Development and Initial Validation of the Psychological Characteristics of Developing Excellence Questionnaire version 2 (PCDEQ2)

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RUNNING HEAD: DEVELOPMENT AND INITIAL VALIDATION OF THE PCDEQ2

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Abstract

Given sport's ever-increasing value and competitiveness, the race to identify and develop the next generation of sporting talent has never been more intense. Accordingly, in an effort to increase the effectiveness and efficiency of talent development, and recognising the critical role that psychology plays in these processes, this paper seeks to develop a formative assessment tool that will allow practitioners to measure and monitor the development of the psychological skills, characteristics and behaviours – both adaptive and maladaptive – that underpin effective development. Following a process of item generation and justification, a 135-item questionnaire was completed by 512 developing male athletes from academy-based team sports. Exploratory factor analysis was conducted to identify any underpinning latent factor structures, resulting in an 88-item, 7-factor solution that accounted for 40% of the explained variance, with an overall reliability of α=0.879. A subsequent discriminant function analysis was conducted and the questionnaire was able to correctly classify 72.9% of participants based on their responses. Accordingly, the Psychological Characteristics of Developing Excellence Questionnaire version 2 (PCDEQ2) provides talent development environments with a valid and reliable measure form which to base effective psycho-behavioural interventions, ultimately improving the effectiveness of talent development processes.

Keywords: talent, youth, assessment, coaching, team sport

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Spiralling competition between teams – and, indeed, sports – has led to a greater level of financial investment in talent identification and development (TID) systems, with a view to recruiting and developing the best prospective talent in a bid to guarantee future success. Worryingly, however, despite their widespread adoption (Collins & Bailey, 2013), many TID systems have been criticised for their limited predictive validity (Phillips, Davids, Renshaw, & Portus, 2010), and lack of underpinning empirical evidence. In fact, much of the recent literature on TID in sport has now moved away from the traditional physiological and anthropometric profiling, towards the recognition of psychology as the key determinant of talent development (Blijlevens, Elferink-Gemser, Wylleman, Bool, & Visscher, 2018; MacNamara, Button, & Collins, 2010). Indeed, acknowledging the ubiquitous nature of challenge within talent development supports the importance of psychological skills as a key construct. For example, MacNamara and colleagues (MacNamara et al., 2010; MacNamara & Collins, 2013) demonstrated that the development and deployment of psychological characteristics of developing excellence (PCDEs) enable athletes to optimally benefit from developmental challenge; an inevitable feature of any route to the top. Likewise, Toering and colleagues found that self-regulatory strategies such as metacognition and self-control were key in facilitating the development of both youth and professional soccer players (Toering & Jordet, 2015).

Reflecting the work of Hogan and colleagues (Hogan & Hogan, 2001), a range of psychological characteristics have also been recognised as maladaptive to talent development. For example, poor mental health and clinical issues have been shown to have a detrimental effect on the efficacy of talent development (Hill, MacNamara, Collins, & Rodgers, 2016). Furthermore, some constructs may be both adaptive *and* maladaptive,

depending upon how and when they are applied. An example of such a "dual effect" construct (MacNamara & Collins, 2015) is perfectionism, whereby the pursuit of exceedingly high standards can both drive performance and/or induce burnout (Hill & Curran, 2015). Reflecting the complexity of the skillset required, Hill, MacNamara, and Collins (2015) identified a range of psycho-behavioural characteristics that could be categorised as positive (i.e., adaptive), dual effect, or negative (i.e., maladaptive), in relation to their impact upon talent development.

In considering the differential deployment of these skills and characteristics, the need for individualised challenge (e.g., Phillips et al., 2010), the complexity of human systems, and the non-linearity of emergent behaviours (e.g., Simonton, 1999), it becomes apparent that any desired intervention must be done on an individual basis. Therefore, to guide such interventions, individualised formative assessment is required to identify an individual's profile, any issues that may require attention, and to monitor the athlete's progress. There are a number of existing psychometric tools designed to measure many of the identified constructs. The most pertinent one in relation to TID is the Psychological Characteristics of Developing Excellence Questionnaire (PCDEQ; MacNamara & Collins, 2011); a 59-item, 6-factor questionnaire assessing a range of PCDEs. The PCDEQ has been shown to offer both criterion and ecological validity (MacNamara & Collins, 2011, 2013). Notably, however, the PCDEQ does not measure the maladaptive and dual effect PCDEs that have emerged from recent literature (e.g., Hill et al., 2015). There is already a plethora of psychometric tools that address *some* of these factors. For example, multidimensional perfectionism scales such as the Frost-MPS and the Hewitt-MPS (Frost, Marten, Lahart, & Rosenblate, 1990; Hewitt & Flett, 1991) were adapted and validated for developing athletes, resulting in the Sport-MPS (Dunn et al., 2006). Similarly, the Performance Failure Appraisal Inventory (PFAI) has since been validated with British sports participants as a measure of fear of failure (Conroy,

Willow, & Metzler, 2002). Outside of sport, several other psychometric tools have been developed to assess some of the other dual-effect and maladaptive constructs pertinent to talent development. For example, Connor and Davidson (2003) devised a 25 item tool to assess resilience in clinical populations (the CD-RISC). Similarly, Fairburn and Beglin's 28-item Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 2008), the 9-item Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001), and the 7-item Generalised Anxiety Disorder questionnaire (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006), have all been developed in clinical settings, yet may be relevant to TID environments, given the potential impact of mental health on effective talent development (see Hill et al., 2016).

Given the range of psychometric tools available, it may be tempting for practitioners to administer separate tests to measure each construct. However, the practicality of administrating a bank of questionnaires, and the lack of validation for their use in a talent development environment, would limit this approach. Recognising this, there was a clear need for a comprehensive psychometric assessment tool to assess the full range of psycho-behavioural characteristics, validated within a talent development context, and with practical utility. Accordingly, the purpose of this paper was to develop and provide initial validation for the Psychological Characteristics of Developing Excellence Questionnaire V2 (PCDEQ2).

Study 1 Item Generation

Methods

Item Generation

To develop a pool of items for the PCDEQ2, qualitative interviews were conducted with UK based coaches and clinicians experienced in talent development, in a bid to determine the key psychological characteristics and behaviours that differentiated between those that went on to achieve elite-level success and those who did not (Hill et al., 2015; Hill

et al., 2016). Based on these results, an initial pool of 19 themes was developed that would inform the item generation for the PCDEQ2. To further improve content validity, items from previously published and validated psychometric tools (e.g., the PFAI; Conroy et al., 2002) were examined. This initial item generation resulted in a pool of 182 items across 18 themes, including all 59 items from the original PCDEQ (see Table 1).

Item Justification

Expert panel. The initial list of 182 items was submitted to three expert panels (n = 3, 2 and 2 respectively), all of whom had extensive applied and research experience within the fields of talent development, coaching, psychology, and psychometric questionnaire development. Subsequently, an individual expert review was conducted by a clinical psychologist with experience of working with both young people and athletes, specifically focussing on the clinical aspects of the PCDEQ2. Each expert was fully briefed on the aims and rationale underpinning the PCDEQ2 and invited to critically discuss each item in relation to its relevance, comprehensibility, face validity, and content validity. In line with the recommendations of Dunn, Bouffard, and Rogers (1999), experts rated each item on a scale of 1 (“not at all relevant”) to 5 (“completely relevant”). Items scoring 4 or less were discussed by the panel. Where consensus was reached, amendments were made to the item; where consensus could not be reached, the items were marked for deletion.

Following the first expert panel, 75 items were amended due to grammatical, comprehension, and face validity issues, and 32 items from removed including one factor. Twenty five items were added to the questionnaire to ensure an appropriate item-to-factor ratio for subsequent stages of analysis. The second and third expert panels resulted in no additions, although the terminology used for nine items not previously addressed was amended to aid clarity. The individual expert clinical review resulted in the removal of two

further items due to their lack of relevance. Following this process, the PCDEQ2 consisted of 173 items, across 17 factors.

Cognitive interviews. Conrad and Blair (1996) propose that response problems to questionnaire items can be categorised into five different types: lexical, temporal, logical, computational, and omission/inclusion issues. Furthermore, these errors can occur at each stage of the response process (i.e., understanding, task performance, and response formatting). In order to address this, cognitive interviews were conducted with six purposively sampled young athletes from football (n = 4) and rugby union (n = 2) academies (Willis, 2005). The questionnaire items were randomised and split across 16 sections. Following the completion of each section, respondents were invited to comment upon their answers. In line with the recommendations of Willis (2005), a combination of proactive and reactive verbal probing and observations were utilised. Comments for each item were collated and categorised according to Conrad and Blair's (1996) taxonomy. This process resulted in the amendment of nine items due to lexical problems and temporal issues.

Pilot Test

The 173-item version of the PCDEQ2 was piloted to establish the comprehensibility of the questionnaire items from the perspective of its intended subjects, and to identify any potential issues around the practicalities of its administration.

Participants. Participants were purposively sampled from elite football (n = 38) and rugby union academies (n = 25). All 63 participants were male, and ages ranged from 14 – 20 years old (M = 16.35; SD = 1.536), again reflecting the intended target demographic.

Procedure. Ethical approval was granted by the authors' research ethics committee. Informed consent was gained from all participants, and informed parental assent was also obtained for participants under the age of 16. The PCDEQ2 consisted of 173 statement items, with similarity responses marked on a 6-point Likert scale from 1 ("very unlike me") to 6 ("very like me"). A combination of positively framed (n = 129) and negatively framed (n = 44) items were used in an attempt to minimise acquiescence bias. The questionnaire was administered electronically and took between 40 and 55 minutes to complete.

Data analysis. As the PCDEQ2 is intended to differentiate amongst respondents according to the characteristics being measured, analysis of the facility and discrimination of each item was undertaken. The facility index was used in order to measure the extent to which items were answered in the same way and therefore did not discriminate (Rust & Golombok, 2009). Items that scored approaching or equal to either of the extreme scores, and displayed standard deviations of less than 1.00, were subsequently disregarded due to their limited differentiation. Care was also taken to ensure that items whose scores fell within the accepted range also displayed adequate deviation from the item's mean score.

Results. Following the analysis of the pilot study data, 38 items were removed due to their inability to discriminate between respondents, leaving 135 items representing 17 higher-order constructs. Each of these higher-order constructs was represented by at least four items, ensuring sufficient data for subsequent stages of analysis.

Study 2. Exploratory Factor Analysis and Reliability

Method

An exploratory factor analysis (EFA) was conducted to determine the underpinning latent factor structure, allowing important items to be retained and subsequently interpreted.

Participants. 512 male participants, aged between 13 and 21 years of age (M = 15.54, SD ± 1.377), were purposively recruited from elite rugby union (*n* = 252), football (*n* = 141), and rugby league (*n* = 119) academies.

Data analysis. An EFA with principal axis factor extraction (PAF) was conducted with the aim of identifying any latent variables that cause the manifest variables to covary and therefore determining a more parsimonious factor structure for the PCDEQ2, whilst eliminating measurement error and acknowledging the potentially skewed distribution of the data (Costello & Osborne, 2005). A direct Oblimin rotation with Kaiser Normalisation and a default delta value of 0 was adopted to improve the interpretation of the factor structure, recognising the likely correlation between factors identified in the extant literature (e.g., Sagar & Stoeber, 2009).

Results.

To ensure that the data analysis was appropriate, the factor correlation matrix was examined, revealing moderate correlations between several factors. Given these correlations, PAF with direct Oblimin rotation was deemed an appropriate method of analysis. The Kaiser Meyer Olkin measure of sampling adequacy showed that the sample size was sufficient for factor analysis (KMO = 0.870). Bartlett's test of sphericity was also significant (χ^2 = 29130.531; df = 9045; p = 0.000), suggesting that there was adequate correlation between the variables and further supporting the appropriateness of EFA.

Item communalities ranged from 0.280 to 0.703 (M = 0.519), indicating that multiple criteria would be required for factor extraction (Costello & Osborne, 2005). Examination of the Kaiser criterion revealed no fewer than 38 factors with eigenvalues greater than 1. However, this is recognised as one of the least accurate methods of extraction due to its

inherent assumptions (Fabrigar & Wegener, 2012), while a 38-factor solution also lacks theoretical underpinning when set against the existing literature (e.g., Hill et al., 2015). Accordingly, a scree plot was analysed, showing a clear break at 6 factors and again at 10 factors. Further support for a 10-factor solution was gained from parallel analysis, recognised as the "gold standard" for determining the number of factors (Field, 2005). Given this variation in results, further analyses were conducted, examining 6-, 7-, 8-, 9-, and 10-factor solutions in a bid to identify the most suitable solution, as both over-factoring and under-factoring can lead to substantial errors (Tabachnick & Fidell, 2014). The criteria used were: items loading above 0.3; no or few cross-loading items; and no factor with less than three items (Costello & Osborne, 2005). Despite the purpose of EFA being to identify discrete groups within the data, items that cross-loaded across factors were considered where there was a clear theoretical rationale (e.g., the empirically established relationship between fear of failure and perfectionism; see Sagar & Stoeber, 2009). Following this step, the 7-factor solution was retained for further analysis. This 7-factor structure accounted for 38% of the total variance, with eigenvalues ranging from 18.292 to 2.358, and offered the most conceptually coherent solution. Although it has to be acknowledged that the percentage variance explained by the 7-factor solution is relatively low, Henson and colleagues (Henson, Capraro, & Capraro, 2004) analysis of peer-reviewed and published EFA studies found that extracted factors accounted for an average of 45% of the explained variance.

Relationships between factors. Given that a direct Oblimin rotation was used, it was important to examine both the pattern matrix and the structure matrix (Henson et al., 2004). The pattern matrix (see Table 2) identified the factor loadings of each item, while the structure matrix highlighted any potential correlations between factors. Such relationships between factors are not necessarily of concern, and can facilitate a more meaningful interpretation of the data (Field, 2005). Accordingly, this examination revealed a relationship between Factors 1, 4 and 7, and a separate relationship between Factors 2, 3, 5, and 6.

Interpreting and naming the factors. Interpretation of the factors was based primarily on the item pattern coefficients in the pattern matrix (Table 2), with each coefficient representing the unique contribution of each variable to its factor (Russell, 2002). Accordingly, and in line with recommendations in the literature (Costello & Osborne, 2005; Tabachnick & Fidell, 2014), the meaning of each factor was based upon the strongest loading items within that factor. Once the highest loading items (i.e., those with pattern coefficients > 0.4) without cross-loadings had been identified and examined for each factor, lower loading items were then considered to aid factor interpretation. Items with complex loadings (e.g., unexpected negative loadings, cross loading items, correlated factors etc.) were examined to determine whether they fitted conceptually with their intended factors. Following this process, 44 items were removed due to low loadings. Two cross loading items were retained, as they fitted conceptually and logically into the factor in which they loaded strongest. The remaining 91 items were assessed using corrected item-total correlation values to determine their meaningful contribution to their scales. All bar three items returned acceptable results (i.e., > 0.3), with the three low scoring items subsequently removed from the questionnaire. In line with the recommendations of Henson et al. (2004), a second EFA was conducted on the 88 items retained post rotation, confirming the 7-factor structure and accounting for 40% of the total explained variance.

Reliability of the PCDEQ2

Participants

The same participants and data set (n = 512) was used to test the PCDEQ2's internal consistency.

Data Analysis

To assess the internal consistency of the PCDEQ2, Cronbach alpha coefficients were calculated using SPSS. In line with standard recommendations (e.g., Field, 2005; Tabachnick & Fidell, 2014), scores of 0.7 or greater were considered good.

Results

The internal consistency of the whole questionnaire was very good, with a Cronbach alpha of 0.879. Internal consistencies for Factors 1 to 7 were also good, returning Cronbach alpha values of 0.905, 0.876, 0.829, 0.715, 0.814, 0.805, and 0.720 respectively.

Study 3. Examining the Discriminant Function of the PCDEQ2

As another step in the validation process, it was important to examine the discriminant function of the PCDEQ2 by testing whether the questionnaire could effectively discriminate between "very good" and "very poor" developers based on their current potential to progress to top level.

Participants

342 male athletes aged from 13 to 19 years (M = 15.16, SD ± 1.248) were purposively sampled from UK based academy programmes in football, rugby union, and rugby league recruited.

Procedure

Ethical approval was granted from the authors' research ethics committee, and informed consent was obtained from all participants. Where participants were under 16 years of age, parental assent was also obtained. All participants completed the PCDEQ2. Once the data had been collected, a suitable assessor, typically that player's coach, was asked to rate the players on a five-point Likert scale based on their perception of the player's potential to develop to elite level in their sport (see MacNamara & Collins, 2013). The five-point Likert scale ranged from 1 ("extremely unlikely"), through to 5 ("extremely likely"), with the remaining response options "unlikely", "neutral", and "likely". Assessors were given descriptions of each category and these were discussed to ensure a shared understanding. Of course, although the subjective nature of these assessments must be acknowledged, the coaches all had significant experience of talent development in their sport. Furthermore, all were used to applying such scoring methods as part of the regular reporting methods used in their academies.

Given the need to discriminate between groups, all data classified as "neutral" were discarded, while the remaining data were classified into two groups. Those ranked "unlikely" or "extremely unlikely" on the subjective player rating scale were classified as "low likelihood" (n = 155), whilst those scoring either 4 or 5 on the scale were classified as "high likelihood" (n = 70).

Data Analysis

To examine the discriminant validity of the PCDEQ2, a multivariate analysis of variance (MANOVA) was first employed to test for differences between groups using SPSS (with significance set at $p < 0.05$). DFA was subsequently used to establish whether the variables within the PCDEQ2 could reliably predict group membership.

Results

Assumption testing was conducted to check for normality, homogeneity of variance, outliers, linearity, multicollinearity and singularity, with no concerns noted. A Mahalanobis distance of 23.36 was calculated, below the critical value of 24.32 for seven dependent variables, suggesting multivariate normality (Tabachnick & Fidell, 2014). Correlations between the variables ranged from 0.147 to 0.609, offering no cause for concern. Box's M test was not significant ($F = 1.287$, $p > 0.05$), indicating homogeneity of variance-covariance matrices for each group. Preliminary analysis revealed that there was a difference in PCDEQ2 scores between the high likelihood and low likelihood groups ($F(7,217) = 8.101$, $p < 0.001$, Wilks Lambda = 0.793, partial eta squared = 0.207). The means, standard deviations and levels of significance from the tests are presented in Table 3. An initial examination of the groups' means show that those in the high likelihood groups scored better (i.e., higher on the adaptive factors, lower on the maladaptive factors) than their low likelihood counterparts, suggesting that those athletes rated as more likely to progress to the elite level were more likely to possess adaptive PCDEs, whilst simultaneously avoiding negative developmental behaviours.

Six of the seven factors showed statistically significant differences between the two groups. These were Factor 1 "Adverse Response to Failure", Factor 3 "Self-Directed Control and Management", Factor 4 "Perfectionistic Tendencies", Factor 5 "Seeking and Using Social Support", Factor 6 "Active Coping", and Factor 7 "Clinical Indicators". As the calculations involve a number of separate analyses, a Bonferroni adjustment was made to give a new alpha of 0.007. Subsequent to this, Factors 1, 3, 5, 6, and 7 remained significant, whilst Factors 2 and 4 failed to reach statistical significance. In line with criteria established by Cohen (1988), large effect sizes were noted for Factors 1 and 6, whilst medium effect sizes were noted for Factors 3, 5, and 7.

The DFA was conducted in order to determine the PCDEQ2's ability to predict group membership. Given the unequal group sizes, probabilities for each group were computed from the group sizes. The results showed a statistically significant discriminant function of the PCDEQ2 (Wilks Lambda = 0.793, $\chi^2 = 50.959$, $p < 0.001$), with a canonical correlation of 0.455. The PCDEQ2 was able to correctly predict 85.8% (133 out of 150) of the 'low likelihood' group members and 44.3% (31 out of 70) of the 'high likelihood' group members, in total 72.9% of the 225 participants could be correctly classified. The standardised canonical discriminant function coefficients and the canonical structure matrix were also examined, as these indicate the extent to which the different variables contribute to group separation. These highlight the particularly large contribution of Factor 6 (active coping) and Factor 1 (adverse response to failure) in group differentiation.

Discussion

The aim of this study was to develop, and provide initial validation of, the PCDEQ2, a psychometric assessment tool to formatively assess the key psycho-behavioural characteristics – adaptive, maladaptive, and dual-effect – that underpin effective talent development. The PCDEQ2 consisted of 88 items measuring seven different constructs and accounted for 40% of the total variance. Following the DFA, the PCDEQ2 correctly classified 72.9% of participants based on their responses.

The Factor Structure

Given that the initial pool of 17 constructs were drawn from empirical data and extant literature, it is important to consider the new factor structure. Factor 1, *Adverse Response to Failure*, draws primarily on the literature around fear of failure (e.g., Conroy, Poczwardowski, & Henschen, 2001; Sagar, 2009), but also includes items initially intended to relate to anxiety, depression, focus, and perfectionism; assessing the individual's maladaptive responses to failure. Such a grouping of items from these different constructs is

unsurprising, given their established relationships (e.g., Sagar & Stoeber, 2009). Accordingly, athletes scoring high in this domain are likely to have suboptimal interaction with developmental challenge (Collins, MacNamara, & McCarthy, 2016). Indeed, there is growing evidence suggesting that differences between levels of adult achievement relate more to the skills performers *bring to* the challenge, rather than the challenge itself (Collins et al., 2016). This points to the need for specific psychological skill development as essential preparation for the inevitable challenges of development (Collins & MacNamara, 2012).

Factor 2, *Imagery and Active Preparation*, highlights the need for effective and controllable imagery in both skill refinement and the management of arousal (e.g., Gould et al., 2002; Orlick & Partington, 1988). Factor 3, *Self-directed Control and Management* draws heavily on the construct of self-regulation and self-control, and is an adaptive influence on talent development. Factor 4, *Perfectionistic Tendencies*, consists of a combination of items initially included to assess perfectionism, anxiety, fear of failure, and the obsessive component of passion, along with one negatively framed item relating to realistic performance evaluation. *Seeking and Using Social Support* is Factor 5, and is based around the facilitative role effective support networks play along the talent development pathway. Factor 6, *Active Coping* recognises the proactive, self-regulated deployment of coping mechanisms. Again, the importance of holding a positive and proactive coping and "learn from it" approach to challenge is a well-established factor associated with both development and performance (Greenglass & Fiksenbaum, 2009). The contribution, therefore, of Factors 1 and 6 to group differentiation was unsurprising. Factor 7, *Clinical Indicators*, incorporates items from each of the original constructs relating to mental health, namely eating disorders, anxiety, depression, and behavioural change; issues that not only impact upon the talent development process but also athlete wellbeing (Hill et al., 2016).

It is also important to consider the PCDEQ2 factor structure in relation to the original PCDEQ. While both questionnaires serve to assess a multitude of factors that influence development, the PCDEQ2 seeks to assess characteristics that are adaptive, maladaptive, and dual-effect to the development process. As such, the seven factor model of the PCDEQ2 is not intended to replace the existing PCDEQ structure but reflects, following EFA, the way PCDEs are deployed on the pathway.

The subjective nature of EFA must also be acknowledged not least the range of (sometimes) contradictory criteria available to inform methodological decisions (Fabrigar & Wegener, 2012). Recognising this, care was taken throughout the paper to ensure that all relevant decisions were presented and justified appropriately. Finally, issues associated with the participants themselves must be acknowledged. For example, given the competitive nature of talent development environments, there is potential for individuals to employ impression management strategies when responding to any questionnaire. Another issue associated with the participants is that they are – by definition – developing. Given that PCDEs are a range of skills and behaviours that themselves are differentially developed and deployed over a period of time (MacNamara et al., 2010), and that the PCDEQ2 is designed to assess an ideal or fully developed set of attributes (MacNamara & Collins, 2011), it may be that the required attributes may be undeveloped or not yet apparent. This would be further exacerbated since there is often a lack of emphasis placed on promoting psycho-behavioural characteristics within some talent development environments, potentially impacting upon an individual's self-awareness in relation to their own possession and deployment of PCDEs.

The PCDEQ2 and Applied Practice

The PCDEQ2 was designed as a formative assessment tool. Given that the findings of this study have shown that the PCDEQ2 has a good level of predictive validity, practitioners may be tempted to use it as part of a TID process. However, to do so would go

against the epistemological beliefs that lie at the heart of its development (Collins & Bailey, 2013). Cross-sectional, "snapshot" assessments of athletes' physiological, physical, anthropometrical, technical *and* psycho-behavioural attributes do not consider the temporal and dynamic nature of development. Instead, the PCDEQ2 is best used as part of a triangulation process, alongside other measures such as behavioural observations, expert opinion, and dialogue with the individual athlete involved. By assessing characteristics associated with effective development, the PCDEQ2 is able to identify areas that may require support. In a similar vein, the PCDEQ2 can be used as a monitoring tool to assess the impact and effectiveness of such interventions.

It is important to acknowledge some limitations of this study, not least the male, team sport, UK-based context in which the PCDEQ2 was developed. As such, care should be taken not to administer the PCDEQ2 outside of its established context, as to do so would likely compromise its criterion validity. Accordingly, work is currently underway, including confirmatory factor analysis, to validate the PCDEQ2 is a variety of settings and developmental contexts. It is also important to acknowledge that the PCDEQ2 was better at predicting "low potential" athletes compared to "high potentials". Although the absence of PCDEs may characterise "low potential" athletes, the highly dynamic and complex nature of the talent development process cannot be comprehensively explained by seven factors. This further supports the administration of the PCDEQ2 as part of a triangulation process, offering multiple perspectives and methods, in order to generate the most accurate assessment possible.

References

Blijlevens, S.J.E., Elferink-Gemser, M.T., Wylleman, P., Bool, K., & Visscher, C. (2018). Psychological characteristics and skills of top-level Dutch gymnasts in the initiation, development and mastery stages of the athletic career, Psychology of Sport & Exercise doi: 10.1016/j.psychsport.2018.07.001

Collins, D., & Bailey, R. (2013). 'Scienciness' and the allure of second-hand strategy in talent identification and development. *International Journal of Sport Policy and Politics, 5*(2), 183-191. doi:10.1080/19406940.2012.656682

Collins, D., & MacNamara, Á. (2012). The rocky road to the top: why talent needs trauma, *Sports Medicine*, 42(11): 907-914. http://dx.doi.org/10.1007/BF03262302

Collins, D., MacNamara, Á., & McCarthy, N. (2016). Super champions, champions and almosts: Important differences and commonalities on the rocky road. *Frontiers in Movement Science and Sport Psychology*, 6. p. 2009. ISSN 1664-1078.

Connor, K. M., & Davidson, J. R. T. (2003). Development of a new resilience scale: The Connor-Davidson Resilience Scale (CD-RISC). *Depression and Anxiety*, *18*(2), 76-82. doi:10.1002/da.10113

Conrad, F., & Blair, J. (1996). *From impressions to data: Increasing the objectivity of cognitive interviews.* Paper presented at the Proceedings of the Section on Survey Research Methods Section of the American Statistical Association, Alexandria, VA.

Conroy, D. E., Poczwardowski, A., & Henschen, K. P. (2001). Evaluative criteria and consequences associated with failure and success for elite athletes and performing artists. *Journal of Applied Sport Psychology*, *13*(3), 300-322. doi:10.1080/104132001753144428

Conroy, D. E., Willow, J. P., & Metzler, J. N. (2002). Multidimensional fear of failure measurement: The performance failure appraisal inventory. *Journal of Applied Sport Psychology, 14*(2), 76-90. doi:10.1080/10413200252907752

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation, 10*(7).

Dunn, J. G. H., Bouffard, M., & Rogers, W. T. (1999). Assessing item-content relevance in sport psychology scale-construction resaerch: Issues and recommendations. *Measuremetn in Physical Education and Exercise Science, 3*(1), 15-36.

Dunn, J. G. H., Dunn, J. C., Gotwals, J. K., Vallance, J. K. H., Craft, J. M., & Syrotuik, D. G. (2006). Establishing construct validity evidence for the Sport Multidimensional Perfectionism Scale. *Psychology of Sport & Exercise, 7*(1), 57-79.

Fabrigar, L. R., & Wegener, D. T. (2012). *Exploratory Factor Analysis*. Oxford: Oxford university Press.

Fairburn, C. G., & Beglin, S. (2008). Eating Disorder Examination Questionnaire (EDE-Q 6.0). In C. G. Fairburn (Ed.), *Cognitive Behavior Therapy and Eating Disorders* (pp. 309-313). New York: Guilford Press.

Field, A. P. (2005). *Discoverring Satistics Using SPSS* (2nd ed.). London: Sage.

Frost, R. O., Marten, P., Lahart, C., & Rosenblate, R. (1990). The dimensions of perfectionism. *Cognitive Therapy and Research, 14*(5), 449-468.

Gould, D., Dieffenbach, K., & Moffett, A. (2002). Psychological characteristics and their development in Olympic champions. *Journal of Applied Sport Psychology, 14*(3), 172-204. doi:10.1080/10413200290103482

Greenglass, E.R., & Fiksenbaum, L. (2009). Proactive coping, positive affect, and well-being: Testing for mediation using path analysis. *European Psychologist,* 14(1), 29–39. DOI 10.1027/1016-9040.14.1.29

Henson, R. K., Capraro, R. M., & Capraro, M. M. (2004). Reporting practice and use of exploratory factor analysis in educational research journals: errors and explanation. *Research in the Schools, 11*(2), 61-72.

Hewitt, P. L., & Flett, G. L. (1991). Perfectionism in the self and social contexts: conceptualization, assessment, and association with psychopathology. *Journal of Personality and Social Psychology, 60*(3), 456.

Hill, A., MacNamara, Á., & Collins, D. (2015). Psychobehaviorally based features of effective talent development in Rugby Union: A coach's perspective. *The Sport Psychologist, 29*(3), 201-212. doi:10.1123/tsp.2014-0103

Hill, A., MacNamara, Á., Collins, D., & Rodgers, S. (2016). Examining the role of mental health and clinical issues within talent development. *Frontiers in Psychology, 6*. doi:10.3389/fpsyg.2015.02042

Hill, A. P., & Curran, T. (2015). Multidimensional perfectionism and burnout: A meta-analysis. *Personality and Social Psychology Review*. doi:10.1177/1088868315596286

Hogan, R., & Hogan, J. (2001). Assessing leadership: A view from the dark side. *International Journal of Selection & Assessment, 9*(1/2), 40.

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606-613.

MacNamara, Á., Button, C., & Collins, D. (2010). The role of psychological characteristics in facilitating the pathway to elite performance part 2: Examining environmental and stage-related differences in skills and behaviors. *The Sport Psychologist, 24*, 74-96.

MacNamara, Á., & Collins, D. (2011). Development and initial validation of the Psychological Characteristics of Developing Excellence Questionnaire. *Journal of Sports Sciences, 29*(12), 1273-1286. doi:10.1080/02640414.2011.589468

MacNamara, Á., & Collins, D. (2013). Do mental skills make champions? Examining the discriminant function of the psychological characteristics of developing excellence questionnaire. *Journal of Sports Sciences, 31*(7), 736-744. doi:10.1080/02640414.2012.747692

MacNamara, Á., & Collins, D. (2015). Profiling, exploiting, and countering psychological characteristics in talent identification and development. *The Sport Psychologist, 29*(1), 73-81. doi:10.1123/tsp.2014-0021

Orlick, T., & Partington, J. (1988). Mental links to excellence. *The Sport Psychologist, 2*, 105-130.

Phillips, E., Davids, K., Renshaw, I., & Portus, M. (2010). Expert performance in sport and the dynamics of talent development. *Sports Medicine, 40*(4), 271-283.

Russell, D. W. (2002). In search of underlying dimensions: The use (and abuse) of factor analysis in Personality and Social Psychology Bulletin. *Personality and Social Psychology Bulletin, 28*(12), 1629-1646. doi:10.1177/014616702237645

Rust, J., & Golombok, S. (2009). *Modern Psychometrics: The science of psychological assessment* (3rd ed.). Hove, UK: Routledge.

Sagar, S. S. (2009). Fear of failure in youth sport: Building on the momentum of the new research. *Sport and Exercise Psychology Review, 5*(1), 5-15.

Sagar, S. S., & Stoeber, J. (2009). Perfectionism, fear of failure, and affective responses to success and failure: The central role of fear of experiencing shame and embarrassment. *Journal of Sport and Exercise Psychology, 31*(5), 602-627.

Simonton, D. K. (1999). Talent and its development: An emergenic and epigenetic model. *Psychological Review, 106*(3), 435-457.

Spitzer, R. L., Kroenke, K., Williams, J. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine, 166*(10), 1092-1097. doi:10.1001/archinte.166.10.1092

Tabachnick, B. G., & Fidell, L. S. (2014). *Using Multivariate Statistics* (6th ed.). Harlow, UK: Pearson.

Toering, T., Elferink-Gemser, M., Jordet, G., Jorna, C., Pepping, G.-J., & Visscher, C. (2011). Self-regulation of practice behavior among elite youth soccer players: An exploratory observation study. *Journal of Applied Sport Psychology, 23*(1), 110-128. doi:10.1080/10413200.2010.534544

Toering, T., Elferink-Gemser, M. T., Jordet, G., & Visscher, C. (2009). Self-regulation and performance level of elite and non-elite youth soccer players. *Journal of Sports Sciences, 27*(14), 1509-1517. doi:10.1080/02640410903369919

Willis, G. B. (2005). *Cognitive Interviewing: A tool for improving questionnaire design*. London: Sage.

Table 1.

Psycho-behavioural constructs influencing talent development (adapted from Hill et al., 2015)

Positive Characteristics	Dual-Effect Characteristics	Negative Characteristics
Resilience	Perfectionism	Anxiety-related behaviours
Self-regulation and self-control	Passion	Depressive symptoms
Goal setting and self-reinforcement	Fear of failure	Eating disorders
Creating and using support networks		Behavioural change
Realistic and controllable imagery		
Focus and distraction control		
Quality practice		
Realistic performance evaluation		
Planning and organisation		
Coping with pressure		
Commitment and role clarity		

Table 2.

Factor loadings for 88-item Psychological Characteristics of Developing Excellence Questionnaire 2

	Factor						
	1	2	3	4	5	6	7
Q112	-0.651						
Q19	-0.566						
Q69	-0.528						
Q88	-0.489						
Q31	-0.484						
Q10	-0.464					-0.330	
Q74	-0.450					-0.309	
Q75	-0.447					-0.329	
Q46	-0.445						
Q54	-0.438						
Q51	-0.433						
Q122	-0.431						
Q115	-0.418		-0.307				
Q16	-0.395			0.372			
Q66	-0.385						
Q45	-0.350						
Q125	-0.349						
Q8	-0.322						

Q99	-0.306			
Q134	-0.304			
Q90	-0.301		0.301	
Q135		0.783		
Q96		0.755		
Q58		0.707		
Q57		0.704		
Q82		0.646		
Q55		0.639		
Q12		0.590		
Q67		0.476		
Q64		0.461		
Q76		0.396		
Q65		0.375		
Q39		0.334		
Q118		0.333		
Q73		0.308		
Q121		0.300		
Q18			0.729	
Q86			0.712	
Q106			0.461	
Q102			0.461	
Q108			0.460	
Q114			0.457	

Q107	0.422		
Q126	0.420		
Q83	0.417		
Q120	0.414		
Q59	0.406		
Q25	0.406		
Q105	0.363		
Q68	0.314		
Q84		0.505	
Q20		0.499	
Q116		0.497	
Q7		0.484	
Q28		0.399	
Q91		0.396	
Q48		-0.379	
Q92		0.354	
Q13		0.307	
Q1		0.303	
Q131			0.779
Q71			0.656
Q109			0.590
Q34			0.546
Q127			0.532
Q70			0.521

Q81			0.442			
Q111			0.397			
Q77	0.345		0.396			
Q30				0.616		
Q37				0.534		
Q36				0.490		
Q11				0.476		
Q35				0.414		
Q110				0.384		
Q101		0.338		0.350		
Q117				0.333		
Q9				0.311		
Q27				0.301		
Q133						0.397
Q94						0.388
Q128						0.380
Q87						0.346
Q80						0.342
Q33		-0.320				0.328
Q62						0.325
Q42						0.318
Q61				-0.340		0.313

Notes. Factors 1 to 7 had Cronbach alpha values of 0.905, 0.876, 0.829, 0.715, 0.814, 0.805, and 0.720 respectively.

Table 3.

Means, effect sizes, and significance levels for PCDEQ2 factors for the high- and low progression likelihood groups

Factor	High likelihood group mean (±SD)	Low likelihood group mean (±SD)	Effect size	Significance	Significance following Bonferroni adjustment
Adverse Response to Failure	2.599 (0.669)	3.285 (0.828)	0.143	$p < 0.001$	$p < 0.001$
Imagery and Active Preparation	4.191 (0.829)	4.206 (0.776)	0.000	$p > 0.05$	$p > 0.05$
Self-Directed Control and Management	4.764 (0.636)	4.386 (0.658)	0.068	$p < 0.001$	$p < 0.001$
Perfectionistic Tendencies	3.267 (0.808)	3.555 (0.716)	0.031	$p < 0.01$	$p > 0.005$
Seeking and Using Social Support	4.667(0.744)	4.261 (0.876)	0.048	$p < 0.005$	$p < 0.005$
Active Coping	4.981 (0.538)	4.410 (0.665)	0.152	$p < 0.001$	$p < 0.001$
Clinical Indicators	1.992 (0.615)	2.393 (0.717)	0.069	$p < 0.001$	$p < 0.001$

Note. Responses were on a 6-point Likert scale from 1 (“very unlike me”) to 6 (“very like me”)

Appendix A

PCDEQ2 Factors and Items

Factor	Items
Factor 1	Even minor setbacks disturb my focus
Adverse response to	I often keep thinking about the mistakes I have made and let this interfere with my performance
Failure	When I am not succeeding, I feel like people lose interest in me
(21 Items)	When things are not going well, I get worried about what other people will think
	I often feel nervous
	I find it difficult to overcome my feelings of anxiety when I perform
	I often worry that bad things will happen
	My sleep is often disturbed by worrisome thoughts
	I often lie awake at night thinking things over and over
	I sometimes feel down without really knowing why
	When I am failing, I am afraid I might not have what it takes
	If I make a mistake I dwell on it and can't see the big picture

	When I make a mistake, I find it difficult to get my focus back on task
	When things are going wrong for me, my future seems uncertain
	Although they may not say it, other people get upset when I make mistakes
	When I am failing at something, I hate the fact that I am not in control of the outcome
	When I am failing, I worry most about what others think about me
	I get distracted thinking about how other performers are doing
	The day-to-day setbacks can often get me down
	When things go wrong, I find it difficult to see a way forwards
	I tend not to worry about things*
Factor 2	I include imagery in my preparation
Imagery and Active	When I have to do something that worries me, I imagine how I will overcome my anxieties and perform successfully
Preparation	Before attempting a skill, I imagine myself performing it
(15 Items)	I incorporate mental rehearsal in my practice
	Before I arrive at a performance venue, I mentally rehearse my performance there
	I tend to run through things over and over again
	I take time to clarify what is required

	I regularly imagine what a good performance feels like
	I regularly set clear targets for myself
	I have a carefully thought out plan of my pathway to the top
	I like to try things out in my head first
	I use imagery to improve my physical performance
	I imagine coping with setbacks
	I can clearly see my pathway to the top
	I use mental rehearsing to focus myself on what I have to do
Factor 3	I do certain things that are bad for me if they are fun*
Self-Directed Control	I am good at resisting temptation
and Management	I sometimes forget items of equipment*
(14 Items)	I would usually blame other people or circumstances for failure*
	I often forget appointments or timings*
	I often do things I know I shouldn't do*
	I prepare carefully for training sessions
	My life is well organised

	I wish I had more discipline*
	People would say that I am very self-disciplined
	I have a hard time breaking bad habits*
	I am lazy*
	I often act without thinking through all the alternatives*
	I give myself treats even when I don't achieve my goals*
Factor 4	When I fail, people are less interested in me
Perfectionistic	When I am failing, significant others are often disappointed in me
Tendencies	I get annoyed very easily
(10 Items)	The people around me expect me to be perfect at everything I do
	If I don’t give my sport all of my attention, all of the time, my performances will suffer
	I only feel happy when I win
	The day-to-day setbacks can often get me down
	I can't be bothered with people who don't always strive to better themselves
	My preparation for competition has to be exactly the same each time
	My mood depends entirely on my sporting success

Factor 5	I dislike asking people for help and advice*
Seeking and Using	When faced with a problem there is no one I can ask to help*
Social Support	If I don't know something, I will find out who to ask
(9 Items)	I often find it hard to talk to other people about things that are bothering me*
	I know who to ask, to get things done
	I often seek advice from different people
	I value and use the opinion of others about my performance
	I think asking other people for help is a sign of weakness*
	I am keen to ask other people for help
Factor 6	I find it hard to push myself to overcome difficulties*
Active Coping	I am able to adapt and change when things aren’t going right for me
(10 Items)	Failures do not distract me from my pathway to success
	I can deal with whatever comes my way
	My teammates would describe me as a consistent person
	If I encounter a problem I make a plan to get around it
	I work through set backs

	When we need to work hard I am first in the queue
	When things seem hopeless, I still keep going
	I like to take control when dealing with problems
Factor 7	I often lack energy
Clinical Indicators	I socialise with my teammates much less than I used to
(9 Items)	If something unexpected happens I find it really hard to adapt
	I worry about putting weight on
	I have lost interest in socialising with my training group
	After eating, I sometimes feel guilty about its effect on my body shape
	Compared to my teammates I often fail to complete a heavy training session
	I struggle to get myself motivated
	I feel tired and have little energy more often than my peers

** Negatively scored item*