Profiles of psychological skill use and their relations with self and coach-rated mental toughness in Thai athletes

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Author Contributions

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Conceptualisation				
Data Collection				
Analysis				
Writing - Original Draft				
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Abstract

We examined two questions relating to athletes use of psychological skills and techniques (PS). First, we consider whether athletes differ in the configuration of PS they use. Second, we examine how PS use is related to both self-reported and informant-rated mental toughness. A sample of 309 elite Thai athletes reported their frequency of PS use in practice and competition settings and completed a self-report measure of mental toughness; coaches provided informant ratings of mental toughness for a subset of athletes. Using latent profile analysis, we replicated previous findings (Ponnusamy, Lines, Zhang, & Gucciardi, 2018) to show that athletes could be best classified in to three subgroups based on their PS use, and these subgroups differed in the relative frequency of their PS use rather than in the specific patterns of PS. Further, we find that mental toughness differed as a function of PS use with higher frequency of PS use associated with higher self-rated mental toughness, and higher coach-ratings of mental toughness. These findings suggest that athletes do not appear to differ in the configurations of PS used and show that PS not only relate to self-perceptions of mental toughness but also to the display of more mentally tough behaviour.

Keywords: Mental Toughness, Coping Strategies, Elite Athletes, Thai

1 Introduction

2 In the sporting domain, athletes can engage in a broad range of psychological skills and
3 techniques (PS) to enhance performance and motivation. For example, an athlete may use
4 imagery to prepare for an event, engage in self-talk and relaxation techniques to regulate emotion
5 and arousal before or during competition, and set specific goals in training to maintain
6 motivation. There is a distinction (see: Arthur, Callow, Roberts, & Glendinning, 2019) between
7 *basic* PS that reflect trainable techniques that can be practiced (e.g., imagery, self-talk,
8 relaxation, goal setting) and *advanced* PS as a desired outcome that are indicative of an athlete's
9 obtained skill level (e.g., increased attentional control, emotional control, negative thinking,
10 etc.). PS benefits skill-based (e.g., Brown & Fletcher, 2017; Connaughton, Wadey, Hanton, &
11 Jones, 2008) and endurance performance (McCormick, Meijen, & Marcora, 2015) and the
12 reported frequency of PS use also discriminates between athletes based on objective markers of
13 success (i.e., Olympic medalists versus non-medalists) or performance level (elite versus non-
14 elite), with higher achieving athletes consistently engaging in greater overall use of PS (Gould &
15 Maynard, 2009; Tanaka & Gould, 2015; Taylor, Gould, & Rolo, 2008).

16 Despite the potential importance of PS for athlete success, relatively little is known about
17 whether athletes differ in the configurations of PS they use. Indeed, the majority of research
18 examining the relations among PS variables has taken a variable-centered approach, assuming
19 that athlete's use of PS is relatively homogenous. In other words, athletes are thought to share
20 similar characteristics in the combinations of PS they use. However, it is unclear if this
21 assumption of homogeneity is always true and there may exist subgroups of athletes that can be
22 distinguished by their use of specific configurations of PS. In the first effort to address this
23 question, Ponnusamy, Lines, Zhang, and Gucciardi (2018) used latent profile analysis, a

1 statistical approach that can be used to identify homogenous subgroups of athletes based on their
2 PS use. In a sample of elite Malaysian athletes, they found that athletes could be best classified
3 in to three subgroups. However, when examining the patterns of PS use across the three
4 subgroups, there were quantitative, rather than qualitative, differences in reported PS use. Across
5 both practice and competition settings, athletes were classified into groups that were
6 characterized by relatively high use of all PS, medium use of all PS, or low use of all PS.

7 Despite this initial evidence, it is not known whether synchronous profiles in athlete's PS
8 use is more broadly applicable, e.g., extending to athletes in other cultures. One focus of the
9 present research is to address this by replicating the study by Ponnusamy et al. (2018) in a
10 sample of elite Thai athletes. Despite the geographical proximity, there are important
11 sociocultural differences between Thailand and Malaysia that make it unclear whether we would
12 observe only quantitative differences in Thai athlete's PS use. First, the vast majority of the Thai
13 population identify as Buddhist with 94% of the Thai¹ population reporting that Buddhism exerts
14 at least a moderate influence on their daily life (Komin, 1990). Buddhist teachings place strong
15 emphasis on contemplative meditation and mindfulness with students receiving regular
16 instructions on these practices from early childhood. This Buddhist influence is relevant because
17 it may cause Thai athletes to be more likely to adopt "meditative techniques to quieten the mind
18 and attain focus prior to competition" (Watson & Nesti, 2005, p. 232). Further, mindfulness
19 practice that includes a focus on attentional processes, self-regulation and nonjudgemental
20 acceptance is theorized to exert an influence on specific PS related to attentional control and
21 negative thinking (Birrer, Röthlin, & Morgan, 2012). In an examination of mindfulness practice
22 in (Western) athletes, mindfulness improves sport-specific coping via its benefits on emotion

¹ Less than 20% of the Malaysian population identify as Buddhist (Pew Research Center, 2012).

regulation and reduced rumination (Josefsson et al., 2017). Thus, although no empirical evidence directly speaks to this, it is possible that Thai athletes might engage in extensive use of PS that align with mindfulness and meditation-based strategies to aid relaxation deal with negative thoughts and emotions through nonjudgmental acceptance. Second, within Thai athlete programs, not all athletes formally engage in PS training delivered by applied sport psychologists, resulting in considerable variability in the development and use of PS within Thai athletes. As a consequence of these two factors, it is possible that within the population of Thai athletes there exists groups that exclusively using (Buddhist) mindfulness-based techniques only and a subgroup of other athletes who supplement these practices with additional PS (e.g. goal setting). Although the theorizing above is largely speculative, testing whether the quantitative differences in PS usage hold within a different sociocultural context is useful to clarify the broader relevance of whether differences in PS usage are qualitative or quantitative.

Psychological Skills and Mental Toughness

A second focus of our research is to extend the current understanding of the relationship between PS use and mental toughness. Mental toughness is often a poorly defined construct with a lack of consensus regarding how it should best be conceptualised and assessed (Gucciardi, 2017; Gucciardi & Gordon, 2011). Although initial research efforts argued that mental toughness is a multidimensional collection of attributes, values, cognition and emotions (e.g., Clough, Earle, & Sewell, 2001; Jones, 2002), recent evidence favours an alternative approach. In a comprehensive update to the conceptualization and measurement of mental toughness, Gucciardi and colleagues combined theoretical perspectives from multiple sources to identify aspects (i.e., self-efficacy, optimism, emotion regulation, etc.) that are central to mental toughness and found

1 that these combined to form a unidimensional construct of mental toughness (Gucciardi, Hanton,
2 Gordon, Mallett, & Temby, 2015).

3 From the perspective that mental toughness can be assessed as a self-reported collection
4 of attributes, a range of evidence attests to the positive effect of PS on self-rated mental
5 toughness. In a correlational analysis of non-elite UK athletes, Crust and Azadi (2010) found that
6 mental toughness was positively associated with a range of PS, including self-talk, emotional
7 control, goal setting, relaxation activation, and reduced negative thinking. These findings are
8 supplemented by intervention studies showing that self-reported mental toughness increases after
9 training individuals to use PS (Sheard & Golby, 2006). In their study examining the latent
10 profiles of athlete's PS use, Ponnusamy et al. (2018) found that mental toughness differed as a
11 function of PS class membership such that athletes who reported the highest PS use rated
12 themselves as more mentally tough than those in the moderate PS use groups, who in turn, rated
13 themselves as more mentally tough than athletes in the low PS use group. Taken together, these
14 findings offer evidence that PS use positively correlates with self-rated attributes of mental
15 toughness.

16 However, correlating PS with self-rated mental toughness is problematic for several
17 reasons. First, although self-report measures of mental toughness assess attitudes and cognitions
18 associated with mental toughness, they fail to capture whether an athlete displays mentally tough
19 behaviour (Hardy, Bell, & Beattie, 2014). Second, self-report measures of mental toughness are
20 potentially confounded by socially desirable responding, an issue compounded by the nature of
21 mental toughness being a desirable characteristic to possess. Third, correlational studies
22 comparing self-reported PS and mental toughness are likely to suffer from issues of common
23 method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Fourth, there are issues with

construct overlap in the assessment of PS and mental toughness and this may artificially inflate their observed association. For example, the Mental Toughness Index (MTI; Gucciardi et al., 2015) includes several items assessing the personal resources associated with mental toughness that demonstrate clear overlap with PS such as: the regulation of emotions (“I am able to use my emotions to perform the way I want to”) and attentional control (“I am able to regulate my focus when performing tasks”). Whilst most other items on the MTI assess aspects of mental toughness that are distinct from PS, this overlap is likely to account for some of the shared variance across these measures.

Given these limitations with self-report measures, one important advance to understanding would be to examine how PS use relates to measures of mental toughness that are not similarly confounded. In this regard, an alternative, and arguably more pragmatic approach to the assessment and conceptualization of mental toughness is to focus on mental toughness as an observable behaviour that can be measured through informant coach-ratings. Hardy et al. (2014) have argued that although various values, attitudes, emotions and cognitions might be associated with mental toughness, whether an athlete is mentally tough or not is best studied through careful consideration of behavioural indicators of mental toughness, in other words, to what degree can an athlete maintain their performance level in the face of various stressors. Evidence that PS use is associated with behavioural mental toughness comes from two intervention studies in cricketers and military recruits. In one study, training cricketers’ to implement individually tailored coping strategies, combined with desensitisation training, increased coach-rated behavioural mental toughness (Bell, Hardy, & Beattie, 2013). Outside the sporting domain, Fitzwater, Arthur, and Hardy (2018) delivered a psychological skills intervention targeting basic

PS (i.e., goal setting, relaxation and arousal regulation, self-talk strategies and imagery) and found an increase in instructor ratings of mental toughness in military recruits.

Present Study

In summary, this study has two goals². The first is to examine the latent profiles of PS use in elite Thai athletes to examine how athletes differ in the configuration of PS. We examine whether the quantitative differences of PS use reported by Ponnusamy et al. (2018) can be replicated and are therefore more broadly applicable in other cultures. Although we have offered some reasons why there may be subgroups of Thai athletes who use qualitatively different patterns of PS, these reasons are largely speculative, and we make no hypothesis regarding the expectation of synchronous or asynchronous profiles in the current sample. The second goal is to examine the relationship between PS use and mental toughness using both self-report and coach-rated measures of mental toughness. This study will provide the first examination of whether PS use is associated with coach-ratings of mentally tough behaviour. We hypothesize that PS use (both in practice and competition) will be positively related to both self and coach-rated mental toughness.

Methods

² Note that the original design of the experiment intended to address the second goal only. After data collection but prior to analysis we decided to also address the first goal in testing whether the effects of Ponnusamy et al. (2018) could be replicated in our sample.

All analysis scripts and data are available on the Open Science Framework (https://osf.io/cqus3/?view_only=94ab73c2c2a94ff4b0ac30db591a66ec)³.

Participants

We recruited 309 elite Thai athletes (180 males, 129 females). All athletes were members of the Thai national squads across a range of 38 different teams (e.g., sepak takraw, swimming, athletics, etc.) and included both able ($n = 224$) and disabled ($n = 85$) athletes. At the time of data collection, participants were aged 15-58 years ($M = 26.06$, $SD = 8.21$). Based on the classification taxonomy proposed by Swann, Moran and Piggott (2015), we use the term *elite* to refer to the vast majority of athletes in the present sample who could be best characterized as a combination of semi-elite (e.g., in talent development programs) and competitive elite (i.e., regularly competing at the highest level in their sport).

Measures

Two bilingual speakers (second and third authors) with experience in measurement translation were responsible for translating all measures from English to Thai using back-translation procedures (Brislin, 1970). All items were first translated from English to Thai, a second bilingual speaker then translated the Thai version back to English. The back translation for each item was compared to the original for equivalence in meaning and language and where necessary items were translated again until there was agreement. Any issues were resolved through discussion between the first author and the translation team. Descriptive statistics, reliability and correlations are presented in Table 1.

³ In addition to the measures discussed here we also assessed athletes' narcissism and self-esteem; these measures addressed a separate research question concerning their association with mental toughness (Manley, Jarukasemthawee, & Pisitsungkagarn, 2019) and are not discussed further here.

Psychological skills and techniques. We assessed athletes' use of PS during practice (32 items assessed facets relating to: goal setting, self-talk, imagery, attentional control, emotional control, activation, relaxation, automaticity) and competition (36 items assessed facets relating to: goal setting, self-talk, imagery, negative thinking, attentional control, emotional control, activation, relaxation, automaticity) using the 68-item Test of Performance Strategies (TOPS-3; Hardy, Roberts, Thomas, & Murphy, 2010). Each of the items describes a specific situation that the athletes may encounter in their practice or competition. An example item from the imagery in practice subscale is, "During practice I visualize successful past performances". Participants indicated how frequently the situation applied on a five-point Likert scale (1 = *Never*; 5 = *Always*). For conceptual simplicity and to aid illustration when plotting, we reverse scored the negative thinking scale such that higher scores reflected lower levels of negative thinking.

Self-rated mental toughness. We assessed mental toughness using an eight-item, uni-dimensional mental toughness index (MTI; Gucciardi et al., 2015). Participants were asked to indicate on a five-point Likert scale (1 = *false 100% of the time*; 5 = *true 100% of the time*) how true each of the statements is an indication of their typical thoughts, feelings and behaviors as an athlete. Note the original measure used a seven-point scale. Example items are: "I strive for continued success", "I consistently overcome adversity", etc.

Coach-rated mental toughness. We assessed coach-rated mental toughness using a 6-item Mental Toughness Inventory (Hardy et al., 2014). The Mental Toughness Inventory was developed to assess mentally tough behaviour through observer ratings of performance and has reported good fit and reliability (Hardy et al., 2014). However, the scale was developed to examine mental toughness in the context of cricket and not all items on the original scale were

applicable for all athletes across different sports in the present sample. Consequently, after reviewing the items we removed the following two questions: “when he has to perform at a high level all day” and “when the opposition are using aggressive tactics”. This was because not all sports occur over a prolonged time period or involve interaction with the opposition. For each of the six items, coaches were asked to indicate whether the player is able to maintain a high level of performance in competition when: e.g., “... there are a large number of spectators present”. Responses were measured on a seven-point Likert scale from 1 (*never*) to 7 (*always*).

Procedures

Ethical approval was obtained from the Human Research Ethics Committee (086.1/60). We first contacted coaches to explain the purpose of the research and request permission to approach athletes. Athletes completed the measures either before or after a physical assessment, during the weeks preceding the 2017 South East Asian games. In a single session, consenting athletes completed all measures assessing psychological skills and self-rated mental toughness. All athletes were informed that their involvement in the research was voluntary and that their coach would not have access to any of their individual responses.

Analysis

To classify athletes based on their use of PS in practice and competition, we performed exploratory latent profile analysis (LPA) in MPlus (Version 8.2; Muthén & Muthén, 2019). Missing data accounted for fewer than 5% of all cases and was handled using robust maximum likelihood estimation, which is resistant to outliers⁴ and robust to non-normality and non-independence of observations.

⁴ We identified three outliers (Cook’s distance > 1) when specifying our LPA examining PS in competition settings. Excluding these outliers had no substantive effect on the decision regarding the optimal class solution (the three-class solution was optimal) or the effect of group membership on the distal outcome variables, although there was a shift in the distribution of athletes classified in each group. Here, we have reported the results of the analysis

Class Enumeration. In the initial phase of our analysis we sought to determine the number of profiles that best classify athlete's PS use by fitting a model with two latent profiles and increasing this up to a maximum of six profiles. To determine the best fitting solution and the number of classes to retain, we first compared the relative fit indices for each of the models, examining the change in Akaike's Information Criteria (AIC), Bayesian Information Criteria (BIC), and its sample size adjusted variant (ABIC). Similar to the interpretation of a scree plot in factor analysis we sought to find the solution with the lowest fit indices until a plateau is reached in the reduction of fit indices (Nylund-Gibson & Choi, 2018). Fit was considered alongside likelihood based tests of relative fit; the Lo-Mendell-Rubin likelihood ratio test (LMR LR) and its adjusted version (ALMR). These tests provide a statistical test of the improvement in model fit of the current and smaller ($k - 1$) class solution, where a significant test indicates an improvement in model fit (Nylund, Asparouhov, & Muthén, 2007). These statistical criteria were also balanced with theoretical consideration for the relative sample sizes in each profile, and a preference for a parsimonious solution that uses as few latent classes as possible to explain the data. Interpretation of how well the selected classes differentiated was provided by entropy ($> .80$ indicating good classification) and average classification probability (where closer to 1 is better).

Mental Toughness as an Outcome Variable. We examined the effect of class membership on mental toughness by including mental toughness as distal outcome variables. In order to account for the probabilistic nature of group membership, we used the three-step method to model both mental toughness as an auxiliary outcome variable within the LPA using the DU3STEP command (Asparouhov & Muthén, 2014).

Results

All study variables were approximately normally distributed. Notably, the internal reliability estimates of several constructs were poor, especially in relation to the use of PS in practice and this should be held in consideration when interpreting the results.

A summary of the statistical information for the various solutions is presented in Table 2. This indicated that the three-class solution best fit the data for PS use in both practice and competition settings. In practice settings, the three-class solution was a significant improvement over the two-class solution, after which there was a plateau with only small improvement of the four, five and six class solutions. The three-class solution also displayed good entropy (that decreased for the four-class solution) and the average classification accuracy was better for the three compared to the four-class solution. In competition settings, the three-class solution again provided the optimal fit with relative fit indices indicating an improvement on the two-class solution and good entropy. The four-class solutions had better relative fit indices and equivalent entropy and the average classification accuracy was equivalent for the three and four-class solution, see Table 3. However, because the four (and five and six) class solution all had non-positive definite matrices we therefore retained the three-class solution.

1 Table 1.

2 *Descriptive statistics and zero-order correlations for mental toughness and psychological skills and techniques.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Self-Rated MT	(.90)																		
2. Coach-Rated MT	.32*	(.93)																	
Practice																			
3. Goal Setting	.53*	.09	(.62)																
4. Imagery	.40*	.22*	.49*	(.70)															
5. Attentional Control	.43*	.28*	.53*	.26*	(.55)														
6. Self-talk	.28*	.09	.44*	.60*	.02	(.80)													
7. Activation	.44*	.23*	.48*	.40*	.46*	.31*	(.37)												
8. Emotional Control	.28*	.15	.48*	.20*	.55*	.15*	.36*	(.62)											
9. Automaticity	.14*	-.02	.05	.31*	.03	.17*	.26*	-.08	(.38)										
10. Relaxation	.41*	.21*	.44*	.58*	.18*	.47*	.49*	.13*	.25*	(.71)									
Competition																			
11. Goal Setting	.36*	.36*	.45*	.39*	.30*	.31*	.38*	.18*	.17*	.34*	(.73)								
12. Imagery	.38*	.27*	.43*	.37*	.23*	.30*	.35*	.17*	.15*	.36*	.65*	(.75)							
13. Attentional Control	.39*	.24*	.46*	.22*	.51*	.13*	.43*	.45*	.01	.24*	.38*	.35*	(.51)						
14. Self-talk	.46*	.24*	.51*	.41*	.31*	.46*	.40*	.26*	.14*	.36*	.61*	.68*	.39*	(.81)					
15. Activation	.40*	.30*	.40*	.36*	.24*	.38*	.41*	.14*	.16*	.33*	.50*	.52*	.40*	.65*	(.66)				
16. Emotional Control	.19*	.09	.27*	.08	.41*	-.03	.25*	.42*	-.02	.01	.14*	.13*	.61*	.19*	.10	(.77)			
17. Automaticity	.42*	.30*	.35*	.42*	.26*	.31*	.41*	.18*	.38*	.38*	.53*	.51*	.41*	.53*	.59*	.18*	(.69)		
18. Relaxation	.42*	.30*	.46*	.44*	.27*	.41*	.45*	.23*	.17*	.56*	.52*	.63*	.44*	.67*	.70*	.10	.60*	(.85)	
19. Negative Thinking	.34*	.22*	.49*	.19*	.45*	.10	.39*	.50*	.09	.14*	.27*	.21*	.62*	.35*	.26*	.59*	.32*	.28*	(.74)
Age	.17*	.12	.24*	.21*	.18*	.17*	.24*	.17*	.14*	.22*	.06	.11	-.14*	-.01	-.01	-.10	-.03	-.05	-.02
Sex	.03	.02	.12*	.06	.09	.13*	-.01	0.08	-.03	.01	-.02	0.01	.06	.11	.11*	.10	-.04	.10	.07
N	307	139	307	298	303	303	304	304	301	303	303	301	300	304	303	297	300	305	289
Mean	4.04	5.32	4.08	3.76	3.70	3.68	3.66	3.58	3.10	3.64	3.90	3.93	3.83	4.08	3.75	3.61	3.80	3.86	3.27
SD	0.63	0.99	0.61	0.65	0.59	0.57	0.51	0.64	0.52	0.70	0.72	0.69	0.67	0.68	0.56	0.87	0.65	0.75	0.74
Skewness	-0.83	-0.44	-0.51	-0.59	-0.25	-0.56	-0.13	-0.02	-0.23	-0.45	-0.56	-0.57	-0.16	-0.65	-0.67	-0.30	-0.17	-0.51	-0.73
Kurtosis	1.65	-0.72	-0.09	0.80	0.15	1.14	0.29	-0.42	0.51	0.56	0.36	0.42	-0.07	0.56	2.86	-0.41	0.08	0.62	-0.03

3 *Note.* * $p < 0.05$, McDonald's ω reported as a measure of scale reliability in brackets. Sex coded 0 = male, 1 = female

1 Table 2.

2 *Model fit indices for all latent profile models tests*

	AIC	BIC	ABIC	LMR LR	ALMR	Entropy
Practice						
Two	4038.92	4132.26	4052.97	0.023	0.024	0.732
Three	3881.67 (-3.89%)	4008.60 (-2.99%)	3900.77 (-3.76%)	0.002	0.002	0.825
Four	3797.36 (-2.17%)	3957.89 (-1.27%)	3821.51 (-2.03%)	0.280	0.286	0.784
Five	3745.71 (-1.36%)	3939.84 (-0.46%)	3774.92 (-1.22%)	0.130	0.135	0.837
Six#	3701.31 (-1.19%)	3929.04 (-0.27%)	3735.57 (-1.04%)	0.501	0.507	0.861
Competition						
Two	5109.62	5214.06	5125.26	0.319	0.324	0.798
Three	4840.95 (-5.26%)	4982.70 (-4.44%)	4862.18 (-5.13%)	0.056	0.058	0.875
Four#	4698.67 (-2.94%)	4877.72 (-2.11%)	4725.48 (-2.81%)	0.044	0.046	0.878
Five#	4587.02 (-1.38%)	4803.36 (-1.52%)	4619.41 (-2.24%)	0.410	0.416	0.861
Six#	4523.10 (-1.39%)	4776.75 (-0.55%)	4561.08 (-1.26%)	0.592	0.596	0.874

3 *Note.* Number in parentheses for AIC, BIC and ABIC, change value in percentage; AIC, Akaike
 4 Information Criteria; BIC, Bayesian Information Criteria; ABIC, sample size adjusted BIC;
 5 LMR LR test, Lo–Mendell–Rubin likelihood ratio test; ALMR LR, Lo-Mendell–Rubin
 6 adjusted likelihood ratio test. # Non-positive definite matrix.

8 Table 3.

9 *Classification probabilities for the 1 to 4 profiles*

	Practice					Competition			
	1	2	3	4		1	2	3	4
1	0.909	0.091			1	0.929	0.071		
2	0.068	0.932			2	0.054	0.946		
1	0.923	0.077	0		1	0.928	0.072	0	
2	0.012	0.929	0.059		2	0.014	0.951	0.035	
3	0	0.093	0.907		3	0	0.051	0.949	
1	0.856	0.011	0.080	0.053	1	1	0	0	0
2	0.042	0.939	0.019	0	2	0.002	0.951	0.048	0
3	0.109	0.008	0.836	0.047	3	0	0.036	0.922	0.042
4	0.065	0	0.024	0.911	4	0	0	0.077	0.923

Examining the zero-order relationship between PS and mental toughness revealed medium size positive correlations between self-rated mental toughness ($.40 > r < .53$) and most PS in practice and competition. In contrast, although the associations between PS use and coach-rated mental toughness were positive, they were generally weaker and less consistent effects.

Profiles of PS Use

The means for each of the three latent profiles is plotted for PS in practice in Figure 1 and for PS in competition in Figure 2. Visual inspection of the PS use across the three profiles indicated that for both practice and competition the differences were largely quantitative in nature. In practice settings there were notable differences between the profiles, across each PS the groups differed in their relative level (low, moderate and high) of PS use. The only exception was for automaticity where there was little difference between the high and moderate groups. In competition settings there were similar differences in the relative level (low, moderate and high) of PS use between the profiles. The only exception here was the smaller differences between moderate and low use groups for negative thinking and emotional control.

1
2 *Figure 1.* Mean PS usage in practice. Estimates are displayed for individuals classified in low
3 (black, $N = 30$), moderate (dark grey, $N = 174$) and high (light grey, $N = 105$) use groups. Error
4 bars indicate standard errors. All group means are significantly different ($p < .001$), except
5 between the high and moderate use groups for automaticity.

Figure 2. Means for PS used in competition. Estimates are displayed for individuals classified in low (black, $N = 38$), moderate (dark grey, $N = 168$) and high (light grey, $N = 102$) use groups. Error bars indicate standard errors.

PS and Mental Toughness

The zero-order relationship between PS and mental toughness revealed medium size positive correlations between self-rated mental toughness and most PS in practice and competition. In contrast, although the associations between PS use and coach-rated mental toughness were positive, they were generally weaker and less consistent than the correlations between PS use and self-rated mental toughness.

We examined a distal outcome model (with self and coach-rated mental toughness as auxiliary variables) to test whether the three classes of PS differed in their mean level of self and coach-rated mental toughness. The distribution of mental toughness scores for each class are illustrated in Figure 3.

Self-rated mental toughness. In practice settings, self-rated mental toughness differed as a function of class membership ($\chi^2 (2) = 153.99, p < .001$). High PS ($M = 4.53$) use athletes reported significantly higher mental toughness than athletes in the moderate ($M = 3.89; \chi^2 (1) = 99.53, p < .001$) and low ($M = 3.20; \chi^2 (1) = 77.22, p < .001$) PS use group. The self-rated mental toughness level of athletes in the moderate group was also significantly higher than athletes in the low PS use group ($\chi^2 (1) = 19.70, p < .001$).

In competition settings, self-rated mental toughness again differed as a function of class membership ($\chi^2 (2) = 104.21, p < .001$). High PS ($M = 4.48$) use athletes reported significantly higher mental toughness than athletes in the moderate ($M = 3.94; \chi^2 (1) = 49.05, p < .001$) and low ($M = 3.34; \chi^2 (1) = 57.12, p < .001$) PS use group. The self-rated mental toughness level of athletes in the moderate group was also significantly higher than athletes in the low PS use group ($\chi^2 (1) = 12.66, p < .001$).

Coach-rated mental toughness. In practice settings, coach-rated mental toughness differed as a function of class membership ($\chi^2 (2) = 13.36, p = .001$). High PS ($M = 5.59$) use athletes were rated significantly more mentally tough than athletes in the low PS use group ($M = 4.39; \chi^2 (1) = 13.35, p < .001$). The moderate group ($M = 5.29$) was also rated more mentally tough than the low PS use group ($\chi^2 (1) = 7.56, p = .006$). The difference between the coach-rated mental toughness of athletes in the moderate and high PS use group was not significant ($\chi^2 (1) = 1.63, p = .202$).

In competition settings, coach-rated mental toughness again differed as a function of class membership ($\chi^2 (2) = 21.46, p < .001$). High PS ($M = 5.59$) use athletes were rated significantly more mentally tough than athletes in the low PS use group ($M = 4.25; \chi^2 (1) = 21.40, p < .001$). The moderate group ($M = 5.31$) was also rated more mentally tough than the

1 low PS use group ($\chi^2 (1) = 13.33, p < .001$). The difference between the coach-rated mental
 2 toughness of athletes in the moderate and high PS use group was not significant ($\chi^2 (1) = 1.92, p$
 3 $= .165$).

5
 6 *Figure 3.* PS use classification and mental toughness. Individual data points are plotted, Tukey
 7 box plots and violin plots indicate distribution of self-rated (A, B) and coach-rated (C, D) mental
 8 toughness as a function of PST use classification (low, moderate, high) in practice (left) and
 9 competition (right).

Discussion

Replicating the findings of Ponnusamy et al., (2018), we found evidence that when identifying subgroups of athletes based on their PS use, these subgroups displayed differences in the frequency of PS use, rather than in the configuration of PS used. In both competition and practicing settings our sample of Thai athletes were best classified in three subgroups that reflected low, moderate and high PS use. Further, high compared to low PS usage was associated with not only higher self-reported mental toughness but also higher coach-ratings of mental toughness. This is an important extension to the literature because it demonstrates that PS are not only related to self-perceptions of mental toughness (and associated measurement confounds) but is also related with a more objective measure coach-rated mental toughness showing that athletes with high PS use actually display more mentally tough behaviour than athletes with low PS use.

Although we observed mainly quantitative differences in athlete's PS use across practice and competition settings, when examining the between-profile differences in reported PS use it was interesting that in competition settings there were no differences between low and moderate PS use groups on two of the advanced PS: negative thinking and emotional control. One interpretation for this is that athletes only gain discernible improvements in their ability to control negative thoughts and regulate emotion if they frequently practice and engage in basic PS, such as using self-talk or imagery (Arthur, Fitzwater, Roberts, Hardy, & Arthur, 2017). Here, it may be the case that low to moderate engagement in basic PS is simply insufficient to lead to beneficial changes desired outcomes of reduced negative thinking and greater emotional control.

From a variable-centered approach, it was notable that the correlation between PS and mental toughness was both stronger and more consistent for self than coach-rated mental toughness. Although most PS were moderately correlated with self and coach-rated mental

toughness, in competition settings emotional control had a relatively small association with self-rated mental toughness and was unrelated to coach-rated mental toughness. This weak correlation between emotional control and mental toughness is similar to what was observed by Ponnusamy et al. (2018), yet inconsistent with other studies showing the importance of emotional control (e.g., Crust & Azadi, 2010; Kristjánsdóttir, Erlingsdóttir, Sveinsson, & Saavedra, 2018). Although it is unclear why emotional control has only a small association with mental toughness in the present sample, one possibility is that Thai athletes have qualitatively different interpretations and responses to emotions, such that rather than being motivated to exert control over their emotions they would instead be motivated to acknowledge emotions in a mindful and dispassionate way (e.g., Kaufman, Glass, & Pineau, 2016).

The relatively small shared variance ($r = .32$) between self and coach-ratings of mental toughness supports the idea that these measures are capturing, to some degree, different constructs of mental toughness. Whereas self-ratings reflect the personal resources associated with mental toughness, coach-ratings reflect whether or not mentally tough behaviour has actually occurred. This modest association raises some broader questions regarding the validity of self-rated attributes of mental toughness as it appears that only a relatively small amount of variance in self-ratings of mental toughness would explain the degree to which an athlete actually displays mentally tough behaviour.

Implications

An applied implication of these findings is to emphasize to coaches and athletes the relevance and potential benefit of engaging in PS. Although our results do not demonstrate a causal relationship between mental toughness and PS, the current evidence combined with data from intervention studies (e.g., Bell et al., 2013) points towards PS use playing an important role

in the development of mentally tough athletes and it is the athletes who are unequipped with PS that are likely to display a lack of mental toughness. This link is particularly important to demonstrate in cultural contexts (e.g., Thailand) where the benefits of PS are not universally recognized and by coaches and athletes.

Limitations

We observed poor reliability ($\omega < .70$) for some facets of PS using the Test of Performance Strategies (Hardy et al., 2010), and most notably in the practice domain (e.g., automaticity, activation). The cause of the poor reliability is unclear but one possible explanation concerns cultural differences in coaching techniques. For example, the automaticity dimension contains items that to many (Western) athletes would be identified as (unambiguously) suboptimal for performance, i.e., “I need to monitor all the details of each move in order to successfully execute skills in practice”. In the current sample, Thai athletes reported surprisingly high agreement with this item ($M = 3.77$) and, although no empirical evidence attests to this, one explanation for this discrepancy is that Thai coaches often encourage athletes to explicitly monitor their actions. Similar reliability issues for the TOPS were reported by Ponnusamy et al. (2018) in Malaysian athletes and taken together there may be other cultural factors in the coaching and teaching of PS that are important to consider in the future when measuring their use.

In the present research, our assessment of PS captured the frequency of athlete’s use of basic techniques (e.g., goal setting, imagery, etc.) and advanced skills (e.g., the ability to regulate emotion and appropriately direct attention). However, there remain many potentially important qualitative differences in PS use that we didn’t examine using our measures and that may be useful to consider in future research. For example, there are different types of imagery (e.g.,

cognitive and motivational) and these may have different relations with mental toughness (Mattie & Munroe-Chandler, 2012). With regard to understanding the broader predictors of mental toughness in Thai athletes, the contribution of relevant sociocultural factors (e.g., poverty, family pressures, collectivism, etc.) are unknown and warrant further study with mixed methods approaches that combine an understanding of dispositional traits, characteristic adaptations, and the narrative identity of athletes (e.g., Coulter, Mallett, & Singer, 2018).

Conclusion

Using latent profile analysis to compare the reported use of PS across athletes, we replicate previous findings (Ponnusamy et al., 2018) to show that there are quantitative, rather than qualitative differences in PS use across athletes. Further, we show that PS are positively associated with both self and coach-rated mental toughness.

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