The final article is available, upon publication, at: http://doi.org/10.1037/spy0000146

Running head: MENTAL TOUGHNESS AND TRAINING IN SWIMMING

The Mediating Role of Training Behaviours on Self-Reported Mental Toughness and Mentally Tough Behaviour in Swimming

Stuart Beattie[1], Ahmad Alqallaf[2], Lew Hardy[1], & Nikos Ntoumanis[3]

Institute for the Psychology of Elite Performance

Bangor University, Gwynedd, UK[1]

School of Physical Education.

College of Basic Education, Kuwait[2]

School of Psychology and Speech Pathology

Curtin University, Perth, Australia[3]

Date of submission;

11th April, 2018

Abstract

Self-regulated training behaviours plays a vital role in athletes' physical and mental sporting development. The purpose of the present study was to investigate the mediating role of self-regulated training behaviours (self and coach rated) on the relationship between self-reported Mental Toughness (MT) and coaches perceptions of swimmers Mentally Tough behaviour (MTb) in competition. A second purpose of the study was to examine how discrepancies in coach and athlete perceptions of training behaviours related to coach perceptions of swimmers MTb in competition. A sample of 12 swimming coaches (11 men and 1 women) and 208 of their competitive swimmers (86 men and 122 women) participated in the study. The swimmers completed self-report assessments of MT and self-regulated training behaviours. The coaches completed questionnaires regarding observations of their swimmers MTb in competition and a smaller pool of items from the athletes self-regulated training behaviours questionnaire. Findings supported our hypotheses that MT was positively related to self-regulated training behaviours (self and coach rated) and training behaviours was positively related to coach rated MTb. Further, self-regulated training behaviours (β = 0.12; CI = 0.05 – 0.20) and coach rated perceptions of training behaviours (β = 0.07; CI = 0.03 – 0.13) mediated the relationship between self-report MT and coach rated MTb in competition. Finally, a significant amount of variance in MTb was accounted for (23%) only when there was agreement between the coach and the athlete regarding the level of self-regulated training behaviours. We recommend that future research examines what specific types of training behaviours positively influence MT.

Keywords: training behaviours, mental toughness, swimming, polynomial regression analysis, discrepancies

The Mediating Role of Training Behaviours on Self-Reported Mental Toughness and Mentally Tough Behaviour in Swimming

Athletes who regularly maintain a high level of performance and goal directed behaviour under a range of stressors are generally described as being mentally tough (e.g., Gucciardi, Hanton, & Mallett, 2012; Hardy, Bell & Beattie, 2014). Mental toughness (MT) is a desirable skill allowing athletes to utilize a range of cognitive, emotional, and behavioural resources to maintain (or even improve) performance standards under pressure (e.g., Hardy et al., 2014; Gucciardi & Gordon, 2011). Research shows that MT contains state-like and trait-like factors. For example, Weinberg, Butt, Mellano, and Harmison, (2017) interviewed 12 elite performance academy tennis players on their perceptions of the stability of MT across different situations. They found that tennis players reported that they could be more mentally tough in some situations than others, supporting a state view of MT. Further, Gucciardi (2017) defined MT as "a state-like psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits" (p. 18). Indeed, while assessing MT across a 10-week period in a sample of undergraduate students, Gucciardi, Hanton, Gordon, Mallett and Temby (2015) found that in their 8-item measure of MT (Mental Toughness Index; MTI), 56% of the variance in MT could explained as a state-like concept that varies across situations (thus providing further support for Weinberg et al., 2017). However, this also indicates that a large amount of variance (44%) is also explained by trait-like between-person differences. This latter finding also supports research showing a behavioural genetic explanation in individual differences in MT across 219 sets of twins (Horsburgh, Schermer, Veselka, & Vernon, 2009).

MT and Mentally Tough behaviour

Recently, the over use of self-report MT questionnaires have been criticised based on the possible confound of social desirability and self-presentation issues (Hardy et al., 2014).

Recent research has also criticised the general overreliance of self-report MT questionnaires that make no obvious links to meaningful behavioural outcomes (e.g., Anderson, McCullagh, & Wilson, 2007). Hardy et al. (2014) also note that before one can make reasonable claims about the usefulness of cognitions, attitudes, and emotions that underpin qualitative assessments of MT, there needs to be an evaluation of whether Mentally Tough behaviour (MTb) has occurred (see also Gucciardi et al., 2015). In addition, MTb in sport tend to be assessed in highly stressful environments such as competitive situations. To this end, Hardy et al. (2014) developed their own informant rating of MTb in cricket where coaches rated eight MT behaviours of the cricketers they coached in a competitive environment. For example, coaches were asked how well their athletes could maintain a high level of performance in competitive matches "When the match is particularly tight". In a comprehensive study on a behavioural analysis on MT in soccer, Diment (2014) created a systematic observation instrument containing 15 different types of mentally tough behaviours assessed under competitive circumstances that were agreed upon by expert coaches and sport psychologists. These observed competition behaviours included players 'having a physical presence', playing with confidence' and 'quickly recovering after an error'. Others have also advocated a behavioural approach to assessing MT (Arthur, Fitzwater, Hardy, Beattie, & Bell, 2015; Beattie, Alqallaf, & Hardy, 2017; Bell, Hardy, & Beattie, 2013). Finally, in distinguishing the difference between MT and the behavioural component MTb, Anthony, Gordon, Gucciardi, and Dawson, (2017) described MTb as "a purposeful yet adaptable verbal or physical act that contributes positively to performance through the attainment and progression of self-referenced objectives or goals" (p. 5).

However, despite researchers claiming the importance of examining MTb in competition, and distinguishing it from quantitative assessments of MT, there has been little research directly examining the relationship between self-report assessments of MT and

informant ratings of MTb (Arthur et al., 2015; Gucciardi et al., 2015). Therefore, the first purpose of the study was to further examine the relationship between a self-report assessment of MT (i.e., the MTI; Gucciardi et al., 2015) and an informant rating of MTb in competition (i.e., the coach). Our first hypothesis predicted that higher levels of self-reported MT would be positively related to higher levels of informant ratings of MTb (i.e., the coach).

Training Environment effects upon MT

Research shows that in the very early stages of an athlete's career, the training environment plays a large part in the development of MT. For example, in an elite sample of female gymnasts, Thelwell, Such, Weston, Such and Greenlees (2010) found that training factors (e.g., simulating competition, competition preparation, overcoming problems, recover and train with injury, and learn new moves/complex skills) contributed to the development of MT. In a sample of elite level cricketers, Bull, Shambrook, James and Brooks (2005) found that the environment (e.g., exposure to foreign cricket and opportunities to survive early setbacks) was a strong foundation upon which MT develops. In a sample of elite cricket coaches, Gucciardi, Gordon, Dimmock and Mallett (2009) found that coaches who exposed their athletes to competition simulation, set challenging training environments, and emphasized improvement and enjoyment over winning, were important characteristics in developing MT. Further, Connaughton, Wadey, Hanton and Jones (2008) found that environmental factors such as coaches' leadership, vicarious experience, skill mastery, critical incidents, and social support, were perceived underlying mechanisms in the development of MT. In a survey of mentally tough adolescents from three performance contexts (i.e., sport, academia, and music) it was found that MT development was predicated by significant others, supportive social processes, critical incidents, and curiosity (Mahoney, Gucciardi, Mallett, & Ntoumanis, 2014). The above research also indicates that successful interactions with the training environment fosters the development of a range of MT

characteristics such as being tough in character, attitude and thinking (Bull et al., 2005); being able to handle pressure, increased self-belief and resilience (Gucciardi et al., 2009); and having a heightened awareness, being persistent and optimistic (Mahoney et al., 2014).

MT effects upon the Training Environment

However, as the athletes career progresses, there appears to be a role reversal in the relationship between the training environment and MT. That is, after MT beliefs are established, such beliefs are then used to deal with tough training environments. For example, Driska, Kamphoff, and Armentrout (2012) found that in their interview with high level swimming coaches from the United States, MT was invaluable in training contexts. That is, the coaches noted that MT swimmers pushed themselves to the limit in training by being relentless, controlling their training environment, pushing themselves into pain zones where most swimmers would not go, swimmers had vision and goals that justified their need for relentless effort, and MT swimmers retained emotional and psychological control on poor training days. Finally, MT swimmers appeared to have developed a strong sense of self-regulated training behaviours and did extra things in training that the coach did not ask for. However, Driska et al. (2012) did not use any quantitative assessments of MT to quantify the link between MT and self-regulated training behaviours. Therefore, a second purpose of the study was to examine such a relationship. Our second hypothesise predicted that a strong and positive relationship would occur between MT and self-regulated training behaviours (self and coach rated).

Self-Regulation and Training

Self-regulation refers to "the many processes by which the human psyche exercises control over its functions, states and inner processes" (Vohs & Baumeister, 2007, p 1). Self-regulation has been linked to goal directed behaviour via the regulating processes of thoughts, emotions, impulses, appetites, task performances and attentional processes (Vohs &

Baumeister, 2007). More pertinent to the current study is the self-regulation of behavioural maintenance (e.g., choosing to repeat certain behaviours until they manifest themselves as habits; Wood, 2016). Habits often originate from repeated goal-directed behaviours (e.g., prolonged swim training), and once they are formed they can be resistant to lapses in self-control due to boredom, high levels of stress, or lack of willpower (Neal, Wood, & Drolet, 2013). Therefore, self-regulation seems particularly important for athletes who spend long arduous hours in a confined training environment especially in the sport under current investigation that is, swimming.

In examining self-regulation and swim training, Young and Starkes (2006a) identified seven non-regulated training behaviours that helped to identify ineffective swim training, namely, poor attendance, off-task in warm-up, incomplete volume in warm-up, incomplete volume for the entire workout, inaccurate recall of pace times, last to arrive on the pool deck, and unfocused during kick sets. Interestingly, in a follow-up study, Young and Starkes (2006b) found that swimmers who showed higher levels of self-regulatory behaviours (i.e., showed high on-task behaviours) completed significantly higher swim volume in training. Therefore, in relation to the findings from Driska et al. (2012) and Young and Starkes (2006b), our third hypothesis is that self-regulated training behaviours will have a strong and positive relationship with MTb in competition. But perhaps more importantly, as research indicates that individuals high in MT train harder, and self-regulated training behaviours will lead to higher levels of MTb in competition, our fourth hypothesis predicted that training behaviours will mediate the relationship between self-assessed MT and coach rated MTb in competition.

Congruence between athlete and coach perspectives of training upon MTb

Finally, we set out to examine what (if any) congruence existed between the athlete and the coach on their perceptions of self-regulated training behaviours and how these beliefs

predicted MTb in competition. For example, Vazire (2010) and Vazire and Mehl (2008) found that both self and significant others possess unique insights into how an individual typically behaves. To examine these viewpoints, both the swimmer and the coach completed a measure of self-regulated training behaviours. That is, the coach also reported training behaviours for each swimmer in the study. This enabled us to examine how discrepancies between the athletes vs. observer (i.e., coach) ratings of training behaviour predict coach ratings of MTb by using polynomial regression analysis (e.g., Shanock, Baran, Gentry, Pattison, & Heggestad, 2010). Polynomial regression analysis allows the examination of the combined relationship between two predictor variables upon an outcome variable, particularly when discrepancies between the two predictor variables are important. We use this technique to examine the combined view of athlete and coach ratings of self-regulated training behaviour upon coach rated MTb. Research examining coach athlete relationships, show that emphatic accuracy (a capacity to perceive the psychological condition of another, such as thoughts, feelings, moods, motivations, and reasoning behind behaviour [Ickes, Stinson, Bissonnette, & Garcia, 1990]) leads to a higher level of coach-athlete relationship satisfaction (e.g., Lorimer & Jowett, 2009). Further, the successful interaction between the coach and the athlete in the training environment positively influences performance (e.g., Jowett & Poczwardowski, 2007). Therefore, our fifth hypotheses predicted that a stronger relationship between training and MTb in competition would occur when the coach and the athletes' viewpoint regarding self-regulated training behaviours are congruent, compared to when they are incongruent.

Method

Participants

Twelve UK swimming coaches (11 men and 1 women M_{age} = 49.77, *SD* = 15.60) and 208 of their competitive swimmers (86 men and 122 women M_{age} = 14.82, *SD* = 2.29)

completed the study. Coaches had on average 21.80 years (*SD* = 12.09) of coaching experience and the swimmers had 5.13 years (*SD* = 2.54) of competitive experience. Coaches rated training behaviours on a range of 6 to 34 of their own athletes. The average cluster size was 1 coach to 17 athletes. Power analysis indicated that 109 participants were required for detecting a moderate indirect effect (partial r for all paths = .30, alpha = .05 and power = .80) (MedPower; Kenny, 2017).

Measures

Mentally Tough Behaviour in Competition. We used the Swimming Mental Toughness Inventory (Beattie et al., 2017) as a measure of informant rating of a range of MT behaviours in competitive swimming (see also Hardy et al., 2014). The Swimming Mental Toughness Inventory contains 11 items and asks the coach to rate their swimmers on the following stem; "Swimmer X is able to maintain a high level of performance in competitive meets even when…" The inventory contains items such as "S/he has a number of events during a competition"; "S/he has underperformed after swimming several races during a meet"; "S/he is swimming up an age group and/or against a national squad member"; and "S/he has to achieve a National qualifying time". Items were scored from 1 (*never*) to 7 (*always*) with a midpoint of 4 (*sometimes*). Beattie et al. reported adequate fit statistics for the Swimming Mental Toughness Inventory (χ^2 [44 / 58.92 = 1.33]; CFI = 0.97, RMSEA = .042, SRMR = .045, Cronbach's Alpha = .91). In this study, we also test the concurrent validity of the Inventory. However, due to limitations of Cronbach's Alpha (i.e., the conservative nature of Cronbach's Alpha yields estimates of reliability that are too small, making measure look less reliable), McNeish (2017) recommends using Omega values[1]. These are reported throughout.

[1] The interested reader can calculate these values using an excel spreadsheet from here https://sites.google.com/site/danielmmcneish/acdemic-work/reliability

Mental Toughness Index. The Mental Toughness Index (Gucciardi et al., 2015) is a single factor 8 item measure that asks athletes to rate the extent to how the 8 items reflect how they typically thought, felt and behaved in their sport, in this case swimming. The MTI contains items such as "I believe in my ability to achieve my goals" and "I consistently overcome adversity". The Index is rated on a scale of 1 = *false, 100% of the time* to 7 = *true, 100% of the time*. Gucciardi et al. reported Cronbach's alpha for the Mental Toughness Index at .86. In the current study, Omega was .98.

Self-Rated Training Behaviours. As no measure presently exists that specifically assesses self-regulated training behaviours in swimming, we selected 11 items from a larger pool of regulated and non-regulated swimming training behaviours reported by Young and Starkes (2006b). The 11 items were selected based on them being highly effective training behaviours (see Young & Starkes, 2006b) and scored on a Likert scale ranging from 1 (*Strongly Agree*) to 9 (*Strongly Disagree*). Sample items include "I attend all training practices" and "I am continuously active and engaged in warm-up" (see Table 1). In the current study, Omega value reached .98.

Coach-Rated Training Behaviours. To obtain an informant rating of training behaviours from the coach, we selected five items from the athletes self-regulated training behaviours questionnaire upon which the coach could report. Out of the 11 items reported above, these five items were selected based upon coaches rating them as the most effective training habits (Young & Starkes, 2006b). We only used 5 items as we did not want to overburden the coaches who were also completing 11 items from the Swimming Mental Toughness Inventory for each swimmer. The wording of the items changed slightly from above. That is, we used the stem, "Swimmer X (name)" followed by the five items e.g. "Is continuously active and engaged with warm up" and "Always completes the prescribed swim

volume in warm-up". Items were scored from 1 (*Strongly Agree*) to 9 (*Strongly Disagree*) (see Table 1). In the current study, Omega values reached .98.

Procedure

After obtaining University ethical approval, 12 swimming coaches and 208 swimmers agreed to take part in the study. To obtain reliable informant data, we requested that all coaches should have coached their athletes for a minimum of 1 year. Questionnaire packs, consent and information sheets were hand delivered to the coach and their swimmers. The coach completed the Swimming Mental Toughness Inventory and the 5-item Coach-Rated Training Behaviour scale for each competitive swimmer they were coaching. The swimmer completed the Sport Mental Toughness Questionnaire, Mental Toughness Index, and the 11-item Self-Rated Training Behaviours Questionnaire at home, and returned them to their coach in a sealed envelope. All questionnaires packs were collected by hand or posted by the coaches within 10 weeks of being handed out.

Results

Descriptive Statistics

Means, standard deviations, and correlations for the variables measured in this study are displayed in Table 2.

Measurement Validation

We used confirmatory factor analysis with Mplus version 7 (Muthén & Muthén, 2012) to test the factor structure of the 11-item Swimming Mental Toughness Inventory, the 11-item Self-Rated Training Behaviours Questionnaire, and the 5-item Coach-Rated Training Behaviours Questionnaire. As we had a nested data structure (i.e., 12 coaches rated 208 swimmers), it is recommended that the Cluster command is used to control for nested data at the coach level. We used recommendations from Hu and Bentler (1999), in that a model was considered as having a good fit if the χ^2/df ratio was less than 2.00 the comparative fit index

(CFI) was greater than 0.90 but approached 0.95, the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR) were less than 0.08 but approached 0.05. CFA results for the 11-item Swimming Mental Toughness Inventory offered evidence of a satisfactory statistical fit, χ^2 (44 / 58.92 = 1.77; $p < .01$), CFI = 0.92, RMSEA = 0.06, SRMR = 0.05, supporting concurrent validity for the measure (Beattie et al., 2017). CFA results for the 11-item Self-Rated Training Behaviours Questionnaire also displayed a statistically adequate fit, χ^2 (44 / 72.53 = 1.64; $p < .01$), CFI = 0.91, RMSEA= 0.06, SRMR = 0.05. Regarding CFA results for the 5-item Coach-Rated Training Behaviours Questionnaire, fit statistics failed to reach recommended levels, χ^2 (5 / 13.57 = 2.71; $p < .05$), CFI = 0.95, RMSEA= 0.09, SRMR = 0.03. Upon examination of the modification indices, factor loadings and item content, items 2 and 3 had high cross loadings. Therefore, we removed item 3 (see Table 1). This resulted in a good statistical fit, χ^2 (2 / 3.21 = 1.60; $p = .20$) CFI = 0.99, RMSEA = 0.05, SRMR = 0.01.

Mediating Effects of Self-Rated Training Behaviours on the Relationship between Self-Report MT and MTb (Swimming Mental Toughness Inventory[2]).

We tested our hypotheses regarding the mediating effects of Coach and Athlete-Rated Training Behaviours upon the relationship between self-report MT (i.e., the Mental Toughness Index) upon coach rated MTb in competition using PROCESS (Hayes, 2013) with 5,000 bootstrap samples. Lower and upper bound 95% confidence intervals (CI) that do not encompass zero indicate significance at the .05 level (see Table 3). To control for nested data at the coach level, all subsequent mediation analyses were conducted using the cluster command for coach. Finally, as MT has been shown to increase across the life span of an athlete and that male and female athletes mature at different rates (Connaughton, Hanton, &

[2] For ease of interpretation, where possible, we refer to MTb (Mentally Tough behaviour) in competition rather than the Swimming Mental Toughness Inventory.

Jones, 2010), we controlled for the possible influences of athlete gender, age, athlete competitive experience in years and coaching experience in years.

Self-rated training behaviours. Model 1 examined the mediating role that Self-Rated Training Behaviours has upon the relationship between self-rated MT (Mental Toughness Index) and MTb in competition. The demographics explained 3% of the total variance in coach assessed MTb and only the path between athlete experience and coach rated MT behaviours was significant (β = 0.08; CI = .007 –0.15). After controlling for the demographics, all paths in the model were significant and positive (although the direct path between MTI and coach ratings of MTb was marginally significant; $p = .06$). Further, Self-Rated Training Behaviours had a significant and positive indirect effect (β = 0.12; CI = 0.05 – 0.20). The Mental Toughness Index (and demographics) explained 37% of the variance in Self-Rated Training Behaviours (F (16, 189) = 6.91, $p < .001$). Together, the Mental Toughness Index and Self-Rated Training Behaviours (and demographics) explained 26% of the variance in the outcome variable MTb (F (17, 188) = 3.98, $p < .001$).

Coach-rated training behaviours. Model 2 examined the mediating role that Coach-Rated Training Behaviours has upon the relationship between self-rated MT (Mental Toughness Index) and MTb in competition. The demographics explained 4% of the total variance in coach assessed MTb and only the path between athlete experience and coach rated MT behaviours was significant (β = 0.08; CI = .008 – 0.16). After controlling for the demographics, all paths in the model were significant and positive. Further, Coach-Rated Training Behaviours had a significant and positive indirect effect (β = 0.07; CI = 0.03 – 0.13). The Mental Toughness Index (and demographics) explained 29% of the variance in Coach-Rated Training Behaviours (F (16, 189) = 4.95, $p < .001$). Together, the Mental Toughness Index and Coach-Rated Training Behaviours (and demographics) explained 33% of the variance in the outcome variable MTb (F (17, 188) = 5.42, $p < .001$; see Table 3).

Polynomial Regression Analysis

We used polynomial regression with response surface analysis (Shannock et al., 2010), to examine what extent coach-athlete discrepancies in reported athlete training behaviours predicted coach rated MTb in competition. This technique has more exploratory potential than moderation analysis or difference scores (Shannock et al., 2010). According to Fleenor, McCauley and Brutus (1996), discrepancies occur when a participant has a score on a predictor variable that is half a standard deviation above or below the standardised score of the other predictor variable. Using this recommendation, out of the 208 responses in the current sample, 65 athletes rated their training behaviours higher than their coach did. Seventy athletes rated their training behaviours lower than their coach did. Finally, 73 coach-athlete responses were in general agreement regarding training behaviours.

Shanock et al. (2010) propose three types of questions can be answered via polynomial regression. The first examines how agreement between the two predictor variables relate to the outcome variable. The second examines how the degree of discrepancy between the two predictor variables relate to the outcome variable. The third examines how the direction of the discrepancy between the two predictor variables relate to the outcome variable. At a simple regression level, results revealed a significant quadratic relationship between the coach's ratings of athlete training behaviours and MTb (see top tier of Table 4). Showing that at this level of analysis, the coach's perception of training predicted MTb in competition in a non-linear fashion.

Polynomial Regression Results

As hypothesised, results revealed that coach-athlete perspectives of training behaviours significantly predicted MTb (b = 0.42; p = .03). That is, when both the coach and the athlete agreed that training behaviours were high, then MTb was high. When both parties agreed that training behaviours were low, MTb was also rated low (see solid line from back

left corner to front right corner in Figure 1). Further the degree of the discrepancy (e.g., the size of discrepancy) between the two predictor variables was not related to MTb, as the slope from front left corner to back right corner is generally flat (see dashed line of Figure 1). Subsequently, the direction of the discrepancy was also not related to MTb. That is, it did not matter whether the athlete rated training higher (front left corner) or lower (back right corner) than the coach. In total, training behaviours predicted 22.83% of the variance in coach rated MTb (see Table 4).

Discussion

Due to a lack of research directly testing the relationship between self-assessments of MT and meaningful behavioural outcomes (Anderson et al., 2007; Arthur et al., 2015; Gucciardi et al., 2015; Hardy et al., 2014), part of the study's aim was to examine such relationships. A further aim of the study was to examine whether self-regulated training behaviours would have an indirect effect upon the relationship between self-report assessments of MT and coach rated assessment of MTb in competition. The final purpose of the study was to examine what (if any) discrepancies existed between coach and athlete perceptions of self-regulated training behaviours, and whether these perceptions (discrepant or not) predicted coach ratings of the athlete's MTb in competition.

Results supported our first hypothesis and previous research (Arthur et al., 2015; Gucciardi et al., 2015) that a significant and positive relationship occurred between self-report assessments of MT and coach rated MTb in competition (although it was marginal when self-rated training behaviours was used on model 1). With regards to our second hypothesis, previous research highlighted a possible link between MT and coach and athlete perceptions of self-regulated training behaviours (Driska et al., 2012). Results supported this link in that, a significant and positive relationship occurred between MT and coach and athlete perceptions of self-regulated training behaviours. Finally, with regards to our third

hypothesis, results revealed a positive relationship between self-regulated training behaviours (self and coach rated) with MTb in competition.

As noted in the introduction, the training environment is a major antecedent in developing MT (Anthony, Gucciardi, & Gordon, 2016; Bull et al., 2005; Gucciardi et al., 2009; Mahoney et al., 2014). Therefore, the second aim of the study was to examine the mediating role that athlete and coach-rated self-regulated training behaviours had upon the relationship between athlete self-report assessments of MT and coach rated assessment of MTb in competition. Findings supported the fourth hypothesis that coach and athlete ratings of self-regulated training behaviours mediated the relationship between self-report MT and coach rated MTb. In other words, the direct positive relationship between MT and coach rated MTb can partially be explained by how well the athlete trains (regardless of whether the coach or athlete assessed self-regulated training behaviours).

Concerning our final hypothesis, results revealed that coach rated MTb in competition was best accounted for when there was congruence between the viewpoint of the coach and the athlete's perceptions of self-regulated training behaviours (see front right corner to back left corner in Figure 1). It could be suggested that coach rated assessment of athletes MTb would be best predicted by coach ratings of athletes self-regulated training behaviours (single source data), but this was not the case. These results also concur with the viewpoint that a high level of self-peer agreement is normally demonstrated when behaviours are directly observable and are almost trait like (Hayes & Dunning, 1997). However, one interesting question remains as to why almost two thirds of the sample disagreed on the level of self-regulated training behaviours that the athlete demonstrated. Perhaps these coach-athlete dyads lacked emphatic accuracy and had poor meta-perceptions in the coach-athlete relationship (Lorimer & Jowett, 2009).

To the best of our knowledge, this is the first study to examine coach-athlete discrepancies in relation to perceived training behaviours upon coach assessment of athlete MTb. However, previous research has examined the relationship between coach and athlete's perceptions of athletes self-reported MT (Cowden, Anshel, & Fuller, 2014). In this study, 16 elite tennis players and their respective head and assistant coaches completed the Sports Mental Toughness' Questionnaire (SMTQ; Sheard, Golby, & van Wersch, 2009). The athletes rated themselves and the coaches rated their athletes. There was some agreement between the athletes and coaches on what the most important items reflecting MT in tennis are and there was general agreement on the tennis player's skill level. However, athletes generally rated their MT higher than their coach did and athlete MT did not correlate with their coach's ratings of MT. The authors noted that it is perhaps not clear whether the coaches could accurately appraise the athlete's self-perceptions of MT. In the current study there was a significant correlation (r = .22) between the coach and the athlete's perceptions of training behaviours. There was also general agreement regarding the ratings of training behaviours with the coach rating the athlete training behaviours with a mean of 6.81 (SD = 1.45) and the athlete rating training behaviours with a mean of 7.03 (SD = 1.05). Hence, congruence between a coach and the athlete's levels of MT may be best predicted when assessing overt behaviours rather than covert perceptions of MT.

The present results show how important self-regulated training behaviours are as a source of self-report MT and coach reported MTb in competition. According to Rothman, Baldwin and Hertel (2007), for training to become a habit, an individual must go through four behavioural change processes, initial response (e.g., enrolling in training), continued response (e.g., continued effort in training), maintenance (e.g., sustained effort to continue behaviour), and habit, (e.g., self-perpetuating pattern of behaviour). However, in the present study, the causal nature of the relationship between self-regulated training behaviours and MT is

unclear. It would perhaps seem that this relationship is reciprocal. That is, as athletes start training from a young age, then their training environment (e.g., simulated competitions, overcoming challenging environments, leadership, parental influence etc.) is a likely antecedent of MT (e.g., Bull et al., 2005, Connaughton et al., 2008, Connaughton et al., 2010, Gucciardi et al., 2009, Thelwell et al., 2010). However, as athletes start to compete under more difficult environments, the MT that they have developed from a younger age, may help them to deal with challenging training and performance environments at a later stage (Bell et al., 2013; Driska et al., 2012).

In the present study, the assessment of MTb in competition and self-regulated training behaviours were designed to encompass a wide array of positive and adaptive behaviours. However, what constitutes adaptive from maladaptive MTb is not as clear. For example, Driska et al. (2012) noted that coaches reported that athletes high in MT were characterised as "pushing themselves into pain zones where most swimmers would not go" (p. 196). The outcome of this behaviour clearly could go in two opposite directions i.e. injury or enhanced performance. Researchers have also suggested that athletes with high levels of MT may appraise risky situations as 'less risky' which may lead an athlete returning too soon from injury (Levy, Polman, Clough, Marchant, & Earle, 2006). However, research has yet to fully tackle the 'grey' area that exists between adaptive and maladaptive MT behaviours which seems a potentially fruitful avenue for further research.

One anonymous reviewer also suggested that the self-regulated training behaviours questionnaire used in the current study also contains elements of MTb. This may lead to a conceptual overlap with MTb in competition (e.g., Podsakoff, MacKenzie, & Podsakoff, 2016). That is, the attributes and themes developed in the MTb in competition questionnaire are based upon observable adaptive behaviours of athletes in stressful environments based upon a given definition of MT (see Hardy et al., 2014). The attributes and themes developed

in the self-regulated training behaviours questionnaire are based upon observable adaptive self-regulated behaviours displayed by athletes "whose training behaviours allow them to get the most out of their training" (Young & Starkes, 2006a; p. 56). One could easily argue that both questionnaires contain elements of MTb, and perhaps they do. However, one could also argue that many sport psychology questionnaires also assess elements of MTb. The difference here is that athletes who train well (self-regulated training), are not always the athletes who perform well (MTb in competition).

At an applied level, results show support that self-regulated training behaviours are a strong source of variance in self-reported MT assessments and coach rated MTb in competition. The strength of such relationships however depends on the perspective used. Nevertheless, training behaviours (self or coach rated) and self-report MT predicted between 26% and 33% of coach rated MTb. Future research would do well to discover exactly what type of training behaviours best influences MT and MT behaviour. For example, athletes who have well developed training strategies (Woodman, Zourbanos, Hardy, Beattie, & McQuillan, 2010) and emotional regulation skills e.g. cognitive reappraisal strategies (Christou-Champi, Farrow, & Webb, 2015; Mutz, Clough, & Papageorgiou, 2017), will be able to use such strategies in competition and hence perform better under pressure as indicated from coach ratings of MTb. Further, Bell et al. (2013) found that when used in a transformational manner, repeated exposure to punishment-conditioned stimuli in the training environment increased coach-rated MTb in competition and competitive performance statistics in a sample of elite young cricketers.

A strength of the study lies in our use of dual assessments of self-regulated training behaviours and an observational assessment of MTb in competition. Using multiple perspective in this case avoids an overreliance upon single source cross-sectional data sets. In fact, the use of informant observational data has become more popular in recent years when

examining the usefulness of self-report personality and MT constructs (Anderson et al., 2007; Arthur et al., 2015; Beattie et al., 2017; Gucciardi et al., 2015; Hardy et al., 2014). However, limitations in the current study is that the coach completed a smaller number of training behaviour items (4) compared to the athlete (11). We would have liked to have an equal number of items in both perspectives, but this would likely have put an extra burden on the coach (completing 22 items for each swimmer they coached may have deterred some coaches from completing the study). Further, although the outcome variable MTb in competition assessed how an athlete generally competes across time, the cross-sectional nature of the data prevents us from inferring causality. Future research would have to follow many athletes across perhaps many years to assess the reciprocal relationship between MT, training behaviours and MTb in competition.

In summary, there is a vast amount of research examining possible antecedents of MT. However, research is still in its infancy with regards to assessing and developing informant reports of MTb. The current study has shown that self-regulated training behaviours seems to be a strong antecedent in both assessments of self-report MT and informant ratings of MTb and indeed has an indirect effect upon this relationship. Regardless of perspective, at its worst, self-regulated training behaviours and self-assessed levels of MT explained 26% of the variance in informant ratings of athlete MTb. Future research may want to explore exactly what type of training behaviours are more beneficial in developing MT and coach rated MTb and how exactly does the coach-athlete relationship moderate such effects.

References

Anderson, M. B., McCullagh, P., & Wilson, G. H. (2007). But what do the numbers really tell us?: Arbitrary metrics and effect size reporting in sport psychology research. *Journal of Sport and Exercise Psychology, 29*, 664-672. doi.org/10.1123/jsep.29.5.664

Anthony, D. R., Gordon, S., Gucciardi, D. F., & Dawson, B. (2017). Adapting a behavioural coaching framework for mental toughness development. *Journal of Sport Psychology in Action, 9,* 32-50. doi.org/10.1080/21520704.2017.1323058

Anthony, D. R., Gucciardi, D. F., & Gordon, S. (2016). A meta-study of qualitative research on mental toughness development. *International Review of Sport and Exercise Psychology, 9,* 160-190. doi:10.1080/1750984X.2016.1146787

Arthur, C. A, Fitzwater, J., Hardy, L., Beattie, S., & Bell, J. (2015). Development and validation of a military training mental toughness inventory. *Military Psychology, 27,* 232-241. doi.org/10.1037/mil0000074.

Beattie, S., Alqallaf, A., & Hardy, L. (2017). The effects of punishment and reward sensitivities on mental toughness and performance in swimming. *International Journal of Sport Psychology*, *48,* 246-261. doi: 10.7352/IJSP.2017.48.246

Bell, J., Hardy, L., & Beattie, S. (2013). Enhancing mental toughness and performance under pressure in elite young cricketers: a 2 year longitudinal intervention. *Sport, Exercise, and Performance Psychology, 2*, 281-297. doi.org/10.1037/a0033129.

Bull, S. J., Shambrook, C. J., James, W., & Brooks, J. E. (2005). Towards an understanding of mental toughness in elite English cricketers. *Journal of Applied Sport Psychology*, *17*, 209– 227. doi:10.1080/10413200591010085.

Christou-Champi, S., Farrow, T. F., & Webb, T. L. (2015). Automatic control of negative

emotions: Evidence that structured practice increases the efficiency of emotion regulation. *Cognition and Emotion, 29,* 319–331. doi: 0.1080/02699931.2014.901213.

Connaughton, D., Hanton, S., & Jones, G. (2010). The development and maintenance of mental toughness in the world's best performers. *The Sport Psychologist, 24,* 168–193. doi.org/10.1123/tsp.24.2.168.

Connaughton, D., Wadey, R., Hanton, S., & Jones, G. (2008). The development and maintenance of mental toughness: Perceptions of elite performers. *Journal of Sports Sciences, 21,* 83–95. doi:10.1080/02640410701310958.

Cowden, R. G., Anshel, M. H., & Fuller, D. K. (2014). Comparing athletes' and their coaches' perceptions of athletes' mental toughness among elite tennis players. *Journal of Sport Behaviour, 37,* 221-232. https://www.questia.com/library/journal/1G1-378247830/comparing-athletes-and-their-coaches-perceptions

Diment, G. M. (2014). Mental Toughness in Soccer: A Behavioural Analysis. *Journal of Sport Behaviour, 37,* 317-332. doi.org/10.1037/t01346-000

Driska, A. P., Kamphoff, C., & Armentrout, S. M. (2012). Elite swimming coaches' perceptions of mental toughness. *The Sport Psychologist, 26,* 189–206. doi.org/10.1123/tsp.26.2.186.

Fleenor, J. W., McCauley, C. D., & Brutus, S. (1996). Self-other rating agreement and leader effectiveness. *Leadership Quarterly, 7,* 487–506. doi.org/10.1016/S1048-9843(96)90003-X.

Gucciardi, D. F. (2017). Mental toughness: Progress and prospects. *Current Opinion in Psychology, 16,* 17-23. doi.org/10.1016/j.copsyc.2017.03.010.

Gucciardi, D. F., & Gordon, S. (Eds.). (2011). *Mental toughness in sport: Developments in research and theory.* Abingdon, Oxon, UK: Routledge.

Gucciardi, D. F., Gordon, S., Dimmock, J. A., & Mallett, C. J. (2009). Understanding the coach's role in the development of mental toughness: Perspectives of elite Australian football coaches. *Journal of Sports Sciences, 27,* 1483–1496. doi.org/10.1080/02640410903150475.

Gucciardi, D., Hanton, S., Gordon, S., Mallet, C., & Temby, P. (2015). The concept of Mental Toughness: Tests of dimensionality, nomological network, and traitness. *Journal of Personality, 83,* 26–44. doi: 10.1111/jopy.12079.

Gucciardi, D. F., Hanton, S., & Mallett, C. J. (2012). Progressing measurement in mental toughness: A case example of the Mental Toughness Questionnaire 48. *Sport, Exercise, and Performance Psychology, 1,* 194–214. .doi.org/10.1037/a0027190.

Hardy, L., Bell, J., & Beattie, S. (2014). Mental Toughness and Reinforcement Sensitivity: Preliminary evidence for a neuropsychological model of mental toughness. *Journal of Personality, 82,* 69–81. doi: 10.1111/jopy.12034.

Hayes, A. F. (2013). *Introduction to mediation, moderation and conditional process analysis: A regression-based approach.* NY, USA: The Guilford Press.

Hayes, A. F., & Dunning, D. (1997). Construal processes and trait ambiguity: Implications for self–peer agreement in personality judgment. *Journal of Personality and Social Psychology, 72,* 664–677. doi.org/10.1037/0022-3514.72.3.664.

Horsburgh, V., Schermer, J.A., Veselka, L., & Vernon, P.A. (2009). A behavioural genetic study of mental toughness and personality. *Personality and Individual Differences, 46,* 100-105. doi:10.1016/j.paid.2008.09.009.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling, 6,* 1–55. doi:10.1080/10705519909540118.

Ickes, W., Stinson, L., Bissonnette, V., & Garcia, S. (1990). Naturalistic social cognition:

Empathic accuracy in mixed-sex dyads. *Journal of Personality and Social Psychology, 59*, 730–742. doi.org/10.1037/0022-3514.59.4.730.

Jowett, S., & Poczwardowski, A. (2007). Understanding the coach-athlete relationship. In S. Jowett, & D. Lavallee (Eds.), *Social psychology in sport* (pp 3–14). Champaign, IL: Human Kinetics.

Kenny, D. A. (2017, February). MedPower: An interactive tool for the estimation of power in tests of mediation [Computer software]

Levy, A. R., Polman, R. C. J., Clough, P. J., Marchant, D. C., & Earle, K. (2006). Mental toughness as a determinant of beliefs, pain, and adherence in sport injury rehabilitation. *Journal of Sport Rehabilitation, 15*, 245-254. doi.org/10.1123/jsr.15.3.245

Lorimer, R., & Jowett, S. (2009). Empathic accuracy, meta-perspective, and satisfaction in the coach–athlete relationship. *Journal of Applied Sport Psychology*, *21,* 201-212. doi: 10.1080/10413200902777289.

Mahoney, J. W., Gucciardi, D. F., Mallett, C. J., & Ntoumanis, N. (2014). Adolescent performers' perspectives of mental toughness and its development: The utility of the bioecological model. *The Sport Psychologist, 28*, 233-244. doi.org/10.1123/tsp.2013-0050.

McNeish, D. (2017). Thanks coefficient alpha, we'll take it from here. *Psychological Methods*. Advance online publication. doi:10.1037/met0000144

Muthén, L. K., & Muthén, B. O. (1998-2012). *MPlus User's Guide*. Seventh Edition. Los Angeles, CA: Muthén & Muthén.

Mutz, J., Clough, P., & Papageorgiou, K. (2017). Do individual differences in emotion

regulation mediate the relationship between mental toughness and symptoms of depression. *Journal of Individual Differences, 38,* 71-82. doi 10.1027/1614-0001/a000224.

Neal, D. T., Wood, W., & Drolet, A. (2013). How do people adhere to goals when willpower is low?: The profits (and pitfalls) of strong habits. *Journal of Personality and Social Psychology, 104,* 959-975. doi: 10.1037/a0032626.

Podsakoff, P, M., MacKenzie, S. B., & Podsakoff, N. P. (2016). Recommendations for creating better concept definitions in the organizational, behavioural, and social sciences. *Organizational Research Methods, 19,* 159-203. doi: 10.1177/1094428115624965.

Rothman, A. J., Baldwin, A. S., & Hertel, A. W. (2007). Self-regulation and behaviour change. Disentangling behavioural initiation and behavioural maintenance. In Baumeister, R. F., & Vohs, K. D. (2004). *Handbook of self-regulation: Research, theory, and applications* (p. 130-148). New York: Guilford Press.

Shanock, L. R., Baran, B. E., Gentry, W. A., Pattison, S. C., & Heggestad, E. D. (2010). Polynomial regression with response surface analysis: A powerful approach for examining moderation and overcoming limitations of difference scores. *Journal of Business Psychology, 25,* 543-554. doi 10.1007/s10869-010-9183-4.

Sheard, M., Golby, J., & van Wersch, A. (2009). Progress toward construct validation of the Sports Mental Toughness Questionnaire (SMTQ). *European Journal of Psychological Assessment, 25,* 186–193. doi:10.1027/1015-5759.25.3.186.

Thelwell, R., Such, B., Weston, N., Such, J., & Greenlees, I. (2010). Developing mental toughness: Perceptions of elite female gymnasts. *International Journal of Sport and Exercise Psychology, 8,* 170–188. doi.org/10.1080/1612197X.2010.9671941.

Vazire, S., & Mehl, M. R. (2008). Knowing me, knowing you: The accuracy and

unique predictive validity of self-ratings and other-ratings of daily behaviour. *Journal of Personality and Social Psychology, 95*, 1202–1216. doi:10.1037/a0013314

Vazire, S. (2010). Who knows what about a person? The self-other knowledge asymmetry (SOKA) model. *Journal of Personality and Social Psychology, 2*, 281–300. doi: 10.1037/a0017908

Vohs, K. D & Baumeister, R. F. (2007). Understanding self-regulation: An introduction. In Baumeister, R. F. & Vohs, K. D (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 1-9). The Guilford Press.

Weinberg, R., Butt, J., Mellano, K., & Harmison, R. (2017). The stability of mental toughness across situations: taking a social-cognitive approach. *International Journal of Sport Psychology, 48*, 280-302. doi.org/10.7352/IJSP 2017.48

Wood, W. (2016). The role of habits in self-control. In Vohs, K. D. & Baumeister, R. F. (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 95-108). The Guilford Press.

Woodman, T., Zourbanos, N., Hardy, L., Beattie, S., & McQuillan, A. (2010). Do performance strategies moderate the relationship between personality and training behaviours? *Journal of Applied Sport Psychology*, *22*, 183-197. doi: 10.1080/10413201003664673.

Young, B. W., & Starkes, J. L. (2006a). Coaches' perceptions of non-regulated training behaviours in competitive swimmers. *International Journal of Sports Science and Coaching, 1*, 53-68. doi: 10.1260/174795406776338427.

Young, B. W. & Starkes, J. L. (2006b). Measuring outcomes of swimmers' non-regulation during practice: Relationships between self-report, coaches' judgments, and video observation. *International Journal of Sport Science and Coaching, 1*, 131-148. doi: 10.1260/174795406777641320.

Table 1

Item and Mean Scores for the Self-Regulated Training Behaviours Questionnaire

Self-regulated training behaviour items	Athlete Mean (SD)	Coach Mean (SD)
1- I attend all training practices.*[r]	7.71 (1.20)	
2- I am continuously active and engaged in warm-up.* [r]	7.92 (1.32)	7.30 (1.62)
3- I always complete the prescribed swim volume in warm-up.* [r a]	5.87 (2.25)	7.35 (1.67)
4- I often fail to complete the prescribed swim volume because I miss repetitions or get out early.*	6.59 (2.22)	6.79 (1.87)
5- Sometimes I am unable to recall my pace times.*	6.74 (1.79)	
6- I am often unfocussed in dry-land training.	7.37 (2.09)	6.45 (1.94)
7- I always achieve the prescribed pace times. [r]	6.92 (2.17)	6.75 (1.53)
8- I am always one of the last to make it on to the pool deck.	6.88 (2.03)	
9- I always challenge myself during kick sets. [r]	6.45 (2.51)	
10- I often fail to attend to the technical aspects of the stroke during stroke sets.	7.51 (1.39)	
11-I am often reminded by my coach to be more into my training.	7.48 (1.91)	

Note. *Items used in coach training behaviours informant-rating CTB
[r] Denoted items that were reversed so that large values equate good training behaviours
[a] Item removed from the coach rated self-regulated training behaviours

Table 2

Means, Standard Deviations, and Correlations Among Variables of Interest

	Mean (SD)	CRTB	SRTB	MTI
CRTB	6.81 (1.45)			
SRTB	7.03 (1.05)	0.22**		
MTI	5.59 (0.95)	0.13[a]	0.56**	
SMTI	4.83 (0.74)	0.36***	0.33***	0.30***

CRTB; Coach rated training behaviours; SRTB; Self-rated training behaviours; MTI = Mental Toughness Index; SMTI = Coach rated mentally tough behaviour.
[a] = 0.06; *p < 0.05; **p < 0.01; ***p < .001

Table 3

The Mediating Effects of Training Behaviours (Self and Coach Rated) upon the Relationship Between Self-Report MT and Coach Rated MT Behaviour

Mental Toughness (MT)	Predictor (MTI) to mediator SRTB		Mediator (SRTB) to SMTI) (Y)		Direct effect MTI to SMTI (Y)		Indirect effect		95% CI	
	B	SE	B	SE	B	SE	B	SE	LL	UL
MTI	0.62***	0.07	0.19***	0.06	0.12[a]	0.06	0.12	0.04	0.05	0.20
	Predictor (MTI) to mediator (CRTB)		Mediator (CRTB) to SMTI (Y)		Direct effect MTI to SMTI (Y)		Indirect effect			
MTI	0.34**	0.10	0.20***	0.04	0.17***	0.05	0.07	0.02	0.03	0.12

Note. B = unstandardized regression coefficients; MTI = Mental toughness index; SE = Standard error; SRTB = Self-rated training behaviours; CRTB = Coach rated training behaviours; SMTI = Coach rated mentally tough behaviour; LL = lower limit of 95% confidence interval; UL upper limit of 95% confidence interval. [a] = .06; *p < 0.05; **p < 0.01; ***p < .001.

Table 4

Simple Regression and Surface Fitting Procedure Coefficients of Coach-Athlete Rated Training Behaviours upon Coach Rated MTb

	MT behaviour	
Variable	*b*	*(se)*
Constant	3.99	(0.18)***
Athlete ratings of training	0.29	(0.16)
Coach ratings of training	0.12	(0.07)
Athlete ratings x Coach ratings	-0.04	(0.03)
Athlete ratings squared	-0.01	(0.04)
Coach ratings squared	0.04	(0.02)*
R^2	0.23***	
Surface tests		
a_1	0.42	(0.19)*
a_2	-0.01	(0.05)
a_3	0.17	(0.16)
a_4	0.07	(0.05)

Note. a_1 = Slope along x = y; a_2 = Curvature on x = y; a_3 Slope along x = -y; a_4 = Curvature on x = -y

Figure 1. Coach and Athlete Ratings of Training Predicting Coach rated MT Behaviour.