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Initial validation of the coach-created Empowering and Disempowering Motivational Climate Questionnaire (EDMCQ-C)

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Abstract

This article employs Duda's (2013) hierarchical conceptualization of the coach-created motivational climate to inform the validation of a questionnaire (Empowering and Disempowering Motivational Climate Questionnaire-Coach; EDMCQ-C) that assesses junior athletes' perceptions of the social environmental dimensions proposed by achievement goal theory and self-determination theory. Confirmatory factor analyses (CFA) were initially employed to reduce the number of items required to measure the targeted climate dimensions. A series of competing models were then tested to determine the best representation of the questionnaire's factor structure. The findings revealed that exploratory structural equation modelling (ESEM) provided a better fit of the data to the hypothesised model than CFA solutions. Specifically, the bi-factor ESEM provided the best fit, although parameter estimates suggest that none of the ESEM solutions replicated the underlying theoretical model of the motivational climate proposed by Duda (2013). The evidence from this study suggests that the EDMCQ-C is a promising, parsimonious questionnaire to assess empowering and disempowering facets of the motivational climate albeit the development of the questionnaire remains a work in progress.

Initial validation of the coach-created Empowering and Disempowering Motivational Climate Questionnaire (EDMCQ-C)

Over the past 30 years, a large body of research in sport psychology has confirmed that athletes' performance, motivation, well-being and continued participation in sport is influenced by a range of coach-related factors. Research has demonstrated that athletes' experiences in sport are predicted by the characteristics of the relationship with their coach (see Jowett & Poczwaedoski, 2007), their coach's leadership style (see Riemer, 2007), coaching efficacy (see Myers, Vargas-Tonsing, & Fletz, 2005), and coach's behaviors including the incidence of positive reinforcement and punishments (see Smith & Smoll, 2007). There is also substantial evidence that the social psychological environment or 'motivational climate' created by the coach is relevant to variability in athletes' cognitions, affect and behaviors. The majority of research focused on the coach-created social psychological environment has been guided by contemporary theories of motivation, including achievement goal theory (AGT; Ames, 1992; Nicholls, 1989) and self-determination theory (SDT; Deci & Ryan, 1985, 2000; Ryan & Deci, 2007).

Building upon this work, Duda (2013) recently proposed a hierarchical conceptualization of the coach-created motivational climate that integrates the major social environmental dimensions emphasized within AGT and SDT. According to Duda's conceptualization, the coach-created motivational climate should be considered as multidimensional in nature and can be more or less 'empowering' and 'disempowering'. The purpose of this article is to present the initial validation of a scale that assesses athletes' perceptions of characteristics of empowering and disempowering coach-created motivational climates from Duda's integrated framework in the context of youth sport.

Task- and ego-involving motivational climates

The coach-created 'motivational climate' is a term initially proposed in early AGT-based research (e.g., Ames, 1992; Seifriz, Duda, & Chi, 1992). According to AGT, the coach-created motivational climate concerns what the coach does, says and how he/she structures the environment in training and competitions (Duda, 2001). A central assumption of AGT is that the motivational climate can shape an individual's interpretation of, and responses to, achievement-related activities such as sport by contributing to the use of task- and/or ego-involving criteria to judge competence. When adopting a task-involved criterion, emphasis is placed on effort, personal mastery and/or individual improvement. A task-involved criterion of competence is assumed to be fostered by a task-involving climate, which is characterized by athletes perceiving that trying hard, skill development and cooperative learning are valued by the coach (Newton, Duda & Zin, 2000). Conversely, when an ego-involved conception of competence is adopted, the individual values 'being the best' compared to others. This conception of competence is assumed to be facilitated in a coach-created climate that is strongly ego-involving. Ego-involving climates are characterized by athletes perceiving that mistakes result in punishment, the coach providing differential treatment based on the ability level of the athletes, and that intra-team member rivalry is encouraged on the team (Newton et al., 2000).

The majority of work that has incorporated assessments of the task- and ego-involving coach-created motivational climates has employed the 33-item Perceived Motivational Climate in Sport Questionnaire-2 (PMCSQ-2; Newton et al., 2000). The PMCSQ-2 is a multi-subscale measure which assumes the higher-order task- and ego-involving climate dimensions are undergirded by more specific situational structures or characteristics (Duda & Balaguer, 2007). The lower-order task-involving dimensions are labeled "effort/ improvement", "important role" and "cooperative learning". The lower-order ego-involving dimensions include “intra-team member rivalry”, “unequal recognition” and “punishment for mistakes”. Psychometric work on the PMCSQ-2 has found athletes scores on the measure to have adequate factorial validity (Newton et al., 2000), albeit the internal consistency of the intra-term subscale is generally lower when contrasted to the other subscales. The development of the PMCSQ-2 has resulted in a body of research that provides overwhelming support for the benefits of a task-involving coach-created climate for sport participants, as well as the negative outcomes associated with participating in a sport climate marked by ego-involving characteristics (see Duda & Balaguer, 2007; Roberts, 2012).

Autonomy-supportive, controlling and socially-supportive climates

Other coach behaviors that have motivational relevance, but that are not directly or specifically captured within AGT, have been identified within SDT. A central assumption within SDT is the degree to which we observe optimal or diminished functioning and well- and ill-being is dependent on the extent to which the social psychological environment supports or blocks the fulfillment of three innate psychological needs. The three psychological needs proposed by SDT include competence, autonomy and relatedness. Greater need satisfaction is associated with more autonomous striving (i.e., participating in an activity because one enjoys it for its own sake and/or personally values the benefits of the activity), and adaptive, healthful engagement which are conducive to sustained behaviour (Ryan & Deci, 2000a, b). Conversely, diminished or actively thwarted autonomy, competence and relatedness leads to more controlled reasons for engagement (e.g., engaging in the activity for extrinsic rewards or out of feelings of guilt and pressure), ill-being and the compromised welfare of the participants involved (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Ryan & Deci, 2000a, b).

In terms of the environmental dimensions of focus in SDT research, the extent to which significant others are more or less autonomy-supportive has received considerable attention (Deci & Ryan, 2000; Reeve, 2009). In an autonomy-supportive sport environment, athletes' preferences are recognized and their perspectives are considered, their feelings are acknowledged, they are provided with meaningful choices, their input into decision-making (when and where possible) is welcomed, and a rationale is provided when they are asked to do something (Mageau & Vallerand, 2003). A popular measure that has been adapted to assess autonomy support in sport is the Health Care Climate Questionnaire (HCCQ; Williams, Grow, Freedman, Ryan, & Deci, 1996). Although the HCCQ originally included 15 items that captured support of the three basic psychological needs, Williams and colleagues also proposed a 6 item version. This briefer version was first employed in the context of sport by Reinboth, Duda and Ntoumanis (2004) as a scale that focused exclusively on the coach's support for athletes' autonomy need satisfaction (e.g., "the coach provides players with choices and options"). However, subsequent research (e.g., Adie, Duda, & Ntoumanis, 2012; Quested & Duda, 2010) has demonstrated that this shortened version predicts, respectively, athletes' and dancers' feelings of autonomy, competence and relatedness. Previous research has also supported the reliability and validity of athletes' scores on the brief version of the HCCQ (Adie, Duda & Ntoumanis, 2008; Reinboth et al., 2004).

Building upon the body of work that has examined autonomy-supportive environments in sport, recent studies have also determined the concomitants of a controlling coaching climate (see Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2009). Bartholomew, Ntoumanis and Thøgersen-Ntoumani (2010) proposed that coaches may create both autonomy-supportive and controlling climates simultaneously and thus low scores on the HCCQ do not automatically equate to the presence of a controlling climate. A controlling coaching climate was characterized by Bartholomew et al. (2010) as pressuring, coercing and intimidating for sports participants and is measured via the 15-item Controlling Coach

Behaviors Scale (CCBS). Initial work with the CCBS suggests this scale has sound psychometric properties (Bartholomew et al., 2010). Previous research has also confirmed that a controlling coaching climate, assessed via the CCBS, is associated with the higher levels of psychological need thwarting (Balaguer, Gonzalez, Fabra, Castillo, Mercé, & Duda, 2012; Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011).

Drawing from SDT, a third aspect of the environment that is assumed to be particularly relevant to the relatedness psychological need is the level and quality of social support (or interpersonal involvement; Skinner & Edge, 2002). From an SDT perspective, in a socially-supportive environment, every athlete feels cared for and is empathized with, and is valued as an athlete and as a person (Mageau & Vallerand, 2003; Reinboth et al., 2004). In previous SDT-grounded studies (e.g., Reinboth et al., 2004), the degree of social support offered by coaches has been measured using an adapted version of the 7-item Social Support Questionnaire (SSQ; Sarason, Sarason, Shearin, & Pierce, 1987). The initial psychometric properties of the adapted (for sport) SSQ have been supported and socially-supportive coaching has been positively correlated with the satisfaction of relatedness in sport participants (Reinboth et al., 2004).

The Motivation Climate from the Perspectives of AGT and SDT

In addition to examining facets of the coach-created social psychological environment according to AGT or SDT, previous research has determined the utility of conjointly considering facets of the environment targeted within both theories (e.g., Quested & Duda, 2010; Reinboth et al., 2004; Standage, Duda & Ntoumanis, 2003). The aim of research that has adopted a broader, multi-dimensional perspective of the social psychological environment has been to examine the mechanisms (in particular, the implications for basic psychological needs) that underpin the relationship between the various theory-informed dimensions of the motivational climate outlined above and targeted outcome variables.

Reinboth and colleagues' analysis, for example, revealed that task-involving, autonomy supportive and socially-supportive climates predicted the satisfaction of adolescent cricket and soccer players' autonomy, competence and relatedness needs, respectively.

Reinboth et al's (2004) study was extended by Quested and Duda (2010) within the vocational dance setting. Quested and Duda's findings revealed dancers' perceptions of task-involving climate to positively predict satisfaction of the three psychological needs, although the strongest path was to competence need satisfaction. Dancers' perceptions of an autonomy supportive climate were positively related to autonomy and relatedness need satisfaction, and these paths were stronger than the relationships between a task-involving climate and autonomy and relatedness needs. Finally, an ego-involving climate corresponded negatively with dancers' competence and relatedness need satisfaction. The findings of Quested and Duda (2010) are particularly important as they demonstrate that when facets of the social psychological environment according to AGT and SDT are considered simultaneously, they vary in their relationships with basic psychological need satisfaction. Moreover, the evidence from Quested and Duda's study suggests the environmental dimensions from AGT and SDT predicted unique variance in the dancers' basic psychological need satisfaction. That is, despite being included in the same structural equation model, the effects of autonomy-support did not suppress the effects of a task- and ego-involving climates (or vice-versa).

In addition, previous research suggests that while there is interdependence between the targeted climate dimensions (i.e., there is a significant relationship), the relationship between the various dimensions is not perfect (i.e., r = 1.00). For example, Reinboth et al. (2004) reported bivariate correlations ranging from .32 to .70 for autonomy support, task-involving and social support, and the bivariate correlation between autonomy support and task-involving climates in the Quested and Duda study was .59. Taken together, the research conducted to date suggests that although the broad spectrum of environment dimensions proposed by AGT and SDT are inter-related, each dimension may not be redundant with other included dimensions. Furthermore, because each climate dimension is assumed to hold distinct implications for the satisfaction (or thwarting) of athletes' psychological needs, a fuller understanding of the potential impact and determinants of the coach-created motivational climate should emerge when the environmental factors emphasized in AGT *and* SDT are considered together (rather than taken into account in isolation from one another).

Highlighting past work which has adopted this multiple theory approach to studies of the concomitants of the motivational climate, Duda (2013) recently described the importance of pulling from AGT and SDT when investigating the features and consequences of the coach-created social psychological environment. Within Duda's hierarchical and multidimensional conceptualization, it is proposed that the coach-created motivational climate can be more or less 'empowering' and 'disempowering'. An empowering coach-created motivational climate is characterized by lower-order task-involving, autonomy-supportive and socially-supportive features. In contrast, a disempowering climate is marked by lower-order ego-involving and controlling (including those which are relatedness thwarting) characteristics. Duda's conceptualization also assumes that an empowering climate will be supportive of athletes' basic psychological needs, but importantly differentiates between support of competence per se and the support of a task-focused conception of competence. This is an important extension to the assumptions of SDT because, in some instances, the support of this basic psychological need can lead to maladaptive or undesirable consequences if competence is conceived in a primarily ego-involving manner (Ntoumanis & Standage, 2009). Duda also suggested that coach-created climates which are highly disempowering hold implications for psychological need thwarting.

Present Study

In an attempt to measure the underlying dimensions of ‘empowering’ and ‘disempowering’ coach-created motivational climates in sport, researchers would be forced to rely on numerous multi-item questionnaires (described above) that are distributed throughout the literature. Although scores on these questionnaires have been shown to be acceptably valid and reliable, they may place burden on research participants; i.e., when used conjointly, 67 items in total tap the five features of the environment dimensions proposed by AGT and SDT. Such a length may be acceptable to study participants when a researcher is interested solely in motivational climate scores, but less tolerable when used in combination with a battery of other instruments and particularly in the case of youth sport participants. As sport psychology researchers are generally interested in the correlates (i.e., determinants and potential consequences) of the motivational climate, as well as the psychological mechanisms that explain the relationship between the climate and targeted outcome variables, there is clearly a need for a brief, multi-dimensional scale that measures particular coach behaviors comprising empowering and disempowering motivational climates. Moreover, this scale should balance brevity with psychometric integrity. To date, there has been no systematic psychometric attempt to produce a relatively short scale that is informed by both AGT and SDT and that simultaneously taps features of empowering and disempowering coach-created motivational climates aligned with Duda’s (2013) conceptualization. To address this gap in the literature, the present paper outlines the initial validation of the multiple theory-grounded Empowering and Disempowering Motivational Climate Questionnaire-Coach version (EDMCQ-C) within youth sport specifically. The aims of the studies were to: 1) reduce the number of overall items required to measure empowering and disempowering climates to a more manageable number (i.e., approximately half of the original item pool); 2) identify the best approach to modelling the factor structure of the scale, and; 3) establish the internal reliability of athletes’ scores on the EDMCQ-C.

Methods

Description of Three Samples

The total sample in this series of studies consisted of 2273 children and adolescents from sport teams in England and Wales. All participants were competing at the grassroots level and completed the questionnaire at the start of a competitive season and after at least four weeks of interaction to their coach. Group one completed the original version of five questionnaires (i.e., 67 items) described below tapping the targeted features of empowering and disempowering motivational climates (Duda, 2013). Following the item reduction analysis, athletes from groups two and three completed shortened versions of the climate scales.

Group One: The sample (*N* = 378) comprised 227 males and 140 females aged between 8 and 17 years old (*M* = 12.6; *SD* = 3.0); 11 athletes did not report their gender. The athletes represented soccer (*n* = 297) and hockey (*n* = 81) grassroots teams. Mean number of seasons with the current team was 1.87 (*SD* = 1.8) and mean hours training per week with the current team was 3.36 (*SD* = 3.0).

Group Two: The sample (*N* = 1211) comprised of 1018 male and 175 females (18 athletes did not disclose their gender) soccer players aged between 9 and 15 years old (M = 11.46; SD = 1.56). The mean number of seasons on team was 2.43 (SD = 1.92) and the mean number of hours training per week with the current team was 2.77 (SD = 1.09). Athletes in group 4 were recruited as part of the Promoting Adolescent Physical Activity (PAPA) project (see Duda et al., 2013). The data included in this study from group two was collected prior to their coaches being exposed to the intervention tested in the PAPA project (i.e., the Empowering Coaching™ training programme, Duda, 2013).

Group Three: The sample (*N* = 706) comprised 440 males and 265 females (1 athlete did not indicate gender) aged between 9 and 17 years old (*M* = 13.9; *SD* = 2.1). The athletes participated in soccer (*n* = 379), hockey (*n* = 158), dancing (*n* = 94), basketball (*n* = 33), rugby (*n* = 23), netball (*n* = 17), and lacrosse (*n* = 2). Mean number of seasons with the current team was 3.59 (*SD* = 3.1) and mean hours training per week with the current team was 3.52 (*SD* = 2.4).

Original Climate Measures

Athletes in group one completed the original measures of the climate scale described below. To ensure consistency between the scales, responses to all items were provided on a 5-point scale (i.e., 1 = *strongly disagree* - 5 = *strongly agree*). Athletes from group one completed one of two versions of the original climate questionnaires to counterbalance the order in which the scales described below were presented. As previous research (e.g., Smith, Smoll & Barnett, 1995) has shown that scales developed using data from older populations may not function successfully in younger athletes, and because a number of the original scales were developed using data from older study participants, we reworded and/or modified certain statements to ensure the participants could read and understand the items. The average Flesch-Kincaid reading level was 5.5, suggesting the items were suitable for children around the age of 10 years.

Task- and ego-involving climates. Athletes' perceptions of coach-created task- (17 items) and ego- (16 items) involving motivational climates were assessed with the 33-item PMCSQ-2 (Newton et al., 2000). Newton et al. identified three facets of a task-involving climate, including cooperative learning (e.g., "On this team, players help each other learn"), important role (e.g., "On this team, each players contributes in some important way") and effort/improvement (e.g., "On this team, the coach wants us to try new skills"). Three sub-dimensions of the ego-involving climate were also revealed, including intra-team rivalry (e.g., "On this team, the coach only praises players when they outplay their teammates"), punishment for mistakes (e.g., "On this team, the coach gets mad when players make a mistake") and unequal recognition (e.g., "On this team, the coach gives most of his or her attention to the stars"). Psychometric work on the PMCSQ-2 has found scores on the majority of the subscales and higher-order dimensions to have adequate internal reliability and factorial validity (e.g., Newton et al., 2000).

Autonomy-supportive climate. Athletes' perceptions of autonomy support were assessed using 7 items (e.g., "the coach encourages players to ask questions") from Reinboth et al's (2004) adapted version of the HCCQ for sport. An additional 5 items were generated to capture an aspect of autonomy support not measured by the HCCQ. Aligned with Reeves' (2006) proposals regarding creating autonomy-supportive climates in the classroom, the additional 5 items tapped athletes' perceptions that their coach emphasises the importance of participating in sport for intrinsic reasons (e.g., "The coach emphasizes to players that it is important to enjoy playing this sport"). Previous research has supported the internal reliability and predictive validity of athletes' scores on the adapted seven-item version of the HCCQ (e.g., Reinboth et al., 2004; Smith, Ntoumanis, & Duda, 2007).

Controlling climate. Athletes' perceptions of their coach's controlling behaviors were measured using the 15-item Controlling Coach Behaviors Scale (CCBS; Bartholomew et al., 2010). The CCBS is a multidimensional scale that captures controlling use of rewards (e.g., "the coach tries to motivate players by promising to reward them if they do well"), negative conditional regard (e.g., "the coach is less accepting of players if they have disappointed him or her"), intimidation (e.g., "the coach shouts at players in front of others to make them do certain things"), and excessive personal control (e.g., "the coach tries to control what players do during their free time"). Bartholomew et al. (2010) confirmed athletes' responses to the CCBS were valid and reliable.

Socially-supportive climate. Athletes' perceptions of their coach's social support were tapped using the 7 item (e.g., "The coach is always there to comfort players when they are upset") Social Support Questionnaire (SSQ6; Sarason et al., 1987) modified for use in sport by Reinboth et al. (2004). Reinboth et al. revealed athletes' scores on the adapted version of the SSQ6 to be reliable.

Procedures

Ethical approval for this series of studies was granted by a committee from the first and fourth authors' university. Initial contact was made with the representatives of youth teams/clubs to obtain their permission to approach athletes regarding the study. Parents of the athletes were informed of the details of what participation would involve, both verbally and in writing. An opt-out approach to parental informed consent was adopted, in which parents could decide to exclude their child/children from the project by signing and returning the consent form. The athletes were also invited to participate, and they received verbal and written information regarding the nature of their voluntary participation in the study. Athletes completed the questionnaire before, during or after a training session in a location away from their coach and/or parents. The original versions of the questionnaire took group one athletes approximately 20 minutes to complete, while the shortened version took group two and three athletes approximately 10 minutes. A trained research assistant was present to address any questions and to provide support with questionnaire completion in the case of the younger children.

Data Analysis

Selection of Items: Data from group one were employed to select the items. To reduce the overall number of items (i.e., 67) to a more manageable number (approximately half of this item pool), we adopted similar procedures to those outlined by Marsh, Martin and Jackson (2010). In reducing the number of items our overall aim was to retain statements that preserved the content of the five climate dimensions, with at least three items per subscale, and that resulted in a factor structure in which goodness-of-fit indexes were acceptable.

Items were selected via CFAs conducted in EQS 6.1 (Bentler & Wu, 2002) using the robust maximum likelihood (ML) estimation procedure (Chou, Bentler, & Satorra, 1991). Missing data were replaced using the expectation maximization algorithm, a widely recommended approach to imputation for missing data (Marsh, 2007), as operationalized using missing value analysis in SPSS. Initially, we analyzed each climate scale individually. The decision to analyze each scale individually (rather than include all 67 items in one initial CFA) was taken to ensure each questionnaire had a good factor structure before moving onto examine the interrelationships between items from different scales. In addition, because the PMCSQ-2 and CCBS are multidimensional in nature, individual CFAs allowed us to retain as many subscales from these scales as possible.

Items were deleted based on theoretical rationales, low standardized factor loadings, standardized residuals, modification indices, and in the case of the PMCSQ-2 and the CCBS, high standardized cross loadings, until the data demonstrated good fit to each structural model. Following the CFAs on the individual scales, a CFA was conducted on a three factor lower-order "empowering climate" model that included task-involving, autonomy-supportive and socially-supportive items. A separate CFA on a two factor lower-order "disempowering climate" model that included ego-involving and controlling coaching items was also tested. Items were removed in both CFAs following the procedures outlined in step one to produce two clean structures (i.e., minimal cross-loading items, standardized factor loadings > .50). Finally, a CFA was conducted on a five-factor lower-order model and any problematic items removed.

Testing alternative models: Once the final items were selected based on the procedures described above, we evaluated the best approach to modelling the factor structure of the EDMCQ-C. To do this, we tested a number of models using the procedures outlined by Morin, Arens and Marsh (2014) and Myers, Martin, Ntoumanis, Celimli and Bartholomew

(2014). Previous studies (e.g., Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Newton et al., 2000) concerning the development (and subsequent cross-validation) of theory-based multidimensional scales in sport and exercise generally proceed by first testing a correlated first-order factor model using confirmatory CFA. Here, the first-order factors are permitted to correlate and items are restricted to load on their intended factor. To account for the (often) high correlations between the lower-order factors, researchers follow their initial CFA with a post-hoc test of a higher-order (e.g., second-order) model (H-CFA) (Myers et al., 2014). In a higher-order model, each item is specified as loading on its targeted first-order subscale and each first-order factor is permitted to load on one or more higher-order factors (e.g., Rindskopf & Rose, 1988).

Recently, CFA has been critiqued due to its reliance on the highly restrictive Independent Cluster Model (ICM). The ICM limits each item to load on its intended factor but all possible cross-loadings on non-intended factors are restricted to be zero. In reality, items from multidimensional scales are seldom ‘pure’ indicators of the construct they are proposed to measure and often have systematic associations with non-intended, albeit related subscales (Morin et al., 2014). One consequence of the highly restrictive ICM-CFA model is inflated correlations between the lower-order factors (see Marsh, Liem, Martin, Morin, & Nagengast, 2011; Marsh, Nagengast, Morin, Parada, Craven, & Hamilton, 2011). To overcome this limitation, a more flexible approach has been proposed (Asparouhov & Muthén, 2009; Morin, Marsh, & Nagengast, 2013) that is thought to provide a better representation of complex multidimensional structures. This approach, labelled Exploratory Structural Equation Modelling (ESEM) (Asparouhov & Muthén, 2009), integrates the principles of Exploratory Factor Analysis (EFA) (i.e., items permitted to cross-load on non-intended factors) within the CFA/SEM framework (i.e., fit indices to assess model fit).

The advantages of using ESEM in the development and cross-validation of multidimensional scales has been supported inside (e.g., Myers, 2013) and outside (e.g., Marsh, Muthén, Asparouhov, Lüdtke, Robitzsch, Morin et al., 2009) of sport-related research. Recent developments by Morin, Marsh and colleagues (see Morin, Marsh et al. 2013; also see Marsh, Morin, Parker, & Kaur, 2014; Marsh, Nagengast, & Morin, 2013) have also proposed an ESEM-Within-CFA model, which permits tests of higher-order factor models based on ESEM models (H-ESEM). Here, a CFA is employed to estimate high-order factors defined from the first-order ESEM factors (Morin et al., 2014). An ESEM-Within-CFA model is advantageous when testing the factor structure of a multidimensional scale because the inclusion of a higher-order construct/s ensures the aforementioned item cross-loadings are not inflated (Morin et al., 2014).

In addition to ESEM and ESEM-Within-CFA, psychometric experts (e.g., Morin et al., 2014; Myers et al., 2014; Ntoumanis, Mouratidis, Ng & Viladrich, 2015) have acknowledged the usefulness of testing the structure of multidimensional scales using a bi-factor model (Holzinger & Swineford, 1937). In a bi-factor approach, a theory-informed measurement model is represented by one or more higher-order (or “general”) factors (e.g., empowering and disempowering climates), lower-order (or “group”) factors (e.g., task- and ego-involving climates, autonomy- and social-supportive climates, and controlling climates), and a pattern matrix in which each item loads onto a general factor and onto a group factor. In addition, all correlations between the group-factors and the global-factor/s are constrained to be zero. A bi-factor model is therefore distinguished from an ICM-CFA higher-order model and the ESEM-Within-CFA model because items are permitted to be directly influenced by a general factor, as well as a more narrowly defined group factor (Myers et al., 2014). In turn, a bi-factor model (unlike the H-CFA model and ESEM-Within-CFA model) permits the researcher an opportunity to examine the predictive validity of both the general factor (e.g., empowering climate) and the group factors (e.g., task-involving, autonomy and social supportive climate) simultaneously. Traditionally, researchers were forced to rely on a bi-factor CFA approach (B-CFA) where items were permitted to load on the global factor and only one of the group factors (while loadings on non-intended group factors were constrained to be zero). However, it is now possible to conduct a bi-factor rotation within the Exploratory Factor Analysis/ESEM framework, resulting in a direct estimation a of bifactor-ESEM model (B-ESEM). Thus, in this study we tested six competing structural representations of the EDMCQ-C: CFA, H-CFA, B-CFA, ESEM, H-ESEM, and B-ESEM.

The alternative models were tested in Mplus 7.0 (Muthén & Muthén, 1998-2013), based on the robust maximum likelihood (MLR) estimator. The MLR estimator provides standard errors and fit indices that are robust to the Likert nature of the items, violations of normality assumptions, and is able to handle missing data. When modelling the B-CFA structure, the global and group factors were specified as orthogonal to ensure the interpretability of the solution was in line with bifactor assumptions. That is, the group factors reflected the part of the items' variance not explained by the global factors, and the global factors reflected the proportion of the items' variance that is shared across all items (e.g., Chen, West, & Sousa, 2006; Reise, 2012). For the ESEM, a target rotation was adopted in which all cross-loadings were "targeted" to be close to zero and all main loadings were freely estimated. From this ESEM model, an H-ESEM model was estimated using ESEM-Within-CFA (Morin, Marsh et al., 2013) where task-involving, autonomy support and social support factors were specified as related to a higher-order empowering climate factor, and ego-involving and controlling coaching factors specified as related to a second higher-order factor labelled disempowering climate. For the B-ESEM, an orthogonal bi-factor target rotation was employed when estimating the model (Reise, 2012; Reise et al., 2011). The five group factors were defined from the same pattern of target and non-target factor loadings that was used in the first-order ESEM solution, and task-involving, autonomy support and social support items were allowed to define a global empowering factor, and ego-involving and controlling items defined a global disempowering factor. Given the EDMCQ-C includes two higher-order/global factors, we employed CFA to model the empowering and disempowering factors as part of the B- ESEM model[1].

Assessment of model fit: To evaluate goodness of fit, common goodness-of-fit indices were employed rather than the chi-square test of exact fit which is known to be oversensitive to sample size and minor model misspecifications (Marsh, Hau, & Grayson, 2005). Goodness-of-fit indices and information criteria included the (robust) comparative fit index (CFI; Bentler, 1990), the (robust) Tucker-Lewis index (TLI; Tucker & Lewis, 1973), and the (robust) root mean square error of approximation (RMSEA; Steiger, 1990) with its 90% confidence interval. CFI and TLI values > .95 and RMSEA values < .06 are considered as indicators of excellent fit (Hu & Bentler, 1999). CFI and TLI values > .90 and RMSEA< .08 are considered as indicators of acceptable fit (Marsh, Hau, & Wen, 2004).

To compare the fit of the six alternative models, we adopted the procedures specified by Morin et al. (2014). When comparing alternative (nested) models, it is recommended (e.g., Chen, 2007; Cheung & Rensvold, 2002) that models provide a similar degree of fit to the data when the change (from the restrictive to more restrictive model) in CFI is < .01 and increases in RMSEA are < .015. Changes in the TLI (adopting similar guidelines associated with changes in CFI), which includes a penalty for parsimony, are also recommended for models with a complex structure (Marsh et al., 2009; Morin, Marsh et al., 2013). We also examined the Akaike Information Criteria (AIC; Akaike, 1987), the Bayesian Information Criterion (BIC; Schwartz, 1978), and the sample size adjusted BIC (ABIC; Sclove, 1987) when comparing the alternative models. The AIC, BIC, and ABIC do not describe the fit of the model. However, lower values are considered to reflect better fit to the data of one model compared to a model with a higher value.

It should be noted that the guidelines described above regarding assessment of model fit and model comparisons have, to date, been established for CFA rather than ESEM solutions. Previous applications of ESEM (e.g., Marsh et al., 2009; Morin, Marsh et al., 2013; also see Grimm, Steele, Ram, & Nesselroade, 2013) have, however, relied on similar criteria albeit the adequacy of the guidelines for ESEM is still to be determined. Thus, it is generally recommended that the previously described interpretation guidelines are treated as rough rather than "golden" rules (for both CFA and ESEM related analyses). In addition to these rules, it is also recommended that researchers consult the parameters estimates, statistical conformity and theoretical adequacy when evaluating and comparing model (Fan & Sivo, 2009; Marsh et al. 2004; 2005).

Results

Item selection: Using data from group one, the analyses resulted in 17 empowering items and 15 disempowering items. The retained items loaded significantly ($p < .001$) on their intended factor and the standardized factor loading for retained items ranged between .51 - .79 (see Table 1). The fit of the data to the final model was excellent: CFI = .95, TLI = .95, RMSEA = .03 (90% CI = .02 to .04). The final pool of items included nine task-involving items, five autonomy-supportive items, three socially-supportive items, seven ego-involving items, and eight controlling items. The nine task-involving items captured the three sub-dimensions of a task-involving climate as originally assessed by the PMCSQ-2, and eight controlling items captured the four subscales of controlling coaching as assessed by the CCBS. In contrast, items measuring perceptions of an ego-involving climate were limited to punishment for mistakes and unequal recognition subscales. The final model consisting of 32 items was retested on three occasions, with each version of the model including a different

[1] Thanks for Alexandre Morin for this recommendation.

intra-team member rivalry item from the ego-involving subscale. The inclusion of each intra-team member rivalry item decreased model fit and the standardized factor loading for each item was unacceptable. Therefore, the retained items did not include items capturing intra-team rivalry.[2]

In addition to the 32 items selected during this initial analysis, two further items capturing coach controlling use of rewards were added to the controlling climate pool of items. The rationale for including two additional items was that we felt they captured additional controlling use of rewards strategies commonplace in youth sport but not included in the original CCBS. The two additional items were "My coach only allows something we like to do at the end of training if players have done well during the session" and "My coach only rewards players with prizes or treats if they have played well" (items 15 and 20 in Table 3, respectively). Thus, the final number of items was 34.

Testing alternative models: The alternative models were initially tested using data from group two. Table 2 (top section) presents the goodness-of-fit indices and information criteria associated with the models and Table 3 and 4 presents the standardised factor loadings and uniquenesses. The CFA solution (CFI = .893; TLI = .884; RMSEA = .037) provides poor degree of fit to the data, as do the H-CFA and the B-CFA (CFI and TLI $\leq$ .90 and higher values on the BIC and ABIC). The ESEM and H-ESEM solutions provide an adequate (CFI $\geq$ .948; TLI $\geq$ .927) to excellent (RMSEA; .028) degree of fit to the data, and an apparently better representation of the data than the CFA model according to improvement in fit indices and a decrease in the values of the AIC and ABIC. The B-ESEM model provides an adequate (TLI = .942) to excellent (CFI = .962; RMSEA = .025) degree of fit to the data, and a slightly better level of fit to the data and a lower AIC value than all other models. Based on this information, ESEM solutions provided a better fit compared to the CFA models, with the B-ESEM model appearing to provide the best representation of the data.

In addition to using information on model fit to guide the selection of the best model, Morin et al. (2014) proposed that a detailed examination of the parameter estimates and theoretical conformity of the various models should guide researchers' decisions. Morin et al.[2] suggest that initially, the researcher should compare the CFA and ESEM models before moving onto compare the ESEM (and related H-ESEM) and B-ESEM models.

CFA versus ESEM. In addition to consulting the fit indices, it is recommended that the ESEM model is adopted over the CFA model when the estimated factor correlations are substantially reduced in the ESEM (Marsh et al., 2009; Morin, Marsh et al., 2013). In the current study, the ESEM resulted in lower factor correlations ($|r|$ = -.03 to r = .599) than the CFA ($|r|$ = -.409 to r = .903). For the ESEM, the highest correlations involved facets of the empowering climate (e.g., task-involving and social support) or facets of the disempowering climate (e.g., ego-involving and controlling coaching) (see Table 5).

An examination of the ESEM parameter estimates (see Table 3) reveals well-defined factors for task-involving, socially-supportive, and ego-involving climate due to substantial target factor loadings (varying from $|\lambda|$ = .359 to .680). In contrast, the autonomy-supportive (target $|\lambda|$ = .058 to .235) and controlling coaching factors (target $|\lambda|$ = .124 to .680) were less well defined. Specifically, none of the autonomy support items and five controlling coaching items loaded significantly on their intended factor. The parameter estimates for the ESEM also revealed multiple non-target cross-loadings, and the majority of the more substantial non-target cross-loadings (> .200) involved autonomy support and controlling coaching items. The autonomy support items had elevated scores on the task-involving and, to a lesser extent, the social support factors, while a number of controlling coaching items demonstrated elevated factor loadings on the ego-involving and autonomy support (negative loadings) factors. In sum, then, the results from group two provide support for the ESEM model, albeit there are issues with the autonomy support items and half of the controlling items. Regarding

[2] The results from the CFAs involved with selecting the items are available by request from the first author.

the H-ESEM, the analysis revealed that none of the lower-order dimensions loaded significantly onto their respective higher-order dimensions.

ESEM (and H-ESEM) versus B-ESEM. Although the B-ESEM provides a slightly better fit to the data (according to both fit indices and lower AIC values) than ESEM and H-ESEM, the G factors were not particularly well defined by strong and significant target loadings (empowering: $|\lambda|$ =.000 to .515; disempowering: $|\lambda|$ =.153 to .497). Specifically, only eight task-involving and three autonomy-supportive items presented significant target loadings on the empowering G-factor, while none of the ego-involving and controlling items loaded significantly on the disempowering G-factor. Over and above the G factors, 21 items also failed to demonstrate significant target factor loadings of their respective S factors, and four autonomy-supportive items and six controlling items had elevated (λ > .200) and significant factor loadings on non-intended S factors (see Table 3). This suggests that the socially-supportive, ego involving, and (to a lesser extent) the task-involving S factors tap into relevant specificity and add information to the G-factor. In contrast, the autonomy-supportive and controlling coaching S factors appear to be more weakly defined.

In sum, the ESEM related models provide a better fit to the data than the CFA. The ESEM (and associated H-ESEM) demonstrates a slightly poorer fit to the data compared to the B-ESEM model, albeit the three ESEM-related models provide an acceptable-to-excellent fit to the data. However, an examination on the parameters suggests the ESEM-related solutions are problematic and they fail to align with the theory underpinning this model. Thus, we decided to re-test the ESEM-related models using the data from group three to determine whether any of the limitations identified in the current analyses were as a result of idiosyncrasies of group two only.

Re-testing the ESEM-related models. Data from group three were employed to re-test the ESEM-related models. The ESEM and H-ESEM solutions provided an adequate (CFI ≥

.941; TLI $\geq$ .918) to excellent (RMSEA; $\leq$ .03) degree of fit to the data (see Table 2 bottom section). The ESEM resulted in similar factor correlations ($|r|$ = .07 to r = .531) as reported in the analysis conducted with group two (see Table 5). In addition, the parameter estimates (see Table 4) revealed well-defined factors for task-involving, ego-involving, and controlling climates due to substantial target factor loadings (varying from $|\lambda|$ = .218 to .781). In contrast, the autonomy-supportive (target $|\lambda|$ = .027 to .198) factor was less well defined with four items failing to load significantly onto their intended factors but loading significantly onto the task-involving dimension (target $|\lambda|$ = .195 to .514). In addition, two socially-supportive items failed to load significantly onto their intended factor. Regarding the H-ESEM, the analysis revealed that four of five lower-order dimensions loaded significantly onto their respective higher-order dimensions ($|\lambda|$ = .71 to .78, p < .05). Only the task-involving lower order factor failed to load significantly onto its intended higher-order factor ($|\lambda|$ = .23, p > .05).

Regarding the B-ESEM, the fit was adequate (TLI = .931) to excellent (CFI = .955, RMSEA .027) (see Table 2 bottom section), with lower information criteria values compared to the ESEM and H-ESEM. However, the empowering G factor was not particularly well defined by strong and significant target loadings ($\lambda|$ =-.014 to .489), with only two task-involving items loading significantly. In contrast, the disempowering G factor was well defined with 15 items loading significantly ($\lambda|$ = .290 to .576). Over and above the G factors, 22 items failed to demonstrate significant target factor loadings of their respective S factors. In particular, items measuring autonomy-supportive and controlling coaching failed to load significantly on their intended S factor (see Table 4). This suggests that the task-involving, socially-supportive and ego involving S factors tap into relevant specificity and add information to the G-factors. In contrast, the autonomy-supportive and controlling S factors appear to be more weakly defined.

In sum, as per the analysis with group two, the ESEM (and associated H-ESEM) demonstrates a slightly poorer to the data compared to the B-ESEM model, albeit the three ESEM-related models provide an acceptable-to-excellent fit to the data. Parameter estimates indicate the autonomy-supportive items are especially problematic in both the ESEM and B-ESEM, with the controlling coaching items also proving problematic in the B-ESEM.

Internal reliability: Cronbach's alphas for group two athletes' scores on the lower-order climate dimensions ranged from .48 to .81 (task-involving α = .81; autonomy-supportive α = .64; socially-supportive α = .48; ego-involving α = .80; controlling α = .73) and for the higher-order dimensions were .87 and .86 for empowering and disempowering climates, respectively. The removal of one item (item 27 in Table One) increased the alpha value for the socially-supportive subscale to .56, and to .88 for the empowering subscale. Cronbach's alphas for group three athletes' scores on the lower-order climate dimensions ranged from .48 to .81 (task-involving α = .83; autonomy-supportive α = .30; socially-supportive α = .61; ego-involving α = .82; controlling α = .77) and for the higher-order dimensions were .90 and .87 for empowering and disempowering climates, respectively. The removal of one item (item 6 in Table One) increased the alpha value for the autonomy-supportive subscale to .67 and a small decrease in the empowering subscale to .89.

Discussion

The purpose of the current research was to examine the initial psychometric attributes of a questionnaire for employment in youth sport that captured the broad array of coach-created motivational climate dimensions proposed by AGT and SDT, and that balanced brevity with psychometric quality. Specifically, pulling from Duda's (2013) conceptualization, this measure proposed a hierarchical, multidimensional structure represented by empowering (i.e., task-involving, autonomy-supportive and socially-supportive) and disempowering (i.e., ego-involving and controlling) dimensions of the coach-created climate.

The initial analyses focused on reducing the number of items required to measure empowering and disempowering facets of the climate. Overall, the retained items captured the majority of coaching behaviors included in the original climate scales. For example, the items retained in the EDMCQ-C measure all four facets of controlling coaching included in the CCBS, the three facets of a task-involving climate according to the PMCSQ-2, and a range of autonomy- and socially-supportive characteristics. The retained items in the EDMCQ-C also measure two facets of an ego-involving climate (i.e., unequal recognition and punishment for mistakes). However, there are no items capturing the third aspect of ego-involving coaching assessed via the PMCSQ-2, namely intra-team member rivalry. Previous research on the psychometric properties of athletes' scores on the PMCSQ-2 has also revealed the problematic nature of the intra-member rivalry subscale scale. For example, across two studies, Newton and colleagues (2002) reported low internal consistency scores for this PMCSQ-2 subscale. Future research centered on the psychometric properties of the EDMCQ-C may wish to examine whether this specific finding is replicated in other samples of athletes or whether it is possible to include intra-team rivalry items (by collecting data using the EDMCQ-C and including all of the items from the original intra-member rivalry subscale from the PMCSQ-2). Until such evidence is available, researchers should remain cognizant that the EDMCQ-C does not currently capture a previously considered characteristic of a disempowering climate.

Having reduced the number of items needed to measure the five climate dimensions, a series of alternative models revealed better fit to the data for the ESEM solutions compared the CFA-related structures across two separate samples of youth athletes. The superiority of ESEM (compared to CFA) was also confirmed via lower factor correlations between the five climate dimensions. This finding complements previous evidence inside (e.g., Myers, Chase, Pierce & Martin, 2011; Perry, Nicholls, Clough & Crust, 2015) and outside (e.g., Marsh et al., 2009) of sport that has compared CFA and ESEM, and provides further support for the employment of ESEM when testing the factor structure of multidimensional scales. In the case of the EDMCQ-C, it is unsurprising that the ESEM-related models outperformed CFA solutions. From a theoretical perspective, it is conceivable that there is considerable overlap between items tapping task-involving, autonomy support and social support coaching behaviours, and between items intended to measure ego-involving and controlling climates. In fact, previous research in sport has confirmed strong associations between the various climate dimensions, with correlations as high as .70 (Reinboth et al., 2004). Thus, when the CFA solutions were imposed on the five climate dimensions and items were prevented from cross-loading onto non-intended factors, the theoretical overlap between climates dimensions was represented in inflated factor correlations and subsequent poor(er) fit. In contrast, this inflation was reduced in the ESEM solutions due to items being permitted to load onto intended and non-intended factors. Ultimately, this flexible approach resulted in a better fit between the data and the ESEM solution of the EDMCQ-C.

Although the ESEM solutions provided a better fit to the data, a detailed examination of the parameter estimates suggested the solutions across groups two and three were discrepant from the theory (see Duda, 2013) underpinning the EDMC-Q. This finding is particularly noteworthy given Morin et al’s (2014) suggestion that decisions regarding the appropriateness of a model should not be based solely on fit indices, but should also take into consideration parameter estimates and substantive theory. Across samples two and three, task- and ego-involving items, and to a lesser extent some socially-supportive and controlling items, loaded as expected with strong loadings on their intended factors and weaker loading values on their non-intended factors. In contrast, the majority of autonomy-supportive (groups two and three) items and some controlling (group two) and socially-supportive (group three) items failed to load significantly on their intended factor and demonstrated elevated and significant factor loadings on their non-intended climate dimension (autonomy-supportive and socially-supportive items loaded on the task-involving factor, and controlling items on the ego-involving and autonomy-supportive factors). In the context of ESEM, cross-loading items are perfectly acceptable because they provide a better representation of a multidimensional structure compared to when items are treated as “pure” indicators of a construct (Marsh et al, 2014; Morin et al., 2014). It is therefore understandable that the autonomy-supportive items, for example, cross-loaded onto task-involving and socially-supportive factors given the commonalities in the content and behaviors of the three empowering climate dimensions. An autonomy-supportive climate in sport, for example, will also likely be task-involving and socially-supportive because athletes of all abilities in such environments are encouraged to derive intrinsic enjoyment and a sense of accomplishment from learning new skills and trying hard, have their questions carefully and considerably answered, and their perspectives are considered no matter what happens in competition or training. Likewise, there are commonalities between ego-involving and controlling behaviours; for example, coaches that adopt an intimidating style in response to mistakes are likely to be less supportive of the athletes who are lower in ability. However, in addition to cross-loadings, ESEM expects that items should load significantly on their intended factor. As this was not the case for the majority of autonomy-supportive items, and a selection of socially-supportive and controlling items, in the current study, further research should attempt to revise this set of items to ensure the empowering and disempowering climate dimensions are more clearly distinguishable from one another.

Relying on the ESEM solutions, a comparison of first-order versus bi-factor and higher-order models was conducted to assess the presence of hierarchical constructs (Morin et al., 2014). The advantage of the B-ESEM approach to modelling a multidimensional scale is that items are permitted to load onto two latent variables; a general construct (e.g., empowering or disempowering) and a sub-domain construct (e.g., task-involving). Support for the B-ESEM solution subsequently presents the researcher with an opportunity to examine the predictors and/or correlates of the sub-domain and general constructs simultaneously (Myers et al., 2014). This is not the case with the ‘traditional’ approach to modelling the higher-order nature of a construct (e.g., H-ESEM), where the correlation between lower-order dimensions (e.g., ego-involving, controlling coaching) is represented by a second-order construct (e.g., disempowering climate). Examining the bi-factor and higher-order ESEM solutions, and comparing to the lower-order ESEM model, made sense in the current study given the multidimensional nature of the EDMC-Q and the possibility of a hierarchical structure as suggested by Duda’s (2013) conceptualisation.

Across groups two and three, the data fit the B-ESEM solution slightly better than the H-ESEM and ESEM. However, as per the lower-order ESEM, the B-ESEM revealed problems with the parameter estimates. In group two, 11 (from 19) items loaded significantly onto the G empowering factor and no items (from 17) loaded significantly on the disempowering G factor. In group three, the number of items loading significantly on the empowering G factor was two, and 15 items loaded significantly on the disempowering G factor. Overall, the results from the B-ESEM suggest that, while this model provided the best fit to the data, the items fail to represent the empowering and disempowering global factors as well as the five sub-domain climate constructs. The evidence from the H-ESEM also fails to fully support Duda’s (2013) theoretically integrated conceptualisations of the multidimensional climate, albeit the model in group three did come close. Specifically, in group three, four of the five lower-order dimensions loaded significant on the higher-order dimensions. Only the task-involving climate dimension failed to load significantly on the higher-order dimension. Conversely, none of the lower-order dimensions loaded significantly on the higher-order dimensions in group two. In sum, the findings from the B-ESEM and H-ESEM models suggest that the hierarchical, multidimensional nature of the coach-created motivational climate (as captured in the 34 items comprising the EDMCQ-C) was not fully replicated across groups two and three in a manner that is consistent with Duda's (2013) original framework.

Study Limitations and Future Research Directions

This study had a number of limitations. Although we tested the factor structure(s) of the scale, we did not consider alternative indicators of validity and reliability. We decided not to examine the additional indicators because our findings suggested that no one solution provided an accurate representation of the multidimensional and hierarchical conceptualisation underpinning the EDMCQ-C, and thus we felt it important to resolve this issue first. However, as the EDMCQ-C is developed further, researchers should consider additional forms of validity (e.g., predictive validity) and reliability when deciding which model to eventually accept (Myers et al., 2014). A further limitation of the study was that the multilevel nature of the data (i.e., athletes nested within teams) which was not accounted. We did not account for the multilevel nature of the data due to the limited number of teams per parameters of the more complex models (i.e., B-ESEM). While it is not possible to conduct a multilevel analysis in ESEM, it is possible to account for 'clusters'. Therefore, future research should attempt to recruit athletes from a larger number of teams and subsequently account for clustering effects when examining the factor structure of the EDMCQ-C (see Myers, 2013, for an example).

Future research should also example the factor structure of the EDMCQ-C with a more heterogeneous sample of athletes. Grassroots youth sport is an important context to examine features of empowering and disempowering coaching climates because previous research has confirmed the role of the lower-order dimensions in determining children's psychological and physical health (Duda, 2013; Duda & Balaguer, 2007; Ntoumanis, 2012). Nonetheless, empowering and disempowering climates are certainly evident and relevant in settings with other groups of athletes (e.g., elite junior performers, adults). Thus, future research is warranted which tests the alternative models (and additional psychometric properties) of the EDMCQ-C in diverse samples of sport participants. The samples pertinent to the present work were also dominated by male athletes and therefore subsequent studies should also attempt to specifically examine the psychometric properties of female athletes' scores on the EDMCQ-C.

Conclusions

In summary, the purpose of the current research was to report the initial psychometric properties of the EDMC-Q, a questionnaire that measures characteristics of empowering and disempowering coach-created motivational climates as originally proposed by Duda (2013). Adopting Duda's (2013) theoretically-integrated conceptualization of the coach-created motivational climate is advantageous because it recognises the broad spectrum of climate dimensions central to AGT and SDT simultaneously and their implications for athletes' motivation, well-being and sustained engagement in sport. The evidence from this study suggests the EDMC-Q should be considered a work in progress. As work continues on developing the psychometric properties of the scale, we encourage researchers to employ their own data sets to test the various ESEM solutions and contribute to a growing body of evidence regarding problematic items that 1) consistently fail to load on the intended lower-order/S or higher-order/G factors, and 2) that have stronger cross-loading values compared to the loading value on the intended factors. The identification of such items will inform decisions regarding re-writing and/or deleting items, which may subsequently provide a platform to produce a cleaner factor structure of the EDMC-Q (i.e., items loading onto intended factor and/or G factors, smaller cross-loadings on non-intended factor) and thus move the scale closer to replicating the hierarchical, multidimensional structure of the motivational climate proposed by Duda (2013).

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Table 1. Item Means, Standard Deviations, Factor Loadings, and Uniquenesses Following Item Reduction CFAs (Group 1).

EDMCQ-C Subscale and Item	*M*	*SD*	Factor Loading	Uniqueness
Task-involving				
1. My coach encouraged players to try new skills	4.09	1.00	.52	.86
4. My coach tried to make sure players felt good when they tried their best	4.11	.94	.69	.73
11. My coach made sure players felt successful when they improved	4.05	1.02	.64	.77
13. My coach acknowledged players who tried hard	3.89	.98	.58	.82
18. My coach made sure that each player contributed in some important way	3.88	1.03	.64	.77
23. My coach made sure everyone had an important role on the team	3.93	1.04	.62	.78
28. My coach let us know that all the players are part of the team's success	3.95	1.01	.64	.77
30. My coach encouraged players to help each other learn	3.84	1.04	.70	.71
34. My coach encouraged players to really work together as a team	4.26	.93	.59	.83
Autonomy-supportive				
3. My coach gave players choices and options	3.68	1.02	.55	.84
6. My coach thought that it is important that players participate in this sport because the players really want to	3.87	.98	.55	.83
16. My coach answered players' questions fully and carefully	3.91	1.01	.61	.79
22. When my coach asked players to do something, he or she tried to explain why this would be good to do so	3.86	1.00	.61	.79
32. My coach thought that it is important for players to play this sport because they (the players) enjoy it	3.86	1.01	.70	.71
Socially-supportive				
8. My coach could really be counted on to care, no matter what happened	3.73	1.09	.79	.61
14. My coach really appreciated players as people, not just as athletes	3.84	1.07	.75	.66
27. My coach listened openly and did not judge players' personal feelings	3.66	1.06	.67	.75
Ego-involving				
5. My coach substituted players when they made a mistake	2.33	1.23	.54	.84
9. My coach gave most attention to the best players	2.21	1.29	.63	.77
10. My coach yelled at players for messing up	2.27	1.29	.67	.75
19. My coach had his or her favorite players	2.35	1.30	.73	.68
21. My coach only praised players who performed the best during a match	2.69	1.22	.51	.83
25. My coach thought that only the best players should play in a match	2.47	1.23	.76	.65
33. My coach favored some players more than others	2.60	1.33		
Controlling coaching				
2. My coach was less friendly with players if they didn't make the effort to see things his/her way	2.70	1.29	.62	.79
7. My coach was less supportive of players when they were not training and/or playing well	2.39	1.21	.56	.83
12. My coach paid less attention to players if they displeased him or her	2.20	1.13	.69	.72
17. My coach was less accepting of players if they disappointed him or her	2.25	1.09	.71	.70
24. My coach shouts at players in front of others to make them do certain things	2.37	1.24	.58	.81
26. My coach threatened to punish players to keep them in line during training	2.05	1.21	.69	.73

29. The coach mainly used rewards/ praise to make players complete all the tasks he/she sets during training	2.26	1.11	.55	.83
31. My coach tried to interfere in aspects of players' lives outside of this sport	1.92	1.13	.54	.84

Note. All factor loadings are statistically significant ($p < .05$).

Table 2. Goodness of Fit Statistics and Information Criteria for the Models Estimated on the EDMCQ-C (Groups 2 and 3).

	X^2	df	CFI	TLI	RMSEA	RMSEA 90% CI	AIC	BIC	ABIC
Model (Group 2)									
CFA	1223.925*	517	0.893	0.884	0.036	.033 - .038	97717	98274	98274
H-CFA	1294.009*	524	0.884	0.875	0.037	.035 - .040	97795	98316	98317
B-CFA	1221.701*	497	0.89	0.876	0.037	.035 - .040	97709	98365	98365
ESEM	743.908*	401	0.948	0.927	0.028	.025 - .031	97264	98398	98398
H-ESEM	742.838*	405	0.949	0.929	0.028	.025 - .031	97266	98380	98380
B-ESEM	614.992*	366	0.962	0.942	0.025	.022 - .029	97115	98422	98422
Model (Group 3)									
ESEM	1022.353*	401	0.941	0.918	0.03	.028 - .032	0.918	159736	159012
H-ESEM	997.422*	405	9.44	0.922	0.029	.027 - .031	0.922	159712	159000
B-ESEM	842.153*	366	0.955	0.931	0.027	.025 - .043	0.931	159692	158857

Note. CFA= Confirmatory factor analysis; H = Hierarchical model; B = Bifactor model; ESEM = Exploratory structural equation modeling; df = Degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; CI = confidence interval; AIC = Akaike information criterion; CAIC BIC = Bayesian information criterion; ABIC = Sample size adjusted BIC; ESEM were estimated with target oblique rotation; bifactor-ESEM were estimated with bifactor orthogonal target rotation; * $p < .01$.

Table 4. Standardized Factor Loadings for First-Order CFA, ESEM and Bifactor-ESEM Solutions of the EDMCQ-C (Group 2)

	First-Order CFA Solution		First-Order ESEM Solution						B-ESEM Solution						
Item	Factor Loading	Uniquenesses	T	A	S	E	C	Uniquenesses	T	A	S	E	C	G-Factor	Uniquenesses
1	0.485**	.764**	0.44**	0.085	-0.013	-0.126	0.053	.758**	0.149	0.070	0.129	-0.269**	-0.027	0.429**	.700**
4	0.513**	.737**	0.469**	0.041	-0.022	-0.092	-0.021	.744**	0.104	-0.013	0.159	-0.294**	0.027	0.515**	.612**
11	0.594**	.647**	0.481**	-0.059	0.136	-0.166**	0.11	.633**	0.279	0.223	0.122	-0.210*	0.160	0.435**	.599**
13	0.467**	.782**	0.391**	-0.034	0.133	-0.035	0.075	.775**	0.188	0.167	0.145	-0.092	0.127	0.401**	.730**
18	0.586**	.657**	0.539**	0.029	0.060	-0.079	0.092	.652**	0.419	0.166	0.066	-0.137	0.051	0.367**	.637**
23	0.612**	.625**	0.565**	0.062	0.064	-0.117*	0.073	.622**	0.468*	0.126	0.087	-0.218**	0.029	0.304**	.618**
28	0.605**	.634**	0.68**	0.032	0.017	-0.023	-0.054	.635**	0.386**	-0.004	0.146	-0.227**	0.062	0.369**	.637**
30	0.643**	.587**	0.498**	0.115	-0.060	0.047	-0.039	.546**	0.498*	-0.019	0.104	-0.168*	-0.035	0.401*	.550**
34	0.504**	.746**	0.498**	0.029	-0.047	0.027	-0.191**	.707**	0.458	-0.139	0.092	-0.212*	0.057	0.206	.672**
3	0.407**	.834**	0.296**	0.085	0.085	-0.121*	0.065	.833**	0.188	0.120	0.121	-0.196*	-0.009	0.272**	.823**
6	0.534**	.714**	0.356**	0.087	0.182*	0.031	-0.062	.735**	0.360**	0.042	0.218**	-0.144*	0.052	0.252*	.735**
16	0.622**	.613**	0.35**	0.131	0.287**	-0.094	0.072	.624**	0.432	0.204	0.230	-0.192**	0.031	0.245**	.621**
22	0.554**	.693**	0.216*	0.235	0.383**	0.039	0.033	.662**	0.371	0.217	0.331*	-0.072	-0.039	0.217	.652**
32	0.587**	.655**	0.434**	0.058	0.153	0.099	-0.207*	.639**	0.582**	-0.047	0.198	-0.119	0.106	0.153	.571**
8	0.677**	.541**	0.066	0.264*	0.518*	0.009	-0.117	.570**	0.292	0.140	0.519**	-0.224**	0.004	0.156	.551**
14	0.629**	.604**	0.052	0.121	0.569*	0.058	-0.111	.600**	0.305	0.108	0.494**	-0.161	0.143	0.106	.594**
27	0.347**	.880**	-0.058	-0.088	0.475*	0.156	-0.148	.768**	0.179	0.038	0.34**	0.029	0.278**	-0.001	.773**
5	0.500**	.750**	-0.013	-0.03	0.004	0.451**	0.093	.738**	-0.052	-0.024	-0.045	0.500**	-0.008	0.153	.721**
9	0.669**	.552**	-0.123	0.079	0.040	0.595**	0.12	.539**	-0.129	-0.049	-0.009	0.640**	-0.116	0.198	.519**
10	0.576**	.668**	-0.055	0.062	-0.016	0.507**	0.128	.648**	-0.053	-0.049	-0.067	0.566**	-0.119	0.183	.623**
19	0.651**	.576**	-0.097	0.03	0.022	0.544**	0.143*	.582**	-0.207*	-0.058	0.014	0.551*	-0.076	0.26	.576**
21	0.551**	.696**	-0.02	-0.224**	0.001	0.359**	0.219	.650**	-0.217*	-0.072	-0.076	0.373	0.146	0.393	.627**
25	0.633**	.599**	-0.131	-0.08	0.008	0.377**	0.261**	.614**	-0.224	0.050	-0.124	0.525*	-0.003	0.237	.600**
33	0.644**	.586**	-0.223*	-0.001	0.031	0.395**	0.233**	.598**	-0.324*	0.051	-0.050	0.527*	-0.071	0.270	.564**
2	0.479**	.771**	0.034	-0.171*	-0.036	0.339**	0.162	.751**	-0.130	-0.079	-0.076	0.338	0.098	0.316	.747**
7	0.553**	.694**	0.13	-0.061	-0.251**	0.378**	0.171**	.685**	-0.089	-0.111	-0.203	0.406	-0.08	0.27	.695**
12	0.569**	.676**	0.024	0.260*	-0.159	0.440**	0.215	.592**	-0.090	-0.190	-0.044	0.343	-0.38	0.416	.518**
15	0.140**	.980**	0.108	-0.267**	0.254*	0.155	0.124	.793**	0.095	0.060	0.102	0.111	0.328*	0.291	.772**
17	0.670**	.552**	-0.021	-0.021	-0.137	0.398**	0.263**	.596**	-0.254	-0.179	-0.107	0.352	-0.111	0.497	.508**
20	0.350**	.887**	-0.002	-0.261	0.151	0.067	0.371	.742**	-0.105	0.118	-0.070	0.145	0.229	0.436	.707**
24	0.534**	.715**	0.067	-0.251**	-0.141	0.203	0.323	.668**	-0.112	0.077	-0.297**	0.408**	0.109	0.255	.650**
26	0.549**	.698**	-0.001	0.084	-0.1	0.093	0.543**	.615**	-0.131	0.181	-0.238	0.294	-0.223	0.376	.615**
29	0.239**	.943**	0.098	-0.208	0.108	-0.124	0.482*	.756**	0.108	0.336*	-0.214	0.116	0.169	0.301	.697**
31	0.347**	.880**	-0.011	0.437	-0.107	-0.162	0.68*	.427**	-0.063	0.327	-0.195	0.063	-0.547	0.327	.442**

Note. T= Task-involving; A = Autonomy Support; S = Social Support; E = Ego-involving; C = Controlling. * $p < .05$. ** $p < .01$

Table 5. Standardized Factor Loadings for First-Order CFA, ESEM and Bifactor-ESEM Solutions of the EDMCQ-C (Group 2)

	First-Order ESEM Solution						B-ESEM Solution						
Item	T	A	S	E	C	Uniquenesses	T	A	S	E	C	G-Factor	Uniquenesses
1	**0.376****	0.182	0.053	-0.079	0.024	.736**	**0.313**	-0.020	0.091	-0.172	-0.063	0.437	.669**
4	**0.354****	0.152	0.11	-0.133**	0.013	.715**	**0.264**	-0.053	0.167	-0.269	0.006	0.489	.589**
11	**0.347****	0.171	0.281**	-0.095*	0.030	.607**	**0.438***	0.123	0.212*	-0.163*	0.034	0.361**	.590**
13	**0.267****	0.161	0.261**	0.086	-0.056	.748**	**0.342**	0.062	0.223	-0.011	0.035	0.306*	.734**
18	**0.462****	0.088	0.105	-0.169**	0.112*	.654**	**0.515****	0.094	0.038	-0.165**	0.009	0.240	.640**
23	**0.495****	0.048	0.077	-0.265**	0.111**	.596**	**0.514****	0.051	0.069	-0.286**	0.009	0.216	.600**
28	**0.502****	0.062	0.09	-0.079	-0.035	.628**	**0.505***	-0.044	0.139*	-0.179*	0.02	0.246	.631**
30	**0.661****	0.016	-0.086	-0.016	-0.020	.587**	**0.585**	-0.134	0.008	-0.101	-0.023	0.199	.590**
34	**0.536****	-0.001	-0.033	-0.043	-0.122*	.665**	**0.546**	-0.145	0.064	-0.138	0.005	0.116	.645**
3	0.249**	**0.221**	0.106	-0.075	0.046	.801**	0.271	**0.05**	0.116	-0.142	-0.08	0.319	.782**
6	0.195**	**0.056**	-0.042	-0.027	0.008	.955**	0.182	**-0.024**	-0.007	-0.048	-0.039	0.087	.955**
16	0.422**	**0.198**	0.153	-0.057	-0.005	.617**	0.518**	**0.039**	0.183*	-0.149**	-0.056	0.230	.619**
22	0.354**	**0.227***	0.182	0.096*	-0.067	.685**	0.433**	**0.003**	0.241**	-0.042	-0.055	0.239	.692**
32	0.514**	**0.027**	0.035	0.079	-0.187**	.657**	0.596**	**-0.135**	0.148	-0.04	-0.008	0.041	.601**
8	0.225	0.249**	**0.251**	-0.005	-0.151	.659**	0.362**	-0.028	**0.456****	-0.221**	-0.097	0.129	.585**
14	0.253	0.111	**0.347**	0.081	-0.178*	.656**	0.399**	-0.029	**0.483****	-0.13**	0.064	0.069	.580**
27	0.065	-0.015	**0.422****	0.130**	-0.152*	.775**	0.244	0.057	**0.387**	0.009	0.189	-0.014	.751**
5	0.004	-0.086	0.042	**0.390****	0.121*	.757**	-0.111	0.005	-0.048	**0.362****	0.107	0.290**	.759**
9	-0.05	0.014	-0.007	**0.678****	0.043	.491**	-0.209**	-0.079	-0.026	**0.570****	0.034	0.362**	.493**
10	0.058	-0.098	-0.086	**0.334****	0.276**	.665**	-0.159	-0.025	-0.163	**0.319***	0.079	0.415**	.668**
19	-0.088	0.100*	0.052	**0.781****	-0.039	.441**	-0.202	-0.085	0.043	**0.626****	0.001	0.330**	.449**
21	-0.024	-0.196	0.12	**0.249****	0.355**	.622**	-0.201**	0.078	-0.1	**0.264****	0.251	0.435**	.622**
25	-0.136*	-0.001	0.072	**0.388****	0.289**	.604**	-0.227*	0.132	-0.108	**0.419****	0.067	0.375**	.599**
33	-0.176*	0.112	0.051	**0.673****	0.049	.485**	-0.240**	0.032	-0.019	**0.619****	-0.043	0.304**	.464**
2	0.054	-0.193**	-0.013	0.146*	**0.384****	.695**	-0.176**	0.038	-0.158	0.169	**0.186**	0.429**	.695**
7	0.163	-0.195	-0.164	0.269**	**0.290***	.657**	-0.131	-0.069	-0.249**	0.274**	**0.137**	0.399**	.663**
12	0.117	-0.026	-0.245	0.300**	**0.334****	.614**	-0.220**	-0.211	-0.155*	0.168	**-0.044**	0.576**	.520**
15	0.140*	-0.238	0.315	-0.016	**0.218***	.787**	0.138	0.137	0.079	0.007	**0.344**	0.211	.793**
17	0.033	-0.106	-0.095	0.238**	**0.439****	.571**	-0.271*	-0.049	-0.176	0.185	**0.118**	0.569**	.521**
20	-0.051	-0.081	0.249**	0.055	**0.383****	.777**	-0.077	0.215	0.013	0.09	**0.190**	0.358**	.775**
24	0.014	-0.13	0.009	0.172**	**0.410****	.677**	-0.097	0.199	-0.284*	0.318*	**0.156**	0.343**	.627**
26	-0.070	0.194*	-0.086	0.036	**0.617****	.571**	-0.174	0.221	-0.238	0.126	**-0.139**	0.477*	.601**
29	0.056	0.013	0.173	-0.148**	**0.472****	.815**	0.142	0.383	-0.126	0.014	**0.073**	0.252	.748**
31	0.009	0.413*	-0.27	-0.036	**0.555****	.538**	-0.078	0.187	-0.207	-0.027	**-0.535**	0.472*	.406*

Note. T= Task-involving; A = Autonomy Support; S = Social Support; E = Ego-involving; C = Controlling. * $p < .05$. ** $p < .01$

Table 5. Standardized Factor Correlations for the CFA (Group 2) and ESEM (Groups 2 and 3) solutions for the EDMCQ-C.

	Task-involving	Autonomy-supportive	Socially-supportive	Ego-involving	Controlling coaching
Task-involving		.903**	.694**	-.503**	-.409**
Autonomy-supportive	.175 / .317		.840**	-.483**	-.441**
Socially-supportive	.599** / .436	-.029 / .074		-.446**	-.520**
Ego-involving	-.269** / -.252**	-.189 / -.331**	-.245** / -.195		.878**
Controlling coaching	-.222** / -.234**	-.188 / -.237**	-.231* / -.171	.473* / .531**	

Note. CFA correlations (above the diagonal) and ESEM correlations (below the diagonal). ESEM correlations for group two to the left and for group three to the right.
* $p < .05$. ** $p < .01$