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Research article

Validation of a French Version of the Psychological Characteristics of Developing Excellence Questionnaire (MacNamara & Collins, 2011): A Situated Approach to Talent Development

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Abstract
This study sought to validate the psychometric properties of a French-language version of the Psychological Characteristics of Developing Excellence Questionnaire (PCDEQ). Data were gathered from 305 athletes in French-speaking Switzerland (mean age: 16.6 yr, *SD*: 2.9). Translation of the PCDEQ followed established guidelines and included a standardized back-translation process. The psychometric properties were examined by descriptive statistics, Cronbach's alphas for internal reliability, confirmatory factor analysis, intraclass correlations and a paired t-test for test-retest reliability. The results provided evidence of validity of the French version of the PCDEQ. Two items were excluded for low factor loading, and the re-specified model was improved and confirmed the six-dimensional structure with acceptable fit using most criteria (χ^2/df), RMSEA, SRMR, TFI, CFI). Cronbach's alpha also indicated that internal reliability was adequate for validation. Given the adequate psychometric properties, the French-version PCDEQ can be used with confidence for monitoring and designing interventions to enable aspiring athletes or artists to develop the psychological skills and characteristics that can act as important catalysts for their development.

Key words: Talent development, formative assessment, mental skills, situativity, elite performance, sport.

Introduction

Talent development is a major concern for the sports organizations and clubs of many countries, as reflected by their financial investments (Bennet et al., 2018; Rees et al., 2016). Many sport programs are based on the assumption that talent is an innate disposition and have thus focused on an individual's anthropometric, athletic and technical characteristics at a given instant to indicate the likelihood of reaching elite status. Yet research has found only a weak correlation between success in lower age categories and success in the elite category (Abbott and Collins, 2002; Güllich and Emrich, 2014; Simonton, 2001), underlining the nonlinearity of athletic talent development. A good example is Pietro Mennea: his coaches saw little hope of him reaching elite status at the beginning of his career because of physical weaknesses, but he went on to become the 200m record-holder for more than 17 years (1979–1996). According to several theoretical models such as holistic ecological framework or differentiated model of giftedness and talent (Davids et al., 2017; Gagné, 2017; Martindale et al., 2005; Simonton, 2008; Subotnik et al ., 2011), talent is therefore not merely innate but is also built and developed over time.

Talent development implies that many performance factors interact to convert athletic potential to situated achievement. These factors include individual dispositions, environmental characteristics, and training and competition details. Among the individual dispositions, mental skills are widely recognized as key factors for exploiting potentialities to produce or maintain high performances (e.g., Collins et al., 2016a; MacNamara et al., 2010). Many studies have sought to define, measure or transform athletes' mental skills (e.g., Durand-Bush and Salmela, 2002; Olszewski-Kubilius et al., 2015; Toering et al., 2009), suggesting that future athletes need psychological characteristics such as self-organization, goal-setting, performance assessment, resilience, grit and self-awareness to commit to practice and meet the challenges inherent to talent development. For example, athletes need to control sources of distraction in order to remain invested as they develop technical, tactical and physical competencies. Also, the ability to set goals and assess personal performances stimulates their investment in training. From this viewpoint, these mental skills are psychological dispositions that can be developed, but they also influence the effectiveness of the interaction with the talent development environment. They should thus be considered less as decontextualized individual characteristics and more as situational dispositions that emerge in relation to the resources offered by the social, physical and cultural environment in which athletes are embedded (Barab and Plucker, 2002; Collins et al., 2016b; Larsen et al., 2013; Plucker and Barab, 2005). These situational dispositions can be grasped through athletes' perceptions, feelings or cognitions of *being capable to do something in context* as available resource systems, as suggested by the "4E" approach to activity: embedded, embodied, extended and enacted (e.g., Barab and Plucker, 2002; Gesbert et al., 2017; Hauw, 2018; Lave, 1997; Rochat et al., 2017; Rowlands, 2010). With this approach, an individual appears skilled in situation and talent is assumed to emerge from distributed and functional relationships between the individual and context.

Acquiring these skills and being able to improve them when developmental opportunities arise are therefore key steps on the path to excellence (Collins and MacNamara, 2017; Olszewski-Kubilius et al., 2015), and the talent development environment should provide athletes with appropriate learning opportunities (Martindale et al., 2005). For example, Collins et al. (2016b) suggested that training programs should systematically foster the acquisi-

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tion and development of psychological skills to ensure that athletes are equipped to seize opportunities and cope with, for example, performance slumps or increased volumes of practice. Although acquiring and using these skills do not necessarily guarantee elite level competition, their absence may nevertheless hinder in overcoming obstacles along the path to excellence (Collins and MacNamara, 2012; MacNamara et al., 2010).

A tool is thus needed to assess and track mental skills as athletes develop and to provide them with regular feedback. To this end, MacNamara and Collins (2011) built and validated the Psychological Characteristics of Developing Excellence Questionnaire (PCDEQ). The PCDEQ is composed of 59 items that prompt aspiring athletes to assess the extent to which the items correspond to their current activity using a 6-point Likert-type scale (from very unlike me to very like me). The psychometric properties reveal a six-factor factorial structure influencing the effectiveness of the process of sports talent development. The first factor refers to athletes' perceptions of coach support for their long-term success. It expresses how athletes judge the coach's role in the development and efficient use of their abilities with regard to skills like fixing objectives and coping with or controlling sources of distraction. The second factor refers to the use of imagery in training and competition, and the third factor concerns skills in coping with the inevitable pressures along the performance path. The fourth factor refers to the ability to self-organize and invest in quality athletic training. The fifth concerns the ability to evaluate personal performance and work on weaknesses, and the sixth concerns athletes' perceptions of friend and family support as they seek to reach their highest potential.

No study has yet used this questionnaire in the French language. Yet French is the official language of 274 million people living in 29 countries (fifth most spoken language in the world) according to the International Organization of La Francophonie (2014 report). The validation of a French version of the PCDEQ would therefore be a major step in expanding the international scientific community that deals with talent development programs (MacNamara and Collins, 2012). Also, sport psychologists are increasingly active in elite sport organizations. In addition to assessing and treating psychopathologies, they are frequently asked to develop and enhance athletes' mental skills while respecting their well-being. For French-speaking sports psychologists, the PCDEQ would be a useful source of information for their practice. This study thus aimed to translate and validate a French version of the PCDEQ to assess the development and exploitation of psychological characteristics in aspiring French-speaking athletes.

Methods

Translation of the questionnaire

A recommended methodology was applied for translating questionnaires (e.g., Hauw et al., 2016). First, the PCDEQ was translated into French by the first and third researchers, both native French translators and experts in this area of research. Each independently produced a forward translation of the original items, instructions and response options. To produce a final version, they compared and discussed their translations and agreed on a single version. A bilingual sport psychologist then compared each of the translated items with the original items and decided whether there were any discrepancies. She also ensured that the translation of technical terms respected the original meanings. No modifications were made. Second, 20 native French-speaking aspiring athletes between 13 and 22 years old rated the clarity of each item on a 7-point Likert scale (1=very clear to 7=not clear at all). Items scored >4 were then modified. Third, the resulting French questionnaire was back-translated into English by a professional native English-speaking translator who was also fluent in French. Last, the first and third researchers compared the final questionnaires in the two languages and decided on the final French version. This study was carried out in accordance with the Declaration of Helsinki.

Participants

Three hundred and five Swiss athletes, performing their sport at the regional (n = 76), national (n = 154) or international (n = 75) level, participated in this study. The mean age was 16.6 years (age range = 12–28; SD = 2.9). Among them, 187 performed individual sports (skiing, tennis, judo, gymnastics, athletics, climbing, swimming, mountain biking) and 118 team sports (soccer, handball, rugby, hockey, rowing, bobsledding, sailing). There is no consensus regarding sample size calculation using CFA: empirical rules vary from 5 to 10 subjects per item (DeVellis, 2003, p. 137). Since we had 59 items, the sample size (n = 305) fulfilled the empirical rule.

Procedure

The study was approved by the Cantonal Ethics Committee on human research (Loi Recherche sur l'Etre Humain; Switzerland). Procedures were explained to the athletes, who then gave written informed consent to participate, as did parents/guardians for those under 18 years. Self-administered paper-pencil PCDEQ questionnaires were distributed to the 305 athletes between September and October 2017. As participation was anonymous, the athletes were given a nickname at the first administration based on their initials and age and their parents' initials (mother then father). To assess scale reliability, they completed the questionnaire a second time, and the nicknames ensured the correspondence between the results at Times 1 and 2. Following Bonnet's guidelines (2002), the sample size to obtain a 95% CI for intraclass correlation (ρ) with a desired width of 0.2 for two repetitions is greater than 159 if ρ is 0.6 or more. Our sample of 158 respondents for the second administration is close to this figure.

Data analysis

Descriptive statistics were performed on the 59 items with means, standard deviations, measures of skewness and kurtosis, and analysis of missing values. To ensure the adequacy of factor analysis, we estimated the correlation matrix and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and performed Bartlett's test of sphericity. Dimensionality was examined by performing confirmatory factor analysis (CFA) with maximum likelihood estimation. While responding to the questionnaires, participants could decide not to answer certain questions. For the 59 items, 0.7% of the values were missing. At the respondent level, 21.3% had one or more missing values: 12.1% had one missing value, 4.8% had two missing values, 2.9% had three, and 1.6% had four to eight. The variables with the most missing data were items 16, 19 and 51, with five missing responses (1.6%). When the missing data percentage is below 5%, the phenomenon can be considered inconsequential (Schafer, 1999). Therefore, we used the pairwise method for the descriptive statistics and the full information maximum likelihood (FIML) algorithm imputation for CFA.

The evaluation of model fit was performed with χ^2/df and completed with measures selected from other classes of fit indices (Nunnally and Bernstein, 2010, p. 565): the comparative fit index (CFI) and the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), 90% CI of RMSEA, and the standardized root mean square residual (SRMR). From the abundant but not fully consonant literature, we chose the following criteria to consider the model fit as acceptable: χ^2/df <2 (Ullman, 2001), CFI and TLI ≥0.90 and RMSEA and SRMR ≤0.08 (Hu and Bentler, 1999). Some authors have criticized the arbitrariness of these limit values, showing that by applying them to simulated data according to a given structure, they sometimes result in not confirming the underlying structure (e.g., Lance et al., 2006; Sharma et al., 2005); they thus consider that a threshold of 0.80 is acceptable for CFI. Modification indexes were used to improve the model.

To examine scale reliability, we calculated the internal consistency coefficients (Cronbach's alphas). According to DeVellis (2003, p. 95), a Cronbach's alpha between 0.65 and 0.7 is a "minimally acceptable" threshold for a scale, while thresholds greater than 0.7, 0.8 and 0.9 indicate, respectively, "respectable," "very good" and "excellent" scales.

For test-retest reliability, the factor scores were compared between the two measurement times using the intraclass correlation coefficient (two-way mixed effects, absolute agreement) and a t-test for paired samples. An intraclass correlation less than 0.5 indicated "low reliability"; between 0.5 and 0.75, "moderate"; between 0.75 and 0.90, "good"; and above 0.90, "excellent" (Koo and Li, 2016).

All data were analyzed using SPSS (version 24.0) and R (library lavaan).

Results

Description of the responses

The response distribution in Table 1 indicated that the respondents mostly agreed with all items (i.e., more toward "very like me" than "very unlike me"). For each item except 44, the mean was higher than 3; for items 12, 27, 33, 52 and 59, the mean was even higher than 5. The skewness and kurtosis coefficients were also examined. To perform factor analysis on items measured using a Likert scale, Muthen and Kaplan (1985) recommended that skewness and kurtosis coefficients be ±1, whereas Kline (1998) defined a coefficient greater than ±3 as critical. The coefficients of 83% of the items had values below the recommended threshold of ±1; the remaining items, except item 33, did not exceed the critical threshold of ±3. The item distribution deviations were thus not too severe and CFA was possible.

Table 1. Descriptive statistics for items of PCDEQ (n = 305).

Item	*M*	*SD*	Item	*M*	*SD*
1.	4.19	1.24	31.	4.92	1.15
2.	4.35	1.30	32.	3.99	1.26
3.	3.32	1.39	33.	5.37	1.12
4.	4.95	1.15	34.	3.98	1.36
5.	3.82	1.53	35.	3.81	1.48
6.	4.44	1.21	36.	4.22	1.28
7.	4.40	1.24	37.	4.52	1.20
8.	4.64	1.19	38.	3.96	1.48
9.	4.11	1.21	39.	4.59	1.17
10.	4.44	1.21	40.	4.25	1.17
11.	4.18	1.26	41.	3.89	1.41
12.	5.00	0.90	42.	4.03	1.22
13.	4.07	1.36	43.	3.80	1.37
14.	3.84	1.48	44.	2.58	1.50
15.	4.14	1.22	45.	3.77	1.31
16.	3.73	1.25	46.	4.06	1.44
17.	3.89	1.31	47.	4.61	1.11
18.	4.03	1.45	48.	4.24	1.21
19.	4.61	1.42	49.	3.07	1.69
20.	4.13	1.36	50.	3.67	1.39
21.	4.27	1.29	51.	4.91	1.08
22.	4.76	0.99	52.	5.09	0.98
23.	4.23	1.30	53.	4.90	1.07
24.	3.62	1.46	54.	3.89	1.52
25.	4.13	1.39	55.	4.75	1.20
26.	4.80	1.33	56.	4.57	1.27
27.	5.00	0.99	57.	3.21	1.53
28.	4.34	1.32	58.	4.76	0.94
29.	4.04	1.20	59.	5.14	0.88
30.	4.28	1.16			

Table 2. Fit indices of the CFA models for PCDEQ (n = 305).

Model	χ^2 (df)	χ^2/df	*p*	RMSEA 90% CI	SRMR	TLI	CFI
PCDEQ 6 factors - 59 items	3282.82 (1637)	2.01	<.001	0.057 0.054-0.060	0.081	0.749	0.760
M1 6 factors - 57 items	3023.26 (1524)	1.98	<.001	0.056 0.053-0.059	0.079	0.765 0.781	0.776 0.791
M2 6 factors - 57 items	2787.39 (1517)	1.84	<.001	0.052 0.049-0.055	0.070	0.800	0.810

χ^2: chi-square; df: degrees of freedom; *p*: significance level; RMSEA = Root mean square error of approximation; SRMR = Standardized root mean square residual; TLI = Tucker-Lewis index; CFI = Comparative fit index.

Table 3. Factor loadings (standardized) of the CFA PCDEQ (n = 305).

Items	F1	F2	F3	F4	F5	F6
2.	0.523					
4.	0.609					
5.	0.676					
7.	0.600					
13.	0.700					
15.	0.666					
17.	0.598					
20.	0.737					
21.	0.690					
23.	0.756					
24.	0.436					
25.	0.583					
36.	0.712					
38.	0.716					
42.	0.757					
54.	0.602					
57.	0.576					
6.		0.348				
8.		0.539				
14.		0.691				
16.		0.342				
18.		0.485				
19.	0.466	0.183				
32.		0.556				
34.		0.567				
35.		0.703				
43.		0.636				
46.		0.779				
50.		0.777				
1.			0.444			
3.			0.291			
11.			0.582			
26.			0.405			
29.			0.490			
31.			0.661			
33.			0.321			
37.			0.721			
41.			0.490			
9.				0.294		
10.				0.623		
27.				0.475		
28.			0.420	0.169		
40.				0.638		
47.				0.646		
51.				0.654		
58.				0.600		
12.					0.575	
22.					0.633	
52.					0.589	
55.					0.651	
56.					0.608	
30.						0.631
39.						0.446
45.				-0.289*		0.841
48.						0.432
53.						0.297
59.						0.242

* non-significant.

Confirmatory factor analysis

The structure of the relations among the items was analyzed to document the adequacy of factor analysis: the KMO measure of sampling adequacy reached 0.88 and Bartlett's test of sphericity signaled the adequacy of the factor analysis (Bartlett's chi-square statistic was 8207.3 and $p < 0.001$).

The PCDEQ was examined with a six-factor factorial structure and relations between some factors, as in MacNamara and Collins (2011). Table 2 presents the goodness-of-fit of the PCDEQ. The 59 items did not show good fit (only RMSEA reached the limit value). After examination of the factor loadings, two items were excluded (items 44 and 49 of factor 3 having non-significant estimates). The modified PCDEQ thus consisted of six factors and 57 items and showed adequate fit for all criteria except CFI and TLI. The modification indices authorized the loading of some items on two factors, as did MacNamara and Collins (2011) (items 19, 28 and 45), and some items were correlated (items 4 and 7 from factor 1, 35 and 46 from factor 2, 8 and 18 from factor 2, and 39 and 48 from factor 6). The fit of the re-specified model was improved and confirmed the six-dimensional structure with an acceptable fit using most criteria. The results of the CFA are presented in Table 3. For all items, loading with the main factor was significant (for item 45, which loaded on two factors, the second loading was non-significant, whereas items 19 and 28, which loaded on two factors, had significant loadings).

Table 4. Internal reliability and descriptive statistics of the PCDEQ (n = 305).

Factor	Number of items	α	*M*	*SD*
F1	17	0.92	4.08	0.81
F2	12	0.85	4.05	0.84
F3	9	0.74	4.36	0.52
F4	8	0.75	4.54	0.68
F5	5	0.75	4.83	0.76
F6	6	0.65	4.48	0.69

Internal reliability

Table 4 presents the descriptive statistics and internal reliability of the six factors of the PCDEQ. Participants generally had moderate to high scores on the factors ($M = 4.05$–4.83), with similar standard deviations among factors (SD=0.52–0.84). Cronbach's alpha indicated that internal reliability was adequate for validation: the coefficients indicated that factor 1 was "excellent", factor 2 was "very good", factors 3 to 5 were "respectable," and factor 6 was "minimally acceptable."

Test-retest reliability

The data supported the test-retest reliability of the scales (Table 5). The intraclass correlations indicated "moderate reliability" between T1 and T2 for factors 2, 3, 5 and 6, and "good reliability" for factors 1 and 4. Cronbach's alpha varied little between T1 and T2. Mean and standard deviations of factor scores varied little between the two administrations, and the paired t-test was not significant.

Discussion

The literature highlights that aspiring athletes without a particular set of psychological characteristics may stumble and fall along the rocky road to the top (Collins and MacNamara, 2012). A tool that assesses whether they possess and deploy these important psychological characteristics

Table 5. Descriptive statistics, internal reliability and intra-class correlation of the PCDEQ across samples (n = 158)

	Time 1 *M (SD)*	Time 2 *M (SD)*	Paired t-test *t*(157)	*p*	Time 1 α	Time 2 α	Intraclass corr.
F1	4.13 (0.92)	4.11 (0.95)	0.258	.797	0.92	0.94	0.837
F2	4.13 (0.85)	4.23 (0.85)	-1.582	.116	0.84	0.88	0.729
F3	4.28 (0.74)	4.30 (0.86)	-0.309	.758	0.71	0.81	0.664
F4	4.58 (0.67)	4.57 (0.69)	0.327	.744	0.72	0.77	0.823
F5	4.85 (0.81)	4.84 (0.73)	0.070	.944	0.76	0.73	0.706
F6	4.50 (0.73)	4.55 (0.72)	-0.681	.497	0.67	0.70	0.558

during the talent development process is therefore useful. MacNamara and Collins (2011) built the only such measurement tool, but to our knowledge no French version of this questionnaire has been validated. Given the number of French-speaking countries that are invested in developing sports talent, a French version is now needed.

After excluding two items (44 and 49) due to low factor loadings, the fit of the re-specified PCDEQ model was improved and confirmed the six-dimensional structure (Table 2). All factors showed satisfactory internal reliability above the minimum recommendation of .65 and ranging from .65 to .92, similar to the range reported for the internal reliability of the original version (.79 to .87) (Table 3). Given the adequate psychometric properties of the French-version PCDEQ, it can be used with confidence by sports psychologists and researchers.

As noted, two items were removed in order to improve the model fit. These items assessed how athletes handle dual careers (e.g., I can't stop my sports activity when I am under pressure with school work). When we compared the UK (origin of the initial PCDEQ version) and Swiss contexts, our finding that these two items did not fit was unsurprising. In Switzerland, it is very difficult to combine studies and elite sport, and few facilities are offered to athletes interested in doing so, contrary to what occurs in most other European countries. Although removing these items reduced the tool's evaluation spectrum, specifically for coping skills (factor 3), it did not impact the ecological validity of the questionnaire and therefore was deemed acceptable, especially given that other tools can evaluate how athletes cope with the demands of dual careers in elite sport and higher education, such as the *Dual Career Competency Questionnaire for Athletes* (e.g., De Brandt et al., 2017).

Conclusion

More specifically, the French PCDEQ should be used as a formative assessment tool (and not a selection tool) to monitor and design interventions to help aspiring athletes develop the psychological skills and characteristics that can be powerful catalysts for development (Collins et al., 2016b; Collins and MacNamara, 2017). In a research context, it can also be used to increase our understanding of the psychological skills and characteristics that contribute to specific stages of the talent development process and how they relate to different outcomes and for different sports. The authors wish to emphasize that this validation in French language is part of a French-speaking Swiss culture that encourages caution with other French-speaking countries.

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Key points

- Talent is assumed to emerge from distributed and functional relationships between the athlete and context.
- The absence of psychological skills may hinder aspiring athletes in overcoming obstacles along the path to excellence.
- The PCDEQ is a questionnaire that assess and track psychological skills as athletes develop.
- The PCDEQ is an assessment tool for sport psychologists to develop and enhance athletes' mental skills while respecting their well-being.

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