Higher-order structure of mental toughness and the analysis of latent mean differences between athletes from 34 disciplines and non-athletes

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ABSTRACT

The aim of this study was to investigate the higher-order structure of mental toughness and to examine differences in mental toughness between athletes and non-athletes. Participants of this study – 927 athletes and 931 non-athletes – completed a battery of questionnaires designed to assess four characteristics of mental toughness: hope, optimism, perseverance and resilience. The higher-order structure of mental toughness was found to be the same for both athletes and non-athletes. The latent mean differences analyses showed that athletes scored higher in mental toughness when compared to non-athletes. Taken together, these findings support the theoretical assumption that mental toughness is a higher-order construct encompassing different characteristics and that sport participation is associated with higher mental toughness.

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1. Introduction

Mental toughness has been defined as "a collection of values, attitudes, emotions, and cognitions that influence the way in which an individual approaches, responds to, and appraises demanding events to consistently achieve his or her goals" (Gucciardi, Gordon, & Dimmock, 2009, p. 54). It is a concept that was developed within the setting of sport psychology and it refers to what we usually call the higher mental abilities of an athlete (Crust, 2008). However, the question of whether athletes differ from non-athletes regarding their mental toughness still needs to be answered.

Gucciardi et al. (2009) suggest that mental toughness is more a function of environment than domains, and as such, mental toughness is potentially important in any environment that requires performance setting, challenges, and adversities, i.e., business, the military, and medicine. Two recent studies examined mental toughness in a non-sport sample (Gerber et al., 2013a, 2013b), however no comparison was made with athletes. In addition, those two studies made the assumption that the structure of mental toughness was similar in athletes and non-athletes without verifying this supposition. In summary, mental toughness has almost exclusively been tested within the sporting domain. This exclusive focus on one population has not only limited our theoretical understanding, but it has also limited the application of mental toughness elsewhere.

With this in mind, it is important to question whether mental toughness should be viewed as a trait, or a constellation of characteristics that are required for high performance. The theoretical answer provided by Gucciardi et al. (2009), which is grounded in personal construct psychology, argues that mental toughness is a phenomenon involving one's interpretation of events, and also the sense that an individual is making of such events rather than a fixed personality trait. As such, mental toughness should be viewed as a constellation of key characteristics that influence the way a person approaches and appraises both the positive and negative events s/he encounters. The effects of these characteristics are seen in the individual's ability to consistently achieve his or her goals. Despite recent conceptual advances (see Gucciardi et al., 2009), one important drawback of the theory supporting mental toughness relates to how the exact relationship between mental toughness and its supposed key characteristics has been determined. To date, this relationship has predominantly either been established by interviews (e.g., Jones, Hanton, & Connaughton, 2002) or by correlating mental toughness inventories with other dimensions (e.g., Nicholls, Polman, Levy, & Backhouse, 2008). As there is still no clear structure for the expected characteristics of mental toughness, the first aim

of this study is to clarify whether mental toughness represents a higher-order construct of several characteristics that are usually associated to it, and whether this structure is consistent between athletes and non-athletes.

Where does mental toughness originate? Mental toughness seems to be strongly linked with the developmental experiences of an individual (Jones & Parker, 2013), and, perhaps more importantly for our study, there are suggestions that sport participation develops mental toughness. This is a view we see revealed in interviews with elite athletes (Thelwell, Such, Weston, Such, & Greenlees, 2010) precisely because sport participation offers challenges, adversity, performance setting, and it requires long-term commitment in order to achieve one's goals. However, once more interviews only provide anecdotal evidence to support this idea. This study aims to address this problem and provide a quantitative perspective on this matter. In addition, we aim to investigate the higher-order structure of mental toughness in relation to the key characteristics that are usually associated to it. Using the theoretical approach of Gucciardi et al. (2009), these characteristics are identified as hope, optimism, perseverance, and resilience. However, as a strong theory that justifies the combination of certain individual constructs into higher-order constructs is one of the bases for establishing a higher-order construct (Johnson, Rosen, Chang, Djurdjevic, & Taing, 2012), a review of each of these characteristics shall be provided in turn, detailing the theoretical arguments that justify their integration into the higher-order construct of mental toughness.

Hope is defined as an expectation of success relative to goals (Snyder et al., 1991). According to Gucciardi's approach to mental toughness, the notion of consistence in goal achievement is a central idea (Gucciardi et al., 2009), and the unshakeable self-belief in one's ability to achieve competition goals is mentioned as one of the major aspects of mental toughness (Jones et al., 2002).

Dispositional optimism has been defined as a generalized expectancy that good things will happen (Scheier, Carver, & Bridges, 1994). These expectancies are relatively stable across time and context, influencing not only one's emotions but also one's decisions about striving on or giving up. A meta-analysis revealed that dispositional optimism was associated with a more adaptive way to face stress (Solberg Nes & Segerstrom, 2006), which is linked to the fact that people with higher mental toughness handle pressure better (Gucciardi et al., 2009).

Perseverance has been conceptualized as persistence by Cloninger, Przybeck, Svrakic, and Wetzel (1994), and refers more specifically to the propensity of being eager to work hard when facing challenges, in spite of fatigue or frustration. Perseverance is supposed to be a characteristic of mental toughness, more specifically it reflects consistency in achieving one's goals and not giving up easily when facing adversity or difficulties (Gucciardi et al., 2009).

Resilience represents a positive adaptation towards risk or adversity and the ability for the individual to maintain stable levels of physical and mental function (Wagnild & Young, 1993). Seeing resilience as a trait means that the individual possesses the characteristics that enable them to adapt to changes in their environment or challenges. Resilience is considered to be one of the core components of mental toughness (Gucciardi et al., 2009).

In parallel to the key characteristics that have just been reviewed, the theory of mental toughness assumes that other variables could play a role as predictors of mental toughness. Repetitive exposure to situations involving challenges and adversities is thought to trigger the development of mental toughness (Gucciardi et al., 2009), therefore one could assume that factors such as age, the number of years a person has been practising a sport, and the quantity of training might impact on the development of mental toughness. In addition, it is thought that mental toughness is affected by environment, as such it would be

interesting to evaluate whether practising an individual or a team sport provokes differences in mental toughness. However, Nicholls, Polman, Levy, and Backhouse (2009) found no difference in mental toughness based on the type of sport being practised. As only one study was available we wanted to examine this issue further here by providing another sample.

This study has been designed to examine the differences in mental toughness between athletes and non-athletes, which is here hypothesized to be a higher-order construct of the characteristics of *hope, optimism, perseverance* and *resilience*. Based on the theoretical view that mental toughness is not associated to a specific domain but is more a matter of environment (Gucciardi et al., 2009), our first hypothesis is that the higher-order structure of mental toughness will be similar in both samples (i.e., athletes and non-athletes). Second, due to the fact that mental toughness is related to higher sport performance (Gucciardi & Gordon, 2011), we hypothesize that athletes will score higher on mental toughness in comparison to non-athletes. In addition, we shall evaluate the associations between mental toughness and potential predictors, which include the amount of time spent practising sports, taking into account when training started and the weekly volume of training, and the type of sport (i.e., individual vs. team sport). We hypothesize that mental toughness is not associated with the type of sport being practised, but that there will be a positive association with the time spent practising the sport.

2. Methods

2.1. Participants

A total of 1858 participants were recruited to participate in this study, all of whom were Spanish. There were a total of 931 non-athletes: 464 males and 467 females (Mage = 20.43 years; age range: 18–25 years old). The non-athletes who were chosen for this study had never been involved in any form of sports training or competition. There were a total of 927 athletes: 441 males and 486 females (Mage = 20.50 years; age range: 13–26 years old. These athletes were selected from 34 disciplines: 9 team sports (242 athletes) and 25 individual sports (685 athletes). All of these athletes were currently involved either in sport training and/or sport competition. They were involved in sport practice for a mean of 6.2 years (SD = 3.95), and practised on average 3.9 days a week (SD = 1.2), with a mean of 113 min per session (SD = 47 min) and of 453 min per week (SD = 276 min). For descriptive statistics of athletes and non-athletes see Table 1. For descriptive statistics concerning each sport see supplementary material online.

2.2. Instruments

As we have already mentioned, we wanted to avoid using instruments that were specific to sports. For this reason, we chose to assess mental toughness by using separate inventories for each characteristic that had already been validated for use on the general population.

2.2.1. Hope

The Snyder's Hope Scale (Snyder et al., 1991) is a 12 item scale. Sample item: "I can think of many ways to get out of a jam". Participants have to indicate the extent to which they agree with each of the items, from 1 = "*strongly disagree*" to 8 = "*strongly agree*". In our study Cronbach's alpha for the entire scale was .80.

2.2.2. Optimism

To assess optimism, we used the Life Orientation Test-Revised (LOT-R, Scheier et al., 1994). It consists of six items, plus four filler

Table 1
Descriptive Statistics of means, standard deviations of all dimensions and subdimensions.

Variables	Athletes (n = 927)						Non-athletes (n = 931)					
	Male (n = 441)		Female (n = 486)		Total		Male (n = 464)		Female (n = 467)		Total	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
HOPE total	6.63	0.79	6.59	0.80	6.61	0.79	6.19	0.90	6.29	0.85	6.24	0.87
HOPE agency subscale	6.57	0.84	6.56	0.86	6.57	0.85	6.07	0.94	6.19	0.91	6.13	0.93
HOPE pathway subscale	6.69	0.94	6.63	0.89	6.66	0.91	6.31	1.02	6.40	0.98	6.35	1.00
LOT-R total	3.69	0.63	3.63	0.61	3.66	0.62	3.47	0.68	3.50	0.58	3.48	0.64
LOT-R positivism	4.00	0.69	3.91	0.66	3.96	0.68	3.70	0.74	3.73	0.70	3.72	0.72
LOT-R pessimism	2.62	0.93	2.66	0.86	2.64	0.89	2.77	0.89	2.74	0.79	2.76	0.84
Persistence total	3.60	0.50	3.57	0.49	3.58	0.49	3.20	0.56	3.23	0.53	3.21	0.55
Persistence – eagerness of effort	3.26	0.56	3.29	0.59	3.28	0.58	2.90	0.67	3.01	0.63	2.96	0.65
Persistence – work hardened	3.79	0.63	3.77	0.56	3.78	0.59	3.36	0.63	3.42	0.63	3.39	0.63
Persistence – ambitious	3.75	0.63	3.65	0.62	3.70	0.63	3.33	0.63	3.31	0.63	3.32	0.63
Persistence – perfectionist	3.59	0.58	3.57	0.58	3.58	0.58	3.20	0.65	3.20	0.63	3.20	0.64
Resilience total	5.88	0.59	5.84	0.57	5.86	0.58	5.50	0.70	5.61	0.64	5.56	0.67

Note: LOT-R: Life Orientation Test-Revised (i.e., instrument assessing optimism), Persistence: Dimension of the temperament and character inventory-revised assessing perseverance in our study.

items. Of the six items, three are coded in a positive direction, and three are coded in a negative direction. Sample item: "In uncertain times, I usually expect the best". Respondents are asked to indicate the extent to which they agree with each of the items using the following scale: 4 = "*strongly agree*", 3 = "*agree*", 2 = "*neutral*", 1 = "*disagree*", and 0 = "*strongly disagree*". Cronbach's alpha in our study was found to be .74.

2.2.3. Resilience

To measure resilience we used the short form Resilience Scale (RS-15, Wagnild & Young, 1993), which contains 15 items. Sample item is: "I do not dwell on things that I can't do anything about". Participants had to rate the items on a Likert-scale from 1 = "*disagree*" to 7 = "*agree*". Cronbach's alpha in our study was .85.

2.2.4. Perseverance

Persistence was assessed with one of the dimensions of the Temperament and Character Inventory-Revised (TCI-R, Cloninger et al., 1994). The persistence subscale consists of four dimensions and 35 items, which the participant has to answer with a Likert-scale from 1 = "*strongly disagree*" to 5 = "*strongly agree*". Sample item: "I am often so determined that I continue working long after other people have given up". Cronbach's alpha in our study was .88.

2.3. Procedures

Athletes and non-athletes were given a brief description of the study and given the opportunity to participate. Consent was obtained from all participants prior to commencing the study. Participants were asked to complete the battery of psychological assessments in a single 25-min session. The study received the approval of the Ethics Committee of the local university.

2.4. Data analysis

Our hypothesized model based on Gucciardi's theoretical perspective (2009) views mental toughness as a higher-order structure of the four assessed characteristics, as shown in Fig. 1. After testing for measurement invariance across samples, latent mean differences are investigated using the software Amos 17.0. Goodness of fit is assessed with the commonly used χ^2 index, the Comparative Fit Index (CFI), and the root mean square error of approximation (RMSEA). Following Hu and Bentler (1999), values below 0.06 for the RMSEA and above 0.95 for CFI indicate an acceptable model fit. To test the difference between two invariance models, we do not rely on the χ^2 difference, as it is judged to be too
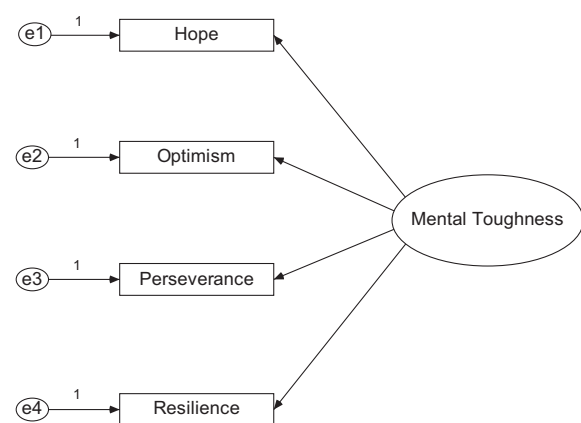
Fig. 1. Hypothesized model for the latent structure of mental toughness.

restrictive, instead we rely on the change in CFI value (Byrne, 2009), which has to be lower than 0.01 (Cheung & Rensvold, 2002). Finally, we test the relationship between mental toughness and its potential predictors with a structural equation model: sport type (coded 1 for team sport and 2 for individual sport); age; years of practice; practice per week (days and min); and practice time per session (min). Due to the fact that they are very likely to be related, the variables related to practice time are set free to covary.

3. Results

Descriptive statistics are presented in Table 1, and the corresponding correlation matrix in Table 2.

3.1. Differences between athletes and non-athletes

We tested the hypothesized model (see Fig. 1) for invariance between athletes and non-athletes. First, the configural invariance model yielded good indices of fit: χ^2 = 14.310, DF = 4, p = .006; CFI = .99; RMSEA = .04. Second, the metric invariance model also showed very good indices of fit: χ^2 = 30.394, DF = 7, p < .001, CFI = .99, RMSEA = .04. As the CFI change between the models representing configural and metric invariance was lower than 0.01, we could assume factor loading invariance between athletes and non-athletes. Third, the scalar invariance model showed an important drop in goodness of fit, making it unacceptable: χ^2: 252.501,

Table 2
Correlation Matrix in athletes.

	1	2	3	4	5	6	7	8	9	10	11
1. Age	–										
2. Gender	.08	–									
3. Practice in years	.21*	.06	–								
4. Practice per week (days)	0	−.08	.25*	–							
5. Practice time per session (min)	−.03	−.03	.24*	.27*	–						
6. Practice time per week (min)	−.03	−.04	.27*	.69*	.84*	–					
7. Sport type	.06	.02	−.30	−.02	.08	.06	–				
8. Hope total	.14*	.02	.07	−.03	.13*	.07	−.02	–			
9. LOT-R total	.06	.05	.04	−.03	.07	.03	.01	.37*	–		
10. Persistence total	.10	.03	.03	.06	.13*	.12*	−.01	.55*	.33*	–	
11. Resilience total	.16*	.04	.08	−.02	.12*	.06	.03	.64*	.41*	.53*	–

Note: Sport type: Individual (1) or team sport (2); LOT-R: Life Orientation Test-Revised (i.e., instrument assessing optimism), Persistence: Dimension of the temperament and character inventory-revised assessing perseverance in our study.
* $p < .001$.
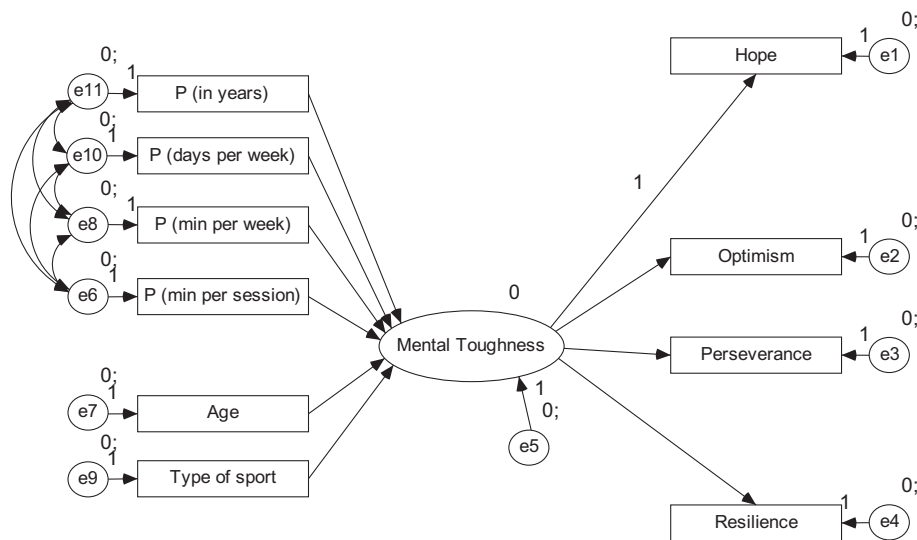
Fig. 2. Hypothesized structural equation model for mental toughness in athletes.

DF = 11, $p < .001$, CFI = .90, RMSEA = .12. As it is not possible to assess latent means with confidence if the scalar structure is not invariant, we checked for partial scalar invariance, as recommended by Byrne (2009). The results support partial scalar invariance as the fit of the latter model and the fit of the metric model did not vary significantly (ΔCFI < .01), obtaining the following values: χ^2: 67.923, DF = 9, $p < .001$, CFI = .98, RMSEA = .05. As partial scalar invariance was supported, it is now possible to interpret latent mean differences with confidence. We chose non-athletes to serve as a reference group and athletes as a comparison group. The mean was set to 0 in the reference group (i.e., non-athletes), and to vary freely in the comparison group (athletes). The results showed a critical ratio (CR) value of 5.912, indicating a significant difference in mental toughness between athletes and non-athletes. The positive CR value suggests that the comparison group (i.e., athletes) has higher latent mean values than the reference group (i.e., non-athletes). In order to calculate the effect size, we followed the recommendations of Kline (1998), who suggested to compute a Cohen's d statistic in order to obtain an effect size index for latent mean differences. The unstandardized mean for athletes was 0.37, and the standard deviations were of 0.06 and 0.08 respectively for athletes and non-athletes. The effect size obtained is equal to 1.42, which represents a large effect size according to Cohen's guidelines (Cohen, 1988).

3.2. Potential predictors of mental toughness

Now that the higher-order structure of mental toughness is confirmed across athletes and non-athletes samples, the implication of potential predictors of mental toughness can now be clarified within the athlete sample. For this we ran a structural equation model, as illustrated in Fig. 2. Indices of fit were acceptable for the model: χ^2 = 216.003, DF = 29, $p > .05$, CFI = .95, RMSEA = .08. However, a closer look at the paths coefficients of the predictors revealed that only two out of six were significant: practice length (i.e., min per session), $p = .007$, and age, $p < .001$. The structural equation model was then rerun only with those two predictors, as illustrated in Fig. 3. This model provided very good indices of fit, χ^2 = 8.189, DF = 9, $p > .05$, CFI = 1, RMSEA = 0. All the paths were significant, as illustrated in Fig. 3. The positive regression weights indicate a positive relationship with mental toughness for both practice length (.16) and age (.18).

4. Discussion

The main aim of this study was to examine whether athletes and non-athletes differ regarding their mental toughness, investigating first the higher-order structure of mental toughness based
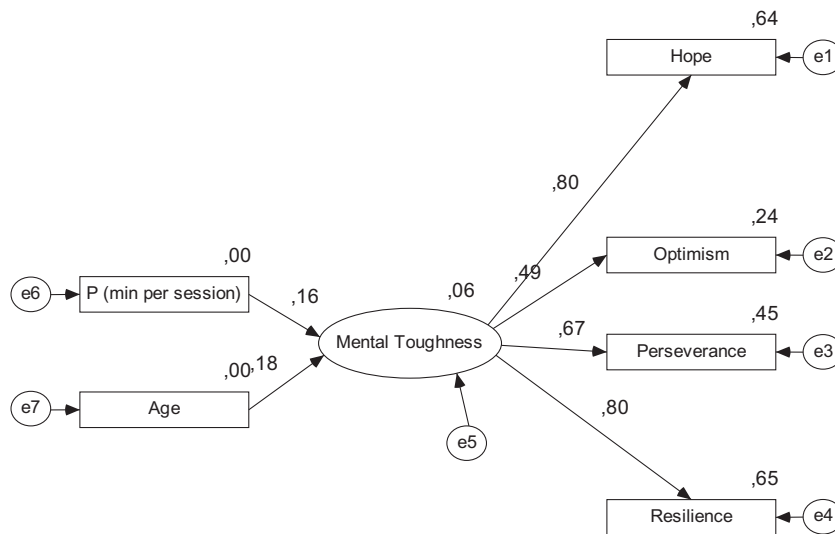
Fig. 3. Final structural equation model for mental toughness in athletes.

on four key characteristics. The hypothesized higher-order structure across samples of mental toughness was supported by our results, in line with the theoretical assumption that mental toughness represents a higher-order construct based on several characteristics. To date, the characteristics of mental toughness had been established in two ways: by interviews (e.g., Fourie & Potgieter, 2001; Jones et al., 2002), which remain somewhat anecdotal; and by correlations with mental toughness inventories (e.g., Nicholls et al., 2008), which were developed not so much on specific theories, but rather on assumptions related to the aforementioned interview studies. Choosing to adopt a different approach, we evaluated the extent to which dimensions related to a soundly established theoretical perspective of mental toughness (Gucciardi et al., 2009) could actually be integrated into a higher-order dimension. This approach, which is based on well-established psychological constructs (i.e., hope, optimism, perseverance, resilience), strengthened the rationale of mental toughness reflecting the ability of an individual to thrive through both the positive and negative situations that one has to face (Gucciardi et al., 2009).

The latent mean differences analysis demonstrated that athletes scored higher than non-athletes on mental toughness, with a large effect size. This result is in line with the fact that higher mental toughness levels are usually associated with higher sport performance (Gucciardi & Gordon, 2011). Each of the characteristics integrated to the higher-order construct of mental toughness is thought to play a role in this direction. Firstly, for hope, Curry, Snyder, Cook, Ruby, and Rehm (1997) demonstrated that athletes had higher dispositional hope than non-athletes, and that dispositional hope was also found to influence sport performance (Curry et al., 1997). Secondly, for optimism, Kavussanu and McAuley (1995) found that participants involved in physical activity were more optimistic and less pessimistic. Thirdly, for perseverance, this is, to the best of our knowledge, the first time that the comparison athletes/non-athletes has been explored in the literature. Perseverance is an intrinsic part of sport: previous research by Fraser-Thomas and Côté (2009) showed that sport requires perseverance and also that sport offers a specific environment that rewards perseverance. Fourthly, regarding resilience, to the best of our knowledge no studies investigated differences between athletes and non-athletes. It seems that it is possible to develop resilience (Padesky & Mooney, 2012), and sport may provide an adequate environment in which to develop resilience, precisely because it presents athletes with a range of negative events (e.g., competition stress, failures, injuries).

A secondary aim of this study was to explore whether mental toughness characteristics in athletes were related to the type of sports they were practising, age, and the amount of time spent practising sports. The structural equation model that was tested in Fig. 2 revealed no significant path between the type of sport being practised (i.e., individual vs. team sport) and mental toughness. This finding is not surprising as it is similar to the findings of Nicholls et al. (2009). The significant path between age and mental toughness would reflect the assumption that mental toughness develops through developmental experiences (Jones & Parker, 2013). Regarding practice time, the only significant path was found with the mean duration of practice sessions. Previous research has shown that mental toughness is associated to physical endurance (Crust & Clough, 2005), which could be linked to practice session length.

5. Limitations

The first limitation regarding the higher-structure of mental toughness is that the precise range of mental toughness characteristics is not precisely defined, as such it is possible to argue that other characteristics, such as self esteem, could have been suitable candidates for integrating into the higher-structure tested in our study. Our second limitation relates directly to our choice to use a cross-sectional study rather than a longitudinal study. As a result of this choice we are unable to infer any causal inferences from our findings. In other words, although we have been able to identify that athletes have higher levels of mental toughness than non-athletes, this choice of design means we are unable to say whether practising sports develops these characteristics or not. To address this problem, we believe that future research should study mental toughness characteristics from a developmental perspective.

6. Conclusion

The purpose of this study was to provoke a methodological shift in mental toughness research. Primarily, it is hoped that this study will encourage researchers to take a step back during the appraisal of mental toughness inventories and recognise that the current proliferation of said inventories is actually detrimental rather than beneficial to the understanding of mental toughness. At the same time, this study also aimed to shed light on the differences in mental toughness between athletes and non-athletes, supporting

the idea that sport participation could be associated to the development of mental toughness. Finally, future studies aiming to understand how mental toughness develops should also aim to clarify its cognitive underpinning mechanisms (Dewhurst, Anderson, Cotter, Crust, & Clough, 2012) as well as its links with performance, like it was done with other individual differences such as trait emotional intelligence (e.g., Laborde, Lautenbach, Allen, Herbert, & Achtzehn, 2014).

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