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| Title | Development and Initial Validation of the Psychological Characteristics of Developing Excellence Questionnaire version 2 (PCDEQ2) |
| Type | Article |
| URL | https://clock.uclan.ac.uk/id/eprint/24420/ |
| DOI | https://doi.org/10.1080/17461391.2018.1535627 |
| Date | 2019 |
| Citation | Hill, A., MacNamara, A., and Collins, D. (2019) Development and Initial Validation of the Psychological Characteristics of Developing Excellence Questionnaire version 2 (PCDEQ2). <i>European Journal of Sport Science</i> , 19 (4). pp. 517-528. ISSN 1746-1391 |
| Creators | Hill, A., MacNamara, A., and Collins, D. |

It is advisable to refer to the publisher's version if you intend to cite from the work.
<https://doi.org/10.1080/17461391.2018.1535627>

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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 $\alpha=0.879$. 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

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

3 Spiralling competition between teams – and, indeed, sports – has led to a greater level
4 of financial investment in talent identification and development (TID) systems, with a view to
5 recruiting and developing the best prospective talent in a bid to guarantee future success.

6 Worryingly, however, despite their widespread adoption (Collins & Bailey, 2013), many TID
7 systems have been criticised for their limited predictive validity (Phillips, Davids, Renshaw,
8 & Portus, 2010), and lack of underpinning empirical evidence. In fact, much of the recent

9 literature on TID in sport has now moved away from the traditional physiological and
10 anthropometric profiling, towards the recognition of psychology as the key determinant of
11 talent development (Blijlevens, Elferink-Gemser, Wylleman, Bool, & Visscher, 2018;

12 MacNamara, Button, & Collins, 2010). Indeed, acknowledging the ubiquitous nature of
13 challenge within talent development supports the importance of psychological skills as a key
14 construct. For example, MacNamara and colleagues (MacNamara et al., 2010; MacNamara

15 & Collins, 2013) demonstrated that the development and deployment of psychological
16 characteristics of developing excellence (PCDEs) enable athletes to optimally benefit from
17 developmental challenge; an inevitable feature of any route to the top. Likewise, Toering and

18 colleagues found that self-regulatory strategies such as metacognition and self-control were
19 key in facilitating the development of both youth and professional soccer players (Toering &
20 Jordet, 2015).

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

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

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

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

81 Item Justification

82 **Expert panel.** The initial list of 182 items was submitted to three expert panels (n =
83 3, 2 and 2 respectively), all of whom had extensive applied and research experience within
84 the fields of talent development, coaching, psychology, and psychometric questionnaire
85 development. Subsequently, an individual expert review was conducted by a clinical
86 psychologist with experience of working with both young people and athletes, specifically
87 focussing on the clinical aspects of the PCDEQ2. Each expert was fully briefed on the aims
88 and rationale underpinning the PCDEQ2 and invited to critically discuss each item in relation
89 to its relevance, comprehensibility, face validity, and content validity. In line with the
90 recommendations of Dunn, Bouffard, and Rogers (1999), experts rated each item on a scale
91 of 1 (“not at all relevant”) to 5 (“completely relevant”). Items scoring 4 or less were
92 discussed by the panel. Where consensus was reached, amendments were made to the item;
93 where consensus could not be reached, the items were marked for deletion.

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

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

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

114 Pilot Test

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

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

144 **Participants.** 512 male participants, aged between 13 and 21 years of age ($M =$
145 15.54 , $SD \pm 1.377$), were purposively recruited from elite rugby union ($n = 252$), football (n
146 $= 141$), and rugby league ($n = 119$) academies.

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

155 **Results.**

156 To ensure that the data analysis was appropriate, the factor correlation matrix was
157 examined, revealing moderate correlations between several factors. Given these correlations,
158 PAF with direct Oblimin rotation was deemed an appropriate method of analysis. The Kaiser
159 Meyer Olkin measure of sampling adequacy showed that the sample size was sufficient for
160 factor analysis ($KMO = 0.870$). Bartlett's test of sphericity was also significant ($\chi^2 =$
161 29130.531 ; $df = 9045$; $p = 0.000$), suggesting that there was adequate correlation between the
162 variables and further supporting the appropriateness of EFA.

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

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

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

193 **Interpreting and naming the factors.** Interpretation of the factors was based
194 primarily on the item pattern coefficients in the pattern matrix (Table 2), with each
195 coefficient representing the unique contribution of each variable to its factor (Russell, 2002).
196 Accordingly, and in line with recommendations in the literature (Costello & Osborne, 2005;
197 Tabachnick & Fidell, 2014), the meaning of each factor was based upon the strongest loading
198 items within that factor. Once the highest loading items (i.e., those with pattern coefficients
199 > 0.4) without cross-loadings had been identified and examined for each factor, lower loading
200 items were then considered to aid factor interpretation. Items with complex loadings (e.g.,
201 unexpected negative loadings, cross loading items, correlated factors etc.) were examined to
202 determine whether they fitted conceptually with their intended factors. Following this
203 process, 44 items were removed due to low loadings. Two cross loading items were retained,
204 as they fitted conceptually and logically into the factor in which they loaded strongest. The
205 remaining 91 items were assessed using corrected item-total correlation values to determine
206 their meaningful contribution to their scales. All bar three items returned acceptable results
207 (i.e., > 0.3), with the three low scoring items subsequently removed from the questionnaire.
208 In line with the recommendations of Henson et al. (2004), a second EFA was conducted on
209 the 88 items retained post rotation, confirming the 7-factor structure and accounting for 40%
210 of the total explained variance.

211 Reliability of the PCDEQ2

212 **Participants**

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

215 **Data Analysis**

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

219 **Results**

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

223 **Study 3. Examining the Discriminant Function of the PCDEQ2**

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

228 **Participants**

229 342 male athletes aged from 13 to 19 years ($M = 15.16$, $SD \pm 1.248$) were purposively
230 sampled from UK based academy programmes in football, rugby union, and rugby league
231 recruited.

232 **Procedure**

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

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

251 **Data Analysis**

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

256 **Results**

257 Assumption testing was conducted to check for normality, homogeneity of variance,
258 outliers, linearity, multicollinearity and singularity, with no concerns noted. A Mahalanobis
259 distance of 23.36 was calculated, below the critical value of 24.32 for seven dependent
260 variables, suggesting multivariate normality (Tabachnick & Fidell, 2014). Correlations
261 between the variables ranged from 0.147 to 0.609, offering no cause for concern. Box's M
262 test was not significant ($F = 1.287, p > 0.05$), indicating homogeneity of variance-covariance
263 matrices for each group. Preliminary analysis revealed that there was a difference in
264 PCDEQ2 scores between the high likelihood and low likelihood groups ($F(7,217) = 8.101, p$
265 < 0.001 , Wilks Lambda = 0.793, partial eta squared = 0.207). The means, standard
266 deviations and levels of significance from the tests are presented in Table 3. An initial
267 examination of the groups' means show that those in the high likelihood groups scored better
268 (i.e., higher on the adaptive factors, lower on the maladaptive factors) than their low
269 likelihood counterparts, suggesting that those athletes rated as more likely to progress to the
270 elite level were more likely to possess adaptive PCDEs, whilst simultaneously avoiding
271 negative developmental behaviours.

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

281 The DFA was conducted in order to determine the PCDEQ2's ability to predict group
282 membership. Given the unequal group sizes, probabilities for each group were computed
283 from the group sizes. The results showed a statistically significant discriminant function of
284 the PCDEQ2 (Wilks Lambda = 0.793, $\chi^2 = 50.959$, $p < 0.001$), with a canonical correlation of
285 0.455. The PCDEQ2 was able to correctly predict 85.8% (133 out of 150) of the 'low
286 likelihood' group members and 44.3% (31 out of 70) of the 'high likelihood' group members,
287 in total 72.9% of the 225 participants could be correctly classified. The standardised
288 canonical discriminant function coefficients and the canonical structure matrix were also
289 examined, as these indicate the extent to which the different variables contribute to group
290 separation. These highlight the particularly large contribution of Factor 6 (active coping) and
291 Factor 1 (adverse response to failure) in group differentiation.

292 **Discussion**

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

299 **The Factor Structure**

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

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

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

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

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

351 The PCDEQ2 and Applied Practice

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

355 against the epistemological beliefs that lie at the heart of its development (Collins & Bailey,
356 2013). Cross-sectional, “snapshot” assessments of athletes’ physiological, physical,
357 anthropometrical, technical *and* psycho-behavioural attributes do not consider the temporal
358 and dynamic nature of development. Instead, the PCDEQ2 is best used as part of a
359 triangulation process, alongside other measures such as behavioural observations, expert
360 opinion, and dialogue with the individual athlete involved. By assessing characteristics
361 associated with effective development, the PCDEQ2 is able to identify areas that may require
362 support. In a similar vein, the PCDEQ2 can be used as a monitoring tool to assess the impact
363 and effectiveness of such interventions.

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

376

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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 (\pm SD) | Low likelihood group mean (\pm 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 Failure | I often keep thinking about the mistakes I have made and let this interfere with my performance |
| (21 Items) | When I am not succeeding, I feel like people lose interest in me |
| | 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 and Management (14 Items) | <p>I am good at resisting temptation</p> <p>I sometimes forget items of equipment*</p> <p>I would usually blame other people or circumstances for failure*</p> <p>I often forget appointments or timings*</p> <p>I often do things I know I shouldn't do*</p> <p>I prepare carefully for training sessions</p> <p>My life is well organised</p> |

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 Tendencies (10 Items) | When I am failing, significant others are often disappointed in me |
| | I get annoyed very easily |
| | 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 |
| <hr/> | |
| 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*