower-order dimensions. The  
2 parameter estimates (see Table 4) revealed well defined factors for task-involving, controlling  
3 and, to a lesser extent, ego-involving climate dimensions due to substantial target factor  
4 loadings (varying from  $|\lambda| = .29$  to  $.90$ ). There were two ego-involving items that did not load  
5 substantially on the intended factor (items 5 and 10,  $\lambda = -.20$  and  $-.07$ , respectively). The  
6 parameter estimates for autonomy- and social-support were less well defined with many items  
7 failing to load on their intended factor but loading significantly on the task-involving factor.

8       Regarding the H-ESEM, the factor correlations showed that the lower-order factors  
9 loaded ( $|r| = .30$  to  $.65$ ) non-significantly ( $p > 0.05$ ) onto the higher-order dimensions. In  
10 addition, the higher-order factors of empowering and disempowering showed a level of multi  
11 collinearity ( $|r|=1.21$ ). For the B-ESEM, there were some inconsistencies with the G factor  
12 where both the empowering and disempowering target loadings were not well defined. The  
13 empowering G factor had only five significant factor loadings ( $|\lambda| = -.23$  to  $.29$ ; see Table 4)  
14 with three task-involving, one autonomy-supportive and one socially-supportive items  
15 loading significantly. The disempowering G factor had nine significant factor loadings ( $|\lambda| = -$   
16  $.235$  to  $.368$ ) including five ego-involving and four controlling items.

17       Over and above the G factors, four items failed to demonstrate significant target factor  
18 loadings on their respective S factor. All nine task-involving and 10 controlling items loaded  
19 significantly on the target factor, and five of the seven ego-involving factors loaded  
20 significantly on the intended factor. This finding is in keeping with S factor results from  
21 group one. There were also similarities with the S factors of autonomy-support and social-  
22 support; however, for group two, all the items failed to load on their intended factor and  
23 loaded significantly on the task-involving S factor. Also similar to group one, the same two  
24 ego involving items cross-loaded significantly onto the controlling factor (items 5 and 10  $\lambda = -$   
25  $-.47$  and  $.69$ ). This suggests that task-involving, controlling and to a lesser extent ego-

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1 involving S factors tap into relevant specificity and add information to the G factor. The  
2 autonomy- and socially-supportive S factors, in contrast, appear to be less well defined.

3 In summary, the fit to the data of all three ESEM models was excellent, with the B-  
4 ESEM model having the best fit. Parameter estimates, particularly in the case of autonomy  
5 support and social support, were problematic, however. Overall, the results based on the  
6 responses to the scale provided by group two were similar with the findings from group one.

7 **Two-factor Composite Model:** In both groups, an ESEM model with two lower-  
8 order factors (i.e., empowering and disempowering) provided a reasonable fit to the data (see  
9 Table 1). Investigation of the parameter estimates (see Table 5) revealed that items loaded  
10 significantly ( $p < .001$ ) onto their intended factor. In addition, the parameter estimates  
11 revealed a well-defined factor for the empowering climate due to substantial target factor  
12 loadings (group one:  $|\lambda| = .29$  to  $.90$ ; group two:  $|\lambda| = .50$  to  $.73$ ). For the disempowering  
13 climate, the majority of target factor loadings were consistent with the underlying conceptual  
14 model (group one:  $|\lambda| = .30$  to  $.83$ ; group two:  $|\lambda| = .20$  to  $.67$ ) with the exception of  
15 controlling coaching items 15 and 29 which loaded more strongly onto the empowering factor  
16 in both groups, and controlling coaching item 20 which loaded more strongly onto the  
17 empowering factor in group one. Standardised correlations were keeping with the theoretical  
18 assumptions of the model (group one:  $|r| = -0.48$ ; group two:  $|r| = -0.51$ ).

19 In sum, the fit of a two factor composite model was not as strong as the other ESEM  
20 models, albeit the fit was still acceptable in both groups and the majority of the items loaded  
21 as intended in the two factor model (which was not the case for the other ESEM models). As  
22 a result, the two-factor model was adopted when testing for gender measurement invariance.

**Internal Reliability**

24 Cronbach's alphas for group one were: task-involving  $\alpha = .86$ ; autonomy support  $\alpha =$   
25  $.67$ ; social support  $\alpha = .65$ ; ego-involving  $\alpha = .78$ ; controlling  $\alpha = .64$ ; empowering  $\alpha = .90$ ;  
26 disempowering  $\alpha = .82$ . Group two's Cronbach's alphas were: task-involving  $\alpha = .86$ ;

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1 autonomy support  $\alpha = .71$ ; social support  $\alpha = .68$ ; ego-involving  $\alpha = .76$ ; controlling  $\alpha = .68$ ;  
2 empowering  $\alpha = .91$ ; disempowering  $\alpha = .82$ .

**Measurement Invariance across Gender for the Two-factor Model**

4 Indices of fit for configural invariance were CFI=.91, TLI=.90, RMSEA=.06,  
5 90%CI=0.06-0.06, WRMR=2.13 and scalar invariance CFI=.91, TLI=.92, RMSEA=.06  
6 90%CI= 0.054-0.058, WRMR=2.49, offering support for scalar invariance. Non-standardised  
7 factor loadings were statistically invariant across gender, thus only standardised factor  
8 loadings for the boys are reported. Standardised factor loadings (see Table 5) revealed the  
9 majority of empowering and disempowering items for the boys positively and more strongly  
10 loaded on their intended factor (than on the non-intended factor), except for controlling  
11 coaching items 15, 20 and 29 which loaded more strongly onto the empowering factor. For  
12 the non-reference (girls) group, standardised factor loadings for empowering items ranged  
13 from .53 to .74 ( $p < .001$ ) on the empowering factor and -.13 to .20 on the disempowering  
14 factor. The standardised factor loadings for the disempowering items ranged from .19 to .74  
15 ( $p < .001$ ) on the disempowering factor and -.23 to .47 on the empowering factor. Again,  
16 controlling items 15, 20 and 29 loaded positively and more strongly onto the empowering  
17 compared to the disempowering factor. Finally, the correlation between the empowering and  
18 disempowering factor was -.46 ( $p < .001$ ) in the boys and -.60 ( $p < .001$ ) in the girls.

**Discussion**

20 This study identified the best approach to modeling the EDMCQ-PE's factor structure,  
21 established the internal reliability of pupils' scores on the scale, and confirmed gender  
22 measurement invariance in two groups of Welsh students. Aligned with Appleton **et al.'s**  
23 (2016) findings in youth sport, the ESEM solution provide a better fit compared to CFA  
24 solution for the scale's structure. Further support for the ESEM over the CFA solution was  
25 gleaned via the reduced correlations between the five climate dimensions. These findings  
26 replicate earlier studies (e.g., Myers, Chase, Pierce & Martin, 2011) which evidenced the

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1 superiority of ESEM, and provide further support for its use when examining the factor  
2 structure of complex, multidimensional scales.

3 From a theoretical perspective, there is a clear overlap between items tapping task-  
4 involving, autonomy- and socially-supportive (empowering) climates, and between items  
5 capturing controlling and ego-involving (disempowering) climates (Appleton et al., 2016). It  
6 is therefore unsurprising that ESEM outperformed CFA when modeling the EDMCQ-PE.  
7 This is because when conducting CFA, items cannot cross loading onto non-intended, albeit  
8 related factors and this subsequently leads to inflated factor correlations and poorer fit (Marsh  
9 et al., 2013). In comparison, ESEM permits items to load on both intended and non-intended  
10 factors. This more flexible approach resulted in a better fit and reduced correlations between  
11 the factors in the current study. Building upon Appleton et al.'s (2016) finding with the  
12 EDMCQ-C, it seems the factor structure of the EDMCQ-PE is best represented by ESEM.

13 Despite best fit emerging with the ESEM solutions, the parameter estimates revealed  
14 elevated cross-loadings. This suggests the ESEM solutions across both groups did not fully  
15 support Duda's (2013) theoretical model underpinning the scale. Specifically, two task-  
16 involving items had elevated and significant factor loadings on autonomy-support in group  
17 one, and many (or all) of the autonomy- and social-support items had high factor loading  
18 values on the task-involving dimension in group one and/or two. Likewise, in both groups,  
19 two ego-involving items had elevated scores on the controlling dimension. Elevated cross-  
20 loadings were also evident in the ESEM conducted by Appleton et al. (2016) when examining  
21 the psychometrics of the EDMCQ-C. Moreover, evidence of cross-loadings is consistent with  
22 the assumption of ESEM that complex, multidimensional structure scales will rarely have  
23 indicators that are "pure" indicators of one factor (Marsh et al., 2013). As Appleton et al.  
24 (2016) explained, the cross-loading of task-involving, autonomy- and social-support items  
25 onto non-intended lower order factors is understandable given the theoretical overlap between  
26 the key features of these empowering climate dimensions. For example, it is likely that in

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1 encouraging a task-focused approach to competence, PE teachers will provide their students  
2 with meaningful choices and rationales during the lessons, welcome pupils' input during  
3 activities and teamwork, and take a socially-supportive approach when correcting mistakes  
4 and errors. In contrast, a controlling PE teacher who conveys negative conditional regard and  
5 intimidates the pupils will likely be ego-involving by responding to students' mistakes with  
6 criticism. Despite permitting items to cross-load onto a non-intended factor in ESEM,  
7 however, it is expected that items load most strongly (and significantly) onto their intended  
8 factor – this was not the case in this study for a number of the items.

9         The failure of some items to load most strongly (and in some case, significantly) onto  
10 their intended factor was also evident in the B-ESEM. The B-ESEM was associated with the  
11 best model fit in both groups, yet only five items (from 17) loaded significantly onto the G  
12 disempowering factor in group one. In group two, only five items loaded significantly onto  
13 the G empowering factor and nine items loaded significantly onto the G disempowering  
14 factor. Moreover, replicating the findings from the ESEM, a number of items failed to load  
15 significantly and most highly on their intended S factor in both groups. The findings relating  
16 to the B-ESEM model are thus generally consistent with those reported by **Appleton et al.'s**  
17 (2016) examination of the EDMCQ-C's factor structure and reinforce their conclusion that  
18 despite being associated with the best fit, the B-ESEM solution does not accurately represent  
19 Duda's (2013) multidimensional, hierarchical model of the motivational climate.

20         The findings associated with the ESEM solutions are noteworthy because Marsh et al.  
21 (2010) suggested that the appropriateness (and adoption) of a particular model should not be  
22 based on fit indices alone, and parameter estimates should be consulted. In contrast to the five  
23 lower-order factors ESEM and B-ESEM solutions, the fit indices for the two factor composite  
24 model were lower. Importantly, however, the model fit was still acceptable and the parameter  
25 estimates were less problematic across both groups. Specifically, all the task-involving,  
26 autonomy and social support items loaded significantly and most strongly onto one

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1 (empowering) factor, and all the ego-involving items and the majority of controlling items  
2 loaded significantly and strongly onto a second (disempowering) factor. The cross-loading of  
3 a number of controlling items onto the empowering factor was consistent in both groups and  
4 was invariant across boys and girls. Despite these cross-loading items, and departing from  
5 Duda's (2013) proposed hierarchical model of the motivational climate, the two factor model  
6 seems to offer a cleaner solution compared to the other models tested in this (and Appleton et  
7 al's) study. The adoption of a two factor model is also partly reinforced by the findings testing  
8 the other ESEM models in this study and in Appleton et al. (2016), where many empowering  
9 items loaded most strongly onto one factor and a number of ego-involving items loaded most  
10 strongly onto a second factor with the controlling items. Thus, researchers adopting the  
11 EDMCQ-PE (and EDMCQ-C) may wish to proceed by adopting this less complex two-factor  
12 structure. Doing so would enable researchers to capture empowering and disempowering  
13 teacher-created motivational climates in PE, and would reduce the complexities associated  
14 with establishing the psychometrics of the scale in other samples.

15 The controlling items that cross-loaded onto the empowering factor in the two-factor  
16 model were 15 ("My teacher only allowed us to do something we like to do at the end of class  
17 if we had done well during class"), 20 ("My teacher only rewarded students with prizes, treats  
18 or fun activities if they performed well in PE"), and 29 ("My teacher mainly used rewards/  
19 praise to make pupils complete all the tasks he or she sets during class"). All three items were  
20 originally included in the EDMCQ to capture the subtle use of rewards that can control  
21 behavior (and performance), as per a key assumption of SDT (and specifically cognitive  
22 evaluation theory; Deci, 1975). This key assumption applied to PE suggests that when  
23 teachers use rewards and praise in a controlling manner (e.g., to ensure pupils complete set  
24 tasks in class), pupils are more likely to have their feelings of autonomy and intrinsic  
25 motivation towards the task undermined (Deci & Ryan, 1975). However, in this study, the  
26 findings suggest that pupils did not interpret these teaching strategies involving rewards and

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1 praise as just controlling/disempowering. Instead, the strategies were also perceived as  
2 empowering. The reason why these controlling items were perceived as empowering is  
3 unclear. One possible explanation, consistent with cognitive evaluative theory, is that the use  
4 of rewards may not have been viewed by the pupils as controlling (thus undermining feelings  
5 of autonomy), but rather as informational which enhancing of feelings of competence, and the  
6 satisfaction of the psychological need for competence is a key correlate of an empowering  
7 motivational climate (Duda & Appleton, 2016). It may also be that the rewards given in  
8 response to doing and performing well during class were interpreted by students in a task-  
9 involving manner, such as recognition for personal development, successfully executing a  
10 teaching instruction, and/or the application of effort. Future research should determine the  
11 extent to which the use of rewards as stipulated in items 15, 20 and 29 in PE are empowering  
12 over the short and long-term. For example, qualitative research with teachers and pupils may  
13 reveal the extent to which the use of rewards is task-involving and competence promoting.  
14 We recommend that until future research clarifies whether (and why) these controlling  
15 strategies are empowering, items 15, 20 and 29 should not be included in the EDMCQ-PE

16       Regarding measurement invariance, the findings in the current study suggest the two  
17 factor model showed scalar invariance across boys and girls. This particular finding provides  
18 further information on the psychometric properties of the scale, and suggests the EDMCQ-PE  
19 can be used to provide meaningful latent mean comparisons across boys and girls in terms of  
20 their perceptions of the overall empowering and disempowering features of the motivational  
21 climate manifested in PE classes. Such comparisons are important given the call by authors  
22 (e.g., Duda et al., 2014) for interventions that attempt to manipulate the teacher-created  
23 motivational climate in PE to enhance the empowering (and minimize the disempowering)  
24 characteristics of this environment. In addition, scalar invariance means it is possible to test,  
25 and compare across gender, theory-informed process models (see Duda & Appleton, 2016)  
26 that include PE teacher-created empowering and disempowering climates. Such research

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1 would also contribute to the nomological validity of the EDMCQ-PE.

2 **Limitations and Future Directions**

3 A limitation of this study is that additional indicators of validity and reliability were  
4 not examined. This is because we wanted to first determine the best solution representing the  
5 structure of the EDMCQ-PE. In the future, researchers should consider other forms of validity  
6 (e.g., predictive validity; invariance across countries, age) and reliability to further establish  
7 the psychometrics of the EDMCQ-PE. A further limitation is that the multilevel nature of the  
8 data (i.e. pupils with classes) was not considered. This is because within the two groups of  
9 pupils, there were a limited number of classes per parameter which made it unfeasible to test  
10 the multilevel nature of the data. Future research should attempt to address this issue by  
11 recruiting pupils from a larger number of classes (and schools) and accounting for clustering  
12 effects when examining the EDMCQ-PE's factor structure (see Myers, 2013, for an example).  
13 Future research should also test EDMCQ-PE's factor structure in a range of school settings  
14 and pupils given the current study was limited to secondary school Welsh pupils. From a  
15 pedagogical and practical perspective, the EDMCQ-PE could be used by teachers and  
16 researchers to establish the empowering and disempowering climate being created in  
17 secondary/high school PE. The scale could be used, for example, to determine the extent to  
18 which teachers (based on self-report and/or students' perceptions) are (or are not) employing  
19 motivational strategies that are known to foster or hinder students' autonomous motivation,  
20 learning, engaging and psychological health. In turn, the identification of the presence and/or  
21 absence of specific motivation-related strategies could inform the content of CPD education  
22 workshops, to ensure PE teachers' future attempts to create a motivational climate in class are  
23 more empowering and less disempowering. Moreover, such CPD education workshops could  
24 enhance PE teachers' understanding of why the motivational climate and specific  
25 empowering and disempowering strategies impact on their students.

26 **Conclusion**



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1           The evidence from this study suggests that, in its current format, the EDMCQ-PE does  
2 not replicate the hierarchical structure of the motivational climate proposed by Duda (2013).  
3 This finding is consistent in youth sport (Appleton et al., 2016) and suggests further work is  
4 required to amend the EDMCQ in order to better represent the structure of the motivational  
5 climate according to Duda's (2013) model. Such work may focus on re-writing and/or  
6 deleting items that failed to load on its intended factor and/or had elevated factor loadings on  
7 non-intended factors in this study. However, the current study does suggest the EDMCQ-PE  
8 may be used by researchers and teachers to capture the two key composite climate dimensions  
9 (i.e., empowering and disempowering) proposed by Duda (2013) and that this approach to  
10 modeling the scale's factor structure (i.e., two lower-order factors) is scalar gender invariant.

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## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE - PE 27

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## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE - PE 28

1 Table 1. Goodness of Fit Statistics and Information Criteria for the Models Estimated on the  
2 EDMCQ-PE

	X2	df	CFI	TLI	RMSEA	RMSEA 90%CI	WRMR
Model (Group 1)							
CFA	2747.02*	517	.88	.87	.07	.07/.08	2.02
ESEM	944.15*	401	.97	.96	.04	.04/.04	0.85
H-ESEM	943.47*	405	.97	.96	.04	.04/.04	0.86
B-ESEM	691.25*	366	.98	.97	.03	.03/.4	0.69
Two Factor (ESEM)	1868.72*	494	.92	.92	.06	.06/.06	1.40
Model (Group 2)							
ESEM	932.71*	401	.97	.96	.04	.04/.04	0.82
H-ESEM	918.70*	405	.97	.96	.04	.04/.04	0.83
B-ESEM	772.45*	366	.98	.97	.04	.03/.04	0.73
Two Factor ESEM	2406.22	494	.91	.89	.07	.07/.07	1.58

3 *Note.* CFA= Confirmatory factor analysis; H = Hierarchical model; B = Bifactor model; ESEM = Exploratory structural equation modeling;  
4 df = Degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; CI =  
5 confidence interval; WRMR = weighted root mean square residual; ESEM were estimated with target oblique rotation; bifactor-ESEM were  
6 estimated with bifactor orthogonal target rotation; \*  $p < .01$ .  
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13 Table 2. Standardized Factor Correlations for the CFA and ESEM solutions for the EDMCQ-

14 PE

	Task Involving	Autonomy- Supportive	Socially- Supportive	Ego-Involving	Controlling Coaching
Task Involving		.94** / .95**	.94** / .98**	-.55** / -.63**	-.68** / -.64**
Autonomy-Supportive	.51** / .43**		.87** / .96**	-.48** / -.54**	-.62** / -.61**
Socially-Supportive	.43** / .34**	.28** / .21**		-.59** / -.73**	-.7** / -.74**
Ego-Involving	-.45** / -.47**	-.23** / -.31**	-.34** / -.32**		.86** / .84**
Controlling Coaching	-.25** / -.19**	-.035 / -.28**	-.25** / .10**	.44** / .42**	

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16 *Note.* CFA correlations (above the diagonal) ESEM correlations (below the diagonal). Group  
17 1 correlations to the left and Group 2 to the right. \*  $p < .05$ . \*\*  $p < .01$   
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## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE 29

1 Table 3. Standardised Factor loadings for ESEM and B-ESEM of the EMCQ (Group 1)

Item	CFA			ESEM				B-ESEM				G-F	Uniq		
	Factor Loading	Uniq	T	A	S	E	C	Uniq	T	A	S			E	C
1	.67**	.56**	.21**	.48**	.1*	-.1*	-.07	.5**	.38**	.32**	.12**	-.19**	-.14**	.44**	.49**
4	.77**	.41**	.29**	.35**	.25**	-.09*	-.10**	.66**	.50**	.21**	.26**	-.20**	-.21**	.4**	.62**
11	.75**	.45**	.44**	.36**	.18**	.11**	-.15**	.68**	.49**	.13**	.20**	-.06*	-.21**	.54**	.68**
13	.58**	.66**	.41**	.28**	.15**	.16**	-.1*	.4**	.4**	.08	.15**	.01	-.13**	.48**	.4**
18	.61**	.62**	.47**	.19**	.03	-.01*	.07*	.73**	.45**	.08*	.04	-.18**	.01	.42**	.73**
23	.70**	.51**	.49**	.07	.06	-.31**	.13**	.51**	.53**	.02	.07	-.35**	.02	.34**	.46**
28	.70**	.51**	.62**	.01	.03	-.15**	.01	.56**	.57**	-.05	.01	-.24**	-.08*	.35**	.42**
30	.73**	.47**	.76**	-.06	.02	-.03	-.08*	.65**	.73**	.04	-.12**	-.12**	-.16**	.21**	.6**
34	.71**	.49**	.78**	-.01	-.06	.01	-.08**	.41**	.67**	.03	-.17**	-.11**	-.14**	.32**	.37**
3	.58**	.66**	.13**	.36**	.1*	-.14**	-.07	.45**	.32**	.26**	.13**	-.2**	-.14**	.29**	.45**
6	.52**	.73**	.04	.68**	-.02	-.01	-.03	.39**	.22**	.55**	.02	-.08*	-.04	.43**	.36**
16	.73**	.47**	.50**	-.01	.23**	-.16**	.06	.47**	.62**	.02	.16**	-.21**	-.07	.22**	.44**
22	.62**	.62**	.46**	.1*	.09*	-.11**	.1**	.59**	.51**	.08	.08	-.15**	.01	.27**	.57**
32	.51**	.75**	.32**	.46**	-.05	.1**	.04	.52**	.35**	.39**	-.11**	.03	.04	.41**	.52**
8	.6**	.64**	.34**	.23**	.13**	-.02	-.06	.7**	.37**	.02	.25**	-.12**	-.13**	.42**	.67**
14	.72**	.48**	.42**	.17**	.04	-.25**	.02	.5**	.49**	.08*	.11*	-.31**	-.09*	.34**	.5**
27	.66**	.57**	.48**	.1*	.04	-.05	-.15**	.57**	.46**	-.03	.10*	-.17**	-.22**	.34**	.56**
5	.31**	.90**	-.29**	.26	-.03	-.13**	.43**	.59**	-.21**	.23**	.08	.01	.38**	.16	.58**
9	.78**	.39**	-.03	-.01	.0	.61**	.24**	.28**	-.28**	.01	-.14**	.62**	.38**	.02	.27**
10	.68**	.54**	-.07	.03	-.39**	.03	.49**	.68**	-.37**	-.07	-.14*	.15*	.45**	.40**	.68**
19	.76**	.42**	.06	.06*	.1**	.88**	.06	.72**	-.17**	.00	.04	.80**	.17**	.15	.72**
21	.5**	.75**	.0	-.01	.06	.35**	.3**	.64**	-.13**	.01	.01	.39**	.31**	.16*	.64**
25	.65**	.58**	-.11*	.03	-.05	.47**	.13**	.48**	-.33**	-.09*	.04	.46**	.19**	.17**	.47**
33	.84**	.29**	.09**	-.01	.01	.92**	.04	.47**	-.24**	-.07**	-.04	.83**	.17**	.17	.36**
2	.59**	.66**	-.16**	-.01	-.04	.21**	.36**	.63**	-.33**	-.07	-.01	.26**	.44**	.01	.61**
7	.70**	.51**	-.17**	-.12**	-.09*	.23**	.35**	.60**	-.43**	-.13**	-.2**	.28**	.50**	-.12	.55**
12	.72**	.48**	-.09*	-.13**	-.02	.28**	.48**	.60**	-.36**	-.15**	-.05	.35**	.53**	.07	.59**
15	-.3**	.91**	.07	.11*	.39**	-.17**	.35**	.49**	.37**	.21**	.31**	-.08*	.22**	.01	.48**
17	.63**	.60**	-.02	-.13**	-.02	.28**	.43**	.74**	-.27**	-.12**	-.1*	.34**	.47**	.08	.68**
20	-.13**	.98	.08	.01	.43**	-.09*	.47**	.41**	.3**	.1	.34**	.02	.33**	.05	.36**
24	.60**	.64**	.02	.09*	-.42**	.12**	.45**	.89**	-.28**	.00	-.17**	.21**	.37**	.59**	.81**
26	.54**	.71**	-.09*	.10*	-.22**	.07	.46**	.6**	-.28**	.00	.05	.18**	.39**	.43**	.54**
29	-.15**	.98*	.29**	.01	.16**	-.09*	.46**	.19**	.39**	.15**	.06	.00	.37**	.43	.19**
31	.2**	.96**	.08	.1*	-.05	.17**	.22**	.41**	.04	.21*	-.2**	.21**	.24**	.43	.39**

Note. Bold signifies items on their intended factor – Note T= Task-involving; A= Autonomy Support; S= Social Support; E= Ego-involving; C = Controlling \*p < 0.05, \*\*p < 0.001.

## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE 30

Table 4. Standardised Factor loadings for ESEM and B-ESEM of the EMCQ (Group 2)

Item	ESEM						B-ESEM						
	T	A	S	E	C	UNIQ	T	A	S	E	C	G-F	UNIQ
1	.65**	.02	0.02	-.06	-.09**	.48**	.62**	.25**	-.12*	-.17**	-.11**	-.13	.49**
4	.56**	.08	.17**	-.03	-.17**	.62**	.65**	.24**	.04	-.16**	-.2**	-.23**	.61**
11	.57**	.13**	.12**	-.08*	-.09**	.57**	.74**	.09*	-.01	-.14**	-.14**	-.14	.56**
13	.56**	.16**	.01	.03	.03	.45**	.63**	.1*	-.09*	-.01	.007	-.07	.41**
18	.35**	.29**	-.02	-.15**	.03	.72**	.61**	.02	-.04	-.08*	-.07**	.13	.57**
23	.29**	.35**	.01	-.38**	.11**	.66**	.66**	.07	-.01	-.26**	-.07	.26**	.61**
28	.38**	.25**	.08	-.21**	-.01	.43**	.58**	.31**	-.01	-.23**	-.13**	.20**	.35**
30	.36**	.3**	.15**	-.14**	-.06	.54**	.7**	.07*	.08*	-.13**	-.17**	.08	.54**
34	.36**	.31**	.12*	-.15**	-.02	.33**	.68**	.07	.06	-.12**	-.13**	.11	.34**
3	.42**	.12*	.24**	-.01	-.15**	.43**	.57**	.2**	.12**	-.12**	-.18**	-.12	.43**
6	.53**	.15**	.04	.08	.01	.43**	.48**	.38**	-.06	-.01	-.02	-.10	.39**
16	.46**	.23**	.05	-.07	-.13**	.45**	.58**	.34**	-.04	-.13*	-.20**	.07	.44**
22	.26**	.42**	-.08	-.07	-.05	.61**	.49**	.23**	-.05	.01	-.17**	.29**	.58**
32	.42**	.27**	.11**	.02	.1**	.42**	.53**	.32**	.04	-.03	.03	.02	.41**
8	.48**	.11*	.03	-.14**	-.13**	.64**	.58**	.21**	-.07	-.2**	-.19**	.02	.6**
14	.48**	.08	.07	-.3**	-.07**	.51**	.66**	.14**	-.06	-.33**	-.17**	-.03	.49**
27	.28**	.28**	.11*	-.15**	-.09**	.50**	.54**	.22**	.04	-.16**	-.2**	.17*	.49**
5	.16**	-.17**	.14	-.2**	.49**	.62**	-.04	.36**	.05	-.29**	.47**	.07	.6**
9	-.16**	.16**	.03	.7**	.18**	.27**	-.38**	.02	.08*	.61**	.32**	.17**	.27**
10	.00	-.18**	-.14	-.07	.69**	.62**	-.24**	-.14**	-.11*	.03	.69**	.08	.57**
19	.06	.04	.05	.9**	.01	.70**	-.32**	.03	.02	.68**	.22**	.35**	.7**
21	-.06	-.04	.07	.41**	.2**	.63**	-.24**	-.09*	.08*	.33**	.3**	.19**	.59**
25	.11*	-.11**	.01	.57**	.20**	.44**	-.26**	-.04	-.04	.41**	.35**	.31**	.42**
33	.13**	-.02	-.01	.88**	.04	.40**	-.34**	.06	-.06*	.65**	.25**	.37**	.36**
2	-.07	.22**	-.23**	.16**	.47**	.55**	-.19**	.08	-.09	.32**	.47**	-.15*	.54**
7	-.26**	.24**	-.19*	.25**	.48**	.53**	-.34**	.01	.04	.46**	.52**	-.24**	.50**
12	-.07	.02	-.10	.26**	.54**	.58**	-.27**	-.11**	-.02	.33**	.60**	.06	.57**
15	.11	-.01	.52**	-.08*	.22*	.51**	.23**	.27**	.41**	-.25**	.16*	.16	.46**
17	-.02	.03	-.17**	.20**	.55**	.72**	-.22**	-.09*	-.06	.31**	.59**	-.02	.73**
20	-.10	.13	.56**	.04	.33**	.47**	.2**	-.06	.52**	-.04	.29**	.18	.45**
24	.05	-.3**	-.14	-.02	.62**	.84**	-.28**	-.2**	-.2**	.01	.66**	.21*	.84**
26	.09	-.33**	.02	-.05	.57**	.63**	-.25**	.02	-.09	-.114	.59**	.25*	.62**
29	.05	.16*	.30**	-.19**	.39**	.27**	.32**	.02	.24**	-.16**	.28**	.04	.26**
31	.23**	.03	-.02	.07	.35**	.5**	.11**	.09*	-.07	.06*	.35**	.1	.48**

Note. Bold signifies items on their intended factor. T= Task-involving; A= Autonomy Support; S= Social Support; E= Ego-involving; C = Controlling. \* $p < 0.05$ , \*\* $p < 0.001$ .



## EMPOWERING AND DISEMPOWERING CLIMATE QUESTIONNAIRE 31

1 Table 5. Standardised Factor loadings for Two Lower-Order Factor ESEM and Measurement Invariance Across Gender

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Item	Group 1		Group 2		Gender Invariance <sup>a</sup>	
	Empowering	Disempowering	Empowering	Disempowering	Empowering	Disempowering
1	<b>.65**</b>	-.10*	<b>.67**</b>	-.08*	<b>.68**</b>	.00
4	<b>.69**</b>	.15**	<b>.67**</b>	.13**	<b>.67**</b>	-.08**
11	<b>.76**</b>	-.12**	<b>.73**</b>	-.1**	<b>.71**</b>	.00
13	<b>.65**</b>	.003	<b>.66**</b>	-.1	<b>.67**</b>	.09**
18	<b>.64**</b>	.25**	<b>.59**</b>	.17**	<b>.64**</b>	.04
23	<b>.61**</b>	-.03	<b>.66**</b>	-.02	<b>.63**</b>	-.11**
28	<b>.62**</b>	-.12**	<b>.65**</b>	-.08*	<b>.62**</b>	-.10**
30	<b>.65**</b>	.01	<b>.67**</b>	-.04	<b>.63**</b>	-.09**
34	<b>.67**</b>	.09*	<b>.67**</b>	.13**	<b>.59**</b>	-.05*
3	<b>.48**</b>	.03	<b>.59**</b>	-.01	<b>.54**</b>	-.04
6	<b>.61**</b>	-.13**	<b>.62**</b>	-.09**	<b>.62**</b>	.16**
16	<b>.61**</b>	-.12**	<b>.63**</b>	-.08*	<b>.59**</b>	-.12**
22	<b>.60**</b>	-.12**	<b>.5**</b>	-.09**	<b>.56**</b>	.00
32	<b>.67**</b>	-.06*	<b>.67**</b>	-.05	<b>.56**</b>	.19**
8	<b>.57**</b>	-.03	<b>.59**</b>	-.13**	<b>.58**</b>	-.06*
14	<b>.59**</b>	-.15**	<b>.64**</b>	-.18**	<b>.61**</b>	-.15**
27	<b>.53**</b>	-.16**	<b>.56**</b>	-.14**	<b>.53**</b>	-.14**
5	.04	<b>.36**</b>	.3**	<b>.40**</b>	.12**	<b>.36**</b>
9	-.06*	<b>.72**</b>	-.21**	<b>.62**</b>	-.10**	<b>.64**</b>
10	-.14**	<b>.54**</b>	-.003	<b>.66**</b>	-.08**	<b>.60**</b>
19	.09*	<b>.83**</b>	-.14**	<b>.67**</b>	.02	<b>.71**</b>
21	.04	<b>.54**</b>	-.14**	<b>.44**</b>	-.04	<b>.47**</b>
25	-.14**	<b>.52**</b>	-.10*	<b>.57**</b>	-.10**	<b>.52**</b>
33	.01	<b>.84**</b>	-.15**	<b>.67**</b>	-.03	<b>.71**</b>
2	-.13**	<b>.49**</b>	-.01	<b>.54**</b>	-.06*	<b>.47**</b>
7	-.27**	<b>.48**</b>	-.19**	<b>.57**</b>	-.22**	<b>.51**</b>
12	-.16**	<b>.61**</b>	-.09*	<b>.67**</b>	-.12**	<b>.65**</b>
15	.44**	<b>.13**</b>	.45**	<b>.19**</b>	.39**	<b>.18**</b>
17	-.10*	<b>.58**</b>	-.04	<b>.65**</b>	-.08**	<b>.64**</b>
20	.39**	<b>.26**</b>	.33**	<b>.33**</b>	.35**	<b>.30**</b>
24	-.05	<b>.59**</b>	-.07*	<b>.63**</b>	-.05*	<b>.60**</b>
26	-.03	<b>.55**</b>	.04	<b>.58**</b>	.01	<b>.57**</b>
29	.45**	<b>.30**</b>	.46**	<b>.28**</b>	.40**	<b>.30**</b>
31	.15**	<b>.37**</b>	.29**	<b>.43**</b>	.19**	<b>.38**</b>

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Note. Bold signifies items on their intended factor. \* $p < 0.05$ , \*\* $p < 0.001$ . <sup>a</sup> = standardised factor loadings of reference group (boys).

**ONLINE SUPPLEMENTARY MATERIAL - EDMCQ-PE Subscale****EMPOWERING**

1	My teacher encouraged pupils to try new skills	Task-Involving
4	My teacher tried to make sure pupils felt good when they tried their best.	Task-Involving
11	My teacher made sure pupils felt successful when they improved.	Task-Involving
13	My teacher acknowledged pupils who tried hard.	Task-Involving
18	My teacher made sure that each pupil contributed in the class in some important way.	Task-Involving
23	My teacher made sure everyone had an important role in the class.	Task-Involving
28	My teacher lets us know that all pupils have the opportunity to make a valuable contribution to activities in class.	Task-Involving
30	My teacher encouraged pupils to help each other learn.	Task-Involving
34	My teacher encouraged pupils to really work together in class.	Task-Involving
3	My teacher gave pupils choices and options	Autonomy-Supportive
6	My teacher thought that it was important that pupils participate in PE because they (the pupils) really want to.	Autonomy-Supportive
16	My teacher answered pupils' questions fully and carefully.	Autonomy-Supportive
22	When my teacher asked pupils to do something, he or she tried to explain why this would be good to do so.	Autonomy-Supportive
32	My teacher thought that it is important for pupils to participate in PE because they (the pupil) enjoy it.	Autonomy-Supportive
8	My teacher could really be counted on to care, no matter what happened.	Socially-Supportive
14	My teacher really appreciated each pupil as an individual, not just as pupils in their classes.	Socially-Supportive
27	My teacher listened openly and did not judge pupils' personal feelings.	Socially-Supportive

**DISEMPOWERING**

5	My teacher makes us do laps/press-ups etc. if we make a mistake.	Ego-involving
9	My teacher gave most attention to the best pupils.	Ego-involving
10	My teacher yelled at pupils for messing up.	Ego-involving
19	My teacher had his or her favourite pupils.	Ego-involving
21	My teacher only praised pupils who performed the best during a class.	Ego-involving
25	My teacher thinks only the pupils best at PE should play in school teams.	Ego-involving
33	My teachers favoured some pupils more than others.	Ego-involving
2	My teacher was less friendly with pupils if they didn't make the effort to see things his or her way.	Controlling Coaching
7	My teacher was less supportive of pupils when they were not performing well.	Controlling Coaching
12	My teacher paid less attention to pupils if they displeased him or her.	Controlling Coaching
15	My teacher only allowed us to do something we like to do at the end of class if we had done well during class.	Controlling Coaching
17	My teacher was less accepting of pupils if they disappointed him or her.	Controlling Coaching
20	My teacher only rewards pupils with prizes, treats or fun activities if they have performed well in PE.	Controlling Coaching
24	My teacher shouted at pupils in front of others to make them do certain things.	Controlling Coaching
26	My teacher threatened to punish pupils to keep them in line during class.	Controlling Coaching
29	My teacher mainly used rewards/praise to make pupils complete all the tasks he or she set during class.	Controlling Coaching
31	My teacher tried to interfere in aspects of pupils' lives outside of PE.	Controlling Coaching