# Relationships between Talent Development Environments and Mental Toughness: The Role of Basic Psychological Need Satisfaction

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**Abstract**

Although the talent development environment and mental toughness are critical for athletes to realise their athletic potential, there is a dearth of literature on whether the talent development environment can enhance mental toughness among those athletes who are identified with athletic potential (i.e., talented athletes). Drawing on self-determination theory (Deci & Ryan, 2000), this research examined the relationships between the talent development environment, basic psychological needs satisfaction, and mental toughness. Talented athletes ($n$ = 261) completed a survey measuring key features of the talent development environment, needs satisfaction, and mental toughness. The results of structural equation modeling indicated that three environmental factors (i.e., long-term development focus, holistic quality preparation, and communication) were positive predictors of needs satisfaction, which then positively predicted mental toughness. The talent development environment may be considered for promoting talented athletes' mental toughness.

## Introduction

The number of excellent performers produced or medals harvested in international competitions is a key indicator of sporting success. In the pursuit of sporting success, many sports organisations around the world have invested considerable resources in developing talented athletes (Baker & Schorer, 2010). Governing bodies often have detailed plans with regards to the development of these athletes. These *talent development* processes attempt to prepare talented athletes for excellent performance through a series of progressive stages, training, and practice (Vaeyens, Lenoir, Williams, & Philippaerts, 2008). However, it is clear that developing a talented athlete into an excellent performer may take more than ten years (Ericsson, 2007), as such it is important that athletes have the mental ability to commit and progress through the many challenges that are inevitable on the route to the top (Collins & MacNamara, 2012). In line with this, two concepts that are related to long-term athlete progression have received increasing attention in academia recently: talent development environment and mental toughness (Bailey et al., 2011; Mahoney, Gucciardi, Ntoumanis, & Mallett, 2014).

## Talent development environment

The term *talent development environment* refers to all aspects of the coaching contexts (e.g., training programmes developed and delivered by coaches) that affect sports development of athletes with athletic potential (Henriksen, Stambulova, & Roessler, 2010; Martindale, Collins, & Daubney, 2005). Talented athletes are required to acquire key attributes through training programmes while adapting to numerous environmental constraints for progressing and performing optimally in their sport (Phillips, Davids, Renshaw, & Portus, 2010). This highlights the critical

role effective talent development environments play in positive athletic development (Li, Wang, & Pyun, 2014).

Given the importance of environmental factors and the large number of factors that have emerged across a range of research over the years, Martindale and colleagues (2005) attempted to collate the key environmental factors that consistently emerged for effective talent development through an extensive literature review. This work formed the groundwork for the development and validation of the Talent Development Environment Questionnaire (TDEQ; Martindale et al., 2010), a tool that enabled athlete perception of key elements of talent development environment to be measured. Following this work, a comprehensive validation study was conducted to examine the psychometric properties of the TDEQ, leading to a revised tool (i.e., TDEQ-5) with sound reliability and validity (Li, Wang, Pyun, & Martindale, 2015; Li, Martindale, Wu, & Si, 2018). The TDEQ-5 measured five factors associated with effective development environments, including long-term development focus (i.e., designed programmes focus on facilitating athletes' long-term success such as providing fundamental training and ongoing opportunities), alignment of expectations (i.e., goals for athletic development are set, reviewed and aligned among different parties such as coaches and parents), communication (i.e., effective coach-athlete communications on areas such as development path and rationale for training in different settings), holistic quality preparation (i.e., development programmes are holistically prepared both inside and outside of sports such as clear coaching guidance, psychological training, and balanced life), and support network (i.e., a systematic network for supporting athletes in different areas such as sports development and schools; Li et al., 2015).

With the emergence of the TDEQ, researchers have begun to investigate talent development environments through quantitative methodology. For example, Martindale, Collins, Douglas, and Whike (2013) found that rugby players and swimmers who were trained under high quality talent development environments were likely to progress to elite status. Mills, Butt, and Maynard (2014) have used the TDEQ as a tool to review environments of UK football academies and they suggested the need to build a strong environment at the academies. A number of researchers have investigated the role of the environment on motivational characteristics of developing athletes (e.g., Wang et al., 2011; Wang, Pyun, Li, & Lee, 2016). Furthermore, work examining the role of the environment on the stress, wellbeing, and burnout of athletes has also been conducted (e.g., Ivarsson, Stenling, Fallby, Johnson, Borg, & Johansson, 2015; Li, Wang, & Pyun, 2017a). The predictive utility of the talent development environmental factors was generally evidenced among these studies. An additional outcome that may be associated with talent development environments, but that has received minimal attention in the research literature is mental toughness.

**Environmental factors and mental toughness**

A recent working definition that is based on a comprehensive synthesis of the literature defines *mental toughness* as "a personal capacity to produce consistently high levels of subjective or objective performance despite everyday challenges and stressors as well as significant adversities" (Gucciardi, Hanton, Gordon, Mallett, & Temby, 2015, p.28). As mental toughness is a critical personal capacity for athletes to survive and thrive in demanding situations (Weinberg, Butt, & Culp, 2011), researchers have invested considerable efforts in studying this concept. One of the research lines that has received increasing attention is to study the predictors of

mental toughness (e.g., Cook, Crust, Littlewood, Nesti, & Allen-Collinson, 2014; Mahoney, Gucciardi, Mallett, & Ntoumanis, 2014). The social contexts, immediate settings in which people live, are believed to shape one's development (Bronfenbrenner, 2005). Accordingly, social contexts such as the talent development environmental factors, where athletes are situated may affect their development of mental toughness (Weinberg et al., 2011).

Many researchers suggested that the development of mental toughness is subject to environmental influence such as training programme and social support (e.g., Crust & Clough, 2011; Gucciardi, Gordon, Dimmock, & Mallett, 2009). Early research interviewing coaches, support staff, and adolescent athletes has identified many predictors of mental toughness such as enhancing a positive coach-athlete relationship, fostering independence, offering coping resources, providing intense competitive practices, and advancing problem-solving skills (Cook et al., 2014; Gucciardi et al., 2009; Mahoney, Gucciardi, Mallett et al., 2014). These predictors show similarities inherent within the characteristics of effective talent development environments. For example, a long-term development focus is likely to require athletes to take responsibility for their own development progressively (i.e., independence). Support network focuses on offering athletes sports science, parental, and school support to cope with challenges (i.e., coping resources). Part of holistic quality preparation requires challenging training tasks and competitions, and also focuses on athletes' capacity to cope with challenges and adversities inside and outside of sport (i.e., intense practices and problem-solving skills; Li et al., 2015). Thus, it is quite likely that effective talent development environments will positively predict, and indeed facilitate mental toughness.

**Conceptualisation of the environment-mental toughness link**

Although it is not new to investigate predictors of mental toughness (e.g., Connaughton, Wadey, Hanton, & Jones, 2008; Gucciardi et al., 2009), little research has been carried out and guided by a theoretical framework (Mahoney, Gucciardi, Ntoumanis et al., 2014). Self-determination theory (SDT; Deci & Ryan), a meta-theory of motivation and personality, was recently proposed as a promising theory for understanding the development of mental toughness (see Mahoney, Ntoumanis, Mallett, & Gucciardi, 2014). SDT consists of six mini-theories and basic psychological need theory (BPNT) is the one that is particularly apt for the present study (Deci & Ryan, 2002).

According to BPNT (Deci & Ryan, 2000), human beings have three basic psychological needs: *autonomy* (the need to experience ownership of one's own actions and choices), *competence* (the need to feel adequate and capable of doing optimally challenging activities and achieving desired outcomes), and *relatedness* (the need to have a sense of belonging and mutual respect for others). BPNT maintains that social environmental factors can facilitate the satisfaction of the three basic psychological needs (Deci & Ryan, 2000). Recent cross-sectional and diary studies have supported the positive role of social environments (e.g., coaches' provision of choices and parents' emotional support) in fostering needs satisfaction in sport among young and adult athletes (Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011; Gaudreau et al., 2016). Given the evidence, it would seem likely that for successful development to occur, talented athletes' three basic psychological needs would be enhanced by their environmental experiences. For example, elements of successful talent development environments include the de-emphasis of winning, promotion of self-growth, provision of personnel support, rationale for training, and establishment of goals (Martindale et al., 2010). According

to Deci and Ryan (2000), very similar environmental factors will nourish athletes' three basic psychological needs. For example, providing rationale for training and focusing on self-referenced improvement is likely to build an athlete's autonomy and competence, respectively (Deci & Ryan). One cross-sectional study of talented young athletes in Singapore supports this contention, in which three out of the five effective talent development environmental factors (i.e., long-term development focus, communication, and holistic quality preparation) were positively related to needs satisfaction (Li, Wang, & Pyun, 2017b).

BPNT also posits that on going satisfaction of one's basic psychological needs will bring him/her positive consequences to functional outcomes including behavioural, cognitive and affective factors (Deci & Ryan, 2000). The quantity and quality of a psychological outcome (e.g., mental toughness) is contingent on the degree to which needs satisfaction is nurtured. Both field-based experiments and prospective surveys have shown that need satisfaction is positively related to athletes' sports performance and number of Olympic medals harvested (e.g., Cheon, Reeve, Lee, & Lee, 2015; Gaudreau et al., 2016). In addition, Mahoney, Gucciardi, Ntoumanis et al.'s (2014) cross-sectional survey provides the first piece of evidence on that needs satisfaction is positively related to mental toughness among adolescent runners. As explained by these authors (2014), it might be because needs satisfaction facilitates one's senses of personal control and self-efficacy (key facets of mental toughness), which subsequently leads to an increase in mental toughness level.

Within BPNT (Deci & Ryan, 2000), social contexts or environmental factors are expected to influence the three basic psychological needs, which will in turn lead to a host of functional consequences such as mental toughness (i.e., environmental factors → needs satisfaction → consequences). This tenet has received some

empirical support among cross-sectional and diary studies with adolescent and adult athletes (e.g., Bartholomew et al., 2011; Mahoney, Gucciardi, Ntoumanis et al., 2014). Accordingly, it is expected that needs satisfaction will have an indirect effect in the relationship between the talent development environment and mental toughness. Yet, their relationships have not been examined through the lens of BPNT.

**The present research**

In summary, while the talent development environmental factors and mental toughness are central psychological constructs for effective talent development (Li et al., 2014; Gould, Dieffenbach, & Moffett, 2002), their link is still unknown among talented athletes. Moreover, little research guided by a theoretical framework (e.g., BPNT) has been done to investigate the predictors of mental toughness (Mahoney, Gucciardi, Ntoumanis et al., 2014). Answering these research questions may give practitioners insight on how to develop mental toughness during the talent development process. From theoretical perspectives, researchers will be able to bridge relevant literature gaps, and understand the underlying mechanisms between the environment-mental toughness link and the usefulness of the BPNT in the talent development context. Guided by the BPNT, this cross-sectional study therefore aims to explore the relationships between the effective talent development environmental factors, needs satisfaction, and mental toughness among talented athletes. Specifically, the model depicted in Figure 1 will be tested. According to the literature articulated above, it is hypothesised that the five talent development environmental factors are positively associated with needs satisfaction (Hypothesis 1; Li et al., 2017b). It is also expected that needs satisfaction will be positively related to mental toughness (Hypothesis 2; Mahoney, Gucciardi, Ntoumanis et al.,

2014). Finally, we hypothesised that needs satisfaction will mediate the relationships between the talent development environmental factors and mental toughness (Hypothesis 3; Bartholomew et al., 2011; Wang et al., 2016).

****Figure 1 near here****

## Methods

### Participants

Participants were, at the time of data collection, selected and active participants in talent development programmes of the Chinese sports institute. As such their athletic potential to develop into an excellent performer in a specific sport had been identified and they had been selected to receive specific support to facilitate their development in an elite sport development pathway. General practice for the selection of athletes into the Chinese sports institute talent development programmes involves a consideration of coach opinion and athlete performance on various physical test batteries. We subsequently defined these athletes as “talented athletes”. The participants were 261 talented young athletes (male = 96, female = 156, missing = 9) from China. They were recruited from 17 different individual and team sports such as badminton, fencing, swimming, table tennis, and volleyball (individual sport = 186, team sport = 60, missing = 15). They had participated in their sport for 4.67 (*SD* = 2.65) years and their age ranged from 13 to 21 years (*M* = 18.69, *SD* = 1.64). On average, they trained 5.89 sessions per week (*SD* = 3.18) with each training session lasted for 2 hours (*SD* = 0.82). All of them competed at either national or international levels.

### Measures

A range of demographic items (i.e., age, gender, sport, years of sports participation, number of training sessions/week, and training hours/session) and three established scales were used.

***Talent Development Environment***

The Chinese version of the Talent Development Environment Questionnaire (TDEQ-5; Li et al., 2015; Li et al., 2018) was used for measuring the talent development environmental factors. The reliability and validity of TDEQ-5 was evident with talented young athletes (see Li et al., 2015, 2018). The TDEQ-5 consisted of 25 items measuring the five effective environmental factors: long-term development focus (5 items; e.g., "I would be given good opportunities even if I experienced a dip in performance"), alignment of expectations (5 items; e.g., "The advice my parents give me fits well with the advice I get from my coaches"), communication (4 items; e.g., "My coach and I often try to identify what my next big test will be before it happens"), holistic quality preparation (7 items; e.g., "I don't get much help to develop my mental toughness in sport effectively"), and support network (4 items; e.g., "Currently, I have access to a variety of different types of professionals to help my sports development"). A 6-point Likert scale was used for item responses (1 = *strongly disagree*, 6 = *strongly agree*). Mean subscale scores were used for subsequent analyses.

***Need Satisfaction***

The Chinese version of the Basic Needs Satisfaction in Sport Scale (Ng, Lonsdale, & Hodge, 2011) were applied for assessing participants' needs satisfaction in sport. Evidence of reliability and construct validity of this scale was established in university and talented young athletes (see Ng et al., 2011; Li et al., 2015). The scale consisted of 15 items tapping into three basic psychological needs, including

autonomy (5 items; e.g., “In my sport, I get opportunities to make decisions”), competence (5 items; e.g., “I feel I am good at my sport”), and relatedness (5 items; e.g., “I have close relationships with people in my sport”). Participants were asked to refer to their sports participation experience when responding to the scale with a 7-point Likert scale of 1 (*not true at all*) to 7 (*very true*). For the sake of model parsimony, a need composite (an overall composite score of the three subscale scores) rather than individual constructs was used for testing the model depicted in Figure 1 (Bollen, 1989). For those who are interested to examine the role of each subscale score in the model, data are available from the first author upon request.

***Mental toughness***

The eight-item Chinese version of the Mental Toughness Index (MTI; Gucciardi et al., 2015; Li, Zhang, & Zhang, 2017) were used to measure participants’ mental toughness. The scale has received psychometric support from youth elite athletes (see Li, Zhang et al., 2017). The MTI is a unidimensional scale measuring eight facets of mental toughness such as emotion regulation, buoyancy, optimistic style, and self-belief (see Gucciardi, Mallett, Hanrahan, & Gordon, 2011). A sample item is “I can find a positive in most situations”. Participants responded to each item on a 7-point scale (1 = *false, 100% of the time*, 7 = *true, 100% of the time*). A mean scale score was calculated for subsequent analyses.

**Procedure**

Ethics approval was obtained from the Human Research Ethics Committee of The Education University of Hong Kong. Invitation letters to participate in the survey were sent to participants via their head coaches during a China national youth sports competition. Upon receiving their agreements, informed consent was obtained from both guardians and athletes before the survey. Research assistants then administered

the survey form to participants in a quiet meeting room. Coaches assisted with the data collection to ensure participants took the research seriously. Participants were encouraged to complete the questionnaire honestly. It took participants approximately 15 minutes to complete the survey.

**Data analysis**

Negatively worded items were reversely coded before data analyses. As the percentage of missing data for each item ranged from 0% to 3.4%, the missing data were imputed using Expectation-Maximization algorithm (Little, 1988). A few univariate outliers ($n$ = 18) that had an absolute value of $Z$ score greater than 3.29 were recoded into the nearest raw score (Hair, Black, Babin, & Anderson, 2010). The data were univariate normally distributed (skewness = -0.84 to 0.21, kurtosis = -0.83 to 0.96). Means, standard deviations, Cronbach's alpha (α) reliability, and zero-order correlations among study variables were calculated. One-way multivariate analysis of variance (MANOVA) was used to determine whether there were gender or sport differences on talent development environmental factors, needs satisfaction, and mental toughness. The aforementioned analyses were conducted using SPSS 21 (IBM, Armonk, NY, USA).

Full structural equation modeling was conducted to test the proposed model depicted in Figure 1 and Hypotheses 1-2. The robust maximum likelihood estimation procedure was used (i.e., MLM), which has been found to generate reliable parameter estimates in the presence of multivariate non-normality (Mardia's multivariate kurtosis = 10.21; Bollen, 1989). To test Hypothesis 3, mediation analyses with bootstrapping approach (5,000 samples) were applied to generate bias-corrected confidence intervals. A 95% confidence interval (CI) that does not include zero indicates a significantly indirect effect (Preacher & Hayes, 2008). To determine

the model fit, four fit indices were used: Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). Traditionally, values higher than .90 for CFI and TLI as well as values below .08 for the RMSEA and the SRMR indicate an acceptable fit (Kline, 2005). *M*plus 7.0 (Muthén & Muthén, 1998-2012) was used for conducting the structural equation modeling.

## Results

Table 1 presents descriptive statistics, internal reliability, and zero-order correlations among study variables. The participants reported a moderate to high level of talent development environmental factors (*M*s = 3.73 to 4.29, *SD*s = 0.77 to 0.96) as well as a relatively high level of needs satisfaction (*M* = 5.16, *SD* = 0.85) and mental toughness (*M* = 5.26, *SD* = 0.90). The used scales showed adequate to excellent internal reliability (αs = .71 to .91) with an exception that the internal reliability of long-term development focus (α = .69) was slightly below the traditional cut-off (α = .70; Hair et al., 2010). Three demographic items (i.e., age, training session/week, and training hour/session) had negative associations with some of the scale variables (see Table 1), which were entered as co-variates in structural equation modeling. The results of one-way MANOVA showed that there were no gender (Wilk's Lambda = 0.97, $F[7, 244] = 1.02$, $p = 0.42$) and sport differences (Wilk's Lambda = 0.95, $F[7, 238] = 1.63$, $p = 0.13$) on the talent development environmental factors, needs satisfaction, and mental toughness.

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

The hypothesised model fit the data adequately: MLM$\chi^2$ (576) = 844.46, $p < .01$, CFI = .92, TLI = .91, RMSEA = .042 90%CI [.036, .048], SRMR = .065. Figure 1 shows the standardised parameter estimates. Long-term development focus (β =

.29, $p < .01$), communication ($\beta = .22$, $p < .01$), and holistic quality preparation ($\beta = .12$, $p < .01$) were found to positively predict needs satisfaction. However, alignment of expectations ($\beta = -.23$, $p = .22$) and support network ($\beta = -.01$, $p = .86$) were not significant predictors. Thus, Hypothesis 1 was partially supported. The five talent development environmental factors explained 45.1% of the total variance in needs satisfaction, which was considered as a large effect (Cohen, 1992). Hypothesis 2 was supported in that needs satisfaction positively predicted mental toughness ($\beta = .75$, $p < .01$). Table 2 lists the results of indirect effects of the five talent development environmental factors on mental toughness via needs satisfaction. Needs satisfaction was a mediator in the relationships between long-term development focus/holistic quality preparation and mental toughness. However, needs satisfaction did not mediate the relationships between alignment of expectations/communication/support network and mental toughness. These findings supported Hypothesis 3. According to Cohen (1992), predictors in the model explained large variance (56.5%) in mental toughness.

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

## Discussion

### Overview of results

This is the first research, to the best of our knowledge, to explore the relationships between key talent development environmental factors, needs satisfaction, and mental toughness among talented youth athletes. The results supported the predictive role of a long-term development focus, communication, and holistic quality preparation for needs satisfaction of athletes. Interestingly, alignment of expectations and support network were not significant predictors. Needs satisfaction was found to predict mental toughness and acted as a mediating variable between two features of

the environment, namely long-term development and holistic quality preparation and mental toughness.

**The contribution of the talent development environment**

Understanding which elements of the environment may be most relevant to successful development is an important step towards effective talent development. In line with the cross-sectional survey study conducted in the Singapore context (Li et al., 2017b), our results also revealed the same three environmental factors positively predicted needs satisfaction. This finding means that athletes who perceive high levels of these three environmental factors tend to have high levels of needs satisfaction. The three environmental factors show that important features of the environment relate to a clear long-term drive and process focus, a recognition of mistakes as a developmental necessity, and the de-emphasis of the pressure for short-term outcome success. They also highlight the importance of developing athletes' understanding of *how* to reach the top through understanding and planning for future challenges in a holistic way. Finally, these features emphasise the need to develop athletes' capability to reach the top through the facilitation of mental skills development and wellbeing.

In line with the definitions within BPNT (Deci & Ryan, 2000), these important environmental features would be expected to predict participants' autonomy (e.g., offering opportunities to make mistakes), competence (e.g., building capacities to face future challenges), and relatedness (e.g., building a close relationship through regular communications). This point is reinforced by the fact that when considered as a whole, these three features of the talent development environment have some overlap with features of autonomy-supportive and task-involving climates, which have shown robust links to needs satisfaction (Amorose &

Anderson-Butcher, 2007; Hodge, Henry & Smith, 2014). For example, autonomy-supportive environments and task orientated motivational climates also emphasise learning and process rather than outcome focus. They facilitate understanding and provide choices and opportunities for athletes to take initiative and act independently. They also emphasise an interest in athletes' feelings. However, importantly, the TDEQ measures key environmental factors that have been linked specifically to successful athletic talent development. While some items share features that are similar to motivational and/or autonomy supportive climate literature, there are clear and important distinctions. For example, the TDEQ focusses on the influence of the broader environment (e.g., coaches, support staff, peers, parents, educational institutions, competition, recovery, etc.), the recognition of the need for clear long-term development aims, for tangible skill development (e.g., psychological skills) and understanding and planning for future challenge. Therefore, it is suggested that researchers consider additional facets of the social environment such as talent development environments in addition to autonomy-supportive and task-involving climates in future work.

It is interesting that no relationship was apparent with support network or alignment of expectations and needs satisfaction. Between them, these environmental factors measure the extent to which there is an accessible, wide-ranging support network available to the athlete, and a particular focus on individualised development and parental involvement. This may suggest that the clarity of an environment's philosophy for long-term development (as opposed to short-term success) with an explicit focus on *how* the athlete negotiates this "long-term" pathway, and the development of skills that will help facilitate this process is more important, than the amount of support that is available or the relevance of

parental input. Indeed, research has shown that parents' role in the talent development process often relates more to emotional and/or functional support over time and "advice" from parents is perhaps less significant for athletes who are part of a talent pathway, where coaching expertise is available (Côté, 1999). While research has shown (perceived) support to be linked to positive outcomes, it may be that the skills or attitudes of the athlete to utilise the support that are most important for needs satisfaction fulfilment (Van Yperen, 2009).

**The mediating role of needs satisfaction**

The finding that the satisfaction of basic psychological needs acts as a mediator of the environmental influence on mental toughness development is generally pertinent within the recent studies that needs satisfaction mediated the relationship between social environments and outcomes (e.g., Bartholomew et al., 2011; Gaudreau et al., 2016). However, it is interesting, that only the impacts of long-term development and holistic quality preparation were mediated by needs satisfaction in this regard. While communication was associated with the satisfaction of basic psychological needs, its role in predicting mental toughness through needs satisfaction was not significant. It may well be that needs satisfaction mediates the impact of environmental features on mental toughness for those factors that are associated with athlete behaviour, not just features of communication. For example, items within the long-term development and holistic quality preparation factors often related to the athlete being encouraged to "plan", "develop", "learn", "do", or "work", whereas items in the communication factor relate to the coach "talking", "explaining", or "identifying". As such, it would be a reasonable assumption that an athlete with higher perceived competence for example, may engage better or interpret the outcomes of their behaviour more positively, which may result in more

effective mental toughness development.

Indeed, understanding that basic psychological needs satisfaction may mediate the experience or challenges presented in the environment is supported by research. For example, Yeung, Lu, Wong and Huynh (2016) highlight that needs satisfaction can act as a proxy for coping resources and how satisfied someone is with those resources. Relatedness may show how satisfied someone is with his or her social network; competence may be related to self-efficacy and autonomy related to control. Indeed, even after extreme or traumatic experiences factors such as control, self-esteem, self-efficacy, social support satisfaction and closeness have all been shown to be related to growth outcomes (Linley & Jospeh, 2004). Furthermore, there is some support for the role of needs satisfaction in predicting cognitive appraisal, whereby those with their needs met are more likely to appraise a situation as challenging (rather than threatening), and have a higher perception of control, resourcefulness and connectedness (Ntoumanis, Edmunds, & Duda, 2009; Quested Bosch, Burns, Cumming, Ntoumanis, & Duda, 2011). This highlights how needs satisfaction may help athletes negotiate the challenges within their talent development pathway, helping them to develop the mental toughness characteristics required. Furthermore, in line with the cross-sectional survey with 221 school cross-country runners ($\beta = .59$; Mahoney, Gucciardi, Ntoumanis et al., 2014), needs satisfaction was a strong predictor of mental toughness ($\beta = .75$) in the present study. This finding suggests the significant role of needs satisfaction on the development of mental toughness.

**Summary and limitations**

In summary, this research suggests that talent development environments that focus on long-term development, communication and holistic quality preparation are

associated with the needs satisfaction of athletes. Needs satisfaction was found to predict mental toughness and acted as a mediating variable between long-term development, holistic quality preparation and mental toughness. This supports the contention that talent development experiences, and the challenges associated with them, may not be a direct causative driver of development (e.g., Collins & Macnamara, 2012), but may be mediated by the level of basic psychological needs satisfaction, which support the development experience. As such, the way in which talent development environments prepare and challenge athletes needs to be nuanced and carefully considered.

In relation to limitations, it is important to note that only 45.1% of the variance of needs satisfaction was accounted for by the five talent development environment factors measured in this study, with 56.5% of variance in mental toughness accounted for by the model as a whole. There are clearly other factors that are important to the development of mental toughness. Indeed, the characteristics of athletes are influenced significantly by their genetic, upbringing, and other important environments that they are involved with (e.g., Gould et al., 2002). While the psychometric properties and practicality of using the TDEQ-5 in the field has improved with this development, there are a number of important features of the environment that are not measured in the shortened TDEQ-5, including peer influence, role models and educational support (Li et al., 2015). These may be important influences of development and may improve the predictive ability of the model.

Indeed, hierarchical linear modeling should have been used to analyse our data as the participants were clustered at the team level. However, we did not collect our participants' team membership. Furthermore, a cross-sectional survey design

was used so that causal relations between study variables should be interpreted with caution. This design may also inflate the correlations among our study variables (Lindell & Whitney, 2001). For example, although needs satisfaction and mental toughness are theoretically distinguishable constructs (see Deci & Ryan, 2000; Gucciardi et al., 2015), we found a very strong relationship between them. Further longitudinal and experimental research is therefore clearly warranted. Similarly to the study by Ivarsson and colleagues (2015), researchers can examine the predictive ability of the effective talent development environments on athletes' needs satisfaction and mental toughness through a three-wave longitudinal design. Furthermore, the use of qualitative research methodologies (e.g., athlete tracking studies) would enable researchers to glean a deeper understanding of the mechanisms and complexities that mediate the role of the environment on athlete development. Finally, given the culturally specific nature of talent development and the differences between Chinese and Western culture, it is important to be cautious about interpreting the results of this study into different contexts. For example, cultural differences regarding the relationship between teaching climate and needs satisfaction was found between British and Chinese students, whereby the relationship between perceptions of competence and autonomy support was stronger in Chinese students, but the association between relatedness and effort stronger in UK students (Taylor & Lonsdale, 2010). Future research may examine whether the culture differences can affect the magnitudes of the path tested in this present research. Indeed, other populations could usefully be studied to understand how these effects may be mediated across for example, different types of sport, sex, or performance/talent level of the athletes.

## Conclusions

Grounding on BPNT, this research provides initial evidence on the role that the talent development environment may have in developing mental toughness in talented athletes. Features related to long-term development, holistic quality preparation and communication seem to be particularly important for basic psychological needs satisfaction. Basic psychological needs satisfaction were shown to mediate the role of long-term development and holistic quality preparation on mental toughness, and as such the nature of the talent development environment needs careful consideration, in relation to promoting talented young athletes' mental toughness. In addition, this study demonstrates the usefulness of BPNT as a useful theoretical framework for understanding of how the talent development environmental factors are related to the development of mental toughness.

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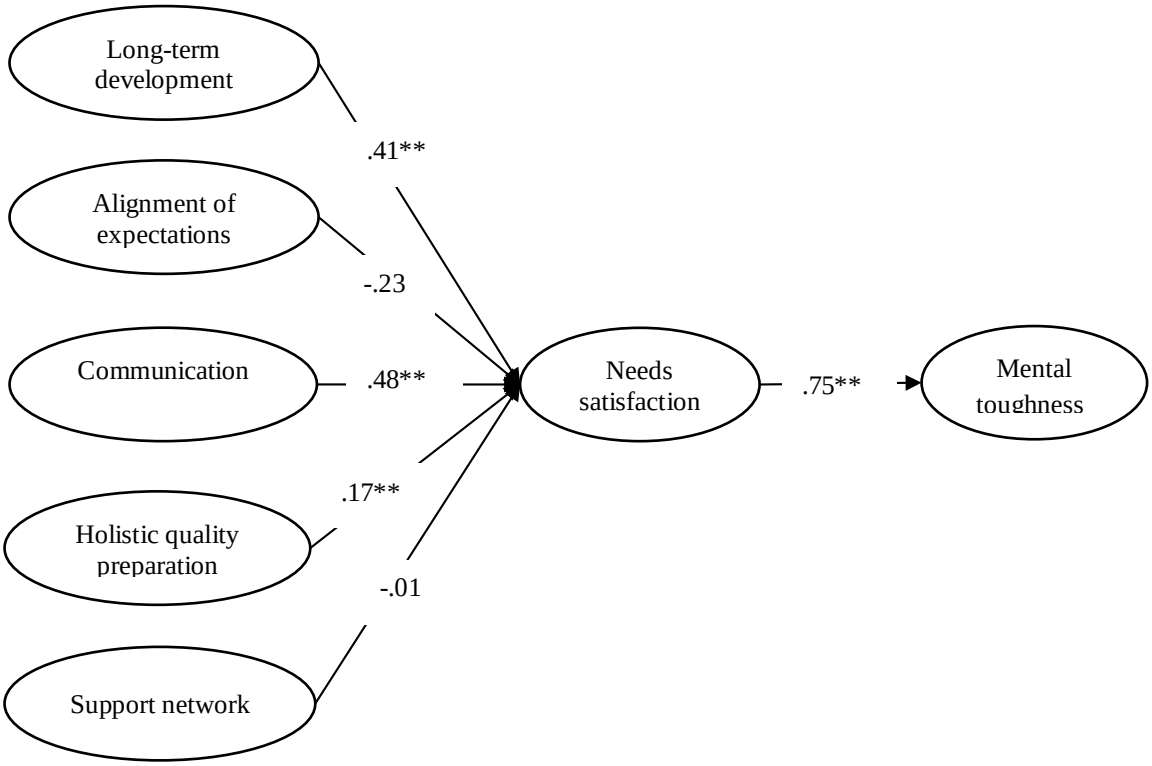


*Figure 1.* Relationships among the talent development environmental factors, needs satisfaction and mental toughness. Note. $^{**}p < .01$. For clarity, the co-variates, disturbances, and correlations among the talent development environmental factors are omitted.

Table 1

*Descriptive Statistics, Internal Reliability, and Zero-Order Correlations among Study Variables*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | — | | | | | | | | | | |
| 2. Years of training | -.03 | — | | | | | | | | | |
| 3. Training sessions/week | -.54** | .37** | — | | | | | | | | |
| 4. Training hours/session | -.23** | .30** | .49** | — | | | | | | | |
| 5. Long-term development focus | -.20** | .05 | .10 | -.04 | — | | | | | | |
| 6. Alignment of expectations | -.14* | .03 | .09 | .02 | .51** | — | | | | | |
| 7. Communication | -.15* | .01 | .05 | -.02 | .48** | .67** | — | | | | |
| 8. Holistic quality preparation | .06 | -.08 | -.15* | -.20** | .07 | .02 | .19** | — | | | |
| 9. Support network | -.03 | -.02 | .07 | -.04 | .33** | .46** | .47** | .07 | — | | |
| 10. Needs satisfaction | .06 | .03 | -.09 | -.16* | .44** | .36** | .44** | .22** | .31** | — | |
| 11. Mental toughness | .05 | .08 | -.10 | -.08 | .33** | .31** | .37** | .23** | .19** | .66** | — |
| *M* | 18.69 | 4.67 | 5.89 | 2.00 | 4.18 | 4.09 | 4.29 | 3.76 | 3.73 | 5.16 | 5.26 |
| SD | 1.64 | 2.65 | 3.18 | 0.83 | 0.77 | 0.90 | 0.94 | 0.96 | 0.90 | 0.85 | 0.90 |
| α | — | — | — | — | .69 | .76 | .78 | .84 | .71 | .91 | .90 |

Note. ** $p < .01$, * $p < .05$.

Table 2

*Results of Standardised Indirect Effects*

| Specific indirect effects | Point estimates | 95%CI |
|---|---|---|
| 1. Long-term development focus → needs satisfaction → mental toughness | .31* | [.07, .54] |
| 2. Alignment of expectations → needs satisfaction → mental toughness | -.17 | [-.81, .47] |
| 3. Communication → needs satisfaction → mental toughness | .36 | [-.23, .96] |
| 4. Holistic quality preparation → needs satisfaction → mental toughness | .12* | [.01, .25] |
| 5. Support network → needs satisfaction → mental toughness | -.01 | [-.19, .17] |

Note. * $p < .05$.