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Development and Initial Validation of the Perfectionistic Climate Questionnaire (PCQ-S)

Michael C. Grugan[1], Andrew P. Hill[1], Sarah H. Mallinson-Howard[1], Tracy C. Donachie[2], Luke F. Olsson[1], Daniel J. Madigan[1], & Robert S. Vaughan[1]

[1]York St John University, UK

[2]Newcastle University, UK

Author Note

Michael C. Grugan, Andrew P. Hill, Sarah H. Mallinson-Howard, Luke F. Olsson, and Daniel J. Madigan, School of Science, Technology, and Health, York St John University, UK; Tracy C. Donachie, School of Psychology, Newcastle University, UK; Robert S. Vaughan, School of Education, Language, and Psychology, York St John University, UK.

Correspondence concerning this article should be addressed to Michael C. Grugan, School of Science, Technology, and Health, York St John University, Lord Mayor's Walk, York YO31 7EX, UK. E-mail: m.grugan@yorksj.ac.uk, Tel: (+44)1904 876512

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Abstract

Perfectionism has traditionally been conceptualised as a personality trait. However, researchers have recently proposed a new construct–*perfectionistic climate*–which focusses on the degree to which the social environment is experienced as perfectionistic. In the current study, we apply this new construct to sport and begin the development and validation of the first scale to measure perfectionistic climate – the Perfectionistic Climate Questionnaire-Sport (PCQ-S). This self-report scale includes five components of coach behaviour central to perfectionistic climate: expectations, criticism, control, conditional regard, and anxiousness. The development of the PCQ-S included five stages and data from four samples of youth athletes (N = 730 total; M_{age} = 14.50, s = 1.83). In stage one, outlined in study one, PCQ-S items were generated and then refined using feedback provided by academics, sport coaches, and youth athletes. In stage two, outlined in studies two and three, exploratory factor analysis, confirmatory factor analysis, and exploratory structural equation modelling techniques were used to examine the structure of PCQ-S items. In stage three, outlined in study four, discriminant validity was assessed by estimating the nomological network of relations between test scores on the PCQ-S and established coach climate measures. Then, in the final stage, outlined in study five, measurement invariance of the PCQ-S was examined across gender and age groups. The result of this process was a 20-item five-factor instrument that shows evidence of good factorial validity, can be differentiated from existing coach climate measures, and has measurement invariance. Based on these initial findings, the PCQ-S provides the first valid and reliable way of measuring perfectionistic climate in sport.

Keywords: perfectionism; climate; coach; scale development; youth athlete

Introduction

Perfectionism has traditionally been conceptualised as a personality trait – a personal quality of the individual. However, researchers have recently proposed a new construct: *perfectionistic climate*. Rather than focussing on the personal qualities of an individual that are perfectionistic, perfectionistic climate focusses on the degree to which the social environment can be considered perfectionistic. The theoretical basis for this new construct is provided by Flett et al.'s (2002) model of the development of perfectionism and defined using motivational climate work (Ames, 1992) guided by Achievement Goal Theory (AGT; Nicholls, 1984). In accord, perfectionistic climate is thought to be instrumental in the development of perfectionism and is defined as the informational cues and goal structures (i.e., components of the environment that emphasise what people are expected to accomplish and how they are to be evaluated) that align with the view that performances must be perfect and less than perfect performances are unacceptable (Hill & Grugan, 2019). The introduction of perfectionistic climate may offer an important new way to study the experience of the pressure to be perfect that complements existing approaches in sport and other domains. Herein, we sought to develop a scale to allow researchers and practitioners to begin to examine if this is the case.

Conceptualising Perfectionistic Climate

The notion that social environments can be perfectionistic is well grounded in models of perfectionism development. Specifically, in their seminal work on the topic, Flett, Hewitt, and colleagues (Flett et al, 2002; Hewitt et al., 2017) have outlined how the social environment is key in acting on biological vulnerabilities and shaping both early childhood experiences (e.g., asynchrony between child and caregiver) and formative development during adolescence (Chen et al., 2019; Flett et al., 1995; Ko et al., 2019). In their approach, the influence that key social agents have in shaping perfectionistic social environments is formalised via various pathways. These pathways focus on important behaviours, practices, and interpersonal styles (i.e., what key social agents do). Specifically, they reflect environments in which key social agents are considered as harsh, negligent, and psychologically controlling, extremely difficult to please, and excessively worried about mistakes and the implications of others not being perfect. This approach therefore accounts for the role of social environments in the development of perfectionism and emphasises features that are overtly perfectionistic. In doing so, it provides the theoretical basis for the construct of perfectionistic climate as a particular type of social environment that encourages perfectionism.

With Flett et al.'s (2002) developmental model as its primary theoretical basis, perfectionistic climate is situated alongside other climate constructs studied in achievement contexts. Specifically, it is considered akin to the motivational climate constructs of AGT and is defined as such. Within AGT, motivational climate represents the informational cues and goal structures that exist in the environment and define what goals people are expected to achieve and the standards against which they will be evaluated (Ames & Ames, 1984). The key factor that differentiates perfectionistic climate from other existing climates is the focus on behaviours and practices that emphasise a strict requirement for perfection. A highly perfectionistic climate is one in which people perceive that performances must be perfect and less than perfect performances are unacceptable. However, in the same way that other achievement climates exert a broad influence on the experiences people have, we can expect a perfectionistic climate to both reinforce perfectionistic beliefs and give rise to perfectionistic problems.

Perfectionistic climate is proposed to include five key components that reflect the various practices and behaviours evident in developmental models (Hill & Grugan, 2019). The first two components of perfectionistic climate are expectations and criticism. In context of perfectionistic climate, the expectations component reflects the perception that key social agents hold and demand unrealistic performance expectations of others. By contrast, the criticism component reflects the perception that key social agents engage in harsh criticism whenever the performance of others is not perfect. These components are drawn from existing models of trait perfectionism that identify unrealistic expectations and harsh criticism from specific others as central dimensions of perfectionism (e.g., parental expectations and parental criticism; Frost et al., 1990). By incorporating these components within perfectionistic climate, Hill and Grugan (2019) propose that, rather than being core features of the trait itself, such perfectionism dimensions are features of the social environment. This proposal follows several claims that these components are developmental aspects of perfectionism rather than core components of the perfectionism personality trait (see Frost et al., 1990; Rhéaume et al., 2000; Shafran et al., 2002).

The next two components of perfectionistic climate are control and conditional regard. In context of perfectionistic climate, the control component reflects the perception that key social agents employ externally controlling strategies that place pressure on others to perform perfectly (e.g., the routine use of punishment or sanctions for minor or inconsequential mistakes). By contrast, the conditional regard component reflects the perception that key social agents employ internally controlling strategies that place pressure on others to perform perfectly (e.g., providing approval, acceptance, or support only when performances are perfect). These components represent distinct forms of psychological control that are emphasised in traditional models of controlling behaviour (e.g., Bartholomew et al., 2010; Soenens & Vansteenkiste, 2010). However, in contrast to existing models, perfectionistic climate entails a narrow focus on controlling strategies that place pressure on others to feel, think, and behave in accordance with a specific requirement for perfect performance. This emphasis on perfection is a distinguishing feature of the controlling practices embedded in models of perfectionism development (Flett et al., 2002).

The final component of perfectionistic climate is anxiousness. In the context of perfectionistic climate, anxiousness reflects the perception that key social agents are extremely worried and vigilant about mistakes and the consequences of others not performing perfectly. This component is drawn from the anxious rearing model of perfectionism development (Flett et al., 2002). This model identifies how an environment in which key social agents signal an excessive focus on mistakes and the negative implications of imperfection may instil a need to be perfect in others. The importance of including anxiousness as a central component of perfectionistic climate is evident in research examining perfectionism and the parental motivational climate (Gustafsson et al., 2016). This research shows that ego-involving aspects of the climate focused on worry and concerns about failure are positively related to perfectionism in young athletes.

Perfectionistic Climate in Sport

In line with existing approaches to studying motivational climate, the study of perfectionistic climate is likely relevant to various contexts including family, education, and sport settings (Appleton & Curran, 2016; Flett et al., 2002). Here, we focus on the relevance of perfectionistic climate in sport and place emphasis on the youth sport domain. We believe that youth sport provides an ideal starting point for the study of perfectionistic climate. This is because sport is a popular activity for young people and a context in which athletes often experience interpersonal pressure, negative feedback, and contingent rewards (Fraser-Thomas et al., 2005; Gould, 2019; Ryan & Deci, 2017). Importantly, some youth athletes report that they experience their environment as excessively demanding and that they frequently encounter performance standards are not just high, but ultimately unrealistic and perfectionistic (see Krane et al., 1997; Lavallee & Robinson, 2007; Udry et al., 1997). By focussing on perfectionistic climate in youth sport, we hope to better understand the experiences of these athletes, identify the effects of training and performing in these environments, and ultimately learn how to better safeguard athletes from any subsequent negative consequences.

This application of perfectionistic climate to sport was underpinned and guided by three key proposals. This first key proposal is that the coach is a key figure responsible for shaping the extent to which athletes experience an environment that is perfectionistic. This is an important consideration as perfectionistic climate is introduced as a construct that can be shaped by various significant others (e.g., parents, teachers, and coaches). However, the especial importance of the coach is evident across research examining youth sport experiences (see Harwood et al., 2015). Moreover, the role of the coach and specific coaching practices as key sources of pressure to be perfect are also heavily emphasised in theory relating to the development of perfectionism in sport (Appleton & Curran, 2016). The strongest empirical support in this regard is for the role of unrealistic coach expectations and harsh coach criticism with numerous studies showing positive relationships between these coach behaviours and perfectionism in youth athletes (e.g., Gotwals, 2011; Madigan et al., 2019; Sagar & Stoeber, 2009).

The second key proposal is that there is a need to differentiate components of coach pressure to be perfect from core components of perfectionism. There are several sport-specific models of trait perfectionism that incorporate a focus on the coach as a source of combined unrealistic expectations and harsh coach criticism (e.g., Dunn et al., 2006). However, there are two key issues that apply to such models. The first issue is that they may be confounding etiological factors with core components of perfectionism (see Sirois & Molnar, 2016, for a related discussion). In this regard, the application of perfectionistic climate to sport is important as it clearly positions components of coach pressure as sources of interpersonal pressure that contribute to experiences of a perfectionistic climate (as opposed to aspects of the trait). The second issue is that subscales measuring coach expectations and criticism are typically collapsed into broader measures of coach pressure. This differs from the model of perfectionistic climate which asserts that expectations and criticism should be studied independently. This distinction may be important as previous research examining parental pressure shows that expectations and criticism have unique effects and interact with each other to predict important outcomes in youth athletes (see McArdle & Duda, 2008).

The final key proposal guiding the current application is that perfectionistic climate in sport involves more than unrealistic expectations and harsh criticism. In line with theory relating to the development of perfectionism, there are various other behaviours, practices, and relational styles that influence the extent to which an environment is experienced as perfectionistic (see Appleton & Curran, 2016). This is particularly relevant to the components of control, conditional regard, and anxiousness, which have all been linked to the development of perfectionism in young athletes

(Barcza-Renner et al., 2016). Here we include each one of these additional components. In doing so, we can test the construct validity of perfectionistic climate by ascertaining the degree to which each of these components capture separate but related aspects of the same multifaceted construct.

Perfectionistic Climate and Established Motivational Climate Constructs

The perfectionistic climate construct is introduced alongside established climate constructs in sport. The most relevant in this regard are coach climate constructs embedded in AGT and Self-Determination Theory (SDT; Ryan & Deci, 2017). AGT includes task-involving and ego-involving climate dimensions (Duda, 1992). In a task-involving climate, athletes perceive that the coach places emphasis on effort and cooperation, views mistakes as central to personal development, and values all performers regardless of ability. By contrast, in an ego-involving climate, athletes perceive that the coach places emphasis on outperforming others, views mistakes as worthy of punishment, and values only the best performers (Smith et al., 2008). As a complementary approach, SDT includes autonomy supportive and controlling dimensions (Vallerand & Losier, 1999). In an autonomy supportive climate, athletes perceive that the coach cares about the opinions of all performers and provides athletes with meaningful information and choice (Mageau & Vallerand, 2003). By contrast, in a controlling climate, athletes perceive that the coach uses coercive, manipulative, and authoritarian practices that pressure performers to feel, think, and behave in a particular way (Bartholomew et al., 2010).

The motivational climate dimensions emphasised in AGT and SDT can be studied independently or integrated and studied under a hierarchical model (Appleton et al., 2016). The model proposed by Duda (2013) differentiates between two higher-order coach climate dimensions: an empowering climate and a disempowering climate. An empowering climate is characterised by task involving features of AGT and autonomy supportive features of SDT, whereas an environment that is disempowering is characterised by ego-involving features of AGT and controlling features of SDT. This hierarchical model is useful as it allows the broad spectrum of climate dimensions proposed in AGT and SDT to be considered simultaneously and has been argued to provide a fuller account of the impact of coach climate in youth sport (Appleton et al., 2016). In support of this approach, research shows that perceptions of an empowering climate are positively related to indicators of athlete well-being (e.g., enjoyment and global self-worth), whereas perceptions of a disempowering climate are positively related to indictors of athlete ill-being (e.g., symptoms of athlete burnout and physical ill-health; Appleton & Duda, 2016).

In situating the construct of perfectionistic climate alongside these well-established climate constructs, it is possible to identify key similarities and differences. In terms of areas of commonality, both an ego-involving climate and perfectionistic climate emphasise punishment for mistakes and recognition for better performers. Similarly, both a controlling climate and a perfectionistic climate emphasise the controlling use of punishments and conditional reward of approval. Importantly, however, perfectionistic climate focusses on a narrower set of cues and behaviours that stress a requirement for perfection. For example, rather than emphasising expectations that are high or even very high, perfectionistic climate emphasises expectations that are rigid and unrealistic. Similarly, unlike existing climate models, perfectionistic climate emphasises a particular style of criticism that is harsh, unreasonable, and unrelenting. In these regards, a perfectionistic climate is altogether more extreme. If this is the case, and perfectionistic climate offers an alternative to existing approaches, differences between climate measures should be evident in the degree to which their components are related to each other and based on their relative positions within a nomological network (e.g., Ziegler et al., 2013).

The Present Study

The aim of the present study was to develop a scale to measure perfectionistic climate in sport – Perfectionistic Climate Questionnaire-Sport (PCQ-S). To this end, five studies are provided. The first study involves initial item generation and refinement procedures. The second study provides an exploratory examination of the factor structure of the PCQ-S items identified in study one. The third study provides a further examination of the factor structure of PCQ-S items using confirmatory and exploratory-confirmatory analyses. The fourth study provides an assessment of discriminant validity by estimating the nomological network of relations between test scores on the PCQ-S and established coach climate measures. The final study provides an initial exploratory examination of measurement invariance across age and gender groups.

Study 1

The primary purpose of study one was to generate items that capture the five perfectionistic climate components. The second purpose of the study was to then evaluate and refine the initial PCQ-S item pool. The procedures outlined in the present study and subsequent studies were approved by an institutional ethics review board. A detailed description of the approved recruitment and consent procedures employed is included in the Supplemental Material.

Initial Item Generation and Item Refinement

Definitions of the five perfectionistic climate components were developed based on existing theory (Appleton & Curran, 2016; Flett et al., 2002) and empirical research (e.g., Frost et al., 1990). In line with the conceptual model of perfectionistic climate proposed by Hill and Grugan (2019), each component incorporated a focus on perfect performance as opposed to high, very high, or exceptionally high performance standards (e.g., "…unrealistic expectations that one should *perform perfectly*"). A parallel list of key characteristics was also created to accompany the definition of each component. In line with the recommendations of DeVellis (2017), the authors independently generated items using the definitions and key characteristics of each component to guide the process. This process yielded an initial pool of 127 items. These were then assessed by the authors for their clarity, readability (assessed via Flesch-Kincaid grade level scores; Kincaid et al., 1975), relevance, similarity to other items generated and items in existing scales, and the degree to which they adhered to the specified criteria. This process led to a first revised pool of 50 items.

Expert Panel Review

The first revised item pool of 50 items was then subject to an external review process. The first external panel consisted of five experts who were independent of the research group, had worked extensively with constructs relevant to perfectionistic climate in sport (e.g., perfectionism, motivational climate, and interpersonal relationships), and held both PhD degrees and senior academic roles at universities in the UK or Sweden. The expert panel members were provided with a document containing the definition of each perfectionistic climate component, the accompanying key characteristics, and the revised pool of 50 items. In line with the recommendation of DeVellis (2017), they were instructed to: (a) identify the component each item reflects; (b) rate the content suitability of each item (high, moderate, or low); and (c) rate the comprehensibility of each item (high, moderate, or low). The experts were also invited to provide comments regarding specific items, recommend new items, and provide alternative wording for existing items.

The same revised pool of 50 items was also subject to an external review by a panel of seven sport coaches (5 male, 2 female, M_{age} = 43.14 years, s = 14.86, range = 23-59). In this review, the coaches were provided with a document containing the revised pool of items and instructed to: (a) indicate whether they considered the content of each item to be applicable to the sport they coached (applicable *versus* not applicable); and (b) rate the clarity of each item (high, moderate, or low).

Using feedback generated through the two external review panels, two members of the research group carefully reviewed the feedback relating to all items before making an informed decision about how to use the advice (DeVellis, 2017). This process helped to identify some potentially problematic items that were addressed by deleting or re-wording items. This included issues pertaining to item replication (e.g., “the coach expects flawless performances” versus “the coach expects performances to be flawless”), content suitability (e.g., controlling items identified that reflect internally rather than externally controlling contingencies), and clarity (e.g., items in which it is not clear who the behaviour or practice is directed toward). In addition, in line with expert feedback, we avoided the use of “flawless” which may be inappropriate for youth athletes and added parallel items to ensure conditional regard captured negative (e.g., “the coach is less approachable when …”) internally controlling contingencies. This process led to a second revised pool of 56 items.

Focus Group Review

The third stage of the external review process involved conducting focus groups with three independent groups of youth footballers (5 males, 15 females, M_{age} = 14.10 years, s = 0.91, range = 13-16). We followed common recommendations (e.g., Hennink, 2014) and assessed the readability, comprehension, and content suitability of the second revised pool of 56 items (DeVellis, 2017). This process was also conducted to assess the stability of item interpretation across athletes and identify any items that athletes may be unwilling or unable to respond to (Collins, 2003). The feedback generated across the three focus groups led to a third revised pool of 54-items.[1]

Study 2

The primary purpose of study two was to explore the factor structure and psychometric properties of the third revised pool of 54 items identified in study one. In doing so, we aimed to identify a parsimonious model which: (a) adequately accounts for the correlations among the set of items; and (b) incorporates factors which are interpretable. The secondary purpose of study two was to assess the final set of items in relation to scale readability and reliability. To achieve these aims, a convenience sample of youth athletes were invited to complete the revised pool of 54 items. This development sample (N = 487) was split into two subsamples via block randomisation (Arifin, 2012). The first subsample (n = 243) was reserved exclusively for study two and the second subsample (n = 244) was reserved exclusively for study three.

Participants

The subsample reserved for study two consisted of 243 youth athletes (110 males; 130 females; 3 missing; M_{age} = 14.19 years; s = 1.72; range = 10-18) who represented various individual

[1] Further details of procedures relating to initial item generation and item refinement, external panel review of items by academic experts and sport coaches, and focus group review of items by youth athletes are provided in the Supplemental Material.

and team sports (e.g., football, rugby, netball, athletics, and rowing) and levels of competition (e.g., recreational = 6, club = 136, county = 18, regional = 25, semi-professional = 4, professional = 11, national = 17, international = 6, and missing = 20). On average, athletes had been competing in their sport for 5.48 years (s = 3.16) and dedicated 7.30 hours (s = 4.46) to training and competition per week. In comparison to other activities in their lives, athletes rated their sport as moderately-to-extremely important (M = 7.79, s = 1.51; 1 = *extremely unimportant* to 9 = *extremely important*).

Data analysis

Exploratory factor analysis (EFA) was carried out with the robust variance-adjusted weighted least squares estimation (WLSMV) method for categorical variables in M*plus* 8.0 (Muthén & Muthén, 1998-2017). The procedure was iterative and followed several common recommendations (Fabrigar & Wegener, 2012). Factor retention was explored using eigenvalues, goodness of fit statistics for competing models, and solution interpretability. This approach highlights the importance of considering both relevant theory and statistical criterion when considering the appropriate number of factors to retain. The factor solutions from EFA were assessed based on the magnitude of parameter estimates (≥ .30 was considered meaningful), degree of cross loading (the number of indicators loading meaningfully on more than one factor), and solution interpretability (Morin et al., 2020).

In line with previous psychometric research (e.g., Appleton et al., 2016), we used multiple fit indices to help evaluate overall model fit: chi-square statistic (χ^2), comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardised root-mean-square residual (SRMR). However, as the χ^2 is oversensitive to sample size and minor model misspecifications, we focussed predominantly on the additional indices specified. In line with established guidelines (Marsh et al., 2004), we considered models meeting the following criteria to reflect adequate model fit: > .90 CFI, TLI, < .08 RMSEA, 90% CI < .05 to < .08; < .08 SRMR. To aid assessment of the magnitude of factor correlations, descriptors for small (.10 ≤ $|r|$ < .30), medium

(.30 ≤ |*r*| < .50), and large (|*r*| ≥ .50) effects were used (Cohen, 1988). Inter-factor correlations exceeding .85 were considered to reflect poor discriminant validity (Brown, 2015).

In terms of readability, we assessed each item using the Flesch-Kincaid grade level score method (Kincaid et al., 1975). We used this analysis to assess the approximate grade-level and associated age range that each item is suitable for. For example, an item receiving a grade-level score of 4.7 is typically suitable for individuals with at least a 4^{th} grade reading level (in the UK, 9- to 10-year-olds). In terms of reliability, we followed recent recommendations for estimating scale reliability by estimating McDonald's omega (ω) over the more traditional Cronabach's alpha (α). The ω estimates and corresponding 95% confidence intervals were calculated in M*plus* 8.0 (see Hayes & Coutts, 2020). We also examined inter-item correlations and corrected item-total correlations in SPSS 25.0 (inter-item correlations .20 < *r* < .70 and item-total correlation > .30 were used to guide assessment; Kidder & Judd, 1986).

Exploratory Factor Analysis

The iterative EFA procedure revealed that the most interpretable solution consisted of 20 items loading on five factors. This model yielded five eigenvalues with a magnitude of one or greater (eigenvalues = 10.24 to 1.00) and provided significantly better fit than the alternative models examined (see Table 1). In this model, well-defined factors for expectations, criticism, control, conditional regard, and anxiousness were evident (see Table 2). This was demonstrated through meaningful factor loadings for each item on their target factor (target λ = .42 to .89) and minimal meaningful cross loadings (only four cases out of a possible 80). In two of these cases, items loaded higher on their target factor (target λ = .52 to .69; non-target λ = .33 to .35). While the other two cases provided a comparable or stronger loading on the non-target factor (target λ = .44 to .50; non-target λ = .44 to .54), we decided to retain these items for further psychometric evaluation.

Assessment of Scale Readability and Reliability

In terms of scale readability, the Flesch-Kincaid grade level scores revealed that the 20 items ranged from 4.7 (4^{th} grade, typically suitable for 9- to 10-year-olds) to 11.2 (11^{th} grade, typically suitable for 16- to 17-year olds). Most item scores (n = 15 or 75%) were within 4^{th} grade to 7^{th} grade reading ability range (typically suitable for 9- to 12-year-olds). Three items were within an 8^{th} grade reading ability range (typically suitable for 13-to 14-year-olds). The remaining two item scores were 9.0 (9^{th} grade, typically suitable for 14- to 15-year-olds; item 12) and 11.2 (item six). Overall, based on these scores, we believe the scale is likely to function best and be most appropriate for athletes ages 12 years and older. While we arrived at this conclusion, it is important to note that we are aware that two items (six and 12) may need further revision to improve readability for younger athletes (e.g., athletes < 16 years). In relation to scale reliability, the ω estimates and corresponding 95% confidence intervals for each PCQ-S factor identified in the EFA analysis were all acceptable: expectations = .82 (95% CI range = .77 to .85); criticism = .85 (95% CI range = .81 to .88); control = .84 (95% CI range = .80 to .88); conditional regard = .86 (95% CI range = .82 to .89); anxiousness = .84 (95% CI range = .80 to .87). The inter-item correlations were also within recommended limits (r = .37 to .70) and the corrected item-total correlations were all acceptable (r = .51 to .74).

Study 3

The primary purpose of study three was to further examine the five-factor 20-item structure identified in study two. We examined three alternative measurement models using confirmatory factor analysis (CFA) and exploratory structural equation modelling (ESEM) techniques (Asparouhov & Muthén, 2009; Myers et al., 2011).

Participants

The subsample reserved for study three consisted of 244 youth athletes (114 males; 130 females; M_{age} = 14.16 years; s = 1.72; range = 10-18) who represented various individual and team sports (e.g., cricket, basketball, rowing, golf, and tennis) and levels of competition (e.g., recreational = 7, club = 138, county = 20, regional = 35, semi-professional = 6, professional = 7, national = 12, international = 2, and missing = 17). On average, athletes had been competing in their sport for 5.71

years (s = 3.09) and dedicated 7.27 hours (s = 5.91) to training and competition per week. In comparison to other activities in their lives, athletes rated their sport as moderately-to-extremely important (M = 7.71, s = 1.53; 1 = *extremely unimportant* to 9 = *extremely important*).

Data Analysis

The first model we assessed involved using CFA to examine a structure in which: (a) items were constrained to load on first-order target factors only; and (b) all latent factors were specified to covary. However, as this first-order CFA specification is highly restrictive and may be inappropriate for evaluating complex multidimensional structures, we also examined a second model. Specifically, we used ESEM with oblique target rotation to examine a structure in which: (a) items were permitted to load on all first-order factors; and (b) all latent factors were specified to covary. The third model we tested was specified to explore the possibility that a hierarchical perfectionistic climate construct may account for the covariation among the five first-order PCQ-S factors. This involved examining a hierarchical ESEM model using ESEM-within-CFA (see Morin et al., 2020). Using this framework, we examined a structure in which: (a) items were permitted to load on all first-order factors; and (b) all latent first-order factors were specified to load on a second-order hierarchical perfectionistic climate factor. In all analyses, we used the WLSMV estimation method for categorical variables in M*plus* 8.0 and assessed the magnitude and interpretability of parameter estimates using the guidelines identified in study two. Similarly, the overall model fit of each model was evaluated using the model fit indices and criteria previously identified.

Alternative Measurement Models

The first-order CFA model examined provided good fit to the data. In terms of parameter estimates (see Table S1 in the Supplemental Material), all factor loadings were significant ($p < .001$) and meaningful ($\lambda \geq .67$). In comparison to this model, the first-order ESEM model examined provided improved model fit and further support for the hypothesised five-factor structure. In line with the EFA results in study two, well-defined and discernible factors for expectations, criticism, control, conditional regard, and anxiousness were evident (see Table 3). This was demonstrated through meaningful factor loadings for each item on their target factor (target $\lambda \geq .42$) and minimal meaningful cross loadings (only two cases out of a possible 80). In all cases of cross loading, items loaded higher on their target factor (target $\lambda = .57$ to $.65$; non-target $\lambda = .31$ to $.40$). In the first-order CFA model, standardised factor correlations were positive, significant, and large ($r = .68$ to $.84$). In the first-order ESEM model, the standardised factor correlations were positive, significant, and moderate-to-large in magnitude ($r = .45$ to $.71$). The hierarchical ESEM model examined also provided excellent fit to the data. In terms of parameter estimates, well-defined factors for the five PCQ-S components were evident. This was demonstrated through meaningful factor loadings for each item on their target factor (target $\lambda \geq .42$) and minimal meaningful cross loadings (only three cases out of a possible 80). In all cases of cross loading, items loaded higher on their target factor (target $\lambda = .50$ to $.62$; non-target $\lambda = .30$ to $.44$). In this model, all second-order factor loadings were also meaningful ($\lambda \geq .64$; see Table S2 in the Supplemental Material).

Study 4

The primary purpose of study four was to provide an assessment of discriminant validity by estimating the nomological network of relations between test scores on the PCQ-S and established coach climate measures. The secondary purpose of this study was to examine the stability of the three PCQ-S measurement models highlighted and tested in study three using an independent dataset.

Participants

A convenience sample of 223 (183 males; 38 females; 2 missing; $M_{age} = 15.25$ years, $s = 1.90$; age range = 12–19) youth athletes recruited from sport clubs and schools in the United Kingdom provided the data for study four. The participants represented various team sports (e.g., football, cricket, hockey, rugby, netball, and basketball) and levels of competition (recreational = 27, club = 140, county = 18, regional = 15, semi-professional = 10, professional = 1, national = 4, international = 1, and missing = 7). On average, athletes had been competing in their sport for 7.51

years (s = 3.68), dedicated 7.61 hours (s = 4.49) to training and competition per week, and had been working with their current coach for 2.47 (s = 2.37) years. In comparison to other activities in their lives, athletes rated their sport as moderately-to-extremely important (M = 7.49, s = 1.87; 1 = *extremely unimportant* to 9 = *extremely important*).

Measures

Perfectionistic Climate. To measure youth athlete perceptions of perfectionistic coach climate components, we used the five-factor 20-item model identified in the previous two studies. In line with previous data collection, participants were instructed to think about the coach that they spend the most time with and rate their level of agreement or disagreement with each statement using a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*).

Empowering and Disempowering Coach Climate Dimensions. To measure youth athlete perceptions of empowering and disempowering coach climate dimensions, we used three measures. The 12-item Motivational Climate Scale for Youth Sports (MCSYS; Smith et al., 2008) was used to assess perceptions of task-involving (TASK) and ego-involving (EGO) cues emphasised in AGT. The 15-item Controlling Coach Behaviour Scale (CCBS; Bartholomew et al., 2010) was used to assess perceptions of four facets of controlling behaviour emphasised in SDT: controlling use of rewards (CREW), negative conditional regard (NCR), intimidation (INT), and excessive personal control (EPC). The 6-item Sport Climate Questionnaire-Short Form (SCQ-SF; Felton & Jowett, 2012) was used to assess perceptions of autonomy supportive behaviours (PAS) emphasised in SDT. In line with the hierarchical model of coach-created motivational climate (Appleton et al., 2016), we considered TASK and PAS to reflect empowering features of the coach climate and EGO, CREW, NCR, INT, and EPC to reflect disempowering features of the coach climate.[2]

Data Analysis

[2] Example items for the MCSYS, CCBS, and SCQ-SF are provided in the Supplemental Material.

The study analyses were carried out using IBM Statistics SPSS 25.0, M*plus* 8.0, and *R* version 3.5.0. The first step of data analysis involved cleaning the raw data. Following this, descriptive statistics and bivariate correlations were computed. The second step involved examining an ESEM measurement model including all coach climate measures.[3] In the third step, we then estimated a regularised partial correlation network using *R* package *qgraph* (Epskamp et al., 2012). This analysis provides a visualisation of the complex covariation between the variables under investigation. In the current application of this technique, we estimated a network of coach climate variables based on partial correlation coefficients (Epskamp & Fried, 2018). This means that the resultant network includes nodes (circles) that represent different coach climate variables and edges (lines connecting nodes together) that represent associations between variables after controlling for all other variables in the network. To account for measurement error in the computation of the coach climate variables, we used the extracted factor scores from the ESEM measurement model.

To limit the number of potentially spurious edges included in the final model, we used the least absolute shrinkage and selection operator (LASSO) which limits the sum of absolute partial correlation coefficients. This regularisation technique shrinks all partial correlations and constructs a sparse network in which likely spurious associations are excluded (i.e., some partial correlations are shrunk to exactly zero; see Epskamp & Fried, 2018). The edges not identified to be exactly zero can therefore be considered sufficiently strong to be included in the estimated network (Epskamp et al., 2018). This approach functions well in retrieving the true network structure and is particularly useful for dealing with relatively small datasets when estimating psychological networks (Costantini et al., 2015; Epskamp & Fried, 2018).

Once a psychological network is constructed there are several analyses that can be applied to examine global structure and local patterns within the network (Costantini et al., 2015). In the current

[3] The results pertaining to the data screening protocol and ESEM measurement model are reported in the Supplemental Material.

application, we examined: (a) the overall dimensionality of the network; and (b) the associations between specific pairs of nodes. To examine network dimensionality, we employed exploratory graph analysis (EGA; Golino et al., 2020) and followed the recommendations and *R* code provided by Christensen et al. (2020). EGA has been found in simulation studies to yield comparable or improved accuracy in identifying dimensionality in comparison to traditional factor analytic techniques (Golino et al., 2020). To examine the associations between specific pairs of nodes, we computed the edge weights (i.e., regularised partial correlation coefficients) of each association in the estimated network. This allowed us to explore the relative strength of each retained edge weight.

Descriptive Statistics, Bivariate Correlations, and Scale Reliability Estimates

The descriptive statistics and bivariate correlation estimates are displayed in Table 4. The bivariate correlations show that each of the five PCQ-S components shared positive relationships with the disempowering coach climate subscales. The only exception to this was the non-significant relationship between the criticism component of the PCQ-S and the EPC subscale of the CCBS. By contrast, the five PCQ-S components shared either negative or non-significant relationships with the empowering coach climate subscales. In line with previous research, the disempowering climate subscales shared mainly inverse relationships with the empowering subscales examined (Appleton et al., 2016). The scale reliability estimates and corresponding 95% confidence intervals for each coach climate variable are also reported in Table 4 (ω = .68 to .90).

Regularised Partial Correlation Network

The regularised partial correlation network is displayed in Fig. 1. The network features 12 nodes and 39 edges (59% of all possible associations). The LASSO regularisation technique resulted in 27 of the possible 66 edges being removed (41% of all possible associations were shrunk to exactly zero). The EGA identified that this network contained three dimensions. The dimensions identified reflect perfectionistic (dimension one: five PCQ-S components), disempowering (dimension two; five disempowering coach climate subscales), and empowering (dimension three; two empowering coach climate subscales) features of the coach climate. The nodes within each dimension were well connected and located closely to one another in the estimated network (see Fig. 1). The edge weights (i.e., regularised partial correlation coefficients) are reported in Table 4.

Stability of Alternative Measurement Models

The three models examined (i.e., first-order CFA, first-order ESEM, and hierarchical ESEM model specifications) provided support for the stability of the 20-item five-factor PCQ-S. In line with the findings from study two, all three models provided good fit to the data (see Table 1). The findings were also consistent in that the first-order ESEM model provided superior model fit in comparison to the first-order CFA model. In terms of parameter estimates, both models provided support for the 20-item five-factor PCQ-S (see Table S1 for CFA results and Table 3 for ESEM results). In terms of the ESEM parameter estimates, model support was based on the high percentage of meaningful (λ = > .30) target factor loadings (95% of cases) and small percentage of meaningful non-target factor loadings (only 7.5% of cases). In terms of the final model examined, we again found support for a hierarchical perfectionistic climate construct accounting for the covariation among the five first-order PCQ-S factors (see Table S2 in the Supplemental Material).

Study Five

The purpose of study five was to test the measurement invariance of the first-order five-factor 20-item ESEM model across meaningful subgroups defined based on gender and age. This testing procedure was adopted as it provides a robust test of model generalisability and generates important statistical information regarding the applicability of making gender- and age-based comparisons in future research. To provide the data needed to examine measurement invariance, we created one combined dataset (*N* = 710) comprised of data from the initial development sample used across studies two and three (*N* = 487) and the independent sample used in study four (*N* = 223).

Data Analysis

In line with the approach to evaluating measurement invariance adopted by Jin (2020), we examined three nested ESEM models to evaluate two aspects of measurement invariance per multi-group analysis: metric invariance (i.e., invariance of factor loadings) and scalar invariance (i.e., invariance of factor loadings and thresholds). We used the WLSMV estimator and oblique target rotation with delta parameterisation to analyse each model.[4]

Using the combined dataset, we initially examined measurement invariance across the two independent samples. In line with our primary aim, we then examined measurement invariance of the ESEM model across gender (male = 407; female = 298; total N = 705) and age (≤ 14 years = 360; ≥ 15 years = 349; total N = 709) groups.[5] In each assessment, the first stage involved examining the overall fit of each specified model using the fit indices and corresponding criteria previously identified. In the second stage, metric invariance and scalar invariance were evaluated by differences in CFI (ΔCFI), TLI (ΔTLI), and RMSEA (ΔRMSEA) between nested models. To evaluate metric invariance (i.e., metric versus configural model) and scalar invariance (i.e., scalar versus metric model), we used cut-off values identified based on Jin's (2020) simulation study as an evaluative guide: metric non-invariance (ΔCFI > -.003, ΔTLI > -.004, and ΔRMSEA > +.014) and scalar non-invariance (ΔCFI > -.001, ΔTLI > -.001, and ΔRMSEA > +.005).

Measurement Invariance

The goodness of fit statistics for all invariance models are reported in Table 1. In terms of measurement invariance across independent samples, the three increasingly restrictive models provided a good level of fit. In terms of the specific cut-off values identified, support for metric

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[4] A detailed description of the three nested ESEM measurement invariance models is provided in the Supplemental Material (see also Jin, 2020).

[5] In the combined dataset of 710 athletes, the youngest reported age was 10 years old and the oldest reported age was 19 years old. We therefore used ≤ 14 years and ≥ 15 years as the cut-off values to identify two groups with an equal age range representing younger versus older youth athletes.

invariance was provided by ΔRMSEA (+ .011). By contrast, support for scalar invariance was provided by ΔCFI (-.001), ΔTLI (+.001), and ΔRMSEA (-.001). The two scores that exceeded the specific cut-off values for metric invariance either approximated (ΔCFI = -.013) or satisfied (ΔTLI = -.010) more traditional criteria often applied in tests of measurement invariance (i.e., non-invariance reflected by ΔCFI and ΔTLI > -.010; Chen, 2007). While the applicability of traditional cut-off values is unclear for assessing measurement invariance in this type of analysis, they have been found to show some sensitivity to metric non-invariance with ESEM models that have a small or medium degree of cross-loading (Jin, 2020). With this in mind, the two samples were combined for the purpose of testing gender and age invariance.

In terms of measurement invariance across gender groups, the three increasingly restrictive models provided good fit. In terms of the specific cut-off values identified, support for metric invariance was provided by ΔCFI (-.003), ΔTLI (+.001), and ΔRMSEA (-.001). Similarly, support for scalar invariance was provided by ΔCFI (0.000), ΔTLI (0.000), and ΔRMSEA (0.000). In sum, this evidence shows that the PCQ-S model operates equivalently across the two identified gender groups.

In terms of measurement invariance across age groups, the three increasingly restrictive models provided a satisfactory level of fit. In terms of the specific cut-off values identified, support for metric invariance was provided by ΔTLI (-.001) and ΔRMSEA (+.001). Similarly, support for scalar invariance was provided by ΔTLI (-.001) and ΔRMSEA (+.002). The ΔCFI values used to assess metric invariance (-.004) and scalar invariance (-.002) only marginally exceeded the specific cut-off values identified. With this in mind, there is sufficient evidence the PCQ-S model operates equivalently across the two age groups.

Discussion

The aim of the present research was to develop a scale to measure perfectionistic climate in sport. The five studies outlined above highlight key stages in the initial development and validation of the PCQ-S. In stage one, outlined in study one, PCQ-S items were generated and refined. In stage two, outlined in studies two and three, exploratory, confirmatory, and exploratory-confirmatory analyses were used to further examine the structure of PCQ-S items. In stage three, outlined in study four, discriminant validity was assessed by estimating the nomological network of relations between test scores on the PCQ-S and established coach climate measures. Then, in the final stage, outlined in study five, measurement invariance of the PCQ-S was examined across gender and age groups. The result of this process was a five-factor 20-item scale.

Key Proposals Underpinning the PCQ-S

The development of the PCQ-S was underpinned and guided by several key proposals and considerations. The first key proposal relevant in this regard is that we considered perfectionistic climate in sport to be comprised of five distinct and interrelated components representing expectations, criticism, control, conditional regard, and anxiousness. We found strong support for this hypothesised five-factor structure across multiple measurement models and samples. In line with previous research in sport (e.g., Appleton et al., 2016; Myers et al., 2011; Perry et al., 2015), the ESEM model we examined provided the strongest support for the hypothesised first-order model specification. This was reflected in better model fit and lower factor correlations relative to the alternative CFA model. However, even the more restrictive CFA model provided good fit. In all, the findings suggest that the PCQ-S matches the intended structure of perfectionistic climate with five interrelated components focused on perceived perfectionistic coaching practices.

The second key proposal is that we considered unrealistic expectations and harsh criticism to represent conceptually distinct constructs. While we found evidence for the construct validity of all five PCQ-S factors, support for measuring expectations and criticism as independent factors is particularly noteworthy. The psychometric analyses conducted across multiple measurement models and analyses indicated that the two constructs are unique (Brown, 2015). This was particularly evident in the ESEM model examined in study four which identified an inter-factor correlation that was moderate in magnitude (r = .43). Therefore, rather than collapsing the two factors to create a broader construct of coach pressure as has been the case in previous research (see Dunn et al., 2006), the PCQ-S is the first domain specific scale in sport to capture unrealistic expectations and harsh criticism separately. As such, the PCQ-S can be used to further examine the unique and interactive effects of these two distinct practices in youth sport (see McArdle & Duda, 2008).

The third key proposal that we considered is that perfectionistic climate in sport involves more than just unrealistic expectations and harsh criticism. The identified five-factor PCQ-S includes the additional components of control, conditional regard, and anxiousness. This broader spectrum of climate components better captures the related behaviours, practices, and relational styles central to the development of perfectionism in athletes (Appleton & Curran, 2016). The most compelling evidence in this regard is the strong evidence we found for a hierarchical perfectionistic climate construct. Specifically, the hierarchical ESEM models examined in studies three and four suggest that the five PCQ-S components can all be considered to be manifested as a result of a broader, higher-order, latent perfectionistic climate factor. Researchers can therefore study the components of perfectionistic climate as individual factors or statistically model them in a manner to study the overall construct. This level of modelling flexibility is advantageous as it provides scope to examine the relative influence of each PCQ-S factor in relation to a specified outcome or examine the broader influence of an overall perfectionistic climate factor itself (see Myers et al., 2014).

The final key proposal is that we considered the five PCQ-S components to be conceptually distinguishable from existing AGT and SDT coach climate measures. To examine this proposal, we estimated a regularised partial correlation network. Network analysis offers a novel psychometric approach to identifying the empirical relations between measures of constructs within an identified nomological network (e.g., Ziegler et al., 2013). While this technique is common in areas of clinical, personality, and health psychology, the present study offers one of the first applications of this technique in sport and a means to assessing the discriminant validity of the PCQ-S. The network-based analyses illustrated that while commonalities exist between the PCQ-S and existing climate measures, the five PCQ-S components are empirically distinct from empowering and disempowering coach climate dimensions. This evidence of discriminant validity lends support to our proposal that the coaching practices captured by the PCQ-S reflect an unreasonable, harsh, and altogether more extreme relational style than existing coach climate measures. Importantly, the results suggest that a disempowering climate is not necessarily experienced as perfectionistic, and that a perfectionistic climate is experienced differently than a climate that is disempowering.

Implications of PCQ-S

The application of perfectionistic climate to sport and development of the PCQ-S provides a new and alternative way to study the experience of the pressure to be perfect. While the focus in existing perfectionism measures is on the individual and the extent to which they display perfectionistic traits, experience perfectionistic cognitions, or feel the need to appear perfect to others, the PCQ-S focusses on the extent to which an environment is perfectionistic. This is an important advance in this area. Notably, the construct of perfectionistic climate accounts for the possibility that all athletes–regardless of their own levels of perfectionism–can experience the consequences of the pressure to be perfect. In line with guiding theory, this may include the internalisation of external pressure that encourages the development of personal perfectionism as well as other outcomes that are particularly distressing for athletes.

The introduction of perfectionistic climate also builds on existing climate research to offer another way of studying the social environment in sport. Against a backdrop of a reliance on a small number of existing approaches (e.g., AGT), there have been calls for other approaches to be adopted to better understand practices that shape different athlete experiences (Morgan, 2017). The requirement to move beyond AGT, for example, is already evident in coach climate research drawing upon key tenets of SDT (Mageau & Vallerand, 2003) and integrating multiple theoretical frameworks (e.g., Appleton et al., 2016; Duda, 2013). This type of extension has been critical in improving our understanding of the repercussions that different coach climate experiences may have on athlete motivation, health, and psychological functioning (e.g., Appleton & Duda, 2016). The development of the PCQ-S offers a further alternative that focuses exclusively on the practices that shape environments so that athletes experience an extreme pressure to be perfect.

The development of the PCQ-S also has important implications as far as primary prevention and intervention to help manage perfectionistic problems in sport are concerned. This includes safeguarding mental health, maintaining motivation, and optimising performance. To date, research on perfectionism intervention in sport has focussed on the individual and provided mixed success in terms of intervention effectiveness (e.g., Donachie & Hill, 2020; Mosewich et al. 2013; Thompson et al., 2011). To improve on current intervention strategies, researchers have emphasised that it is important to incorporate a focus on the coaching environment (Appleton & Curran, 2016; Mosewich et al., 2013). In this regard, a focus on coach education and changing current practice offers a new avenue to explore how perfectionistic problems in athletes might be prevented as a routine part of their experience. There is evidence in sport and other contexts that this type of intervention can be effective (e.g., Braithwaite et al., 2011). Thus, the ability to measure the degree to which the social environment is experienced as perfectionistic is an essential tool to help researchers and practitioners assess and redress perfectionistic cues provided by the coach and test these types of interventions.

Limitations and Future Research Directions

The findings of the present research should be considered in relation to some limitations and future research directions. Firstly, while we found strong evidence for the factorial validity of the

PCQ-S, researchers should continue to examine the hypothesised five-factor structure in diverse samples of youth athletes. In doing so, the two items (item six and 12) that returned slightly higher grade level reading scores in our assessment of readability should be closely monitored. Secondly, while we found support that the PCQ-S operates equivalently across different age and gender groups, it is important for researchers to examine whether this is also the case across other meaningful groups. We also only examined metric and scalar invariance. Future research is therefore needed to examine the invariance of structural parameters (e.g., equivalence of factor variances, covariances, and means). Thirdly, in line with existing motivational climate measures, the PCQ-S provides information pertinent to how athletes experience the coach climate in sport as opposed to how coaches actually behave. To better understand perfectionistic climates in sport, researchers should consider measuring both personality (e.g., other-oriented perfectionism) and objective behaviours of the coach alongside perceptions of the perfectionistic climate. The final point relates to the structure of data collected using the PCQ-S. When youth athletes are nested within groups that share the same coach, it will be important for researchers to adopt a multilevel approach that examines both within- and between-group variations in perceptions of the coach-created perfectionistic climate. This is especially important given that climate-based constructs are inherently group-level constructs (see Papaioannou et al., 2004).

Conclusion

The purpose of the present research was to apply the construct of perfectionistic climate to sport and develop the first scale to measure it. Here, we have reported on key stages involved in the development and initial validation of this new scale. Based on these analyses, the PCQ-S shows evidence of good factorial validity, can be differentiated from existing coach climate measures, and is reasonably invariant across different age and gender groups.

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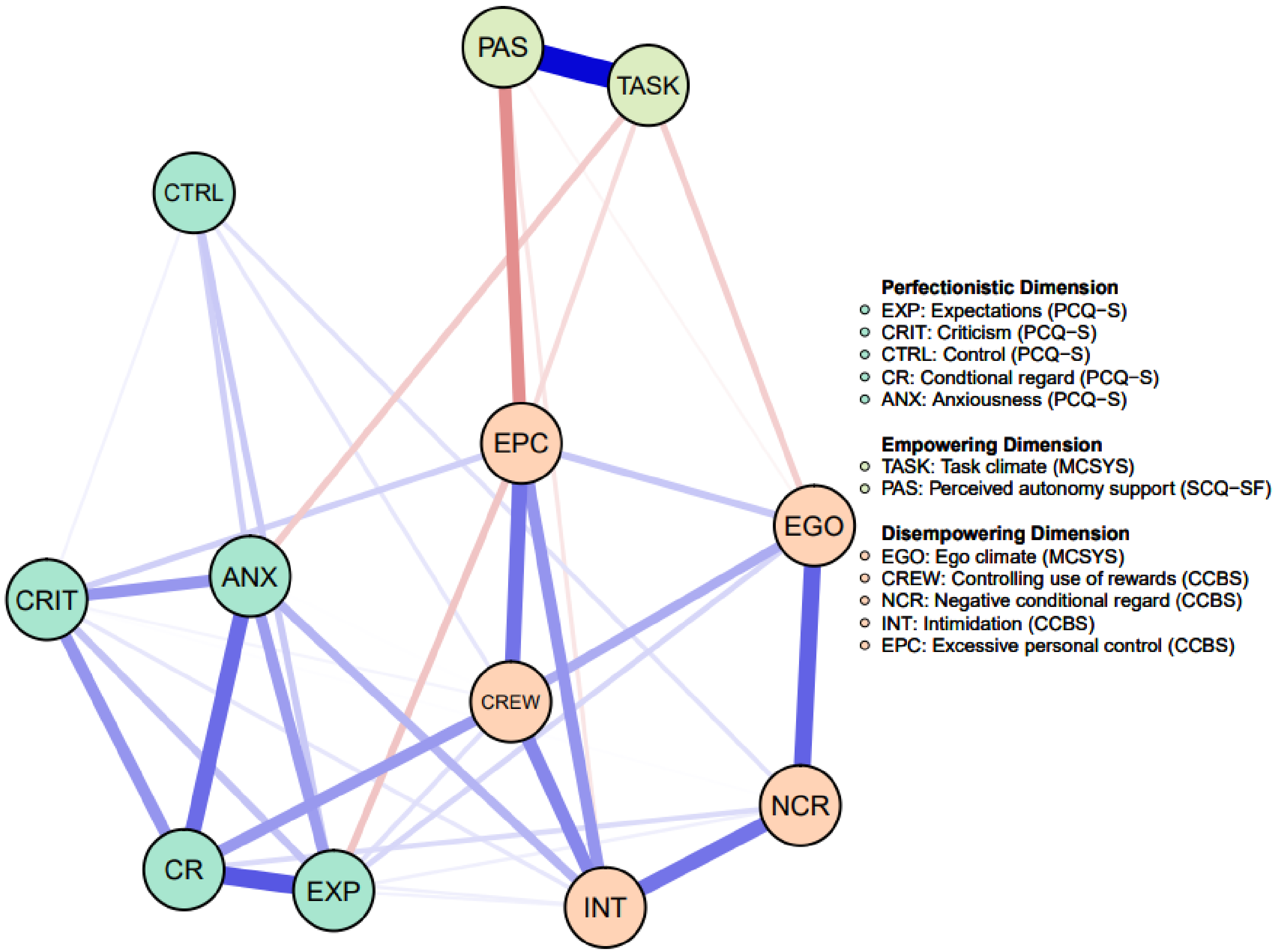

Fig. 1: Regularised partial correlation network containing coach climate nodes (i.e., variables) from the Perfectionistic Climate Questionnaire-Sport (PCQ-S), Motivational Climate Scale for Youth Sports (MCSYS), Controlling Coach Behaviour Scale (CCBS), and Sport Climate Questionnaire-Short Form (SCQ-SF); Blue lines represent positive associations; Red lines represent negative associations; The width and saturation of an edge represent the strength of the association.

Table 1. Goodness of fit statistics for EFA (Study Two), CFA and ESEM (Studies Three and Four), and invariance (Study Five) measurement models.

	WLSMV $\chi 2$ (*df*)	CFI	TLI	RMSEA	RMSEA 90% CI	SRMR	ΔCFI	ΔTLI	ΔRMSEA
Study Two (*N* = 243)									
EFA	152.80*** (100)	.991	.983	.047	[.031, .061]	.021	– –	– –	– –
Study Three (*N* = 244)									
First-order CFA	415.66*** (160)	.964	.958	.081	[.071, .091]	.043	– –	– –	– –
ESEM	179.65*** (100)	.989	.79	.057	[.043, .070]	.022	– –	– –	– –
Hierarchical ESEM	175.13*** (105)	.990	.982	.052	[.038, .066]	.022	– –	– –	– –
Study Four (*N* = 223)									
First-order CFA	384.12*** (160)	.947	.937	.079	[.069, .089]	.055	– –	– –	– –
ESEM	180.14*** (100)	.981	.964	.060	[.046, .074]	.028	– –	– –	– –
Hierarchical ESEM	171.71*** (105)	.984	.971	.053	[.038, .067]	.028	– –	– –	– –
Study Five (*N* = 710)									
	Sample Invariance (Initial Development Sample = 487; Independent Study Four Sample = 223; Total *N* = 710)								
Configural	540.61*** (260)	.984	.977	.055	[.049, .062]	.026	– –	– –	– –
Metric	855.98*** (335)	.971	.967	.066	[.061, .072]	.040	-.013	-.010	+.011
Scalar	872.10*** (350)	.970	.968	.065	[.059, .070]	.040	-.001	+.001	-.001
	Gender Invariance (Male = 407; Female = 298; Total *N* = 705)								
Configural	478.47*** (260)	.987	.981	.049	[.042, .056]	.024	– –	– –	– –
Metric	608.49*** (335)	.984	.982	.048	[.042, .054]	.034	-.003	+.001	-.001
Scalar	628.95*** (350)	.984	.982	.048	[.042, .053]	.034	.000	.000	.000
	Age Invariance (≤ 14 years = 360; ≥ 15 years = 349; Total N = 709)								
Configural	431.75*** (260)	.990	.985	.043	[.036, .050]	.021	– –	– –	– –
Metric	566.86*** (335)	.986	.984	.044	[.038, .050]	.031	-.004	-.001	+.001
Scalar	609.34*** (350)	.984	.983	.046	[.040, .052]	.032	-.002	-.001	+.002

Note. EFA = Exploratory factor analysis; CFA= Confirmatory factor analysis; ESEM = Exploratory structural equation modelling; *df* = Degrees of freedom; CFI = Comparative fit index; TLI = Tucker-Lewis index; RMSEA = Root mean square error of approximation; CI = Confidence interval; SRMR = Standardised root mean square residual; ESEM models were estimated with target oblique rotation; *** $p < .001$; ** $p < .01$; * $p < .05$.

Table 2. Geomin rotated loadings from five-factor EFA in study two.

	M	*s*	F1	F2	F3	F4	F5
1. The coach expects performances to be perfect at all times.	3.20	1.16	**.73* (0.10)**	-.26* (.10)	.03 (0.06)	.00 (0.05)	.04 (0.06)
17. The coach expects performances to be perfect.	2.58	1.16	**.73* (0.09)**	.08 (0.09)	-.04 (0.06)	.01 (0.06)	.08 (0.05)
26. The coach expects performances to include no errors.	2.27	1.08	**.59* (0.09)**	.20* (0.08)	-.01 (0.04)	.21* (0.08)	-.08 (0.05)
29. The coach expects nothing less than perfect performance.	2.25	1.05	**.70* (0.08)**	.03 (0.04)	.07 (0.07)	.09 (0.07)	.07 (0.05)
12. The coach criticises even the best performances.	2.36	1.22	-.01 (0.05)	**.79* (0.06)**	.05 (0.06)	-.02 (0.05)	.06 (0.06)
15. The coach criticises performances that are not perfect.	2.87	1.15	.03 (0.07)	**.57* (0.07)**	.07 (0.07)	-.04 (0.06)	.25* (0.08)
20. The coach criticises all mistakes no matter how small.	2.55	1.12	.15* (0.08)	**.69* (0.07)**	-.01 (0.05)	.01 (0.05)	.11 (0.07)
34. The coach criticises performances all the time.	2.30	1.13	.07 (0.08)	**.65* (0.07)**	.16* (0.07)	.18* (0.07)	-.08 (0.05)
33. The coach uses his/her position unfairly to try to make performances perfect.	2.18	1.11	.44* (0.07)	.08 (0.05)	**.44* (0.06)**	.00 (0.05)	.02 (0.05)
41. The coach uses threats to try to stop mistakes in performances.	1.82	1.05	.35* (0.11)	-.01 (0.04)	**.69* (0.07)**	-.05 (0.05)	-.05 (0.05)
50. The coach uses punishment to try to make performances perfect.	2.17	1.20	.05 (0.07)	.01 (0.05)	**.74* (0.07)**	.05 (0.06)	.07 (0.06)
54. The coach withholds rewards if performances are not perfect.	2.14	1.11	.01 (0.05)	.01 (0.05)	**.66* (0.06)**	.16 (0.08)	.00 (0.05)
45. The coach is less approving when performances are not perfect.	2.28	1.10	.18 (.10)	.10 (0.07)	.25* (0.08)	**.42* (0.06)**	.07 (0.05)
48. The coach is friendlier when performances are perfect.	2.84	1.17	.03 (0.04)	.02 (0.03)	-.08 (0.06)	**.83* (0.06)**	.08 (0.05)
52. The coach is kinder when no mistakes are made when performing.	2.63	1.15	.05 (0.05)	-.09 (0.06)	.06 (0.04)	**.89* (0.06)**	-.05 (0.03)
53. The coach is less friendly when performances are not perfect.	2.34	1.14	-.08 (0.06)	.03 (0.04)	.54* (0.07)	**.50* (0.08)**	.06 (0.04)
6. The coach is anxious about the possibility of even small mistakes when performing.	2.24	1.05	.22* (0.09)	-.13 (0.07)	.15 (0.09)	-.00 (0.04)	**.61* (0.06)**
7. The coach is tense when mistakes are more likely to happen during performances.	2.67	1.09	.01 (0.06)	.01 (0.02)	.09 (0.08)	.05 (0.05)	**.78* (0.05)**
9. The coach is nervous that things will not go perfectly during performance.	2.51	1.14	.05 (0.06)	.11 (0.08)	-.05 (0.06)	-.01 (0.05)	**.77* (0.06)**
11. The coach is concerned about mistakes during performance.	2.94	1.08	-.05 (0.08)	.33* (0.08)	-.02 (0.05)	.15* (0.07)	**.52* (0.08)**
Geomin Factor Correlations F1				.63*	.58*	.56*	.51*
F2					.48*	.48*	.39*
F3						.46*	.43*
F4							.50*

Note. Study two data (N = 243); Bold typeface denotes meaningful loading (≥ .30) on target factor; Underlined typeface denotes meaningful cross-loading (≥.30) on non-target factor; F1 = Expectations; F2 = Criticism; F3 = Control; F4 = Conditional regard; F5 = Anxiousness; Standard errors reported in parentheses; * p < .05.

Table 3. Standardised model results and factor correlations for the ESEM models in studies three and four.

Item	*M*	*s*	Expectations	Criticism	Control	Conditional Regard	Anxiousness
1	3.34	1.14	.63*** (0.09) / .79*** (0.06)	-.03 (0.08) / -.05 (0.05)	.04 (0.07) / -.07 (0.06)	-.01 (0.08) / .11 (0.06)	.08 (0.06) / .01 (0.06)
17	2.67	1.15	.60*** (0.09) / .77*** (0.05)	-.00 (0.08) / .14** (0.04)	.12* (0.05) / .12** (0.04)	.12* (0.06) / -.07 (0.05)	.12* (0.05) / .09 (0.05)
26	2.42	1.08	.80*** (0.08) / .62*** (0.07)	.05 (0.07) / .14* (0.06)	-.01 (0.05) / .27*** (0.04)	.05 (0.05) / .01 (0.06)	-.01 (0.05) / -.02 (0.06)
29	2.77	1.28	.76*** (0.08) / .84*** (0.05)	.10 (0.07) / .08 (0.04)	.03 (0.05) / -.06 (0.04)	.06 (0.05) / .09* (0.04)	-.02 (0.04) / -.03 (0.05)
12	2.82	1.13	.09 (0.07) / -.11 (0.06)	.90*** (0.09) / .78*** (0.06)	-.25*** (0.06) / -.03 (0.05)	-.03 (0.05) / -.09 (0.06)	.04 (0.04) / .07 (0.06)
15	3.12	1.08	.12 (0.07) / .20** (0.06)	.62*** (0.08) / .59*** (0.07)	-.04 (0.07) / -.30*** (0.06)	.18*** (0.05) / .23*** (0.06)	.07 (0.05) / .17** (0.05)
20	2.55	1.11	.04 (0.06) / .38*** (0.06)	.63*** (0.08) / .39*** (0.07)	.17** (0.06) / .05 (0.07)	-.10 (0.05) / .02 (0.06)	.13** (0.04) / .06 (0.06)
34	2.44	1.08	-.13* (0.06) / .12* (0.06)	.65*** (0.07) / .59*** (0.07)	.40*** (0.05) / .33*** (0.05)	.01 (0.05) / -.10 (0.06)	.01 (0.04) / -.02 (0.06)
33	1.97	1.02	.29*** (0.06) / .23** (0.07)	.17** (0.06) / -.05 (0.07)	.49*** (0.06) / .46*** (0.07)	-.07 (0.06) / -.03 (0.08)	.07 (0.05) / .18** (0.06)
41	1.90	1.14	.00 (0.07) / .03 (0.06)	-.02 (0.06) / -.01 (0.06)	.75*** (0.07) / .58*** (0.07)	.04 (0.06) / .02 (0.07)	.18*** (0.05) / .30*** (0.06)
50	2.41	1.26	-.03 (0.08) / .04 (0.05)	.20** (0.07) / .06 (0.05)	.57*** (0.07) / .75*** (0.07)	.23*** (0.05) / .30*** (0.05)	-.02 (0.06) / -.13* (0.05)
54	2.44	1.02	.19* (0.08) / .17* (0.07)	.08 (0.06) / -.05 (0.07)	.42*** (0.06) / .14 (0.07)	.25*** (0.06) / .22** (0.08)	.06 (0.05) / .21** (0.07)
45	3.06	1.05	.13 (0.07) / -.01 (0.06)	.25*** (0.05) / .02 (0.04)	.17*** (0.05) / -.01 (0.06)	.46*** (0.06) / .79*** (0.07)	-.05 (0.05) / .10* (0.05)
48	3.58	1.15	-.08 (0.06) / .21** (0.07)	-.01 (0.05) / -.16** (0.06)	-.13** (0.04) / .00 (0.06)	1.00*** (0.06) / .68*** (0.07)	.03 (0.04) / .04 (0.07)
52	3.30	1.16	.10 (0.06) / -.01 (0.06)	-.14* (0.05) / .01 (0.05)	.04 (0.05) / .10 (0.06)	.70*** (0.06) / .81*** (0.06)	.22*** (0.04) / -.11* (0.05)
53	2.62	1.09	.19** (0.06) / -.04 (0.05)	.05 (0.06) / .09 (0.05)	.31*** (0.04) / .24*** (0.05)	.57*** (0.05) / .60*** (0.06)	-.06 (0.04) / .16** (0.06)
6	2.48	.98	.16* (0.06) / -.07 (0.06)	-.00 (0.06) / .17** (0.06)	.06 (0.05) / .22*** (0.06)	-.13** (0.05) / .15* (0.07)	.74*** (0.06) / .50*** (0.08)
7	2.92	.99	-.05 (0.06) / .11 (0.07)	-.06 (0.05) / .28*** (0.07)	.10* (0.05) / -.05 (0.07)	-.04 (0.05) / .24** (0.07)	.94*** (0.05) / .31*** (0.07)
9	2.38	.94	-.05 (0.07) / .02 (0.05)	.06 (0.06) / -.23*** (0.06)	-.06 (0.05) / .00 (0.06)	.13* (0.05) / -.11* (0.05)	.79*** (0.05) / .90*** (0.09)
11	2.94	.96	-.01 (0.09) / -.05 (0.06)	.26*** (0.07) / .44*** (0.06)	-.08 (0.07) / .10 (0.06)	.19** (0.06) / .12 (0.06)	.48*** (0.06) / .34*** (0.08)
Factor Correlations		F1					
		F2	.71 / .43				
		F3	.53 / .34	.55 / .36			
		F4	.62 / .59	.61 / .42	.47 / .40		
		F5	.59 / .46	.51 / .35	.45 / .39	.60 / .45	

Note. Study three data (N = 244) to left; Study four data (N = 223) to right; Item mean (M) and standard deviation (s) values are for study four data; Bold typeface denotes meaningful loading (≥ .30) on target factor; Underlined typeface denotes meaningful cross-loading (≥.30) on non-target factor; F1 = Expectations; F2 = Criticism; F3 = Control; F4 = Conditional regard; F5 = Anxiousness; Standard errors reported in parentheses; *** p < .001; ** p < .01; * p < .05.

Table 4: Descriptive statistics, bivariate correlations, edge weights, and reliability estimates

	Subscale (Instrument)	*M*	*s*	ω	ω 95% CI	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1.	EXP (PCQ-S)	2.79	.98	.88	[.85, .90]		.10	.09	.28	.16	– –	.07	.05	.03	.02	-.10	– –
2.	CRIT (PCQ-S)	2.73	.81	.74	[.68, .80]	.57***		.02	.17	.17	– –	– –	.02	.00	.04	.08	– –
3.	CTRL (PCQ-S)	2.15	.81	.74	[.68, .79]	.51***	.45***		– –	.08	– –	– –	.04	.05	– –	– –	– –
4.	CR (PCQ-S)	3.12	.90	.84	[.80, .87]	.57***	.45***	.56***		.24	– –	– –	.17	.06	.03	– –	– –
5.	ANX (PCQ-S)	2.67	.71	.74	[.67, .79]	.49***	.53***	.54***	.55***		-.09	– –	.00	– –	.12	– –	– –
6.	TASK (MCSYS)	4.15	.60	.75	[.69, .81]	-.10	-.11	-.29***	-.11	-.11		-.08	– –	– –	– –	-.06	.41
7.	EGO (MCSYS)	2.47	.72	.68	[.54, .75]	.47***	.38***	.40***	.43***	.37***	-.23**		.14	.26	– –	.09	-.02
8.	CREW (CCBS)	3.50	1.24	.80	[.73, .85]	.40***	.25***	.45***	.35***	.34***	.03	.45***		– –	.20	.23	– –
9.	NCR (CCBS)	3.23	1.29	.86	[.82, .89]	.34***	.39***	.41***	.46***	.41***	-.23**	.60***	.55***		.23	– –	– –
10.	INT (CCBS)	2.63	1.29	.82	[.77, .86]	.25***	.31***	.54***	.32***	.38***	-.27***	.48***	.43***	.64***		.17	-.04
11.	EPC (CCBS)	2.24	1.32	.86	[.81, .90]	.15*	.10	.38***	.16*	.16*	-.30***	.37***	.38***	.52***	.64***		-.19
12.	PAS (SCQ-SF)	5.15	1.08	.90	[.87, .92]	-.07	.01	-.26***	-.21**	-.14*	.55***	-.21**	-.04	-.30***	-.30***	-.39***	

Note. Values below the diagonal are bivariate correlations; Values above the diagonal are edge weights (regularised partial correlation coefficients) from the regularised partial correlation network analysis (see Figure 1); Missing values (– –) indicates the LASSO estimation shrunk the partial correlation to exactly “0”; PCQ-S = Perfectionistic Climate Questionnaire-Sport; EXP = Expectations; CRIT = Criticism; CTRL = Control; CR = Conditional regard; ANX = Anxiousness; MCSYS = Motivational Climate Scale for Youth Sports; Task = Task-involving climate; EGO = Ego-involving climate; CCBS = Controlling Coach Behaviour Scale; CREW = Controlling use of rewards; NCR = Negative conditional Regard; INT = Intimidation; EPC = Excessive personal control; SCQ-SF = Sport Climate Questionnaire; PAS = Perceived autonomy support; $N = 211$; *$p < .05$; **$p < .01$; ***$p < .001$.