Psychometric Properties of the Talent Development Environment Questionnaire with Chinese Talented Athletes

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Abstract

The development of talented athletes is a priority for many countries across the world, including China. A validated Chinese five-factor Talent Development Environment Questionnaire (TDEQ-5) would go some way in helping researchers and practitioners investigate talent development systems within China from an evidence based perspective. For this purpose, the 25-item English TDEQ-5 was translated to Chinese through a standardised process. The translated scale was then administered to 538 talented Chinese youth athletes. Confirmatory factor analysis revealed an adequate model fit of the scale. The internal reliability, concurrent and discriminant validity and test-retest reliability of the scale were adequately supported. The scale was also invariant across gender. It is recommended that the Chinese TDEQ-5 can be used with confidence in both applied and research settings.

Introduction

As professional performance standards in sport have increased over recent years, the effective development of talent has become increasingly important (Martindale, Collins, & Daubney, 2005). It is no longer enough to rely on natural aptitude alone, and effective talent development (TD) processes offer the most appropriate environment to help athletes realise their athletic potential (Williams & Reilly, 2000). While it is tempting to focus on pinning down the criteria required to identify talent in order to focus resources at those who are *most* talented, research has shown this to be illusive due to the difficulty and complexity of doing so with any useful accuracy, especially at pre-maturation phases (e.g., Vaeyens, Gullich, Warr, & Philippaerts, 2009).

In contrast to this, practitioners and researchers alike have acknowledged that the environment that an individual plays and trains in can be highly influential to their development (e.g., Henriksen, Stambulova, & Roessler, 2010; Li, Wang, & Pyun, 2014; Martindale et al., 2010). As such, it makes sense to continue to increase the knowledge and understanding around what effective TD environments 'look like', building on work to date. For example, work by Bloom (1985), Côté and colleagues (e.g., Côté, Turnnidge & Evans, 2014) and Durand-Bush and Salmela (2002) have outlined the typical career progression of athletes and types of experiences that are perceived to be useful. Other researchers have focussed on understanding the personal characteristics of successful developers and the environments that promote them (e.g., Abbott, & Collins, 2004; Ames, 1992; Deci & Ryan, 2008; Harwood, Barker, & Anderson, 2015; MacNamara, Button, & Collins, 2010; Toering et al., 2011; Van Yperen, 2009). Others have looked at the characteristics of successful TD cultures (e.g., Henriksen, Stambulova, & Roessler,

2011; Larsen, Alfermann, Henriksen, & Christensen, 2013; Henriksen, Stambulova, & Roessler, 2011), academies (e.g., Douglas & Martindale, 2008; Mills, Butt, Maynard, & Harwood, 2012) and higher order goals and systems associated with an effective 'development phase' leading to elite status (e.g., Martindale, Collins, & Abraham, 2007).

There are clearly a large number of factors that can contribute to athletic development and success (Li et al., 2014). In an attempt to provide a way of facilitating practical application of evidence, Martindale et al. (2005) identified four key features of the TD environment that consistently emerged through the TD literature. These four themes are: (a) long-term aims and methods, (b) coherent support and messages, (c) emphasis on appropriate development, and (d) individualised and ongoing development. The detail of these features were supported and expanded upon through qualitative work within a UK context (Martindale et al., 2007). Based on these four empirical themes and in an effort to facilitate evidence-based practice in TD, Martindale and colleagues (2010) developed the "Talent Development Environment Questionnaire" (TDEQ) for assessing key TD environmental factors. Their exploratory factor analysis with 590 youth athletes led to a 59-item seven-factor structure scale: long-term development focus, quality preparation, communication, understanding the athlete, support network, challenging and supportive environment, and long-term development fundamentals (Martindale et al., 2010). The creation and development of the TDEQ helped to advance the potential for TD research, in particular in relation to monitoring the ongoing environmental factors that are important for effective TD.

To date, there have been several studies that have used the TDEQ to investigate TD environments. For example, environmental qualities associated with quality

preparation and understanding the athlete have been linked with more successful progression rates in UK swimming talent pathways and rugby academies (Martindale et al., 2013). Environments that emphasised a long-term focus, individualised coaching approaches and had more established support networks were found to predict higher psychological wellbeing and lower stress in players involved with Swedish youth football academies (Ivarsson et al., 2015). Also, two studies investigating athletes from Asia found that the environment was positively associated with motivational outcomes. Specifically, within Singaporean and Korean sport schools, long-term development focus, long-term fundamentals, and support network were found to be positively associated with intrinsic motivation and mastery-approach goals (Wang, Sproule, McNeill, Martindale, & Lee, 2011; Wang, Pyun, Li, & Lee, 2016).

It is important to note that ongoing work has been focussing on the development and validation of a shortened TDEQ. Initially, Wang et al. (2011) modified the TDEQ in an attempt to minimise its psychometric limitations (e.g., low internal reliability in the challenging and supportive environment subscale). Their modification led to a 36-item six-factor TDEQ: long-term development focus, quality preparation, communication, understanding the athlete, support network, and long-term development fundamentals (cf., Wang et al., 2011), although the factor structure of the modified TDEQ was not examined.

More recently, Li, Wang, Pyun, and Martindale (2015) examined the reliability and validity of the modified TDEQ through both exploratory factor analysis and confirmatory factor analysis with Singaporean youth athletes. Their analyses yielded a 25-item five-factor structure (i.e., TDEQ-5): long-term development focus ~~(five items)~~, alignment of expectations ~~(five items)~~, communication ~~(four items)~~, holistic

quality preparation ~~(seven items)~~, and support network ~~(four items)~~. The scale was also found to have adequate to good internal reliability (α = .79 to .86). The authors concluded that the refined TDEQ (TDEQ-5) appeared to be a more practical, reliable and valid scale for measuring the key identified TD environmental factors. They also suggested further examining the psychometric properties of the TDEQ-5 (e.g., test-retest reliability, concurrent validity) in different contexts (Li et al., 2015). To date, there is no scale available for use within Chinese speaking cultures. As such, and following recommendations emerging from Li et al. (2015), this study aims to further validate the TDEQ-5 with talented youth athletes in China. Specifically, the psychometric properties of the Chinese translated TDEQ-5 will be examined, including internal reliability, test-retest reliability, factorial validity, and concurrent validity.

Methods

Overview of research population

China has built a system for talent identification and development that is pyramidal in nature and has four layers (Hong, Wu, & Xiong, 2005). At the bottom of the pyramid is the fundamental level. Young athletes, maybe as low as 6 years old, are selected and trained. Some of them may be selected onto next layer (elementary level), where semi-professional training is available. The training is usually provided by sport schools or other schools hosting TD programmes. Only a few of the athletes (about 5%) will be selected into next two layers (i.e., intermediate level and national level) to receive professional training and support. The TD programmes for intermediate level are hosted in institutions such as sport institutes, universities, and professional clubs. The best players are selected into national teams and they receive

highest level of TD programmes hosted in different national or oversea training centres (Wang & Li, 2005).

Participants

A sample of 538 talented youth athletes from China was recruited (males = 222, females = 310, missing = 6). Participants had a mean age of 17.55 (*s* = 2.10) years and were recruited from 28 different individual and team sports such as archery, athletics, badminton, basketball, cycling, fencing, shooting, and handball (individual sports = 149, team sports = 375, missing = 14). On average, they ~~had involved~~reported involvement in their sport for 4.77 years (*s* = 2.79) and attended 7.22 training sessions each week (*s* = 3.44). Each training session ~~with each session~~ lasted for an average of 2.25 hours (*s* = 0.80). All of them represented their province/municipality to compete at The 2015 Fuzhou National Youth Games.

Measures

TDEQ-5

The Chinese translated 25-item TDEQ-5 ~~with 25 items~~ was used to measure participants' ~~perceived~~ perceptions of five TD environment~~al~~ features ~~factors~~. The scale has five factors: long-term development focus (five items), alignment of expectations (five items), communication (four items), holistic quality preparation (seven items), and support network (four items). A 6-point Likert scales (1 = "*strongly disagree*", 6 = "*strongly agree*") was used for measuring participants' responses.

Basic Needs Satisfaction in Sport Scale (BNSSS)

Self-determination theory (Deci & Ryan, 1985, 2000) postulates that ~~People~~ people have three basic psychological needs~~,~~. These three needs are~~including~~ autonomy (i.e., the need to experience ownership of one's own actions and choices), competence (i.e., the need to feel adequate capability in doing optimally challenging activities and achieving desired outcomes), and relatedness (i.e., the need to have sense of belongings and mutual respects; Deci & Ryan, 1985). ~~According to s~~Self-determination theory (Deci & Ryan, 2000~~),~~) also maintains that effective social or environmental factors such as long-term development focus and parental support will lead to the satisfaction of the three basic psychological needs. For example, athletes who are trained under long-term development focus are provided opportunities to understand the rationale of long-term development and gradually improve their sports performance, which are believed to fulfil their autonomy and competence needs. Similarly, parental support is expected to build athletes' sense of belonging (Deci & Ryan, 2000). Therefore, these three theoretically-based constructs were selected to~~To~~ examine the concurrent validity of the Chinese translated TDEQ-5.~~,~~ ~~the~~ The Chinese version of the BNSSS (Ng, Lonsdale, & Hodge, 2011) was applied to measure participants' three basic psychological needs. The scale has three 5-item subscales to measure each of the needs. Evidence of reliability and construct validity of this scale was established (see Ng et al., 2011). Participants used 7-point Likert scales (1 = "*not true at all*"~~;~~, 7 = "*very true*") to give responses.

Procedure

The 25-item TDEQ-5 was firstly translated to Chinese by two bilingual researchers. The Chinese translated TDEQ-5 was then back translated by another two bilingual investigators. Two bilingual investigators with expertise in TD research verified the translation (Brislin, 1980). Thereafter, a pilot study with 20 participants was

conducted to examine the content validity of the verified scale. The wording of three items was slightly modified after the pilot phase. Finally, the modified scale was employed in this validation research (Appendix 1).

Ethical clearance was obtained from the first author's institution. Invitation letters were sent to five sport schools ~~and~~ /institutes located at Fujian Province, Guangdong Province, Hubei Province, Shandong Province, and Tianjin Municipality~~to get their permission to conduct this research~~. After getting the permission to conduct this research from the sports schools/institutes, parental or guardian informed consent was also obtained before the data collection. The questionnaires (i.e., the Chinese translated TDEQ-5, the Chinese version of the BNSSS, and demographic items including participants' age, gender, sport, and training) were then distributed to participants in ~~quite~~ quiet classrooms or meeting rooms by researchers and/or sport psychologists. The researchers and/or sport psychologists encouraged participants to respond to the questionnaire honestly. It took participants approximately 15 minutes to complete the survey. A subsample of the participants (n = 44) from a sport school also completed the TDEQ-5 at a one-week interval to examine the test-retest reliability of the scale.

Data analysis

A small proportion of missing values (0.9%) were imputed using Expectation-Maximization algorithm (Hair, Black, Babin, & Anderson, 2010; Little, 1988). Subscale scores were reported as means and standard deviation. Confirmatory factor analyses were conducted to test the factorial validity of the TDEQ-5 using *M*plus 7.0 with the robust maximum likelihood estimation procedure (MLM; Muthén, & Muthén, 1998-2012). The whole data set ~~will split~~was divided into two by random selection of approximately 50% of all cases for confirmatory factor analysis.

Namely, sample 1 (n = 270) was used as a calibration sample and sample 2 (n = 268) was used as a validation sample. A sample size with 200 or above is generally deemed enough for confirmatory factor analysis (Hair et al., 2010).

To assess the factorial validity, comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA) with 90% confidence interval (CI), and standardised root mean square residual (SRMR) were used. Regarding the cut-off values of ~~CFA~~ CFI and TLI, an index value of over .90 indicates adequate fit and an index value of over .95 represents good fit (Hu & Bentler, 1999). For RMSEA and SRMR, a cut-off value smaller than .08 and .06 represents adequate and good fit, respectively (Hu & Bentler, 1999). To assess internal model fit, composite reliability (CR) was used on the top Cronbach's alpha (α). The values of .70 or above for ~~composite reliability~~CR and α indicate adequate reliability (Hair et al., 2010). A 95% CI of latent factor correlation that does not include 1.00 supports discriminant validity between the two estimated factors (Anderson & Gerbing, 1988).

To examine concurrent validity, zero-order and latent factor correlations between the five subscales of the TDEQ-5 and three basic psychological needs were computed with the whole sample. Intraclass correlation coefficients of the five subscale scores were computed to examine the test-retest reliability of the TDEQ-5. A coefficient value of above .60 indicates good test-retest reliability (Cicchetti & Sparrow, 1981).

Additional analyses were conducted to examine the measurement invariance of the TDEQ-5 across gender (males *vs.* females). Multiple-group invariance across sport type was not tested given a small sample size for the individual sport group (individual sports = 149, team sports = 375). Configural, metric, and scalar variance

were evaluated in this research (cf., Wang & Wang, 2012). The difference of MLMχ^2 statistics and change of CFI values between the restricted and unrestricted models were used for model comparisons. A non-significant ΔMLMχ^2 statistic and a change of ΔCFI value smaller than .01 suggest invariance between the two compared models. It is worthy to note that the ΔMLMχ^2 test is very sensitive to sample size (Cheung & Rensvold, 2002).

Results

Confirmatory factor analysis

The sample 1 data showed adequate fit to the five-factor model: MLMχ^2 (265) = 478.51, CFI = .914, TLI = .902, RMSEA = .055, 90%CI (.047, .062), SRMR = .051. Inspection of modification indices indicated that error terms for items HQP1 and HQP2 (χ^2 ~~(265)~~ = 27.17, expected parameter change = 0.37) as well as items HQP6 and HQP7 (χ^2 = 29.54, estimated parameter change = 0.42) had relatively large modification indices compared with the rest. In addition, as all the four items measured contents related to holistic quality preparation, their residuals were expected to be correlated. Therefore, the ~~measuring~~ measurement model was re-specified by having the above-mentioned pairs of error terms as correlated ~~correlated the two pairs of error term~~. The model fit of the re-specified model was improved: MLMχ^2 (263) = 427.22, CFI = .934, TLI = .924, RMSEA = .048, 90%CI (.040, .056), SRMR = .050. Factor loadings ranged from .51 to .80. Sample 2 was used to cross-validate the measurement model found with sample 1 and the data showed adequate fit to the model: MLMχ^2 (263) = 414.73, CFI = .934, TLI = .925, RMSEA = .046, 90%CI (.038, .055), SRMR = .052. Factor loadings ranged from .48 to .86.

Composite reliability and discriminant validity

Table 1 presents the descriptive statistics, internal reliability, and correlations among the five TD environmental factors. Participants generally reported a moderate to high level of the five TD environmental factors (M = 3.99 to 4.62 out of 6.00). Reliability of the five factors were generally adequate across the two samples (CR = .69 to .89; α = .66 to .89). As expected, the zero-order factor correlations were positive (r = .15 to .67). The latent factor correlations ranged from .20 to .83 and none of its 95%CI correlation coefficients include 1.00, supporting the discriminant validity of the scale. Similar findings regarding reliability and discriminant validity were found with the whole data (see Table 2).

****Table 1 near here****

****Table 2 near here****

Concurrent validity and test-retest reliability

The whole data showed adequate fit to the five-factor model of the TDEQ-5 (MLMχ^2 [263] = 475.34, CFI = .954, TLI = .947, RMSEA = .039, 90%CI [.033, .044], SRMR = .039) and to the three-factor model of the BNSSS (MLMχ^2 [87] = 320.94, CFI = .919, TLI = .902, RMSEA = .071, 90%CI [.063, .079], SRMR = .049). As expected, the five TD environmental factors were positively correlated with the three basic psychological needs (r = .26 to .47, latent factor correlations = .30 to .61; Table 2). Thus, the concurrent validity of the TDEQ-5 was supported. The one-week test-retest reliability of the scale was also supported with a sample (n = 44): long-term development focus (ICC = .79), alignment of expectations (ICC = .84), communication (ICC = .78), holistic quality preparation (ICC = .87), and support network (ICC = .77).

Group invariance across gender

Table 3 presents the results of invariance tests across gender (males = 222, females = 310). There was no difference between the configural (baseline) model and the metric (factor loading) invariance model: $\Delta MLM\chi^2$ (20) = 22.82, p = .30, ΔCFI = 0. According to the difference of $MLM\chi^2$ statistic, the baseline model and the scalar (intercept) invariance model was different: $\Delta MLM\chi^2$ (45) = 72.95, p = .006. However, the ΔCFI value was .006, suggesting there was no difference between the two models. Given the $\Delta MLM\chi^2$ test is very sensitive to sample size, the negligible value of ΔCFI, and the adequate model fit across the tested models (Cheung & Rensvold, 2002), it was summarised that the measurement model of the scale was invariant across gender. Given the TDEQ-5 was invariant across gender, a series of *t*-tests were used to compare gender differences on the five TD environmental factors. Female participants (M = 4.60, s = 0.64) reported higher scores on long-term development focus than males (M = 4.45, s = 0.73), $t(530) = -2.47$, p = .01. There were no gender differences regarding the other four TD environmental factors.

****Table 3 near here****

Discussion

The aim of this study was to translate and validate a Chinese version of the TDEQ-5. This would allow practitioners to investigate TD environments set in a Chinese context more systematically and from an evidence based perspective. To date, there is very little research on the development of talented athletes from a Chinese perspective. Also, given the large scale investment and priority that China places on the success of their elite sportsmen and women (Wang & Li, 2005), it would be

invaluable to facilitate understanding in this area more broadly. The need for understanding the differences across cultures within talent identification and development has been highlighted (Stambulova & Alfermann, 2009~~), ~~). ~~it is hoped that t~~Translating and validating the TDEQ-5 can help facilitate research interest and development regarding TD in Chinese speaking contexts. This study followed typical procedures for translating and validating questionnaires into other languages (Brislin, 1980). ~~This translation work was followed up by a process of checking the content validity of the scale, which involved 20 participants filling out the scale and providing feedback on their understanding of the items. After some minor amendments of three items, the modifed scale was completed by 538 talent Chinese developing elite athletes in order to test the psychometirc properties of the questionnaire. ~~The ~~resutls ~~results of the two confirmatory factor analyses confirmed the five-factor structure of the TDEQ-5 found in the Singapore study (Li et al., 2015).

In order to check the concurrent validity of the scale, the ~~particiapnts~~ participants also filled out the Chinese version of the BNSSS (Ng et al., 2011). According to self-determination theory (Deci & Ryan, 2000), it was expected that features of effective TD environments would correlate positively with the satisfaction of basic psychological needs of the athletes. Effective TD environmental factors such as holistic quality preparation and support network ~~quality training programmes and sports sciences support can be considered as nutriments for enhancing ~~can be considered as positive social antecedents facilitating athletes' basic psychological needs. For example, offering a high quality training programme coupled with sports sciences support to athletes is expected to gradually improve their sports skills and competence (Deci & Ryan, 2000). Similarly, other three TD

environmental factors focus on providing long-term development opportunities, establishing attainable and measurable goals, and giving feedback will also nurture athletes' basic psychological needs (Li, Wang, & Pyun, 2016). As expected, ~~The results~~the current study findings showed that the five TD environmental factors were positively related to the three basic psychological needs, providing the initial evidence of concurrent validity of the TDEQ-5.

Generally, internal reliability of the Chinese version of the TDEQ-5 was adequate (α = .69 to .89) and was comparable to the English version (α = .79 to .86; Li et al., 2015). The current research was the first to investigate the test-retest reliability of the TDEQ-5. Forty four of the participants also filled out the TDEQ-5 a week later to examine the test-retest reliability of the scale and the results showed adequate support to its test-retest reliability. Additional analyses indicated that Chinese talented youth athletes, regardless of their genders, interpreted the translated scale items in a same way. Taken together, the Chinese version of the TDEQ-5 was considered reliable and valid for use across applied and research contexts.

There are several limitations and implications of the current research. First, participants of this research were highly trained athletes from five selective sports schools/institutes in China, the results may not be generalised into other locations. Second, although the TDEQ-5 has been developed as a generic tool assessing environmental factors across sport, stage of TD, and culture, there will be context-specific requirements within TD (Martindale et al., 2010). Given the accepted complexity and culturally specific nature of TD, a context-specific tool may be developed based on the current form of the TDEQ-5 in future. Context-specific items could be generated in future work to cover other critical environmental factors (e.g., club-athlete relationships) that have not been considered under the TDEQ-5 (Aalberg

& Sæther, 2016; Henriksen et al., 2011). Meanwhile, it is also important to examine whether the factor structure of the TDEQ-5 can be replicated in other contexts. Finally, ~~In line with previous TDEQ development,~~ while the TDEQ could be used to examine and classify environments for research purposes, for applied use, it is advised that the TDEQ-5 be used more formatively ~~in applied contexts~~ as a monitoring and development tool. ~~, in order to facilitate formative evaluation and feedback for TD environments, rather than summative assessment of them~~. ~~This will support a developmental agenda and also facilitate open and honest feedback from athletes.~~ ~~This type of application of the TDEQ-5 will also facilitate evidence based practice and reflection.~~ In research contexts, the Chinese TDEQ-5 can ~~allow~~ provide researchers a mechanism by which to investigate TD systems within a Chinese speaking context. In line with previous research, some examples could include investigating the relationship between key features of the environment and athlete progression (e.g., Martindale et al., 2013), stress and wellbeing (e.g., Ivarsson et al., 2015) and motivational orientations (e.g., Wang et al., 2011~~; Wang et al.~~, 2016); and examine the nature or perceived strengths and weaknesses of sport academies (e.g., Mills et al., 2014). ~~Finally, given the accepted complexity and culturally specific nature of TD environments, more work investigating this and the validity of the TDEQ seems a useful avenue for development.~~

Conclusions

This research provides initial evidence of concurrent validity and test-retest reliability for the TDEQ-5 with Chinese youth talented athletes. The Chinese translated TDEQ-5 shows adequate factorial validity, discriminant validity, and internal reliability. It is therefore recommended that the scale can be used with confidence in both applied and research settings in China.

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Table 1

Descriptive Statistics, Reliability, and Correlations among Five Factors across Samples (Sample 1 = 270, Sample 2 = 268)

	CR	α	*M*	*SD*	1. LTF	2. AOE	3. COM	4. HQP	5. SN
1. LTF	.70/.69	.69/.66	4.52/4.55	0.73/0.65	—	.76**/.71**	.79**/.67**	.29**/.26**	.63**/.62**
2. AOE	.77/.79	.77/.78	4.31/4.33	0.80/0.79	.57**/.50**	—	.83**/.80**	.35**/.25**	.68**/.63**
3. COM	.86/.80	.85/.80	4.61/4.62	0.91/0.83	.61**/.46**	.67**/.63**	—	.38**/.35**	.70**/.59**
4. HQP	.88/.89	.88/.89	4.00/3.97	1.01/0.99	.20**/.21**	.28**/.21**	.34**/.30**	—	.20*/.20*
5. SN	.75/.76	.81/.79	4.02/4.04	0.91/0.87	.45**/.46**	.53**/.48**	.56**/.44**	.19**/.15*	—

Note. ** $p < .01$, * $p < .05$. CR = composite reliability, LTF = long-term development focus, AOE = alignment of expectations, COM = communication, HQP = holistic quality preparation, SN = support network. The latent factor correlations are presented above the diagonal, and the zero-order correlations are presented below the diagonal. Values for sample 1 are presented on the left-hand side, and statistics for sample 2 are presented on the right-hand side.

Table 2

Descriptive Statistics, Reliability, and Correlations among Studied Variables (n = 538)

	CR	α	*M* (*SD*)	1. LTF	2. AOE	3. COM	4. HQP	5. SN	6. Autonomy	7.Competence	8. Relatedness
1. LTF	.67	.68	4.54 (0.69)	—	.74**	.73**	.29**	.63**	.58**	.61**	.61**
2. AOE	.80	.78	4.32 (0.79)	.54**	—	.82**	.30**	.66**	.59**	.59**	.52**
3. COM	.83	.83	4.62 (0.87)	.54**	.65**	—	.36**	.65**	.49**	.49**	.45**
4. HQP	.88	.89	3.99 (1.00)	.21**	.25**	.32**	—	.20*	.30**	.30**	.38**
5. SN	.75	.75	4.03 (0.89)	.45**	.50**	.50**	.17**	—	.50**	.50**	.41**
6. Autonomy	.84	.83	5.08 (1.04)	.43**	.47**	.41**	.26**	.40**	—	.85**	.76**

7. Competence	.85	.85	5.36 (0.93)	.45**	.47**	.39**	.28**	.39**	.72**	—	.82**
8. Relatedness	.82	.82	5.46 (0.91)	.45**	.39**	.35**	.30**	.33**	.66**	.67**	—

Notes. ** $p < .01$, * $p < .05$. CR = composite reliability, LTF = long-term development focus, AOE = alignment of expectations, COM = communication, HQP = holistic quality preparation, SN = support network. The latent factor correlations are presented above the diagonal, and the zero-order correlations are presented below the diagonal.

Table 3

Results of Multiple Group Invariance Test (Males = 222, Females = 310)

	MLMχ^2 (*df*)	CFI	TLI	RMSEA (90% CI)	SRMR	Model comparison	ΔMLMχ^2 (Δdf)	ΔCFI
Model 1: Males	342.08(263)	.961	.956	.037(.025, .047)	.051	—	—	—
Model 2: Females	424.83(263)	.937	.929	.045(.037, .052)	.048	—	—	—
Model 3: Configural invariance	765.38(526)	.948	.941	.041(.035, .048)	.049	—	—	—
Model 4: Metric invariance	788.20(546)	.948	.942	.041(.034, .047)	.052	3 *vs.* 4	22.82 (20)	0
Model 5: Scalar invariance	837.53(571)	.942	.939	.042(.036, .048)	.055	3 *vs.* 5	72.95(45)**	.006

Notes. ** $p < .01$. MLMχ^2 = Satorra-Bentler scale chi-square, *df* = degree of freedom, CFI = comparative fit index, TLI = Tucker-Lewis index, RMSEA = root mean square error of approximation, SRMR = standardised root mean square residual, CI = confidence interval.

Appendix 1

The Five-Factor Talent Development Environment Questionnaire Factors and Items

Item Content	Coding
1. My training is specifically designed to help me develop effectively in the long term. 1. 我的训练是经过专门设计的，有助于我长远的发展或未来的成功。	LTF1
2. My coach ~~emphasizes~~ emphasises that what I do in training and competition is far more important than winning. 2. 教练强调训练和比赛中所学的东西，比赢得比赛更重要。	LTF 2
3. I spend most of my time developing skills and attributes that my coach tells me I will need if I am to compete successfully at the top/professional level. 3. 我把大部分时间花在发展那些教练认为会决定我将来成败的运动技巧和素质上。	LTF 3
4. My coach allows me to learn through making my own mistakes. 4. 教练允许我从自身的错误中学习来帮助我长远的发展。	LTF 4
5. I would be given good opportunities even if I experienced a dip in performance. 5. 即使我处在运动表现的低潮期，我仍会得到一些好的锻炼机会（比如：比赛或训练）。	LTF 5
6. My coaches make time to talk to my parents about me and what I am trying to achieve. 6. 教练安排出时间和我的父母交流，让他们了解我的现状和我想实现的目标。	AOE1
7. The advice my parents give me fits well with the advice I get from my coaches. 7. 关于目标，我的父母与教练给出的建议差不多。	AOE2
8. My progress and personal performance is reviewed regularly on an individual basis. 8. 我个人的进步情况和表现会被定期地从查看。	AOE3
9. I am involved in most decisions about my sport development. 9. 我会参与到有关我运动发展的大部分决策中（比如：设定近期训练目标）。	AOE4
10. I regularly set goals with my coach that are specific to my individual development. 10. 我会定期和教练一起设定我的个人发展目标。	AOE5
11. My coach and I regularly talk about things I need to do to progress to the top level in my sport (e.g. training ethos, competition performances, physically, mentally, technically, tactically). 11. 教练和我会定期討論我发展成为优秀运动员所需要做的事（比如：精神面貌，比赛表现，身体状态，心理，技战术）。	COM1

12. My coach and I talk about what current and/or past world-class performers did to be successful. 12. 教练和我会讨论现役或退役的优秀运动员是如何取得成功的。	COM2
13. My coach and I often try to identify what my next big test will be before it happens. 13. 教练和我经常会尝试确认即将到来的重大考验（比如：大赛，改技术）。	COM3
14. My coach explains how my training and competition programme work together to help me develop. 14. 教练会向我解释训练和比赛是如何共同帮助我进步的。	COM4
15. My coach rarely talks to me about my well-being. (R) 15. 教练很少和我谈到我是否开心。	HQP1
16. My coach doesn't appear to be that interested in my life outside of sport.(R) 16. 教练对我运动训练之外的生活没什么兴趣。	HQP2
17. My coach rarely takes the time to talk to other coaches who work with me.(R) 17. 教练很少花时间去和其他帮助我的教练们交流。	HQP3
18. I don't get much help to develop my mental toughness in sport effectively. 18. 我在发展意志力方面并没有得到太多的帮助。	HQP4
19. I am rarely encouraged to plan for how I would deal with things that might go wrong. (R) 19. 我很少被鼓励去计划如何处理一些可能会出问题的事（比如：生活上的问题）。	HQP5
20. The guidelines in my sport regarding what I need to do to progress are not very clear. (R) 20. 关于我需要做什么才能在运动中取得进步的指导方针并不是很清楚。	HQP6
21. I am not taught that much about how to balance training, competing, and recovery. (R) 21. 我并没有学到很多关于如何去平衡训练、比赛和恢复三者之间的关系。	HQP7
22. Currently, I have access to a variety of different types of professionals to help my sports development (e.g. physiotherapist, sport psychologist, strength trainer, nutritionist, lifestyle advisor). 22. 我现在可以从不同的专业人员（比如：理疗师，心理咨询师等）那获得帮助。	SN1
23. I can pop in to see my coach or other support staff whenever I need to (e.g. physiotherapist, psychologist, strength trainer, nutritionist, lifestyle advisor). 23.当有需要时，我可以见到我的教练或者其他专业人员（比如：理疗师，心理咨询师等）。	SN2
24. My coaches talk regularly to the other people who support me in my sport about what I am trying to achieve (e.g. physiotherapist, sport psychologist, nutritionist, strength and conditioning coach, lifestyle advisor). 24. 我的教练定期和其他专业人员讨论我想实现的目标。	SN3

25. Those who help me in my sport seem to be on the same wavelength as each other when it comes to what is best for me (e.g. coaches, physiotherapists, sport psychologists, strength trainers, nutritionists, lifestyle advisors). 25. 当涉及到什么最适合我时，那些专业人员之间的观点基本一致。	SN4

Notes. LTF = long-term development focus, AOE = alignment of expectations, COM = communication, HQP = holistic quality preparation, SN = support network, (R) = reversely coded item.