DOCTOR OF PHILOSOPHY

# Examining the Interactive Effects of Mental Toughness, Self-Regulated Training Behaviors, and Personality in Swimming

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# Examining the Interactive Effects of Mental Toughness, Self-Regulated Training Behaviors, and Personality in Swimming

## Ph.D. Thesis

**Ahmad Salman Alqallaf**

**Thesis submitted to Bangor University in fulfilment of the requirements for the degree of Doctor of Philosophy at the School of Sport, Health, and Exercise Sciences.**

**2016**

# Contents

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Signed: **AHMAD ALQALLAF**.

## Thesis Abstract

The thesis contains five chapters that attempt to extend our understanding of Mental Toughness (MT) in relation to personality, swimming performance, training behaviours and MT behaviours. The thesis focuses predominantly on swimming environments, which can be very stressful and often require athletes to train long hours and perform under intense pressure. As such, it provides a useful context to investigate MT.

Chapter 1 critically reviews some of the previous MT research in the domains of qualitative research and quantitative research. The Chapter introduces personality as a possible trait explanation of MT and proposes that, even though training behaviours has been indicated as an important source of MT, it is yet relatively unexplored. The Chapter then sets out a series of questions upon which the thesis is based.

Chapter 2 focused on three aims. First, an informant rating of MT in swimming was developed (Coach Rated MT). Second, to replicate previous findings (Hardy, Bell, & Beattie, 2014), revised Reinforcement Sensitivity Theory (McNaughton & Gray, 2000) was used to predict coach rated MT behaviour. Our findings supported that of Hardy et al. (2014), that is, when reward sensitivity is low, increasing levels of punishment sensitivity positively related to MT behaviour; but when reward sensitivity was high, increasing levels of punishment sensitivity negatively relate to MT behaviour. Third, the thesis set out to investigate whether punishment and reward sensitivities could actually predict swimming performance. Our findings showed there was a significant punishment sensitivity and reward sensitivity interaction. That is, when reward sensitivity was low, as punishment sensitivity increased, swimming times improved. However, with high reward sensitivity as punishment sensitivity increased, swimming times reduced. However, findings showed that there was no significant correlation between coach assessed MT and actual swimming performance.

Chapter 3 examined the mediating role of training behaviours on self-report MT and MT behaviour in swimming. In this chapter swimmers completed three self-report MT measurements; the Psychological Performance Inventory-Alternative (PPI-A; Golby, Sheard, & van Wersch, 2007); the Sport Mental Toughness Questionnaire (SMTQ; Sheard, Golby, Wersch, 2009); and the Mental Toughness Index (MTI; Gucciardi, Hanton, Gordon, Mallett, &Temby, 2014). Swimmers and coaches also completed a measure of Self-Regulated Training Behaviours (SRTB) and the coach completed the Swimming MT Inventory (SMTI) to assess MT behaviour. Findings supported our hypothesis that self-regulated training behaviours (coach and self-rated) had a positive relationship with coach and self-rated MT. Further, training behaviours mediated the relationship between self-report MT and coach rated MT behaviour.

Chapter 4, examined three main personality profiles of psychoticism, extraversion, and neuroticism in relation to MT and training behaviours. To assess the swimmer's personality profiles we utilized the Eysenck Personality Questionnaire–Revised Short version (EPQR-S; Eysenck, Eysenck, & Barrett, 1985). Coaches completed the MT behaviour measure (CRTB) and the Quality of Training Inventory consisting of distractibility and coping with adversity. Findings revealed that swimmers characterized by high levels of both psychoticism and MT skills displayed higher levels of training and MT behaviours. That is, self-rated MT only had a positive relationship with training and MT behaviour when psychoticism was high.

Chapter 5 concludes the thesis. More specifically, the chapter provides a summary and integrated discussion of the thesis findings, implications, limitations, strengths and avenues for future research.

# Chapter 1

# General Introduction

## Mental Toughness

The concept of Mental Toughness (MT) in sport has attracted a good deal of scholarly debate over the past 15 years. Although scholars in sport psychology research have pained to define what MT is (see Gucciardi & Gordon, 2011), in layman's terms, a MT person seems to be able to maintain a high level of performance whilst under pressure to do so. To date, MT in sport has created numerous avenues of research (e.g., Clough, Earlem, & Sewell, 2002; Crust, 2009; Kaiseler, Polman, & Nicholls, 2009). For example, several researchers have investigated the development and maintenance of MT (e.g., Connaughton, Hanton, & Jones, 2010; Connaughton, Wadey, Hanton, & Jones, 2008). Several studies have looked at the characteristics of MT (e.g., Jones, et al., 2002; Jones, Hanton, & Connaughton, 2007; Loher, 1986; Thelwell, Weston, & Greenlees 2005). Whereas, others have examined MT from a personality trait-like approach (e.g., Hardy, Bell, & Beattie, 2014). From some of the studies reported above, research in MT has also proposed and tested MT interventions (e.g., Bell, Hardy, Beattie, 2013; Gucciardi, Gordon, & Dimmock, 2009).

Due to these different approaches used to investigate the concept of MT, the start of this review will first examine research in MT from both qualitative and quantitative approaches. The review will also examine the development and maintenance of MT from the perspective of coaches, athletes and sport psychologists. As the thesis utilizes a variety of MT assessments, a brief review of quantitative and behavioral assessments of MT follows. The introduction then moves on to examine how the training environment and in particular, self-regulated training behaviors could relate to self-report and behavioral assessments of MT. Finally, recent research has turned its attention to examining the relationship between personality and MT behavior. Hence, a review of how personality relates to MT completes the introduction.

### Qualitative research

Early qualitative studies examining MT tended to focus upon quantifying a definition of MT. For example, Jones et al. (2002) aimed to define what MT is, and to identify essential attributes that the MT performer had. After interviewing ten international athletes (Olympic and Commonwealth Standard) from different sports, Jones et al. (2002) defined MT as "having the natural or developed psychological edge that enables you to generally cope better than your opponents with the many demands (competition, training, lifestyle) that sport places on the performer. Specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure" (p. 209). Jones et al. (2002) went on to presented 12 attributes that are critical for any athlete to be mentally tough. These attributes generally linked to self-belief, desire and motivation, focus, coping with anxiety, and dealing with pain and hardship. Specifically Jones et al. (2002) reported that these attributes allows an athlete to 'have an unshakable self-belief in their ability to achieve their competition goals; being able to bounce back from performance set-backs; havin an increased determination to succeed; having an unshakable self-belief in possessing unique qualities and abilities that make you better than your opponent; having an insatiable desire and internalized motives to succeed; remain fully focused on the task at hand in the face of competition specific distractions; regaining psychological control following unexpected and uncontrollable events; pushing back the boundaries of physical and emotional pain; maintaining technique and effort under distress in training and competition; accepting that competition anxiety is inevitable and knowing that you can cope with it; not being adversely affected by others' good and bad performances; thriving on the pressure of competition; remaining fully-focused in the face of personal life distractions; and switching a sport focus on and off as required'.

Jones et al. (2002) pointed out that the attributes connected to *self-belief* included, having an unshakable self-belief in your ability to achieve your competition goals and having

an unshakable self-belief that you possess unique qualities and abilities that make you better than your opponents. The attribute of *bouncing back* from performance setbacks is characterized by an increased determination to succeed as well as having an insatiable desire and internalized motives for success.

**Development of MT across sports**

Qualitative research has also examined whether different types of sport influences MT characteristics. Interestingly, the majority of this research has been conducted on elite level athletes across a host of different sports. For example, while expanding upon Jones et al. (2002) findings, Thelwell, Weston, and Greenlees (2005) further examined MT characteristics that elite soccer players possessed. They found general support for Jones et al. (2002) definition (see above), with the exception that Thelwell et al. indicated that in order to be soccer MT, players should 'always cope better' than their opponents with the demands of the game, rather than just 'generally cope better'. Furthermore, Thelwell et al. found that soccer players identified 10 characteristics that closely related to the 12 MT characteristics found by Jones et al. These characteristics comprised of having total self-belief at all times that you will achieve success; wanting the ball at all times; having the ability to react to situations positively; having the ability to hang on and be calm under pressure; knowing what it takes to grind yourself out of trouble; having the ability to ignore distractions and remain focused; controlling emotions throughout performance; having a presence that affects opponents; having everything outside of the game in control; and enjoying the pressure associated with performance.

Bull, Shambrook, James and Brooks (2005) went on to examine the development of MT within elite English Cricket. Their first aim was to develop a greater understanding of what MT is within cricket. Second, they wanted to identify how existing cricketers developed MT. Based on their findings, Bull et al. proposed a MT pyramid with four main elements.

The first element labelled ‘environmental influence’. This element consisted of global themes including parental influence, childhood background, exposure to foreign cricket, opportunities to survive early setbacks, and needing to “earn” success. The second element labelled ‘tough character’. This element included the following global themes; independence, self-reflection, competitiveness with self as well as others, and resilient confidence. Third element labelled ‘tough attitudes’. This element comprised global themes such as belief in making the difference, exploit learning opportunities, belief in quality preparation, self-set challenging targets, never say die mindset, go the extra mile, determination to make the most of ability, thrive on competition, and willingness to take risks. The final element labelled ‘tough thinking’. This element covered global themes such as, overcoming self-doubts, feeding off physical condition, maintain self-focus, good decision-making, keeping perspective, and having an honest self-appraisal. In addition, researchers indicated that the environment influence element (e.g., parental influence and childhood background) played a vital role in the development of MT.

Jones et al. (2007) explored a framework of MT with reference to eight super elite athletes, three coaches, and four sport psychologists. Results found support for Jones et al. (2002) earlier definition of MT (see above), and revealed a further 30 attributes that are critical for athletes to be MT. These were categorized under four dimensions namely; attitude/mindset, training, competition, and post competition. The dimension of attitude/mindset categorized seven attributes into two subcomponents termed ‘belief’ and ‘focus’. The dimension of training consisted of six attributes categorized under three subcomponents of ‘using long-term goals as the source of motivation’, ‘controlling the environment’ and ‘pushing yourself to the limit’. The dimension ‘competition’ was considered by the authors as a vital dimension associated with mentally tough performance. This dimension contained 13 attributes categorized under five subcomponents of ‘handling

pressure', 'belief', 'regulating performance', 'staying focused', 'awareness and control of thoughts and feelings', and 'controlling the environment'. The final dimension, post-competition, included four attributes under two subcomponents, 'handling failure' and 'handling success'.

Thelwell, Such, Weston, Such, and Greenlees (2010) also investigated how MT is developed in a sample of ten elite British and American female gymnasts. Gymnasts identified 14 mechanisms that contributed to the development of MT under four categories: sport process (consisting of training, competition, and club support), sport personnel (consisting of coach, teammates, competitors, and sport psychologist), non-sport personnel (consisting of parents, siblings, and significant others), and the environment (consisting of training environment, family environment, modeling, and country support). Thelwell et al. (2010) pointed out that all participants agreed that MT could be developed throughout hard times, learning to deal with physical and mental pressure, learning to cope with adversity as well as positive experience and reinforced behaviors. The authors also pointed out that negative as well as positive experiences had a positive impact upon the development of MT.

In following on from this line of research, Gucciardi, Gordon, and Dimmock (2008) examined the components of MT in the sport of Australian football. After interviewing 11 male coaches, Gucciardi et al. defined MT as "a collection of values, attitudes, behaviors, and emotions that enable you to persevere and overcome any obstacle, adversity or pressure experienced, but also to maintain concentration and motivation when things are going well to consistently achieve your goals" (p. 218). The authors revealed three higher order components of mental toughness termed *characteristics, situations, and behaviors*. Eleven characteristics that reflected mental toughness (and their opposite label) were self-belief (vs. self-doubt); work ethic (vs. lazy); personal values (vs. poor integrity and philosophy); self-motivated (vs. extrinsically and unmotivated); tough (vs. weak attitude); concentration/focus

(vs. distractible/unfocussed); resilient (vs. fragile mind-set); handling pressure (vs. anxious and panicky); emotional intelligence (vs. emotional immature); sport intelligence (vs. lack of knowledge); and physical toughness (vs. weak sense of toughness). Regarding the situational component of MT, Gucciardi et al. indicated that players needed to demonstrate their MT across a variety of situations. These involved working through injury and rehabilitation, and preparation for upcoming challenges. Competition-specific situations contained external pressures e.g. hostile environments and uncontrollable match variables and internal pressures e.g. fatigue. Gucciardi et al. (2008) further indicated two components of MT behavior exhibited by MT players as general behaviors (recover well from injury, preparation, and consistence performances) and competition-specific behaviors (repeatable good performance, play well no matter their position, superior decision-makers, and do the1%er's).

**Maintenance of MT**

Although early research generally focused upon the development of MT, some researchers turned their attention to the maintenance of MT (e.g., Connaughton et al., 2008). To this end, Connaughton et al. re-interviewed seven participants from a previous study (i.e., Jones et al., 2002) to examine how specific MT attributes have been developed and maintained by. The findings revealed that MT developed across three distinct periods of an athlete's career (i.e., early, middle, and later years). Contributions to the development of MT in the early years included, coaches' leadership, social support, vicarious experience, demonstration of ability and parental influence. MT was influenced in the middle years by competitive rivalry, critical incidents, insatiable desire and internalized motives to succeed, and social support. Finally, MT development over later years were influenced by competitive rivalry, social support, demonstration of ability, mental preparation, pre-performance routines, and process goals. Three characteristics were also highlighted as being important to the maintenance of MT. These were, an insatiable and internalized strong desire and

motivation to succeed, sporting and non-sporting personnel support networks, and effective use of basic and advanced psychological skills. Connaughton et al. (2008) also revealed that MT will be at its strongest after 3 years of competing at the highest level. However, like any other psychological resource, MT needs to be maintained with effort or it starts to dissipate.

Connaughton et al. (2010) extended this line of research to further investigated the development and maintenance of MT in a sample of super elite athletes (7 athletes, 2 coaches and 2 sport psychologists) that had previously participated within Jones et al. (2007) study reported above. Findings revealed that MT was developed over four distinct career phases involving three development phases, beginner to intermediate level, intermediate to elite level, elite to Olympic/World Champion level and one maintenance phase. Connaughton et al. (2010) pointed out that underlying themes (e.g., skill mastery, being competitive, observation of older elite performers, increased expectation of success, sporting and nonsporting support network, good communication, using mental skills, challenges in training, positive and negative incidents, and education) contribute to developing MT across the three separate phases. Further underlying themes (e.g., setting new challenging goals, developing training and competition routines, acquiring balance between sport and life, and mental skills, play an important role in the maintenance of MT.

**Coach perceptions of developing MT**

One limitation of the MT research highlighted by Gucciardi, Gordon, Dimmock, and Mallett (2009) is that the coaches' role in developing MT in athletes had largely been ignored. Therefore, within a sample of Australian football athletes, Gucciardi et al. examined what role the coach had in developing or indeed hindering the development of MT. Eleven coaches were re-interviewed from Gucciardi et al. (2008) (see above). Results showed four factors contributed to develop mental toughness. These classifications were termed as, coach–athlete relationship (e.g., trust and respect the coach and establish and maintain

positive relationships), coaching philosophy (e.g., prioritize player development over coaching success and help players acquire an understanding of Australian football), training environments (e.g., continuously challenge players and expose them to challenges and pressures), and the development of specific strategies (e.g., developing game awareness and coach behaviors). The authors also noted that one factor that impeded MT was negative experiences provided by coach. However, if the coach taught the athletes how to overcome negative experiences, then they facilitated the development of MT (see also Bell et al., 2013). Findings supported their hypothesis that coaching philosophy plays an essential role in the development of MT. Finally, in line with previous research presented above, MT development initiates with parental influence, after which the coach plays a more crucial role in developing MT characteristics as the athlete makes the transition to sport.

While examining MT in soccer, Coulter, Mallett, and Gucciardi (2010) examined the perceptions of 4 male coaches, 6 male players and 3 mothers and 2 fathers (from 4 of the aforementioned players) on the key characteristics and their contrasts, situations demanding mental toughness, and the behaviours displayed and cognitions employed by mentally tough soccer players. Findings revealed that having a winning mentality, desire, self-belief, physical toughness, work ethic/motivation and resilience were key attributes in MT soccer players. Key cognitions such as optimism, positive self-talk, concentration on simple plays, perseverance and determination also allowed athletes to remain focused and competitive during training and matches.

Weinberg, Butt, and Culp (2011) further investigated coaches' perceptions of MT and the approaches they used to develop MT in their athletes. After interviewing 10 National Collegiate Athletic Association head coaches from a range of sports, 3 higher order MT themes were proposed: psychological skills (focus, confidence, knowledge and mental planning), motivation to succeed (motivation to work hard and persistence), and resilience

(rebound from setbacks and handling and performing under pressure). These themes linked to tough physical practice environment (e.g., intense competitive practices and tough physical conditioning), positive mental environment (e.g., creating a confident and positive atmosphere and expectations), and providing MT learning opportunities (observing, visualizing, teaching and highlighting MT qualities).

Using the MT framework of Jones et al. (2007), Driska, Kamphoff, and Armentrout (2012) interviewed thirteen highly experience swimming coaches with two main purposes. First, they wanted to determine what MT characteristics are present in MT swimmers and second, to investigate how these MT characteristic are developed. Findings supported eleven of the thirteen subcomponents derived from Jones et al. (2007; see above), as well as a further two subcomponents named coachability and retaining psychological control on poor training days. In terms of coachability, athletes who fitted this dimension were receptive to the coach's feedback (positive and negative), communicated effectively, and bought into the team's philosophy. Athletes who retained psychological control on poor training days were able to control emotional responses and had a broader range of mental skills e.g. arousal regulation, self-talk, and better use of cognitive strategies such as goal setting. In terms of how coaches developed MT, results confirmed three higher order themes. First, the coach was challenging, demanding and had high expectations. Second, the coach had an approach to training and workout planning that developed MT. Third, the coach had developed a motivational climate that fostered MT. In terms of swimmers, actions that developed MT also confirmed three higher order themes. First, the swimmers prepared methodically and rigorously. Second, the swimmers used psychological skills and cognitive strategies. Finally, the swimmers had experienced and overcome hardship in the sport.

Finally, Cook, Crust, Littlewood, and Nesti (2014) examined the perceptions of MT among 3 coaches and 5 support staff within English premier league soccer academy. Results

revealed four general themes of MT that generally supported Driska et al. (2012) and Weinberg et al. (2011). These themes were: competitiveness with self and others, mindset, resilience and personal responsibility. Further, the results showed that the development of MT consisted of two general dimensions: challenging but supportive learning environment, and encouraging independence and personal responsibility.

Even though qualitative research noted above has significantly enhanced our understanding of what some of the characteristics of MT are and how they are developed and maintained, such studies have been noted as being limited in differentiating between the causes, processes and outcomes of MT (e.g., Hardy et al., 2014).

**Quantitative research in MT**

Along with the development of qualitative research, several quantitative measures of MT have been developed. Some of these measures include: the Mental Toughness Questionnaire 48 (MTQ-48; Clough et al., 2002); the Cricket Mental Toughness Inventory (CMTI; Gucciard & Gordon, 2009); the Australian Rules football Mental Toughness Inventory (AfMTI; Gucciardi, Gordon, & Dimmock, 2009); the Mental Toughness Index (MTI; Gucciardi, Hanton, Gordon, Mallett, & Temby, 2014); the Psychological Performance Inventory (PPI; Loher, 1986); the Psychological Performance Inventory-Alternative (PPI-A; Golby, Sheard, & van Wersch, 2007); and the Sport Mental Toughness Questionnaire (SMTQ; Sheard, Golby, Wersch, 2009).

However, one limitation of such approaches is that there seems to be an abundant of factors associated with MT via quantitative assessment. For example, Loher's (1986) PPI consist of 42-items categorized into seven subscales termed self-confidence; negative energy control; attention control; visualization and imagery control; motivation; positive energy and attitude control. Golby et al.'s (2007) PPI-A consists of 14 items testing four subscales termed determination, self-belief, positive cognition, and visualization. Clough et al.'s (2002)

MTQ48 contains 48 items and six subscales termed challenge, commitment, emotional control, life control, confidence in abilities, and interpersonal confidence. Sheard et al.'s (2009) SMTQ consists of 14 items and three subscales (confidence, constancy, and control). Gucciardi et al.'s (2014) MTI contains 8 items framed within a unidimensional construct. Therefore, as in the qualitative research reviewed above, there appears to be a wide range of factors that are associated with MT.

**Sport specific quantitative measures**

According to Gucciardi et al. 2009 (and others e.g., Anderson, 2011) one limitation of quantitative research in MT is that different sports may require different context specific dimensions of MT. For example, it is quite clear that specific dimensions of MT required in snooker, may be quite different to specific dimensions of MT required in rugby. Therefore, Gucciardi et al. (2009) developed a sport specific measure of MT in Australian football (AfMTI). The AfMTI is a 24-item measure consisting of four subscales (consisting of thrive through challenge, sport awareness, desire success, and tough attitudes). Gucciardi & Gordon, (2009) further developed and validated a Cricket specific measure of MT. This inventory examined the following components over 15 items; affective intelligence, desire to achieve, resilience, attentional control, self-belief and cricket smarts (see Gucciardi & Gordon, 2011). However, it appears that these assessments just add to the list of MT factors reported above.

**Research findings regarding quantitative assessments of MT**

Numerous research studies have examined the predictive validity of the MT assessments discussed above. For example, Golby et al. (2004) investigated MT and hardiness in 115 rugby league athletes of differing abilities (International, Super league, and Division). Hardiness was assessed by using the18-item Personal Views Survey III-R (Maddi & Khoshaba, 2001; containing three subscales, commitment, control, and challenge).

Findings revealed that International athletes reported significantly higher scores in all three hardiness subscales as well as in two of the seven MT subscales (negative energy control and attention control).

More recently, Crust (2009) examined the relationship between MT and affect intensity across 112 athletes in order to determine if athletes who were characterized with high levels of MT experienced more or less intense emotions. MT was assessed by the MTQ48 (Clough et al., 2002) with a measure of Affect Intensity (AIM- Larsen, 1984) to assess the levels of emotional reactivity. Findings demonstrated that overall MT as well as the six subscales of MT were unrelated to affect intensity. This suggests that athletes who are high in MT experience just as much affect intensity than their less MT counterparts. They perhaps just deal with it better.

Cowden, Weitz, and Asante, (2016) examined the relationship between MT, resilience, and stress upon a sample of 351 South Africa tennis competitors. They used the SMTQ (Sheard et al., 2009) to measure MT, the Resilience Scale for Adults (RSA; Friborg, Barlaug, Martinussen, Rosenvinge, & Hjemdal, 2005) to assess resilience, and a modified version of the Recovery-Stress Questionnaire for Athletes (RESTQ; Kellmann & Kallus, 2001) to assess stress recovery. Findings illustrated a positive relationship between overall MT (SMTQ mean scored) and resilience, and that mean MT was associated with lower levels of overall stress.

Nicholls, Polman, Levy, and Backhouse (2008) examined the relationship between MT and coping, MT and optimism, as well as coping and optimism on 667 athletes from a different range of sports and performance levels. MT was assessed by using the MTQ48 (Clough et al., 2002) and coping was examined by using the coping inventory for competitive sport (CICS; Gaudreau & Blondin, 2002). Optimism and pessimism was assessed using the Life Orientation Test (LOT; Scheier & Carver, 1985). Findings revealed a significant and

positive relationship between MT with 8 of the 10 coping subscales. Further, MT athletes used more approach and less avoidance coping strategies, and a significant positive relationship between MT and optimism occurred.

Nicholls, Polman, Levy, and Backhouse (2009) re-examined the previous research findings (Nicholls et al., 2008) to investigate the relationship between MT, achievement level, gender, age, experience, and sport type differences. Findings revealed that males scored higher than females on challenge, control emotions, control life, and confidence ability, but not between commitment and interpersonal confidence. Further, there were no differences in MT between athletes from team vs. individual sports as well as between contact vs. non-contact sport. However, increasing age and experience was positively related to MT components of challenge, commitment and life control.

**MT and performance**

It is interesting to note that anecdotal reports of MT are normally made in reference to good performance under pressure. However, the link between MT and performance is as yet underdeveloped, with a limited amount of research devoted to the topic. Two studies stand out. Newland, Newton, Finch, Harbke, and Podlog (2013) investigated the relationship between MT and performance in basketball. The authors also investigated the possible moderating effects of gender and starting status. Newland et al. used the PPI-A (Golby et al., 2007) to assess MT and used Sonstroem & Bernardo (1982) equation to assess performance. That is performance = SHOT% = (TP + REB + AS + ST) – PF – TO + 10. The equation compromised from SHOT% = field goal (percentages were calculated as decimals in the equation); TP = total points in the game; REB = rebounds; AS = assists; ST = steals; PF = personal fouls; TO = turnovers; “10” = a constant to assure positive scores. Findings illustrated males scored higher in overall MT than females. There was no differentiation between starters and nonstarters upon MT. Furthermore, MT related to performance for male

players as both a main effect and interaction with starter status. The interaction showed that for starter athletes, an increase of MT led to an increased performance. However, female starter status was the only significant predictor of performance. The authors reported that MT and starting status can partially predict basketball performance.

While testing the predictive validity of the MTI, Gucciardi et al. (2014) examined the relationship between MT, stress, and performance in the workplace upon 497 employees. The Perceived Stress Scale (Cohen et al., 1983) was used to examine stress. MT was assessed by the MT index (MTI) (Gucciardi et al., 2014) whereas performance was informant assessed thorough 7 employee's supervisor rated items (Williams & Anderson, 1991) such as "Adequately completes assigned duties" and "Fulfills responsibilities specific in job description" (see also Hardy et al., 2014 for informant assessed behaviors). Results showed that employees who were associated with higher levels of MT had lower levels of stress and higher levels of work related performance.

**Limitations of qualitative and quantitative research**

There are some limitations noted with the above research that Anderson (2011) seems to sum up succinctly. For example, according to Anderson (2011), if MT is a robust construct, then it is not clear why sport specific MT measures are required. Anderson (2011) further criticizes sport specific measures of MT in that such constructs are generally validated within a male population. Further, if every sport requires a sport specific measure of MT (and each sport has a separate measure for gender), then according to Anderson (2011), "We may need a bucket load" (p. 76). A further limitation is that interview data (qualitative designs) are heavily replicated. This is especially notable in some of the studies noted above where the same samples of athletes and coaches are used on multiple occasions. Furthermore, through such qualitative approaches, it is difficult to distinguish the causes of MT, the progression of

being MT, the consequences of MT, and other correlates connected with MT (Hardy et al., 2014).

A number of researchers have also pointed out issues associated with the validity self-report MT assessments. For example, Middleton, Marsh, Martin, Richards and Perry (2004a) examined the construct validity related to the PPI (Loehr, 1986). Middleton et al. (2004a) reported inadequate fit indices for its proposed seven-factor structure. Gucciardi (2012) also highlights that there may be problems concerning the PPI-A spanning conceptual and methodological concerns. Furthermore, the MTQ48 (Clough et al., 2002) has also received scrutiny in that the four factor model does not reach adequate fit statistics (Gucciardi, Hanton, & Mallett, 2012). One of the (perhaps) more factorial reliable measures of MT is the SMTQ (Sheard et al., 2009). The SMTQ seems to stand up to psychometric rigor, however according to Gucciardi, Mallett, Hanrahan, and Gordon (2011), the SMTQ may be atheoretical in nature. In other words, the underpinning conceptualization of the SMTQ was not based on any theoretical literature. However, despite limitations concerning the structural validity of the MT measures mentioned above, the majority of these measures show good to strong predictive validity in a vast variety of settings.

**Informant assessment of MT**

More recently, Hardy et al. (2014) commented on the above research directions noting that there is little point in examining MT unless one knows that "mentally tough behavior has actually occurred" (p. 70). To overcome some of the limitations noted above, Hardy et al. (2014) developed an informant rating measure of MT behavior. In this instance, the coach rated the athletes on how well they could manage pressures and stressors that they may typically face in competition (e.g., Woodman & Hardy, 2001). Second, Hardy et al. (2014) used a unique approach to predict MT behavior based on personality theory named revised Reinforcement Sensitivity Theory (rRST- Gray& McNaughton, 2000).

According to Gray and McNaughton (2000), three systems govern approach and avoidance behaviors. Reward or approach centered behaviors are underpinned by a neurological network called the behavioral activation system (BAS). According to rRST, this system is responsible for all goal-focused approach behavior by responding to rewarding stimuli in the environment. The BAS comprises of the brain regions of the cerebral cortex, thalamus, and striatum (McNaughton & Corr, 2004). Second, the Fight, Flight, Freeze system (FFFS) mediates all reactions and responses to avoid threat related stimuli (unconditioned, conditioned, and innate). The FFFs system activates when a person's chief concern is to remove him or herself from a threatening situation. The FFFS comprises brain regions in the anterior cingulate and prefrontal ventral stream (Gray & McNaughton, 2000). The purpose of the third system, termed the Behavioral Inhibition System (BIS), is to mediate any conflict between FFFS and BAS (conflict usually occurs when there are large amounts of punishment and associated rewards in the environment). Such approach-avoidance conflict elicits a series of behavioral responses associated with anxiety, including the inhibition of all pre-potent behavior, an increase in physiological arousal, and the scanning of long-term memory for information that might be relevant to resolving the conflict. The BIS comprises brain regions in the septo-hippocampal system, posterior cingulate, and prefrontal dorsal stream (Gray & McNaughton, 2000).

Hardy et al. (2014) make specific references to studies that have shown how punishment and reward sensitivity relates to performance. For example, Perkins, Kemp, and Corr, (2007) investigated the relationship between reward sensitivity, performance and emotional reactions to highly stressful situations (e.g., military combat scenario). Findings revealed that reward sensitively correlated with lower emotional reactions to threatening situations and higher levels of performance. The opposite findings were shown for those

individuals high in punishment sensitivity. Based on these findings, Hardy et al. (2014) argued that rRST could help to explain performance under pressure.

One caveat to the above research was that according to Hardy et al. (2014), punishment and reward sensitivities had mainly been examined as a set of main effects and interactive effects had been largely ignored. Further, as sport contains a mixture of appetitive and aversive stimuli, then it seems a rather pertinent environment to test for such interactions. Based on the above research overview, Hardy et al. (2014) hypothesized that the highest level of MT would be associated with high levels of reward and low levels of punishment sensitivity. Hardy et al. (2014) conducted four studies with two main purposes. Over the course of the first two studies, they developed an 8-item informant measure of MT. In studies 3 and 4, they examined the interactive effect of punishment and reward sensitivities upon MT behavior. Findings were contrary to what Hardy et al. (2014) predicted. That is, increasing levels of punishment sensitivity positively related to MT behavior when reward sensitivity was low, but negatively related to MT behavior when reward sensitivity was high. Hardy et al. (2014) conducted follow up studies to investigate the relationship between punishment sensitivity and threat detection. The authors hypothesized that punishment sensitivity would be positively related to early threat detection. Hardy et al. used a selection of vignettes to test their hypotheses, e.g., 'Your County's side (U-17 / U-19) are playing in a national final at Lords. There are approximately 1000 spectators present. Your team is batting second. You are chasing 250 and the score is currently 220–4 at the start of the 45th over. You are due to be batting at number 10.' Participants were asked to report when they would normally start mentally preparing for the event by responding to five potential options where '1' referred to the latest time to begin mental preparation and '5' referred to the earliest time to begin mental preparation. Findings supported the author's hypothesis that punishment sensitivity positively related to early threat detection.

However, there exists a number of limitations associated with Hardy et al. (2014). First, the authors conducted their studies upon a specific sample of young elite male athletes cricketers aged between 15-19 years old. Further, the results may only pertain to cricket environments, as there are immediate opportunities for rewards (bowling out a batsman or driving through for a boundary) and punishments (being caught or bowled out). Finally, one may be able to hide poor performance in cricket environments as a batsman could go out and bat with a cushion of 400 runs or more. Therefore, the consequences of failure are minimum. Finally, Hardy et al. (2014) did not attempt to measure performance of any kind. It is perfectly reasonable to expect that if coaches rate athletes (who are high in punishment and low in reward) as being able to perform well under pressure, then athletes should actually perform better!

**Chapter 2 purpose and hypotheses**

The purpose of the first empirical chapter (Chapter 2), was to replicate and extend Hardy et al.'s (2014) findings to a swimming environment where both male and female swimmers with a larger age range could be examined. Further, the context of swimming would also be able to offer a chance to examine performance (i.e., competitive race times).

**Training behaviors and self-regulation**

Qualitative (e.g., Bull et al., 2005; Connaughton et al., 2008; Connaughton et al., 2010; Gucciardi et al., 2009; Thelwell et al., 2010) research suggests that the training environment is a strong source of MT. Therefore, the training environment may warrant further investigation in terms of how it influences MT. Further, with reference to the findings from Hardy et al. (2014), it would appear that if MT athletes engage in early threat detection and modify their behavior accordingly, then they might be doing something rather different in the training environment (e.g., pick up threat early from an upcoming competition and modify their behavior accordingly). From research noted above, it appears that both the coach

and the athlete can develop MT in training. Further, it appears that training, and perhaps swim training requires a great deal of self-regulation on the part of the athlete (Young & Starkes, 2006a).

Self-regulation involves an aspect of self-control where an individual strives to bring themselves into line with some form of preferred standards (e.g., Baumeister & Vohs, 2007). According to Zimmerman (1998), self-regulation is defined as self-generated thoughts, feelings, and behaviors that are planned and cyclically adapted based on performance feedback. Self-regulation contains two essential components connected to cognitive process called metacognition and self-control. Flavell (1979) defined metacognition as 'thinking about thinking'. Zimmerman (1986) pointed out that athletes who tend to have high metacognitions are characterized with higher self-knowledge that better able them to regulate thinking, improve self-monitoring and increase self-reflection. Self-control is an aspect of inhibitory control and refers to ones' ability to regulate emotions, thoughts, and behavior in the face of distractions. Self-control is a cognitive process that is necessary for regulating one's behavior in order to achieve specific goals, and has a limited resource that can become fatigued and depleted by repeated attempts to self-regulate. For example, when a task requires a vast amount of self-control over time, ego depletion can occur (where the individual eventually loses self-control; Baumeister, Bratslavsky, Muraven, Tice, 1998). In such instances, the individual loses self-control and become more readily distracted (Baumeister, Vohs, & Tice, 2007). Furley, Bertrams, Englert, and Delphi (2013) examined the relationship between self-control and ego depletion, attentional control, and decision making in a high interference decision-making task in basketball. They examined self-control at an inter-individual (between person) and an intra-individual (within person) level. Furley et al. (2013) found that an ego-depleted group performed worse on the tactical decision making

task under distraction, supporting their hypothesis that in order to focus attention on task requirements and block out distraction, sufficient self-control capacity is needed.

Besides the previous essential ingredients of self-regulation, Baumeister et al. (2007) proposed that without motivation, self-regulation has very little impact upon behavior. That is, without some kind of motivation, it is unlikely that athletes will be able to self-regulate in training. For example, Duda et al. (2005) proposed that athletes who exhibited adaptive motivational profiles are more likely to pay attention to training processes, engage with interest, invest greater effort to improve, persist in the face of adversity, and consider failure as motivating rather than frustrating.

Zimmerman's (1986) model of self-regulation, comprises of three reciprocal distinct phases; the forethought phase, performance phase, and a self-reflection phase. The forethought phase contains distinctive sub-process such as task analyses (e.g., goal setting and strategy choice) and self-motivational believes (e.g., goal orientation, self-efficacy, and self-determination). The forethought phase directly influences the performance phase. The performance phase includes the distinct sub-process of self-control (e.g., self-instruction, imagery, and attention focus), and self-observations (e.g., self-recording and self-experimentation). The performance process phase, also influences self-reflection phase. The self-reflection phase contains distinctive sub-process called self-judgment (e.g., self-evaluation and attributions) and self-reaction (e.g., self-satisfaction and additivity). After the reflection phase is complete, the forethought phase begins again.

Based on this model of self- regulation, Cleary and Zimmerman (2001) investigated the differences between self-regulation processes in a sample of experts, non-experts, and novice basketball player's free-throw shooting strategies. Findings revealed that experts engaged more in forethought processes, set more specific goals, selected more technique oriented strategies, made more strategy attributions, as well as displaying higher levels of

self-efficacy than non-experts and novices. Further, Kitsantas and Zimmerman (2002) examined the self-regulatory processes within experts, non-experts, and novice volleyball players in relation to an overhand serving skill during practice. Findings revealed that experts exhibited higher levels of goal setting, planning, strategy use, self-monitoring, self-evaluation, attributions, and adaptation than non-experts and novices. Findings also pointed out that experts exhibited higher self-efficacy beliefs, perceived instrumentality, intrinsic interest, and self-satisfaction related to their volleyball serving than non-experts and novices.

The regulation of goal pursuit is considered an important area of research, as understanding how athletes react to challenges and threats (e.g., persistence vs. disengagement) has implications for goal attainment and athlete psychological wellbeing (Smith, Ntoumanis, Duda, & Vansteenkiste, 2011). Brandtstadter (2009) proposed a dual model regarding goal pursuit and goal adjustment to describe the self-regulatory reactions to discrepancies related to goal attainability. Brandtstadter (2009) focused on the distinction between two kinds of moods termed assimilative and accommodative. Assimilative mood aids to increase commitment and focus toward the goal and decrease distractions, whereas the accommodative mood aids to re-focus goal striving and to protect well-being when a goal is no longer attainable. Brandtstadter (2009) further, indicated that both moods (assimilative and accommodative) are adaptive and broadly distinct.

**Self-regulation of emotions**

Individuals dynamically monitor their emotional states and develop self-regulation strategies to maintain or change their emotions to desirable levels (Carver, 2004; Tamir, 2009). Emotion regulation may be defined as seeking to increase pleasant emotions (e.g., happiness, excitement, elation) and reduce unpleasant ones (e.g., anger, anxiety, and sadness) (Russell, 1980). Therefore, individuals strive to regulate their emotions to levels they believe will facilitate successful goal pursuit (Tamir, 2009).

Research has recently examined the relationship between emotion regulation, MT and symptoms of depression (Mutz, Clough, Kostas, & Papageorgiou, 2017). These authors investigated the possible mediating role of two emotional regulation strategies (i.e., cognitive reappraisal and expressive suppression) upon the relationship between MT and depressive symptoms. MT was measured by the MTQ-48 (Clough et al., 2002) and emotional regulation strategies was assessed by the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). Further, symptoms of depression were measured by the Clinically Useful Depression Outcome Scale (CUDOS; Zimmerman, Chelminski, McGlinchey, & Posternak, 2008) as well as the Patient Health Questionnaire-9 (PHQ-9; Kroenke, 378 Spitzer, & Williams, 2001). Results supported the author's hypotheses that MT negatively correlated with both measures of depressive symptoms. Regarding the emotional regulation strategies, cognitive reappraisal negatively correlated with all measures of depressive symptoms while expressive suppression was correlated positively with both measures of depressive symptom. Furthermore, MT was associated positively with cognitive reappraisal strategy and negatively with expressive suppression strategies. Finally, regarding the mediation role, results displayed that expressive suppression strategy mediated the relationship between MT and depressive symptoms.

**Self-regulation of behavior**

Although self-regulation has many facets (e.g., self-regulation of affect, cognitions, or wellbeing), the current thesis focuses upon the self-regulation of behavior. According to Rothman, Baldwin, and Hertel (2007), there are four stages of behavior change. For example, an individual wishing to learn to swim shows and initial response e.g. enroll in swimming classes. If the individual is sufficiently motivated, then there will be a continued response e.g. continue with swimming classes. Third, the maintenance phase is characterized with a desire to maintain the behavior through its perceived value. Finally, a self-perpetuating pattern of behavior occurs where training becomes a habit or the 'norm'.

Although there has been some research devoted to the examination of training behaviors in swimming, studies seem to be few and far between. For example, Young and Starkes (2006a) state that athletes who fail to self-regulate their training are less disciplined and motivated and often fail to maximize upon opportunities to learn. Therefore, Young and Starkes (2006a) set out to examine non-regulated training behaviors in competitive swimmers. In Study 1, Young and Starkes listed 28 poor training habits (or non-regulated training behaviors) identified by a sample of five elite swimming coaches. In study 2, Young and Starkes further developed the list of self-regulated training behaviors (these were semantically opposite to non-regulated behaviors) and asked 18 experience swimming coaches to rate both sets of items in terms of "0" ("is not really a poor training habit"), "5" ("is a moderately poor training habit") and "10" ("is a very poor training habit"). Young and Starkes then shortened the list to a more manageable seven non-regulated training behaviors that they ranked in order of poor training habits, 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 deck; and lack of focus during kick sets. However, to date no confirmatory factor analysis has been conducted on any of these training behavior items.

In a follow up study Young and Starkes, (2006b) examined the relationship between 33 swimmers self-reported training behaviors and their coach's perception of the swimmers training behaviors. Actual training behaviors were recorded over a series of nine training session. Results revealed that swimmers rated high in self-regulation, missed significantly less training volume than non-regulated swimmers. Further, swimmers who were non-regulated in their training under reported their non-compliance in training.

Further, Oliver, Hardy, and Markland, (2010) investigated the critical role of training behaviors to be considered upon coaches within team sports. After interviewing thirty elite

coaches from soccer and rugby, findings demonstrated that thirty four themes were essential for training habits categorized under eight general groups; (1) professionalism, (2) motivation, (3) coping, (4) committed, (5) effort, (6) seeking information to improve, (7) concentration, and (8) negative behaviors. Oliver et al. 2010 also indicated that motivation was the most important approach to training behaviors.

There is also evidence to suggest that personality can influence training behaviors. For example, Woodman, Zourbanos, Hardy, Beattie, and McQuillan (2010) conducted two studies to examine the relationship between personality and performance strategies upon the training behaviors of British Gymnasts. Using predictions from the pyramid model of peak (e.g., Hardy, Jones, & Gould, 1996), Woodman et al. developed a three-factor measure of training behaviors namely distractibility (e.g., being distracted by others in training); coping with adversity (e.g., being good at dealing with problems in training); and quality of preparation (e.g., always having a competitive plan that covers all eventualities). Results from Study 1 revealed that conscientiousness and goal setting positively related to quality of preparation. A marginally significant interaction occurred between extraversion and goal setting upon distractibility (i.e., extraverts were less distractible when they used higher levels of goal setting). Finally, emotional stability and emotional control interacted to predict coping with adversity (i.e., emotional stability was more strongly related to coping when emotional control was high). The purpose of Woodman et al.'s (2010) second study was to extend and replicate their Study 1 findings. In Study 2 they found that conscientiousness significantly predicated quality of preparation. Extroversion and goal setting significantly interacted upon distractibility (replicated the finding from Study 1). However, they failed to replicate their finding from Study 1 in that emotional stability and emotional control interacted upon coping with adversity. The above findings show that some personality types require additional psychological resources in order to maintain goal directed behavior in training. There also

seems to be a significant overlap between Woodman et al.'s (2010) quality of training inventory (e.g., distractibility and coping with adversity) with MT characteristics such as tough thinking and maintaining psychological control (Bull et al., 2005; Jones at al., 2002). We further examine this point in Chapter 4.

Finally, Jonker, Gemser, and Visscher (2010) investigated the differences between self-regulation skills across a sample of 222 national and international level athletes in team and individual sports. Authors examined six skills related to self-regulation; planning, self-monitoring, evaluation, reflection, effort, and self-efficacy. Findings illustrated that reflection skills play an important role in discriminating between national and international level athletes regardless sport type. That is, international athletes scored higher in reflection skills than national athletes. Athletes in individual sport also scored higher than athletes with team sports in self-regulation skills of planning and effort.

**Chapter 3 purpose and hypotheses**

The above research in training behaviors indicate two things. First, training behaviors in swimming seems to be an under developed area of research and requires further scrutiny. Second, training behaviors seems to be an important source of MT (e.g., Bull et al., 2005; Connaughton et al., 2008; Connaughton et al., 2010; Gucciardi et al., 2009; Thelwell et al., 2010). If this is indeed the case, a measure of self-regulated training behaviors should be able to account for some of the variance associated with self-report measures of MT (e.g., SMTQ, PPI-A, MTI). Further, self-regulated training behaviors should also account for some of the variance accounted for by coach rated MT behaviors as reported by Hardy et al. (2014). Third, a positive relationship should also exist between self-reported levels of MT and coach rated levels of MT behavior. Finally, it is also possible that self-regulated training behaviors should mediate the relationship between self-report levels of MT and coach rated measures of MT behaviors. We examine these possible main and mediating effects in Chapter 3.

**Personality and performance**

It was noted above that Hardy et al. (2014) utilized a relevant personality theory, termed the revised Reinforcement Sensitivity Theory (rRST- Gray& McNaughton, 2000), to predict MT behavior in competition. However, it is not the only research that links personality with performance and MT. The investigation of personality in relation to performance in sport has attracted attention from numerous researchers. The Five-Factor model of personality or the 'Big 5' (Costa & McCrae, 1992) seems to have received the most attention in sport. The five-factor model of personality comprises of five main dimensions; extraversion, neuroticism, openness to experience, agreeableness, and conscientiousness. Each trait encompasses specific characteristics. For example, the extraversion dimension reflects individual characteristics of being outgoing, talkative, and energetic. Neuroticism is characterized by anxiety, hostility, depression, and moodiness. The dimension of openness to experience reflects individuals who have the tendency to look for new experiences. Agreeableness is associated with individuals perceived as sympathetic, cooperative, and in social harmony. The final dimension conscientiousness, reflects individuals who display self-discipline, careful organization, and goal-directed behavior.

Since the development of the 'Big 5' (Costa & McCrae, 1992), research in sport has sought to examine whether these personality types relate to sport performance. For example, Piedmont, Hill, and Blanco (1999) examined the relationship between the 'Big 5' and performance in a sample of 79 female athletes within NCAA Division 1 teams. The coach rated each player on 5 performance-relevant dimensions; coachability, athletic ability, game performance, team playerness, and work ethic. Findings demonstrated that, conscientiousness correlated positively with coaches' ratings of performance, whereas neuroticism correlated negatively with coaches' ratings of game performance.

Recently, research has focused on the interactive relationships between the five personality types associated with the 'Big 5' rather than their separate main effects. For example, in a sample of 255 athletes, Allen, Greenlees, and Jones (2011) examined both main and three-way interactive effects of personality traits upon coping behavior. Personality dimensions were assessed by the NEO-Five Factor Personality Inventory (NEO-FFI; Costa & McCrae, 1992) whereas, athletes coping behavior was assessed by the Coping Function Questionnaire for Sport (CFQ; Kowalski & Crocker, 2001). Results revealed that athletes characterized by high levels of extraversion, emotionally stability and open to new experiences, scored higher in problem-focused coping strategies. Further, athletes who scored high on conscientiousness and athletes who scored high on extraversion, openness, and agreeableness, also scored higher in emotion-focused coping strategies. Finally, athletes with low levels of openness and high levels of neuroticism scored higher in avoidance coping strategies.

Bell, Mawn, and Poyner (2013) investigated to what extent neuroticism moderated the relationship between speed-accuracy trade-off and decision-making accuracy among elite young cricketers. Neuroticism was examined by using the International Personality Item Pool (IPIP: Goldberg, 1999). The authors used a cricket batting task to assess decision-making response times based on eight cricket batting-specific scenarios on a computer screen. Decision-making response times to eight scenarios were recorded in milliseconds. Decision-making accuracy was assessed by a cricket coach who identified the most suitable decision for each of the batting scenarios. Findings showed that neuroticism moderated the relationship between decision-making time and decision-making accuracy. In other words, individuals with high levels of neuroticism were associated with quicker and more accurate responses. Further, a decrease in response time was associated with poorer accuracy in individuals with lower levels of neuroticism.

In examining the link between personality and mental toughness, Horsburgh, Schermer, Veselka, and Vernon (2009) investigated the relationship between MT and the Big 5 personality factors and to explore the extent to which genes and/or environmental factors contributed to individual differences in MT among 219 pairs of adult monozygotic and dizygotic twins. MT was assessed by the MTQ48 (Clough et al., 2002) whereas, the Big 5 factors was assessed by 240-item NEO-PI-R (Costa & McCrae, 1992). Results revealed that all components of MT negatively correlated with neuroticism whereas, extraversion, openness to experience, agreeableness, and conscientiousness correlated positively with MT components. Regarding the extent to which genes and/or environmental factors contributed to individual differences in MT, results showed that individual differences in MT and personality were due to shared genetic and non-shared environmental factors.

**The dark triads**

Although the above the research tends to focus on the 'Big5' personality traits, another line of research has examined the relationship between MT and the darker side of personality termed the Dark Triads (Paulhus &Williams, 2002). The dark triads consist of narcissism, psychopathy, and Machiavellianism (Paulhus &Williams, 2002). Research has shown that individuals who score high on such traits tend to cause problems in organization settings, especially if they are in leadership positions (e.g., Penny & Spector, 2002).

In relation to the dark triads, the trait of narcissism has been associated with vanity, grandiosity, self-deception, and manipulativeness (Campbell, Hoffman, Campbell, & Marchisio, 2011; Paulhus &Williams, 2002). Research also demonstrates that individuals scoring higher on narcissism have a selective memory for self-flattering past events (Rhodewalt & Eddings, 2002) and hold overly optimistic views of current performance and performance achievements (Farwell & Wohlwend-Lloyd, 1998; Robins & Beer, 2001). In relation to the 'Big5'model, narcissism is also associated with low score on agreeableness,

but positively correlates with extraversion and open to new experiences (Vernon, Villani, Vickers, & Harris, 2008). People with high levels of psychopathy have been shown to be antisocial, impulsive and immoral (Cooke & Michie, 2001; Paulhus & Williams, 2002). Individuals with high levels of psychopathy have been associated with low scores on agreeableness, neuroticism, and conscientiousness, and high on extraversion and openness to experience (Paulhus & Williams, 2002). Individuals associated with the personality trait of Machiavellianism, tend to be manipulative, mistreat others, and show high levels of deception (Paulhus &Williams, 2002). Machiavellianism tends to negatively correlate with agreeableness and conscientiousness within 'Big 5' (Paulhus & Williams, 2002).

Onley, Veselka, Schermer, and Vernon (2013) conducted the first behavioral genetic study to examine the link between the Dark Triad traits and MT. A sample of 210 adult same-sex twins was used to determine the extent to which individuals who displayed Dark Triad traits succeeded in the workplace. The authors further explored whether the correlations between Dark Triad traits linked to common genetic and/or common environmental factors. The authors used the Narcissistic Personality Inventory (NPI; Raskin & Hall, 1979) to assess narcissism, the Self-Report Psychopathy Scale (SRP-III; Hare, 1985) to assess psychopathy, and Machiavellianism was assessed by the 20-item MACH-IV (Christie & Geis, 1970). MT was assessed using the MTQ48 (Clough et al., 2001). As stated above the MTQ48 assesses the constructs of challenge, commitment, control, and confidence. Findings revealed that, narcissism positively related to all MT components of the MTQ48, psychopathy negatively related to all components of the MTQ48 while, Machiavellianism positively related to the constructs of commitment and control and negatively related to the constructs of challenge and confidence. Further, a positive relationship between narcissism and MT was mostly attributable to common non-shared environmental factors. The association between Machiavellianism and MT however, was influenced by both common genetic and common

non-shared environmental factors. Finally, the authors reported that the association between psychopathy and MT was attributable to genetic factors.

More recently, Sabouri et al. (2016) examined the relationship between the Dark Triads, MT, and physical activity within 341 Iranian mixed sex young adults. Sabouri et al. (2016) pointed out that there is link between Dark Triad traits and MT. For example, individuals with higher levels of MT could be associated with negative health outcomes (e.g., ignoring a doctor's advice). That is, MT athletes may become overconfident or too committed to the pursuit of winning that they fail to recognize or accept medical advice about minor injuries, rendering them at a higher risk of further major injury (Coulter et al., 2010; cf. Sabouri et al. 2016). Therefore, Sabouri et al. (2016) examined three hypotheses. First, Dark Triad traits should positively correlate with MT. Second, there would be a positive correlation between Dark Triad traits, MT, and physical activity. Third, they hypothesized that women would score lower in MT and physical activity compared to men, and that men would be associated with higher Dark Triad traits more than women. Machiavellianism was assessed by the 20-item MACH-IV (Christie & Geis, 2013). The Narcissistic Personality Inventory (Raskin & Hall, 1988) assessed narcissism. Psychopathy measured by Self-Report Psychopathy Scale (SRP-III; Hare, Hart, Harpur, 1991). Finally, MT was assessed by the MTQ-48 (Clough et al., 2002). Finally, physical activity was assessed by the short version of the International Physical Activity Questionnaire (IPAQ). Results indicated that all Dark Triad traits correlated positively and significantly with MT components. Further, the Dark Triad traits and MT correlated positively with vigorous physical activity. Both of these results supported the first and second hypotheses. However, results partially supported their third hypothesis, in that women scored lower than men did on Dark Triad traits (as hypothesized) but there were no differences between MT and physical activity across men and women.

To summarize, research above has shown potential links between personality and MT. The purpose of Chapter 4 was to further examine these links. We used EPQR-S from Chapter 2 to examine perhaps another 'dark' personality trait recorded by the EPQR-S, namely psychoticism. One of the limitations of the Hardy et al. (2014) study is that they did not individually examine the three personality characteristics that defined punishment and reward sensitivity. That is, the EPQR-S assesses three personality types, psychoticism, extroversion and neuroticism. It may be that one of these personality types may be a driving force behind MT behavior as assessed by Hardy et al. Perhaps the leading contender to explain MT is psychoticism. Eysenck and Eysenck (1985) describe people characterized with high psychoticism as aggressive, impulsive, and tough-minded. In contrast, people characterized with low psychoticism tend to display empathy and altruism. Extraverts tend to be active and social and demonstrate sensation seeking behavior. Individuals characterized with low extraversion tend to be introspective and quiet. Finally, individuals characterized with high neuroticism tend to be higher in high anxiety, whereas individuals characterized with low neuroticism tend to be emotionally stable and calm.

Regarding the context of psychoticism within sport, Eysenck, Nias, and Cox (1982) indicated that high-level athletes tend to be higher in psychoticism with the authors explaining that psychoticism is linked to aggressiveness, egocentricity, and general competitiveness. Kirkcaldy (1982) investigated the relationship between personality profiles with gender and level of athlete participation upon 400 students categorized as top-class (international), middle-class (national) and lower class (regional). Kirkcaldy assessed athlete's personality on psychoticism, extraversion and neuroticism via The Eysenck Personality Questionnaire (EPQ; Eysenck and Eysenck, 1975). Findings showed that male athletes within the top-class international standard were associated with higher levels of psychoticism (tough-mindedness) more than middle and low-class athletes. In contrast, top-

level females athletes were associated with higher extraversion but lower aggressive and tough-mindedness compared with middle and lower levels.

Finally, Egan, and Stelmack (2003) examined personality profiles 39 Mount Everest climbers. Seventeen climbers had successfully had reached the summit, the other 22 had yet to reach the summit. The authors assessed personality via The Eysenck Personality Questionnaire-Revised (EPQ-R ; Eysenck & Eysenck, 1991). Findings revealed that climbers reported higher scores on extraversion and psychoticism and lower scores on neuroticism than the general population. One caveat of the study is that the climbers, who had yet to summit, scored higher in psychoticism scale than those who did make the summit.

Through the research noted above, there seems to be a general positive relationship between the Dark Triad traits and MT. Likewise, the research in psychoticism tends to support a link with high-level sport participation, and toughmindedness. However, research also suggests that individuals high in psychoticism tend to show poor attentional control in tasks that require cognitive flexibility. For example, Corr (2003) found that individuals high in psychoticism show performance superiority on easy tasks that do not require a form of effortful control (e.g., the ability to inhibit a dominant response to perform a subdominant response). However, on more complex tasks that require dual processing, performance is often impaired.

Therefore, it is clear, that there are conflicting accounts of psychoticism. On the one hand it has been noted that individuals who are characterized with psychoticism tend to be aggressive, impulsive, show interpersonal hostility, antisocial and tough-minded (Eysenck & Eysenck, 1985). These characteristics do not seem a million miles away from characteristics associated with the Dark Triad. On the other hand, psychoticism has been linked to inflexibility and poor attentional control on tasks involving switching of attention. Therefore, Chapter 4 sets out to examine the relationship between psychoticism and MT upon training

behaviors and MT behavior. Further, we also examined the relationship between extraversion, neuroticism, and MT upon training behavior. There are indications that extraversion may also interact with MT upon training and MT behaviors (see chapter 4).

**Chapter 4 purpose and hypotheses**

The purpose of Chapter 4 was to individually examine the personality traits that are associated with punishment and reward sensitivity, namely, psychoticism, extraversion and neuroticism. We examined the relationship between psychoticism, MT, training behaviors and MT behavior in a swimming environment. Due to psychoticism being associated with tough-mindedness and sensation seeking, then having high levels of psychoticism may be a beneficial commodity to have in a training environment. However, as psychoticism has been associated with inflexibility and poor attentional control, then individuals who have high levels of psychoticism may benefit from having a set of MT skills (i.e., higher levels of MT).

**Purpose of the Thesis**

**Chapter 2**

Relating to Hardy et al.'s (2014) study reported above, the main objects of this thesis chapter was to apply Hardy et al.'s (2014) findings to the sport of swimming with three aims. First to develop an informant rating measure of MT in competitive swimmers. Second, re-examine Hardy et al.'s findings that when reward sensitivity is low, increasing levels of punishment sensitivity will be related to MT behavior and when reward sensitivity is high, increasing levels of punishment sensitivity should be negatively related to MT behavior. Finally, the chapter set out to investigate the relationship between RST and swimming performance. That is, if athletes characterized with high punishment and low reward sensitivities are rated as being MT by their coach, then they should perform better under pressure. Therefore, it was expected that, when reward sensitivity was low, increasing levels of punishment sensitivity would lead to improved swimming performance. However, when

reward sensitivity is high, increasing levels of punishment sensitivity should be negatively related to swimming performance.

**Chapter 3**

Chapter 3 set out to examine the relationship between training behaviors, self-assessed MT and coach rated MT behavior. Specifically, the chapter set out to examine whether self and coach assessed training behaviors mediated the relationship between self-report MT and coach rated MT behavior.

**Chapter 4**

It is noted that a potential limitation of Hardy et al. (2014) is that they did not examine the main effects of psychoticism, extraversion or neuroticism upon MT behavior. We further note that research has generally ignored the potential relationship between MT and psychoticism (despite research linking it to tough mindedness). Therefore, Chapter 4 aimed to investigate the relationship between psychoticism, extraversion, neuroticism and MT. This chapter is exploratory in nature. That is, we set out to examine if there is any link between these three personality traits with MT and training.

# Chapter 2

## The interactive effects of punishment and reward sensitivities on MT and performance in swimming

## Abstract[1]

The purpose of the current study was to examine the interactive effects of punishment and reward sensitivity in predicting Mentally Tough behaviour and performance in swimming. First, we validated a measure of MT behaviour in a mixed sample of competitive swimmers and then examined the interactive effects of punishment and reward sensitivities in predicting MT behaviour. A second purpose of the study was to examine whether punishment and reward sensitivities can account for race time performance. Results found significant interactions between reward and punishment sensitivity across both studies. That is, as punishment sensitivity increased MT and race times improved when reward sensitivity was low. However, both decreased when reward sensitivity was high. Results add to previous research showing that athletes who are sensitive to punishment and insensitive to reward display stronger MT behaviours and as a consequence, swim faster.


[1] This chapter has been accepted for publication as Beattie, S., Alqallaf, A., & Hardy, L. (in Press). The effects of punishment and reward sensitivities on mental toughness and performance in swimming. *International Journal of Sport Psychology.*

**Introduction**

The development and maintenance of Mental Toughness (MT) in sport has become a topic of increasing interest over the past 15 years. Researchers generally agree that MT can be defined as consistently maintaining performance and goal directed behaviour under a range of different stressors (e.g., Gucciardi, Hanton, & Mallett, 2012; Hardy, Bell & Beattie, 2014). However, early research findings were heavily driven by qualitative studies (e.g., Bull, Shambrook, James, & Brooks, 2005; Connaughton, Hanton, & Jones, 2010; Connaughton, Wadey, Hanton, & Jones, 2008; Gucciardi, Gordon, & Dimmock, 2008; Jones, Hanton, & Connaughton, 2002; Jones, Hanton, & Connaughton, 2007) that identified a very large number of characteristics that are associated with MT (e.g., Anderson, 2011 lists over 70). Hardy et al. (2014) also argue that although qualitative studies allow one to examine correlates of MT, they do little to determine the causes, processes, and outcomes of being mentally tough.

Quantitative research in MT has received equal criticism. For example, Gucciardi, Mallett, Hanrahan and Gordon (2011) note various limitations in measures of MT e.g., the Mental Toughness Questionnaire 48 (Clough, Earle & Sewell, 2002); the Cricket Mental Toughness Inventory (Gucciardi & Gordon, 2009); the Australian football Mental Toughness Inventory (Gucciardi, Gordon, & Dimmock, 2009); the Psychological Performance Inventory (Loehr, 1986); and the Sport Mental Toughness Questionnaire (Sheard, Golby, Wersch, 2009). Such limitations include poor construct validation, measurement invariance, reliability, and lack of generalisability across populations. Further, as in the qualitative research, there has been an abundance of factors associated with quantitative measures of MT, which would suggest MT is multidimensional in nature. Some of these factors include self-confidence; negative energy control; attention control; visualisation and imagery control; motivation; positive energy; attitude control; challenge; commitment; emotional control; life

control; confidence in abilities; interpersonal confidence; constancy; and thrive through challenge (to name but a few).

In much of the above research, there also appears to be considerable overlap between proposed MT factors and psychological skills. For example, if some of the MT factors reported above were compared against multifactorial measures of psychological skills (e.g., Test of Performance Strategies; Hardy, Roberts, Thomas, & Murphy, 2010) it would be seen that they contain a number of identical factors (e.g., attention and emotional control). A further limitation of self-report MT inventories is that they are open to social desirability and self-presentation abuse (Hardy et al., 2014).

To overcome some of the limitations presented above, Hardy et al. (2014) conducted a series of studies to develop a theoretical account of MT. These authors noted that there is little point in linking cognitions, attitudes and emotions to MT unless one knows that MT behaviour has actually occurred (see also Arthur, Fitzwater, Hardy, Beattie, & Bell, 2015). Therefore, Hardy et al. validated an 8-item informant rating of MT in which coaches could rate MT behaviours of their athletes under various stressors that they would typically face in competition. Further, as MT is generally thought of as a relatively stable disposition, Hardy et al. (2014) hypothesised that MT behaviour could be predicated by existing personality theories, more particularly, the revised Reinforcement Sensitivity Theory (rRST; Gray& McNaughton, 2000).

According to Gray and McNaughton (2000) there are three neuropsychological systems underpinning rRST. These systems are underpinned by neural circuits that mediate responses to reward, punishment and goal conflict. First, rewarding appetitive stimuli (e.g., money or food) activate the behavioural approach system (BAS) so that the individual approaches such rewarding stimuli. Second, the fight, flight, freeze system (FFFS) is activated when specific threats are detected. For example, one may want to avoid a dental

appointment due to fear of needles and drills. Here, the avoidance of such threatening stimuli is paramount. The final system termed behavioural inhibition system (BIS) is associated with resolving approach-avoidance conflict between the BAS and FFFS. For example, one may put up with mild dental pain (avoidance) in the hope that it may subside. However, if dental pain gets too severe, then the BIS system will resolve such approach-avoidance conflict by engaging with appetitive stimuli due to the reward stimulus (stop the pain) and seek dental support, despite the impending (punishment) consequences.

As discussed above, Hardy et al. (2014) hypothesised that rRST could explain MT behaviour. They noted a number of studies where reward sensitivity was associated with high levels of performance and mild reactions to stress under threatening conditions (e.g., Perkins & Corr, 2006; Perking, Kemp & Corr, 2007). Further, individuals high in punishment sensitivity seem to suffer from poor performance under pressure (Perkins et al., 2007), avoidance in threatening situations (Perkins & Corr, 2006), and negatively evaluate their capacity to deal with pain (Muris et al., 2007). Based on those findings, Hardy et al. proposed that higher levels of reward sensitivity (BAS) would be associated with higher levels of MT behaviour, whereas higher levels of punishment sensitivity (BIS) would be associated with lower levels of MT behaviour. One final point regarding Hardy et al.'s hypothesis is that, even though reward and punishment sensitivities are orthogonal constructs (Gray & McNaughton, 2000), studies testing interactive effects between these two systems are rare. Therefore, Hardy et al. predicted that MT would be associated with high levels of reward and low levels of punishment sensitivity. However, results revealed findings contrary to their hypothesis. Specifically, across two separate studies of elite level county cricketers, a significant interaction between reward and punishment sensitivity revealed that when reward sensitivity was low, increasing levels of punishment sensitivity were associated with an increase of MT behaviour. Further, when reward sensitivity was high, as punishment

sensitivity increased, MT behaviour decreased. To clarify these findings, Hardy et al. conducted a follow up study and found that participants who were high in punishment and low in reward sensitivity detected threats early thereby enabling them more time to plan an effective response.

The purpose of the current study was to examine Hardy et al.'s (2014) findings in the context of a different sport, namely, swimming. We chose the sport of swimming for a number of reasons. First, a limitation in the Hardy et al. study was that only elite level male cricketers aged between 15 and 19 years old participated. Swimming offered us an opportunity to examine data from a wider age range in both male and female athletes. Further, objective performance data is more easily obtained from swimming, as swim times are impartial to the interpretations of others (e.g., as opposed to a coach judging the performance of cricketers who were playing against other players of varying abilities). Finally, cricket is a team sport whereby one player's poor performance can be mitigated by another's exceptional performance. In swimming, individual accountability is much easier to attribute. A second purpose of the study was to examine whether punishment and reward sensitivities could actually predict race time performance.

The current study set out to re-examine and extend the findings from Hardy et al. (2014). Similar to Hardy et al., we aimed to develop an informant rating measure of MT in competitive swimming environments. We also re-examined Hardy et al.'s findings that when reward sensitivity is low, increasing levels of punishment sensitivity would positively relate to MT behaviour; but when reward sensitivity is high, increasing levels of punishment sensitivity would negatively relate to MT behaviour. Finally, on the basis that mentally tough personalities should maintain higher levels of personal performance under pressure than non-mentally tough personalities, a second purpose of the study was to examine the relationship between rRST and swimming performance time. More precisely, we predicted that when

reward sensitivity was low, increasing levels of punishment sensitivity would be associated with improved swimming performance. However, when reward sensitivity was high, increasing levels of punishment sensitivity would negatively relate to swimming performance.

## Method

### Participants

Fourteen UK swimming coaches (12 men and 2 women, $M_{age}$ = 34.71, *SD* = 10.46) and 196 of their competitive swimmers (89 male and 107 female, $M_{age}$ = 14.28, *SD* = 2.36) participated in the study. Coaches had on average 12.85 years (*SD* = 9.24) of coaching experience whereas the swimmers had 5.77 years (*SD* = 2.89) of competitive experience.

### Measures

*Mental Toughness.* In line with Hardy et al. (2014) method, we devised an informant measure of MT that related to competitive swimming. The initial inventory generated by the authors contained 25 items. The authors independently rated which items were more relevant to a swimming context and after discussions, reduced to 15. Seven of the items (items 1-7; see Table 1) were adapted from the cricket MT inventory used by Hardy et al. (2014). The 15 item questionnaire was then handed to four experienced high-performance swimming coaches (all coaches had at least 5 years of coaching competitive swimmers), who agreed upon and rephrased the items (where necessary). Instructions for the Swimming MT Inventory (SMTI) asked 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…" Items were scored from 1 (*never*) to 7 (*always*) with a midpoint of 4 (*sometimes*)

*Reward and Punishment Sensitivity*. The EPQR-S (Eysenck, Eysenck, & Barrett, 1985) is a 36-item self-report questionnaire comprising scores on extraversion (12 items e.g., Does your mood often go up and down), neuroticism (12 items e.g., Do you take much notice

of what other people think), and psychoticism (12 items e.g., Are you rather lively). Participants answer each question by responding with *Yes* or *No*. The EPQR-S scales have displayed good internal reliability (a = 0.77–0.88), and is strongly correlated (r = 0.71–0.96) with longer versions of the Eysenckian personality measure (Francis, Philipchalk, & Brown, 1991). Corr (2001) proposed the following transformations to measure reward and punishment sensitivity: reward sensitivity = (E x 2) + N + P), and punishment sensitivity = (12 – E) + (N x 2) – P), where E = extraversion, N = neuroticism and P = psychoticism. Scores were therefore free to range from 0 to 48 for reward sensitivity and from –12 to 36 for punishment sensitivity (See appendix A).

**Procedure**

After obtaining University ethical approval, fourteen swimming coaches agreed to take part in the study. We requested that the coaches should have known their athletes for a minimum of 1 year and have observed them in at least four competitive meets. A copy of the questionnaire pack was posted or hand delivered to each coach. The pack contained the purpose of the study including the SMTI and the EPQR-S with relevant consent forms. All questionnaires for the swimmers were placed in separate self-sealing envelopes. When second author was not present, coaches handed out the questionnaire packs to their swimmers. All swimmers completed the questionnaire packs at home and coaches were required to complete the SMTI for each competitive swimmer they were coaching. After swimmers completed their questionnaire pack (including consent from the swimmers' parents/guardian or coach), they passed the EPQR-S on to their coaches in a sealed envelope. All questionnaire packs were collected by hand or posted by the coaches within 6 weeks of being handed out.

## Results

**Measurement Validation**

To test the factor structure of the 15-item SMTI, we used Mplus version 7 (Muthén & Muthén, 2012) with a Cluster command to control for nested data at the coach level (i.e., 14 coaches rated 196 swimmers). When using the Cluster command, Mplus has one estimator choice: maximum likelihood with robust standard errors and chi-square (MLR). We used recommendations from Hu and Bentler (1999), in that a good fit was considered if the $\chi^2$ / *df* ratio was less than 2.00, the comparative fit index (CFI) approached .95, the root mean square error of approximation (RMSEA) approached .05, and the standardized root mean square residual (SRMR) was less than .08. The fit for the 15 item SMTI was not statistically acceptable, $\chi^2$ (90) = 237.19, CFI = .83, RMSEA = 0.09, SRMR= 0.069. Upon examination of standardised factor loadings, residuals, the modification indices, and the theoretical content of each item, we removed four items (see Table 1). For example, item 1 "People are relying on him/her to perform well" was removed on the grounds that as swimming is an individual sport, this item may not be as relevant to swimming as it was in cricket (this item was taken from Hardy et al., 2014 study). The resulting eleven-item model demonstrated a statistically good fit, $\chi^2$ (44) = 58.92, CFI = .97, RMSEA = 0.042, SRMR = .045. Cronbach's Alpha for the 11-item SMTI is .91.

**Punishment x Reward Interaction**

We used hierarchical linear modelling (HLM Version 7; Raudenbush & Bryk, 2002) to examine the interactive effects of punishment and reward sensitivity upon MT. We used HLM as we had nested data structures where single-level regression equations are problematic (Beck & Schmidt, 2012). Further, as punishment and reward sensitivities are recorded on different scales (see above), before computing the interactive term we standardised (z-scored) these variables across the group (for interpretation purposes only). We also used a fully randomised intercept and slope model with group mean centering. Table 2 shows the means, standard deviations and correlations between punishment, reward, age

Table 1

Items from the Swimming Mental Toughness Inventory (SMTI)

| Swimmer X is able to maintain a high level of performance in COMPETITIVE MEETS even when: | Loadings | | Mean | (SD) |
|---|---|---|---|---|
| 1. People are relying on him/her to perform well. (R) | .572 | | 4.82 | 1.31 |
| 2. The conditions are difficult (Slippery blocks/walls/not efficient lane ropes). | .472 | (.454) | 4.18 | 1.40 |
| 3. S/he has to perform at a high level all day. | .838 | (.826) | 4.50 | 1.28 |
| 4. It is a very important meet in the competition season. | .793 | (.751) | 4.84 | 1.26 |
| 5. Going into the race the competition is particularly tight. (R) | .784 | | 4.86 | 1.28 |
| 6. There are a large number of spectators present. (R) | .729 | | 5.05 | 1.21 |
| 7. S/he preparation has not gone to plan. (R) | .572 | | 4.22 | 1.10 |
| 8. S/he has to qualify for a final by swimming near their best in the heat. | .642 | (.679) | 4.98 | 1.27 |
| 9. Parental pressure and expectation on him/her is high. | .596 | (.592) | 4.46 | 1.43 |
| 10. S/he has to perform consistently well during a busy competition phase. | .813 | (.843) | 4.65 | 1.25 |
| 11. S/he has a number of events during a competition. | .785 | (.788) | 4.72 | 1.38 |
| 12. S/he is swimming up an age group and/or against a national squad member. | .691 | (.705) | 4.68 | 1.35 |
| 13. S/he has to achieve a National qualifying time. | .597 | (.611) | 4.43 | 1.47 |
| 14. S/he has underperformed after swimming several races during a meet. | .572 | (.601) | 4.28 | 1.24 |
| 15. S/he has to reach more than one final. | .797 | (.780) | 4.58 | 1.37 |

Note (R) signifies items that were removed during the Confirmatory Factor Analysis

Table 2

Means, Standard Deviations, and correlations among variables of interest

| Variable | Mean (SD) | 1 | 2 | 3 |
|---|---|---|---|---|
| 1 MT | 4.57 (.89) | | | |
| 2 Age | 14.28 (2.36) | .013 | | |
| 3 Punishment | 10.22 (7.14) | -.122 | -.027 | |
| 4 Reward | 26.32 (6.55) | -.132 | -.001 | -.092 |

and MT. To examine the proportion of variance that was accounted for across coaches in their ratings of MT we calculated the intraclass correlation (ICC) in the unconditional model (i.e., we only entered MT into the regression model). The ICC for MT was .15 indicating that 15% of the variance in MT was accounted for between coaches. As our sample differed to the sample from Hardy et al. (2014) in terms of age and gender, we conducted two separate

Table 3

Main and Interactive Effects of Reward and Punishment Sensitivity on the 11-item SMTI

| Step | $\beta$ | *SE* | *df* | Total %Var |
|---|---|---|---|---|
| Age | -.06 | .13 | 12 | 5.88 |
| Gender | .06 | .05 | 12 | 5.88 |
| Reward sensitivity | -.11 | .07 | 12 | 8.69 |
| Punishment sensitivity | -.10 | .08 | 12 | 10.14 |
| Reward x Punishment interaction | -.20* | .08 | 12 | 17.39 |

*$p < .05$

analyses. The first analysis re-examined the interaction between punishment and reward sensitivities upon MT in identical fashion to Hardy et al. In the second analysis, we

controlled for age and gender to assess whether these two variables had any independent effects upon MT.

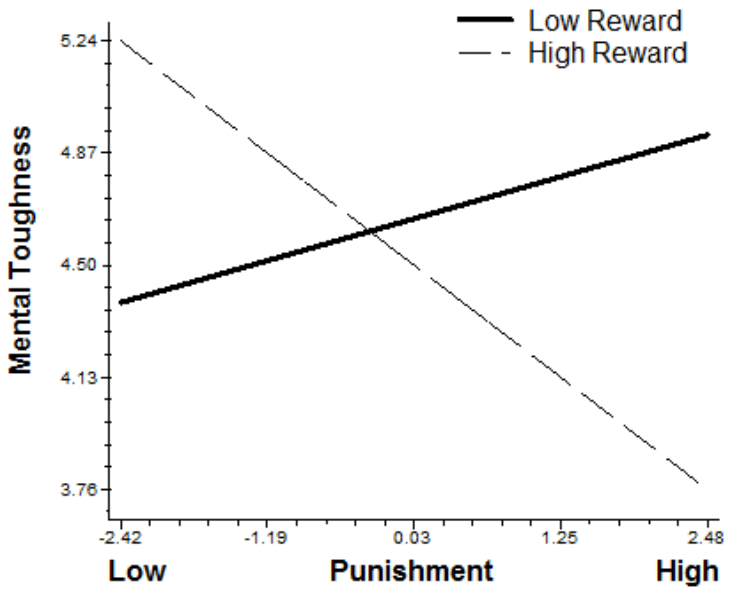
Results revealed that there was no significant main effect for reward ($\beta_1$ = -.11, $p$ = .17) or punishment sensitivity ($\beta_2$ = -.10, $p$ = .15) upon MT. However, there was a marginally significant punishment by reward sensitivity interaction ($\beta_3$ = -.17, $p$ = .06) upon MT. In the second analysis, we controlled for the effects of age and gender. Neither age ($\beta_1$ = -.06, $p$ = .32) nor gender ($\beta_2$ = .08, $p$ = .63) were significantly related to MT. As above, neither reward sensitivities ($\beta_4$ = -.11, $p$ = .16) or punishment ($\beta_3$ = -.10, $p$ = .16) were related to MT. However, the punishment by reward interaction was now significant ($\beta_5$ = -.20, $p$ = .04). The interaction demonstrates that when reward sensitivity is low, as punishment sensitivity increases MT increases. When reward sensitivity is high as punishment sensitivity increases then mental toughness decreases (supporting Hardy et al.'s findings; see Figure 1)[2].

## Discussion

The aim of the study was to develop an informant rating of MT behaviour in swimmers and then test whether punishment and reward sensitivities (Corr, 2001) could account for MT behaviour. Results revealed a good fit for an 11-item observer rating of MT in swimming. In support of the findings presented by Hardy et al. (2014), a significant interaction between punishment and reward sensitivity occurred, where increasing levels of punishment sensitivity led to an increase in MT behaviours when reward sensitivity was low. However, when reward sensitivity was high, an increase in punishment sensitivity led to a decrease in MT behaviours.

[2] As the interaction plots were identical for both analyses, we report the significant interaction where age and gender are controlled

*Figure 1.* Regression slopes (±1 *SD*) showing the moderating effects of reward sensitivity upon punishment sensitivity and MT behaviour in swimming.




As noted in the introduction, if swimmers who are low in reward and high in punishment sensitivity are able to maintain a high level of performance in competitive meets even when they face a series of stressful encounters, then this should translate to better racing times. Swimming performance is relatively unaffected by significant others (i.e., it is less interactive than the cricket environment studied by Hardy et al., 2014) and provides a reasonably objective measurement of performance. Consequently, we went back to a subsample of the swimmers (reported above) and asked them to report their opening heat race times of their main stroke in their previous three competitions. We hypothesised that for swimmers who were low in reward sensitivity, as punishment sensitivity increased, race times would get faster. Further, swimmers who were high in reward sensitivity, increasing levels of punishment sensitivity would lead to poorer race times.

# Method

## Participants

One hundred and six swimmers (50 male and 56 female, $M_{age}$ = 14.26, $SD$ = 2.26) from the above sample agreed to take part. Ninety swimmers did not complete the swimming performance questionnaire for a multitude of reason (e.g., some were on holiday/unavailable, some had moved clubs, and some refused; we do not have the exact numbers of who fitted into each category).

## Measures

*Swimming performance.* Swimmers provided race times for the first heat of their main swimming event (e.g., 100m freestyle) in each of their last three competitions (See appendix C).

## Procedure

After contacting coaches by phone, we sent a short questionnaire for each swimmer to note their name, main swimming event (e.g., 100m freestyle), and race time for their opening heat across their previous three races. We were only interested in their opening heat as it maximised the chances of obtaining data and swimmers who made it through to subsequent heats, may have suffered from fatigue effects. We also requested that the coach report how many years they had been coaching competitive swimming (as a proxy measure of experience). Questionnaires were posted back to the authors or collected in person.

## Results

As gender, distance, stroke, age and coach may all influence race times, we controlled for such possible effects before examining the effects of reward and punishment sensitivity. First, we split the data according to gender. Within each condition we z-scored the data according to stroke and distance. We then used the average race time (z-scored) of the three races as the outcome variable. The final sample consisted of 85 swimmers (we lost a number

of swimmers because we required at least three swimmers in each race category to make z-score transformations meaningful; this left us with a sample of 40 males and 45 females; $M_{age}$ = 13.88, *SD* = 1.90).

We used HLM version 7 in a similar format to that described above. We controlled for coach as a level 2 variable and all level 1 variables were grand mean centred before being entered into the equation (age; reward sensitivity; punishment sensitivity; and punishment sensitivity x reward sensitivity interaction). Results revealed that neither age ($\beta_1$ = -.09, *p* = .21), punishment sensitivity ($\beta_4$ = -.17, *p* = .24) or reward sensitivity ($\beta_3$ = -.13, *p* = .29) were related to swimming race time. However, there was a significant punishment sensitivity x reward sensitivity interaction ($\beta_5$ = .28, *p* = .04; see Table 4 and Figure 2).

Table 4

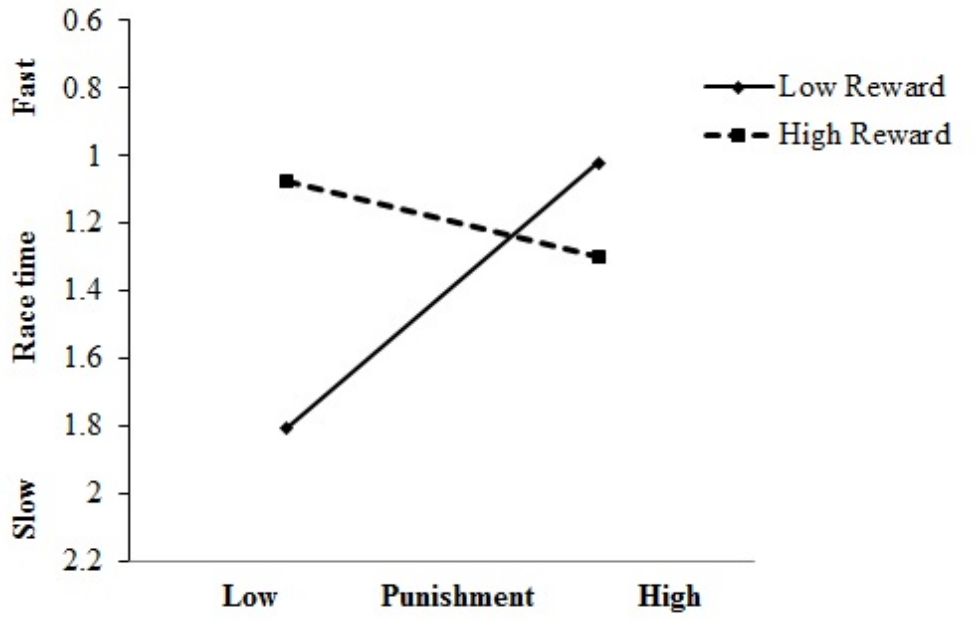
Main and Interactive Effects of Punishment and Reward Sensitivities upon Swimming Performance

| Step | *β* | *SE* | *df* | Total %Var |
|---|---|---|---|---|
| Age | -.09 | .06 | 7 | 11.40 |
| Reward sensitivity | -.13 | .11 | 7 | 16.90 |
| Punishment sensitivity | -.17 | .13 | 7 | 29.50 |
| Reward x Punishment interaction | -.28* | .11 | 7 | 32.39 |

*$p < .05$

The interaction demonstrated that when reward sensitivity was low, as punishment sensitivity increased, swimming times improved. Under conditions of high reward sensitivity as punishment sensitivity increased, swimming times slowed (see Figure 2). Finally, we examined the correlation between MT and swimming performance. It was expected that as MT increased, race times would decrease. However, after controlling for athlete age and coach experience, no significant correlation was found (*r* = -.067, *p* = .57).

*Figure 2.* Regression slopes (±1 *SD*) showing the moderating effect of reward sensitivity upon punishment sensitivity and swimming performance.




## General Discussion

The purpose of the present study was to re-examine Hardy et al.'s (2014) findings where punishment and reward sensitivities predicted MT behaviour. As Hardy et al. examined MT behaviour in elite male cricketers aged between 15-19 years, it was not clear how well their results would generalise across populations and sport. The present study aimed to develop an informant rating measure of MT for competitive swimmers and then to re-examine Hardy et al.'s findings. Results supported the development of an 11-item informant rating measure of MT behaviour in swimming and Hardy et al.'s punishment and reward interactive findings. We further hypothesised that athletes who are characterised as being MT (i.e., low reward and high punishment sensitivity), should perform to a higher level than their less MT counterparts. This indeed turned out to be the case. However, the correlation between MT behaviour and performance was not significant.

The results add further support to Hardy et al.'s (2014) counterintuitive findings that athletes rated as being MT by their coach had higher levels of punishment sensitivity and lower levels of reward sensitivity. Further, as reward and punishment sensitivities are orthogonal constructs (e.g., Gray & McNaughton, 2000), the present results add weight to the argument that the interactive effects of punishment and reward sensitivities rather than their separate effects should be considered. Previous research has failed to do this (e.g., Perkins & Corr, 2006; Perkins et al., 2007). However, it was noted by Hardy et al. (2014) that as punishment sensitive cricketers had been in an elite environment for quite some time, they may have already built up a series of coping strategies to deal with upcoming threats (e.g., overcoming previous stressors or psychological support staff intervention). Therefore, it is unclear whether these findings would generalise to a less elite group of athletes or exactly what mechanisms are causing resilient behaviour under stress (e.g., early threat detection and/or the adaptive use of coping strategies).

A recent study may help to shed some light on this later point. Manley, Beattie, Roberts, Lawrence and Hardy (under review) examined the potential beneficial effects of punishment sensitivity (Perkins & Corr, 2006) on early threat detection on a lab based precision-grip task across two studies. In Study 1, all participants were trained with psychological skills use (i.e., imagery, muscle relaxation and cue words), in Study 2 they weren't. In both studies, participants were randomly placed in an early or a late threat warning condition (i.e., half of the participants were told exactly what the stress test entailed at the start of testing). In Study 1, results revealed that punishment sensitivity positively related to performance under conditions of early threat warning, but negatively related to performance in the late threat condition. In Study 2, where coping strategies were not provided, results mirrored that of Study 1. Therefore, coping strategies appeared to be of limited use. However, one caveat to this finding was that in both studies the *use* of coping

strategies was measured. Across both studies, results revealed that the majority of the punishment sensitive individuals benefitted from using at least one type of coping strategy (even though they were not explicitly taught in Study 2). Consequently, individuals who are punishment sensitive seem to have a set of cognitive strategies that allow them to deal with early threat detection. This could partially explain the current study findings and that of Hardy et at. (2014).

A second purpose of the study was to investigate whether swimmers low in reward but high in punishment sensitivity (rated as being able to maintain a high level of performance under pressure), would perform better. Findings supported our hypothesis that swimmers characterized with low reward sensitivity, as punishment sensitivity increased, performance increased. Further, as punishment sensitivity increased, those with high levels of reward sensitivity showed a decrease in performance levels. This finding is of particular interest especially after controlling for gender, stroke, distance, age and coach. Perhaps punishment sensitive swimmers are better prepared for the competitive environment, as they may have developed self-regulated training behaviours where they have detected and overcome threats (internal or external) in practice, which leads them to be better equipped at dealing with stressors during meets. For example, in a gymnastics environment, Woodman, Zourbanos, Hardy, Beattie, and McQuillan (2010) found that conscientiousness and goal-setting independently predicted quality of preparation for competition. Further, goal setting moderated the relationship between extraversion and distractibility (extroverts were less distracted when they used goal setting). Therefore, training behaviours seems an opportune environment where athletes could self-regulate their training behaviours in picking up threat early and dealing with it (e.g., Young & Starkes, 2006a; 2006b; Young, Medic, & Starkes 2009).

Surprisingly, there was no significant correlation between swimming performance and coach rated measure of MT. However, as we were only examining race times in the opening heat, then this may not have been a sufficiently stressful encounter for the majority of swimmers. During opening heats, swimmers may be conserving energy for later heats. A top four finish will qualify them for the following heat. Hence, for some, the opening heat is merely a formality. Further, external sources of stress such as spectators may be low, reducing a source of potential stress (e.g., Wann, Schrader, & Adamson, 1998). As the MT measure assesses how well a swimmer can maintain performance under a range of stressors, then it may not correlate well to performance under non-stressful conditions. Unfortunately, we could not examine swimming performance in later heats due to insufficient data points. This appears to be a limitation in the current study.

Regarding applied implications, although there are vast performance environment differences between cricket and swimming, the ability to pick up threat early (either internal threats such as poor technique or external threats such as the environment) and prepare for it early, would seem an advantage at any age, gender, or sport type. Evidence from the current set of studies and that of previous research (e.g., Bell, Hardy, & Beattie, 2013; Hardy et al., 2014; Manley et al., under review), suggests that athletes who have a high level of punishment sensitivity may already be benefiting from self-learned coping strategies that allow them to prepare earlier for competition. Results from Manley et al. also suggest that it is not the use of coping strategies per se that count for better performance under preassure, rather it is the interactive effects of early threat detection and coping strategies that lead to better performance. Therefore, it is important for coaches and athletes to recognise the potential benefits of punishment sensitivity with regard to early threat detection. Of course, with early threat detection one may experience a series of negative emotional responses (e.g., anxiety and stress; Eysenck, Derakshan, Santos, & Calvo, 2007), however careful application

of punishment sensitivity intervention (e.g., Bell et al., 2013) seems to be able to mitigate such responses.

In summary, the present study supports previous research (e.g., Hardy et al., 2014) where athletes high in punishment and low in reward sensitivities displayed higher levels of MT behaviour than athletes low in punishment and high in reward sensitivity. Further, these personality profiles also transfer across to faster race times. In terms of future research directions, researchers may want to examine self-regulated training behaviours (e.g., Young & Starkes, 2006a) in developing MT. That is, as athletes (especially in the current study) spend the majority of time training, those who have high levels of punishment sensitivity appear to be doing something quite different than their less punishment sensitive counterparts.

# Chapter 3

## The mediating role of training behaviours on self-report MT and MT behaviour in swimming

## Abstract

Self-regulated training behaviours plays a vital role in athlete's physical and mental sporting development. The purpose of the present study was to investigate the role of training behaviours (self and coach rated) on self-report MT and coach rated MT behaviour in swimming. We hypothesized that training behaviours (self and coach rated) would positively relate to self-report measures of MT and coach rated MT behaviour. Further, training behaviours would mediate the relationship between self-report MT and coach rated MT behaviour. A sample of 12 swimming coaches (11 men and 1 women) and 218 of their competitive swimmers (88 men and 130 women) participated in the study. Findings supported our hypotheses that self-regulated training behaviours (self and coach rated) positively related to self-report MT and coach rated MT behaviour. Further, self-regulated training behaviours (self and coach rated) mediated the relationship between self-report MT and coach rated MT behaviours. Our recommendation for future research is to specifically examine exactly what type of training behaviours positively influences MT.

**Introduction**

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 commodity allowing athletes to utilize a range of cognitive, emotional, and behavioural advantages enabling the athlete to maintaining (or even improve) performance standards under pressure (e.g., Hardy et al., 2014; Gucciardi & Gordon, 2011). Therefore, it is not surprising that research has extensively examined the antecedents of MT (e.g., Bull, Shambrook, James, & Brooks, 2005, Connaughton, Wadey, Hanton, & Jones, 2008, Connaughton, Hanton, & Jones, 2010, Gucciardi, Gordon, Dimmock, & Mallett, 2009, Thelwell, Such, Weston, Such, & Greenlees, 2010).

One important antecedent of MT is the training environment. For example, in an elite sample of female gymnasts, Thelwell et al. (2010) found that general training (e.g., being consistent, simulating competition, preparation, overcoming problems, training camps, recover and train with injury, learn new moves/complex skills and goal setting) were factors that contributed to the developed MT. In a sample of elite level cricketers, Bull et al. (2005) found that the environment (e.g., parental influence, childhood background, exposure to foreign cricket, opportunities to survive early setbacks, and the need to "earn" success) was a strong foundation upon the development of MT. In a sample of eight super-elite athletes (from a range of sports), Jones, Hanton, and Connaughton (2007) found that training characteristics such as using long term goals, pushing oneself to the limit, and controlling the environment were sources of MT. Further, cricket coaches perceived that exposing their athletes to various experiences such as competition simulation, setting challenging training environments, and emphasizing improvement and enjoyment over winning were important behaviours in developing MT (Gucciardi et al., 2009). Connaughton et al. (2008) found that

coaches' leadership, social support, vicarious experience, demonstration of ability, mastery, critical incidents, enjoyment, parents' focus, and social support, were perceived underlying mechanisms in the development of MT. Finally, Driska, Kamphoff, and Armentrout, (2012) found that tough environments promoted MT in swimming and MT swimmers retained psychological control on poor training days.

Despite a wealth of qualitative research studies examining the relationship between the training environment and MT, there appears to be a lack of quantitative evidence directly linking the training environment, but more specifically, training behaviours to MT. Further, we are only aware of a limited number of quantitative studies that actually examine successful training behaviours in sport. For example, Oliver, Hardy, and Markland (2010) found that; professionalism, motivation, coping, commitment, effort, seeking information to improve, concentration, and avoiding negative behaviours were important practice behaviours for the development of high-level youth athletes. Woodman, Zourbanos, Hardy, Beattie, and McQuillan, (2010) reported three important training behaviours namely, distractibility (e.g., the ability to avoid being distracted by other people in training), coping with adversity (e.g., overcoming problems when training session are not going well), and quality of preparation (e.g., always having a competition plan that covers all eventualities). However, even the best planned training environments requires the athlete to have some form of self-regulation (e.g., Young & Starkes, 2006a).

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) and consists of any attempts to modify ones thinking, feelings and behaviour in order to obtain goals, values and ideals (Baumeister, Heatherton, & Tice, 1994). Self-regulation allows one to take the initiative, channel efforts, sustain or improve persistence and determination, as well as maintaining focus where and when required (Zimmerman, 1986; Ntoumanis &

Cumming 2016). Self-regulation has also been linked to goal directed behaviour via the regulating processes of thoughts, feelings, emotions, impulses, appetites, task performances and attentional processes (Vohs & Baumeister, 2007). In sport (such as swimming), as athletes are often left alone to train unsupervised, then those athletes with good self-regulation skills would be better able to deploy appropriate strategies to reach their goals.

Further, successfully engaging with the arduous amount of hours spent in training requires some form of behavioural, emotional, and attentional self-regulation (e.g., Young & Starkes, 2009). Research shows that higher-level athletes are more efficient at self-regulation than their lower level counterparts are (Clearly & Zimmerman, 2001), and that self-regulation has been directly linked to MT. For example, 'emotion regulation' (an awareness of and ability to use emotionally relevant processes to facilitate optimal performance and goal attainment) and 'attention regulation' (the ability to focus on what is relevant while minimizing the intrusion of irrelevant information) are two key factors in the development of the Mental Toughness Index (MTI; Gucciardi, Hanton, Gordon, Mallett, & Tenby, 2014). Mutz, Clough, and Papageorgiou (2017) examined the relationship between emotion regulation, mental toughness and depression. They found that individuals scoring high on MT, frequently use more cognitive reappraisal strategies (e.g., changing the way you perceive certain situations) to regulate emotional responses. However, the purpose of the current study was to examine the behavioural side of self-regulation.

In swimming, Young and Starkes (2006a) identified seven non self-regulated training behaviours that helped to identify ineffective 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) missed significantly less swim volume in training. Further, when examining the relationship between self-report workout volume and actual workout volume, all swimmers regardless of on-task behaviours over reported the volume of work they actually did. One reason being is that social desirability and self-presentation issues influenced the swimmers.

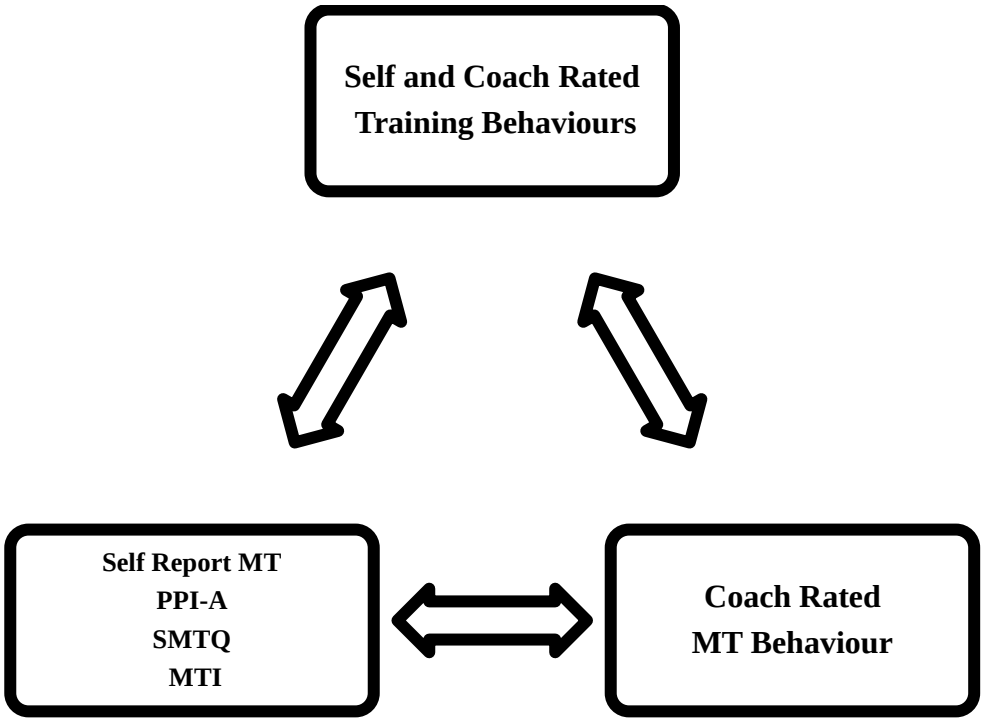
One way to solve the above issue is to obtain reliable observant data (e.g., Hardy et al., 2014). For example, Hardy et al. validated an 8-item informant rating of MT, where coaches could rate MT behaviours that their athletes demonstrated under various stressors. In this way, it is possible to eliminate social desirability and self-presentation issues. In extending this research, Beattie, Alqallaf, and Hardy (2017) also developed an informant (coach rated) measure of MT behaviours in swimming (see measures section below). Other researchers have also adopted this approach. For example, Shokri, Viladrich, Cruz, and Alcaraz, (2014), adapted the Behavioural Regulation in Sport Questionnaire (BRSQ; Lonsdale, Hodge, & Rose, 2008) to assess coach's perceptions of athlete's motivation. The BRSQ assesses behavioural motivation from a self-determination theory perspective (Deci & Ryan, 1985). That is, the BRSQ is scored on six subscales; a motivation, external regulation, introjected regulation, identified regulation, integrated regulation and intrinsic motivation). However, the purpose of the present study was to assess actual training behaviours as a form of regulation rather than behavioural motivation.

The current study set out to address some limitations noted above. For example, research findings (e.g., Beattie et al., 2017; Hardy et al., 2014) show the importance of avoiding single source data when examining such a desirable commodity as MT. Further, research from Young and Starkes (2006b) also show that relying on self-report training behaviours is problematic. Therefore, in order to control for social desirability and self-presentation issues, both the swimmer and the coach (the observer) completed a measure of self-regulated training behaviours. The coach additionally completed a measure of MT

behaviours that the swimmers demonstrated when performing under pressure (Beattie et al., 2017). A further limitation addressed in the current study, relates to the measure of self-report MT. Gucciardi, Mallett, Hanrahan and Gordon (2011) note various limitations in sport specific measures of MT. Therefore, instead of relying on a single source of self-report MT, we examined three relatively well known and used assessments of MT (see measures section).

Although, there appears to be a theoretically strong link between athlete MT, coach rated MT behaviour and self-regulated training behaviours via qualitative research, we note that no study yet has quantitatively examined such relationships. Therefore, we set out to test the following hypotheses. First, due to the research discussed above, as MT is partly developed within a training environment, then self-report measures of MT should have a strong and positive relationship with self-regulated training behaviours (self and coach rated). Further, self-regulated training behaviours (self and coach rated) should have a strong and positive relationship with coach rated MT behaviour. We also predict a strong and positive relationship between self-report MT and coach rated MT behaviour. Finally, if self-report MT and MT behaviours are partly derived from self-regulated training behaviours, then training behaviours (self and coach rated) should mediate the relationship between self-report measures of MT and coach rated MT behaviour (see Figure 3.1).

*Figure 3.* The moderating effect of self and coach rated training behaviours on the relationship between self-report MT and coach rated MT behaviour.




## Method

### Participants

Twelve UK swimming coaches (11 men and 1 women $M_{age}$ = 49.77, *SD* = 15.60) and 218 of their competitive swimmers (88 men and 130 women $M_{age}$ = 14.62, *SD* = 2.58 ) completed the study. Coaches had on average 22.24 years (*SD* = 12.25) of coaching experience and the swimmers had 5.04 years (*SD* = 2.52) of competitive experience.

### Measures

*Behavioural Mental Toughness.* We used the behavioural Swimming Mental Toughness Inventory SMTI (Beattie, Alqallaf & Hardy, in press) as a measure of informant rating of MT behaviour in swimming (see also Hardy et al., 2014). The SMTI 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 SMTI

contains items such as “S/he has a number of events during a competition” and “S/he has underperformed after swimming several races during a meet”. Items were scored from 1 (*never*) to 7 (*always*) with a midpoint of 4 (*sometimes*) (See appendix D). Beattie et al. reported adequate fit statistics for the SMTI ($\chi^2$ (44) = 58.92, CFI = .97, RMSEA = 0.042, SRMR = .045; Cronbach’s Alpha = .91). However, one purpose of the current study was to test the concurrent validity of the SMTI.

*Psychological Performance Inventory-Alternative* (PPI-A; Golby, Sheard, & van Wersch, 2007). The PPI-A consists of 14 items across four different constructs. These are determination (e.g., The goals I’ve set for myself as a swimmer[3] keep me working hard); self-belief (e.g., I can keep strong positive emotion flowing during competition); positive cognition (e.g., I can change negative moods into positive ones by controlling my thinking); and visualisation (e.g., I visualise working through tough situations prior to competition). The PPI-A is rated on a 5-point Likert scale ranging from 1 (*Almost never*) to 5 (*Almost always*). Golby et al. reported Cronbach alphas for each of the four factors as determination .72; self-belief .84; positive cognition .75; and visualization .78. In the current study these were .61, .81, .78, and .76 respectively.

*Sport Mental Toughness Questionnaire* (SMTQ; Sheard, Golby, & van Wersch, 2009). The SMTQ contains 14 item measuring three subscales. These are confidence (e.g., I have an unshakeable confidence in my ability); constancy (e.g., I give up in difficult situations); and control (e.g., I get angry and frustrated when things do not go my way). The SMTQ is rated on a 4-point Likert scale ranging from 1 (*Not at all true*) to 4 (*Very true*). Sheard et al. reported Cronbach’s alpha for the three subscales at confidence .79, constancy .76, and control .72. In the current study these were .71, .63, and .53 respectively.

[3] We changed the terminology from “athlete” to “swimmer” throughout the questionnaire

*Mental Toughness Index* (MTI; Gucciardi, Hanton, Gordon, Mallet, & Temby, 2014). The MTI is a single factor 8 item measure containing items such as "I believe in my ability to achieve my goals" and "I consistently overcome adversity". The MTI 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 MTI at .86. In the current study, Cronbach's alpha was .88.

*Self-Rated Training Behaviours* (SRTB). As no measure presently exists that specifically assesses self-regulated training behaviours, 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 habits (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).

*Coach-Rated Training Behaviours* (CRTB). In order to obtain an informant rating of training behaviours (i.e., coach rated), we selected five items from the athletes self-regulated training behaviours upon which the coach could report (we did not want to overburden the coach who were also completing 11 items from the SMTI for each swimmer). The wording of the items changed slightly from above. That is, we used the stem, "Swimmer X" 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).

**Procedure**

After obtaining University ethical approval, and after emailing a number of swim clubs, 12 swimming coaches agreed to take part in the study. We requested that all coaches should have coached their athletes for a minimum of 1 year. Questionnaire packs (containing information about the study) were hand delivered to the coach and their swimmers. The

coach completed the SMTI and the 5-item CRTB for each competitive swimmer they were coaching. The swimmer completed the PPI-A, SMTQ, MTI and the 11-item SRTB 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, internal consistency coefficients, and correlations for the variables measured in this study are displayed in Table 2.

### Measurement validation

We used confirmatory factor analysis to validate the SMTI, SRTB and CRTB questionnaires. Specifically, we used Mplus version 7 (Muthén & Muthén, 2012) to test the factor structure of the 11-item SMTI, the 11 item SRTB, and the 5 item CRTB. As we had a nested data structure (i.e., 12 coaches rated 218 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 a good fit if the $\chi^2/df$ ratio was less than 2.00, the comparative fit index (CFI) approached .95, the root mean square error of approximation (RMSEA) approached .05, and the standardized root mean square residual (SRMR) was less than .08. CFA results for the 11 item SMTI found a good statistical fit, $\chi^2$ (44) = 78.11, CFI = .92, RMSEA = .061, SRMR = .046, supporting concurrent validity for the measure (Beattie et al., under second review). Cronbach's Alpha for the 11-item SMTI was .886. CFA results for the 11 item SRTB also displayed a statistically good fit, $\chi 2$ (44) = 72.53, CFI = .91, RMSEA= .056, SRMR = .052. Cronbach's Alpha for the 11-item SRTB was .758. Regarding CFA for the 5 item CRTB, fit statistics failed to reach recommended levels $\chi 2$ (5) = 13.57, CFI = .95, RMSEA= 0.089, SRMR = 0.029. Upon examination of the modification indices, factor loadings and item content, items

Table 1

| 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) | SRTB-C | SRTB-A | Det | SB | PC | Vis | Conf | Const | Cont | MTI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SRTB-C | 6.8 (1.4) | 1.00 | | | | | | | | | |
| SRTB-A | 7.0 (1.0) | .22** | 1.00 | | | | | | | | |
| Det | 4.0 (.67) | .12 | .60** | 1.00 | | | | | | | |
| SB | 3.6 (.67) | -.02 | .30** | .21** | 1.00 | | | | | | |
| PC | 3.6 (.77) | .05 | .46** | .46** | .61** | 1.00 | | | | | |
| Vis | 3.4 (.91) | .11 | .48** | .50** | .27** | .47** | 1.00 | | | | |
| Conf | 2.8 (.53) | .08 | .32** | .37** | .62** | .54** | .35** | 1.00 | | | |
| Const | 3.1 (.55) | .24** | .55** | .59** | .30** | .47** | .33** | .36** | 1.00 | | |
| Cont | 2.5 (.60) | -.03 | .20** | .10 | .55** | .33** | .03 | .35** | .27** | 1.00 | |
| MTI | 5.5 (.95) | .13 | .56** | .49** | .52** | .63** | .41** | .60** | .47** | .33** | 1.00 |

SRTB-C; Self-regulated training behaviours coach rated; SRTB-A; Self-regulated training behaviours athlete rated; Det = Determination; SB = Self-Belief; PC = Positive Cognition; Vis = Visualisation; Conf = Confidence; Const = Constancy; Cont = Control; MTI = Mental Toughness Index; *p < 0.05; **p < 0.01; ***p < .001

2 and 3 had high cross loadings. Therefore, we removed item 3. This resulted in a good acceptable fit, $\chi 2$ (2) = 3.21, CFI = .98, RMSEA = .053, SRMR = .013. Cronbach's Alpha for the 4-item SRTB-C was .84.

## Self-rated training behaviours

### Mediating effects of self-rated training behaviours on the relationship between self-report MT (PPI-A) and behavioural MT in Swimming

To test the hypotheses that training behaviours (self and coach rated) would mediate the relationship between self-report MT and MT behaviour, the PROCESS macro (Release 2.10; Hayes, 2012) for SPSS (version 22) was used. We used Bootstrapping set at 5000 and a confidence interval set at 95%. Confidence intervals that do not contain a zero are required for significant mediation to occur.

Model 1 examined the mediating role that self-rated training behaviours (SRTB) has upon the relationship between self-rated MT (PPI-A) and coach rated MT (CRMT). In model 1, after controlling for athletes age, gender, experience, and coach experience, the PPI-A had a significant and positive relationship with SRTB (β = .98, $p < .001$). SRTB also had a significant and positive relationship with CRMT (β = .19, $p = .001$). There was a marginal significant direct effect between the PPI-A and CRMT (β = .18, $p = .06$). Further, SRTB had a significant and positive indirect effect (β = .08l; CI = .064 – .315). The PPI-A (and demographics) explained 38% of the variance in SRTB ($F$ (16, 189) = 7.37, $p < .001$). Both PPI-A and SRTB (and demographics) explained 26% of the variance in the outcome variable CRMT ($F$ (17, 188) = 3.97, $p < .001$; see Table 3).

Follow-up tests further examined the separate subscales of the PPI-A. SRTB had a significant and positive indirect effect upon all four sub-scales of the PPI-A, determination (β = .253; CI = .133 – .391); self-belief (β = .068; CI = .026 – .119); positive cognition (β = .138; CI = .066 – .223); and visualisation (β = .096; CI = .034 – .167; see Table 3).

**Mediating effects of self-rated training behaviours on the relationship between self-report MT (SMTQ) and behavioural MT in Swimming**

Model 2 examined the mediating role that SRTB has upon the relationship between self-rated MT (SMTQ) and CRMT. After controlling for the demographics, the SMTQ had a significant and positive relationship with SRTB (β = 1.14, $p$ <.001). SRTB also had a significant and positive relationship with CRMT (β = .19, $p$ < .001). There was a significant and positive direct effect between the SMTQ and CRMT (β = .13, $p$ = .02). Further, SRTB had a significant and positive indirect effect (β = .22; CI = .09 – .371). The SMTQ (and demographics) explained 28% of the variance in SRTB ($F$ (16, 189) = 4.54, $p$ < .001). Both SMTQ and SRTB (and demographics) explained 27% of the variance in the outcome variable CRMT ($F$ (17, 188) = 4.08, $p$ < .001; see Table 3).

Follow up tests further examined the separate subscales of the SMTQ. SRTB had a significant and positive indirect effect upon all three sub-scales of the SMTQ, confidence (β = .122; CI = .05 – .225); control (β = .079; CI = .023 – .158); and constancy (β = .213; CI = .096 – .355; see Table 3).

**Mediating effects of coach rated training behaviours on the relationship between self-report MT (MTI) and behavioural mental toughness**

Model 3 examined the mediating role that SRTB has upon the relationship between self-rated MT (MTI) and CRMT. After controlling for the demographics, the MTI had a significant and positive relationship with SRTB (β = .622, $p$ < .001). SRTB also had a significant and positive relationship with CRMT (β = .19, $p$ < .001). There was also a marginal significant and positive direct effect between the MTI and CRMT (β = .122, $p$ = .056). Further, SRTB had a significant and positive indirect effect (β = .119; CI = .047 – .198). The MTI (and demographics) explained 37% of the variance in SRTB ($F$ (16, 189) = 6.91, $p$ < .001). Both MTI and SRTB (and demographics) explained 26% of the variance in

the outcome variable CRMT ($F$ (17, 188) = 3.98, $p$ < .001). As the MTI is a single factor measure, no follow-up tests were conducted (see Table 3).

## Coach-rated training behaviours

### Mediating effects of coach rated training behaviours on the relationship between self-report MT (PPI-A) and behavioural mental toughness

Model 4 examined the mediating role that coach rated training behaviours (CRTB) has upon the relationship between self-rated MT (PPI-A) and CRMT. After controlling for the demographics, the PPI-A had a significant and positive relationship with CRTB (β = .39, $p$ =.01). CRTB also had a significant and positive relationship with CRMT (β = .20, $p$ < .001). There was also a significant and positive direct effect between the PPI-A and CRMT (β = .29, $p$ < .001). Further, CRTB had a significant and positive indirect effect (β = .08l; CI = .016 – .168). The PPI-A (and demographics) explained 27% of the variance in CRTB ($F$ (16, 189) = 4.51, $p$ < .001). Both PPI-A and CRTB (and demographics) explained 33% of the variance in the outcome variable CRMT ($F$ (17, 188) = 5.66, $p$ < .001; see Table 3).

Follow up tests further examined the separate subscales of the PPI-A. CRTB had a significant and positive indirect effect upon two sub-scales of the PPI-A, determination (β = .079; CI = .024 – .158) and visualisation (β = .054; CI = .014 – .108). CRTB also had a marginal indirect effect upon positive cognitions (β = .05; CI = -.0008 – .122; see Table 3).

### Mediating effects of coach rated training behaviours on the relationship between self-report MT (SMTQ) and behavioural mental toughness

Model 5 examined the mediating role that CRTB has upon the relationship between self-rated MT (SMTQ) and CRMT. After controlling for the demographics, the SMTQ had a significant and positive relationship with CRTB (β = .62, $p$ =.006). CRTB also had a significant and positive relationship with CRMT (β = .21, $p$ < .001). There was also a significant and positive direct effect between the SMTQ and CRMT (β = .36, $p$ < .001).

Further, CRTB had a significant and positive indirect effect (β = .013; CI = .028 – .273). The SMTQ (and demographics) explained 28% of the variance in CRTB ($F$ (16, 191) = 4.79, $p$ < .001). Both SMTQ and CRTB (and demographics) explained 32% of the variance in the outcome variable CRMT ($F$ (17, 190) = 5.35, $p$ < .001; see Table 3).

Follow up tests further examined the separate subscales of the SMTQ. CRTB had a significant and positive indirect effect between constancy and CRMT only (β = .154; CI = .072 – .274; see Table 3).

**Mediating effects of coach rated training behaviours on the relationship between self-report MT (MTI) and behavioural mental toughness**

Model 6 examined the mediating role that CRTB has upon the relationship between self-rated MT (MTI) and CRMT. After controlling for the demographics, the MTI had a significant and positive relationship with CRTB (β = .34, $p$ = .008). CRTB also had a significant and positive relationship with CRMT (β = .20, $p$ = .001). There was also a significant and positive direct effect between the MTI and CRMT (β = .17, $p$ = .001). Further, CRTB had a significant and positive indirect effect (β = .069; CI = .03 – .125). The MTI (and demographics) explained 29% of the variance in CRTB ($F$ (16, 189) = 4.95, $p$ < .001). Both mean MTI and CRTB (and demographics) explained 33% of the variance in the outcome variable CRMT ($F$ (17, 188) = 5.42, $p$ < .001; see Table 3).

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 (MT) to mediator (SRTB) | | Mediator (SRTB) to (CRMT) (Y) | | Direct effect MT to CRMT (Y) | | Indirect effect | | 95% CI | |
|---|---|---|---|---|---|---|---|---|---|---|
| | B | SE | B | SE | B | SE | B | SE | UL | LL |
| MPPI-A | .98*** | .10 | .19*** | .05 | .18[a] | .10 | .18 | .06 | .06 | .31 |
| MSMTQ | 1.14*** | .16 | .20*** | .05 | .29* | .13 | .22 | .07 | .09 | .37 |
| MTI | .62*** | .07 | .19*** | .06 | .12[a] | .06 | .12 | .04 | .05 | .20 |
| PPI-A Determination | .94*** | .09 | .27*** | .06 | -.04 | .09 | .25 | .07 | .13 | .39 |
| PPI-A Self-belief | .28*** | .08 | .24*** | .05 | .06 | .06 | .07 | .02 | .03 | .20 |
| PPI-A Positive Cognition | .60*** | .09 | .23*** | .05 | .06 | .07 | .14 | .04 | .07 | .22 |
| PPI-A Visualisation | .55*** | .07 | .17** | .05 | .18** | .06 | .10 | .03 | .03 | .17 |
| SMTQ Confidence | .61*** | .13 | .20*** | .05 | .32*** | .09 | .12 | .04 | .05 | .22 |
| SMTQ Control | .32* | .12 | .25*** | .05 | .03 | .08 | .08 | .03 | .02 | .16 |
| SMTQ Constancy | .97*** | .11 | .21*** | .06 | .12 | .10 | .21 | .07 | .10 | .35 |
| | Predictor (MT) to mediator (CRTB) | | Mediator (CRTB) to CRMT (Y) | | Direct effect MT to CRMT (Y) | | Indirect effect | | | |
| MPPI-A | .39** | .15 | .21*** | .04 | .29*** | .08 | .08 | .04 | .02 | .17 |
| MSMTQ | .62** | .22 | .21*** | .04 | .36*** | .11 | .13 | .06 | .03 | .27 |
| MTI | .34** | .10 | .20*** | .04 | .17*** | .05 | .07 | .02 | .03 | .12 |
| PPI-A Determination | .36* | .14 | .22*** | .04 | .13 | .07 | .08 | .03 | .02 | .16 |
| PPI-A Self-belief | .08 | .10 | .22*** | .03 | .11* | .05 | .02 | .03 | -.03 | .07 |
| PPI-A Positive Cognition | .22 | .12 | .22*** | .04 | .15** | .06 | .05 | .03 | -.00 | .12 |
| PPI-A Visualisation | .27* | .10 | .20*** | .03 | .22*** | .05 | .05 | .02 | .01 | .11 |
| SMTQ Confidence | .29 | .17 | .21*** | .03 | .37*** | .08 | .06 | .05 | -.02 | .16 |
| SMTQ Control | .03 | .16 | .23*** | .04 | .08 | .08 | .08 | .08 | -.08 | .23 |
| SMTQ Constancy | .73*** | .16 | .21*** | .04 | .17[a] | .09 | .15 | .05 | .07 | .27 |

Note. B = unstandardized regression coefficients; MT = Self-reported mental toughness; SE = Standard error; SRTB = Self-rated training behaviours; CRTB = Coach rated training behaviours; CRMT = Coach rated mental toughness; MPPI-A = Mean score of psychological performance inventory-alternative; MSMTQ = Mean score of sport mental toughness questionnaire; MTI = Mental toughness index. LL = lower limit of 95% confidence interval; UL upper limit of 95% confidence interval. [a] = .06; *p < 0.05; **p < 0.01; ***p < .001.

## Discussion

The aim of study was to examine whether training behaviours (self and coach rated) mediated the relationship between self-report mental toughness (PPI-A, SMTQ, and MTI) and coach rated mentally tough behaviour (e.g., Hardy et al., 2014). Initial questionnaire validation revealed good support for the development of a single factor qualitative measure of self-regulated training behaviours (self and coach rated). Results also showed strong concurrent validity for Beattie et al.'s (2017) assessment of MT behaviours in a swimming context. Further, findings support the hypothesis that self-regulated training behaviours mediated the relationship between self-report MT and coach rated MT behaviours. In more detail, athlete self-report training behaviours mediated the relationship between all four subscales of the PPI-A (determination, self-belief, positive cognition, and visualization); all three subscales of the SMTQ (confidence, constancy, and control) and the single factor MTI upon coach rated MT behaviour. In contrast, coach rated assessment of training behaviours only mediated the relationship between two subscales of the PPI-A (determination, visualization and marginally, positive cognition); one subscale of the SMTQ (constancy) and the single factor MTI upon coach rated MT behaviour.

The present results show how important self-regulated training behaviours are as a source of self-report MT and coach reported MT behaviour. According to Rothman et al. (2007), in order for training to become a habit, an individual must go through four behavioural change processes, initial response (e.g., enrolling in training), continued response (continued effort in training), maintenance (sustained effort to continue behaviour), and habit, (self-perpetuating pattern of behaviour). However, it is not clear whether athletes are MT because they have strong self-regulated training behaviours, or whether athletes tolerate hours, days and weeks training in a pool because they are MT? Perhaps one could argue that as swimmers usually 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). One could argue that without strong self-regulated training behaviours, the training environment would have a limited success at developing MT.

Although the current study exclusively examined self-regulated training behaviours, it is very likely that emotional self-regulation also plays a strong role in training and the maintenance of MT behaviour (e.g., Mutz et al., 2017). That is, a swimmer who uses emotional regulation, will be able to control their emotional reactions to stressors such as poor training days, injury, competition, which will allow them to demonstrate a whole host of MT behaviours. It is widely reported that the negative emotion of anxiety causes distraction and a host of psychophysiological responses that can impair performance (e.g., Cooke, Kavussanu, Gallicchio, Willoughby, Mcintyre, & Ring, 2014; Eysenck, Derakshan, Santos, & Calvo, 2007). Research has shown that an individual's ability in emotional self-regulation can be developed through training. For example, Christou-Champi, Farrow and Webb (2015) trained participants to emotionally reappraisal their reactions to negative images presented on a monitor. Two weeks after training, participants were better able to down regulate their emotional reactions to aversive film clips and used more emotional reappraisal in their everyday life than a control group.

Due to some limitations regarding assessments of MT (e.g., Gucciardi et al., 2011) that span poor construct validation, measurement invariance, reliability, and lack of generalisability across populations, we chose to use three relatively well used assessments of MT, Golby et al.'s (2007) PPI-A, Sheard et al.'s (2009) SMTQ and Gucciardi et al.'s (2014) MTI. Results differed depending on the assessment of MT and the perspective (coach or athlete) being used. First, self-report MT and demographics predicted (on average) 34.3% of

the variance in self-report training behaviours (i.e., the athlete completed both questionnaires). However, this dropped to 28% when the same variables were regressed against coach rated training behaviours. Further, self-report MT, demographics and self-rated training behaviours predicted 26.3% of the variance in coach rated MT behaviour. This increased to 29.3% of the variance when self-rated MT, demographics and coach rated training behaviours were used to predict coach rated MT behaviours. Therefore (and rather unsurprisingly), higher levels of variance were accounted for when the same perspective (i.e., coach's or athletes) was used.

When examining differences across MT measures, the variance accounted for in coach rated MT behaviour was identical when self-rated training behaviours was used in conjunction with any of the self-rated MT assessments (26-27%). Further, the variance accounted for in coach rated MT behaviours was identical when coach rated training behaviours was used with either the PPI-A or the MTI (both predicted 33%). However, when the SMTQ was analysed, the variance dropped to 22%. Further, it is noted that the 'control' factor in the SMTQ showed a Cronbach's alpha value of only .53, whereas the 'constancy' factor reached .63. Further, the 'determination' factor in the PPI-A questionnaire only reached .61. As a general rule of thumb, good internal reliability is obtained when Cronbach's alpha is .7 and above. This may also explain some of the non-significant correlations to do with the 'control' factor in Table 2. This finding would support our use of multiple assessments of MT. Nevertheless, results support the findings from above that when perspectives match up, a higher proportion of variance is accounted for. Results also suggest that single factor assessments of MT (i.e., the MTI) is just as effective as multi-factor measures and adds weight to the suggestion that MT is effectively assessed as a unidimensional rather than a multidimensional concept (see Gucciardi et al., 2014).

The mediating role self-regulated training behaviours upon self-report MT and coach rated MT behaviour, differed depending on whether the coach's or the athlete's perspectives of training behaviours were used. That is, self-reported training behaviours mediated the relationship between all factors of MT and coach rated MT behaviour. However, coach rated training behaviours did not mediate the relationship between PPI-A subscales of self-belief (and to a lesser extent positive cognition), and the SMTQ subscales of confidence and control upon coach rated MT behaviour. Most likely, this was due to the slight discrepancy in training behaviour perspectives between the coach and the athlete. That is, coaches rated training behaviours slightly lower (M = 6.8, SD = 1.4) but with more variability than the athlete did (M = 7.0, SD = 1.0). This is further highlighted by the fact that there was a relatively small correlation between the two perspective (r = .22). Therefore, the discrepancy in opinion and different perspectives (own vs other ratings of training behaviours), and perhaps poor reliability of some of the subscales in the SMTQ and PPI-A, likely contributed to this result.

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 MT behaviours. The strength of such relationships however depend on how well each perspective matches up. Nevertheless, training behaviours (self or coach rated) and self-report MT predicted between 22% and 33% of coach rated MT behaviour. Future research would do well to discover exactly what type of training behaviours best influences MT behaviours. For example, athletes who have well developed training strategies e.g. distraction control, coping with adversity, quality of preparation (Woodman et al., 2010) and emotional regulation skills e.g. cognitive reappraisal strategies (Christou-Champi et al., 2015; Mutz et al., 2017) will be able to use such strategies in competition and hence perform better under pressure as indicated from coach ratings of MT behaviour.

A strength of the study lies in our use of multiple perspectives of training behaviours and the examination of three self-assessed MT measures. However, one limitation 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 amount 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).

In summary, training behaviours seems a strong source of self-report MT and coach rated MT behaviours. Regardless of perspective, at its worst, training behaviours and self-assessed MT explained 22% of the variance in MT behaviours. However, future research may want to explore exactly what type of training behaviours are more beneficial in developing MT and coach rated MT behaviour.

# Chapter 4

## Examining the relationship between personality and MT upon training behaviours and MT behaviour in swimming

## Abstract

The present study aimed to explore the relationship between personality, MT, and training behaviors in a swimming environment. We hypothesized that swimmers characterized with high levels of psychoticism, extraversion and MT would display high levels of training behaviors. A subsample of swimming coaches (12 men and 1 women) and 154 of their competitive swimmers (67male and 85 female) from Chapter 3 participated in the study. Results revealed significant interactions between psychoticism and MT upon training and MT behavior. That is, MT only had a positive relationship with quality of training, self-regulated training behaviors and coach rated MT behavior under high levels of psychoticism. Further, results showed limited main effects for extraversion on training behaviors and MT behavior. Results support the view that psychoticism is an important personality characteristic to have concerning MT behavior, especially when self-report MT is high.

**Introduction**

Mental Toughness (MT) is a desirable commodity that allows athletes to endure under times of hardship (e.g., Bell, Hardy, Beattie, 2013; Clough, Earle & Sewell, 2002; Jones, Hanton, & Connaughton, 2007). Although there are numerous definitions of MT (e.g., Gucciardi & Gordon, 2011), as the current study focused upon training and MT behaviors, we adopt the stance of Hardy et al. (2014) who defined MT as "the ability to achieve personal goals in the face of pressure from a wide range of different stressors" (p. 70). Research has examined MT from state and trait perspectives. For example, some researchers operationalize MT as a state, where MT can be developed across time (e.g., Bell et al., 2013; Gucciardi, Gordon, & Dimmock, 2009). In support of this notion, researchers suggest that MT can be viewed as a resource caravan that can be dipped into when necessary (Gucciardi, Hanton, Gordon, Mallett, & Temby, 2014). Further, some research findings show that as MT remains stable across time, it is best explained at a personality trait-like level (e.g., Clough et al., 2002; Hardy et al., 2014; Horsburgh, Schermer, Veselka, & Vernon, 2009). Therefore, there appears to be a small debate amongst researchers of what exactly the antecedents of MT are. However, it is the view of the current study that MT can be explained via both state and trait-like factors.

To assess MT at a state level, several multidimensional self-report measures of MT have been developed, e.g. the Mental Toughness' Questionniare-48 (Clough et al., 2002); the Australian football Mental Toughness Inventory (AfMTI; Gucciardi, Gordon, & Dimmock, 2009); the Psychological Performance Inventory (PPI; Loher, 1986); the Psychological Performance Inventory-Alternative (PPI-A; Golby, Sheard, & van Wersch, 2007); and the Sport Mental Toughness Questionnaire (SMTQ; Sheard, Golby, Wersch, 2009). However, as results in Chapter 3 show support for Gucciardi et al.'s (2014) findings that MT may be best

explained as a unidimensional construct, we apply the MTI (Gucciardi et al., 2014) in the current study to examine MT at a state level, or as ‘a resource caravan’.

Although a vast majority of research in MT has been devoted to examining state-like characteristics of MT (e.g., Jones et al., 2002, 2007; Thelwell et al., 2005), in defence of a trait approach, Hardy et al. (2014) applied a relevant personality theory, i.e. revised Reinforcement Sensitivity Theory (rRST; Gray & McNaughton, 2000), to predict trait-like MT behavior. rRST proposes that behavior is underpinned by three neuropsychological systems. First, the behavioral approach system (BAS) is responsible for all goal-focused approach behavior by responding to rewarding stimuli in the environment. Second, the fight, flight, freeze system (FFFS) is responsible for avoiding threat related stimuli. Finally, the behavioral inhibition system (BIS) is responsible for resolving approach-avoidance conflict between the BAS and FFFS. Such approach-avoidance conflicts in sport generally have large consequences for failure, but strong rewards for success (e.g., taking a penalty kick in the football World Cup final).

Further, in order to examine MT behavior and avoid self-assessment of MT (and the inherent problems associated with self-assessments such as social desirability), Hardy et al. (2014) developed an 8-item informant measure of MT behavior. Therefore, cricket coaches could rate MT behavior of their athletes under several different stressors that their athletes may normally face in the competitive environment. Further, when examining test-retest reliability, Hardy et al. found a near perfect correlation ($r = .96$) upon their informant-rated mentally tough behavior over a 3-week period. Supporting their view that MT is a relatively stable trait.

As stated above, Hardy et al. (2014) used rRST (Gray & McNaughton, 2000) to explain MT behavior. That is, Hardy et al. predicted that high levels of reward and low levels of punishment sensitivity would positively predict MT behavior. However, across two

studies, Hardy et al. found that higher levels of MT behavior were associated with higher levels of punishment and lower levels of reward sensitivity. That is, when reward sensitivity was low, increasing levels of punishment sensitivity contributed to an increase in MT behavior (these results were replicated in Chapter 2).

However, across the work of Hardy et al. (2014) and Chapter 2 of the current thesis, one issue remains outstanding. That is, as punishment and reward sensitivities are devised from transforming psychoticism, neuroticism, and extroversion scores ((reward sensitivity = (E x 2) + N + P); punishment sensitivity = (12 – E) + (N x 2) – P), where E = extraversion, N = neuroticism, and P = psychoticism)) it is not clear how these three personality types may individually relate to MT behavior. Therefore, the aim of the present study was to investigate what separate relationships these three personality traits had upon MT behavior. Further, recent research has also examined separate relationships that a distinct set of personalities has upon MT, namely the Dark Triads (e.g., Paulhus & Williams, 2002).

The Dark Triads are a set of three personality traits that relate to a rather malicious side of the human psyche. The Dark Triad traits comprises of narcissism, psychopathy, and Machiavellianism (Paulhus & Williams, 2002). People with high levels of narcissism are often characterized with traits such as vanity, grandiosity, entitlement, self-deception, an inflated sense of self-worth, and they often look for situations that contain opportunities for self-enhancement (Campbell, Hoffman, Campbell, & Marchisio, 2011; Paulhus & Williams, 2002). People with high levels of psychopathy are characterized with traits such as lack of empathy and remorse, they are impulsive, and tend to take risks (Cooke & Michie, 2001; Paulhus & Williams, 2002). Individuals characterized with the personality of Machiavellianism are often immoral, they try to deceive and manipulate others to achieve their own goals, and like a narcissists, they focus upon self-interests and self-gain (Jones & Paulhus, 2009; Paulhus & Williams, 2002).

Research has examined the potential link between the Dark Triads and MT (e.g., Onley, Veselka, Schermer, & Vernon, 2013). To explain why the Dark Triads have been associated with socially desirable outcomes in the workplace (Young & Pinsky, 2006), Onley et al. (2013) conducted a unique behavioral genetic study exploring the relationship between the Dark Triad traits and MT among adult twins. They hypothesized that such a relationship may come about due to an individual's ability to cope under pressure (i.e., individuals with Dark Triad traits may also have some level of MT). Participants completed particular measurements related to the Dark Triad traits consisting of the Narcissistic Personality Inventory (NPI; Raskin & Hall, 1979); the Self-Report Psychopathy Scale (SRP-III; Hare, 1985); and the MACH-IV (Christie & Geis, 1970). Participants also completed the Mental Toughness Questionnaire-48 (Clough, Earle & Sewell, 2002), which assessed four components of MT, control, commitment, challenge and confidence. Findings displayed that the four components of MT significantly and positively correlated with narcissism. Further, these results were due to common non-shared environmental factors. Psychopathy was significantly but negatively correlated with control, commitment and confidence. These correlations were best explained at a genetic level. Finally, Machiavellianism was significantly and positively associated with commitment and control, but significantly and negatively correlated with challenge and confidence. These correlations were associated with both genetic and non-shared environmental factors.

More recently, Sabouri et al. (2016) examined the relationship between the Dark Triad traits, MT, and physical activity among young adults. They also hypothesized that there would be a positive relationship between the Dark Triad and MT. Participants completed assessments of Narcissistic Personality Inventory (Raskin & Hall, 1988), Self-Report Psychopathy Scale (SRP-III; Hare, Hart, & Harpur, 1991), 20-item MACH-IV (Christie & Geis, 2013), MTQ18 (Clough et al., 2002), and International Physical Activity Questionnaire

(IPAQ). Findings revealed a significant and positive relationship between the Dark Triad traits with MT.

Further, there seems to be some common overlap between the Dark Triad traits and psychoticism. For example, Eysenck and Eysenck (1985) pointed out that individuals with high levels psychoticism are associated with aggressive, impulsive, and tough-minded characteristics. In contrast, individuals considered low in psychoticism tend to show higher levels of empathy and altruism. In sport, Eysenck, Nias, and Cox (1982) showed that high-level athletes are characterized with higher levels of psychoticism. Although tentative, research also links high-level athletes with MT characteristics (e.g., Bull et al., 2005; Jones et al., 2002). Further, Kirkcaldy (1982) examined the relationship between male and female athlete personality profiles of varying standards (international, national and regional standard). Kirkcaldy (1982) utilized the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975) to assess the athlete's personality on psychoticism, extraversion and neuroticism. Findings showed that international male athletes had significantly higher levels of psychoticism than national and regional standard male athletes did. In contrast, international standard female athletes had significantly higher levels of extraversion compared with national and regional female athletes.

With relation to extraversion and MT, Eysenck and Eysenck (1985) report that extraverts tend to be socially active and demonstrate sensation-seeking behavior. In a recent study examining genetics, personality and MT, Horsburgh et al. (2009) found that extraversion and conscientiousness (e.g., being vigilant, careful, efficient and organized) were strongly correlated with MT as assessed by the MTQ48 (Clough et al., 2002). Whereas, neuroticism (e.g., being more depressed and anxious) was negatively correlated with MT. Therefore, we would argue that out of the three personality types, as psychoticism is associated with toughmindedness, and extraversion is associated with MT, we would expect

psychoticism, extraversion and self-report MT to be strong predictors of training and MT behaviors.

Presently, we are unaware of any published study that has investigated the relationship between psychoticism, extraversion, neuroticism, and MT and how these variables relate to training and MT behaviors. Training behaviors warranted further investigation for a number of reasons. For example, Hardy et al. (2014; Study 4) demonstrated that the effects of reinforcement sensitivities upon coach rated mental toughness in cricket was mediated by early threat detection. In the context of cricket, early threat detection gave players more time to plan and prepare responses. However, a notable finding was that players characterized with high punishment but low reward sensitivity (rated as being MT by their coach), made slower decisions than their less MT counterparts, but consequently, made fewer mistakes in their decision making. In the context of swimming, it was thought that such early threat detection would manifest itself in swimmers engaging in more appropriate coach rated quality of training, self-regulated training behaviors, and coach rated MT behavior.

This approach is similar to that utilized by Woodman, Zourbanos, Hardy, Beattie & McQuillan (2010) who examined the effects of personality type (extraversion, emotional stability, and conscientiousness) and psychological skills (goal-setting and emotional control) on training behaviors (distractibility, coping with adversity, and quality of preparation). Their findings revealed that there was a positive relationship between personality and training behaviors (e.g., conscientiousness positively related to quality of preparation). Furthermore, research findings indicated that there were both additive and interactive effects of personality and performance strategies on training behaviors (e.g., extroversion and goal setting significantly interacted upon distractibility, where extroverts were less distracted if they used high levels of goal setting). Consequently, this study assessed quality of training, self-

regulated training behaviors and MT behaviors in swimmers, together with their personality profiles.

As psychoticism and extraversion have been associated with higher levels of MT and tough-mindedness (e.g., Eysenck & Eysenck, 1985; Hornsburgh et al., 2009), it was hypothesized that psychoticism and extraversion (but not neuroticism) would be associated with MT behavior. It was not clear whether these personality traits would be additive, or interactive with self-report MT upon training behaviors and MT behavior, but on balance, we hypothesized that some degree of psychoticism and extraversion would be necessary for athletes to be able to utilize their MT 'resource caravan' (Gucciardi et al., 2014) to demonstrate MT behavior. Hence, in relation to Woodman et al.'s (2010) findings reported above, we tentatively hypothesized that psychoticism and extraversion would interact with MT. That is, swimmers high in psychoticism, extraversion and MT would engage in more adaptive training behaviors and demonstrate more MT behavior than swimmers low in either psychoticism, extraversion or MT.

## Method

### Participants

A sub-sample of thirteen UK swimming coaches (12 men and 1 women, $M_{age}$ = 50.8, *SD* = 15.9) and 154 of their competitive swimmers (67 male and 85 female, $M_{age}$ = 15.1, *SD* = 2.20) from Chapter 3 participated in the study. Coaches had on average 20.14 years (SD = 11.74) of coaching experience whereas the swimmers had 5.3 years (*SD* = 2.5) of competitive experience.

### Measures

*Personality*. The EPQR-S (Eysenck, Eysenck, & Barrett, 1985) is a 36-item self-report questionnaire comprising scores on extraversion (12 items e.g., Does your mood often go up and down), neuroticism (12 items e.g., Do you take much notice of what other people

think), and psychoticism (12 items e.g., Are you a talkative person). Participants answer each question by responding with Yes or No. The EPQR-S scales have displayed good internal reliability (a = 0.77–0.88), and is strongly correlated (r = 0.71–0.96) with longer versions of the Eysenckian personality measure (Francis, Philipchalk, & Brown, 1991). Scores range from 0-12. Cronbach's alpha in the current study was 0.56 for psychoticism, 0.80 for neuroticism, and 0.84 for extraversion.

*Mental Toughness Index (MTI).* MT was assessed by using Gucciardi et al.'s (2014) Mental Toughness Index (MTI) that comprises of 8 items measuring one factor (e.g., "I believe in my ability to achieve my goals" and "I consistently overcome adversity"). The MTI is rated on a 7-point Likert-type scale 1 (False) to 7 (True). According to Gucciardi et al., Cronbach's alpha for the MTI was reported at 0.86. Cronbach's alpha in the current study was 0.88.

*Swimming Behavioral Mental Toughness Inventory (SMTI).* We used the behavioural Swimming Mental Toughness Inventory SMTI (Beattie, Alqallaf, & Hardy, 2017; see Chapter 2 and 3) as a measure of informant rating of MT behaviour in swimming. The SMTI 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 SMTI contains items such as "S/he has a number of events during a competition" and "S/he has underperformed after swimming several races during a meet". Items were scored from 1 (*never*) to 7 (*always*) with a midpoint of 4 (*sometimes*). Beattie et al. reported a Cronbach's Alpha value of .91. Cronbach's alpha in the current study was also 0.91.

*Self-Regulated Training Behaviors (coach rated; CRTB).* We used the coach rated training behaviours measure that was developed in Chapter 3. The measure contained 4 items scored on a Likert scale ranging from 1 (*Strongly Agree*) to 9 (*Strongly Disagree*). We used

the stem, “Swimmer X” followed by the four items e.g. “Is continuously active and engaged with warm up” and “Often unfocussed in dry-land training”. Cronbach’s Alpha in Chapter 3 was reported at .84. Cronbach’s alpha in the current study was 0.87.

*Quality of Training Inventory (QTI).* We used two factors from Woodman et al.’s (2010) Quality of Training Inventory (QTI) namely; distractibility and coping with adversity. Both factors contain four items and are scored on a Likert scale from 1 (Strongly Agree) to 9 (Strongly Disagree). To avoid overloading the coach with items we provided the coach with two items from each factor. Further, we rephrased these items from a self-report format to an observer rated format. For example, an item from the distractibility in its original format read, “I rarely get distracted from my training program” which was adapted to Swimmer X…“Is easily distracted by other people in training”. A sample item from the coping with adversity scale e.g. “I find it hard to keep trying if I make a mistake in training.” was adapted to Swimmer X…“Finds it hard to keep trying if they make a mistake in training”. Woodman et al. (2010) reported alpha values of .73 and .85 for coping with adversity and distractibility respectively. Items on the QTI were reversed scored where appropriate before conducting subsequent analyses. Higher scores on the QTI reflect better quality training (See appendix J). Although there were only two items in each scale, we ran scale reliability checks. Cronbach’s alpha for the distractibility scale was 0.88. Cronbach’s alpha for the coping with distraction scale was 0.64.

**Procedure**

After obtaining University ethical approval, thirteen coaches agreed to take part in the study. We requested that the coaches should have known their athletes for a minimum of 1 year and observed them in at least four competitive meets. We then posted or hand delivered a copy of the questionnaire pack to each coach. The pack contained the purpose of the study including the EPQR-S, MTI, SMTI, CRTB, and the QTI with relevant consent forms.

Coaches were asked to complete the SMTI and CRTB for each competitive swimmer they had under their charge. Those competitive swimmers were then asked to complete the EPQR-S and MTI in their own time. After completing informed consent (including consent from the swimmer's parents/guardian), swimmers completed and passed their questionnaire pack to their coaches in a sealed envelope. All questionnaires packs were collected by hand or posted by the coaches within 6 weeks of being handed out. Means, standard deviations and correlations are presented in Table 1.

## Results

To examine the linear relationship between the variables of interest we used Pearson's product-moment correlations. To examine the interactions between our independent variables upon the dependent variables we used moderated hierarchical regression analysis in SPSS version 22. However, as our measures contained different methods of assessment (e.g., the SMTI has a Likert scale ranging from 1-7 and the CRTB ranges from 1-9), we standardized (z-scored) all our independent variables before computing the cross-product term. All variables were entered in the following order; personality at step 1, MT at step 2, and the cross-product term at step 3.

Table 1

Means and bivariate correlations

| Variable | Mean (SD) | CRMT | CRTB | CRD | CWA | MTI | Psyc | Extr |
|---|---|---|---|---|---|---|---|---|
| CRMT | 4.81 (.79) | | | | | | | |
| CRTB | 6.81 (1.44) | .44** | | | | | | |
| CRD | 6.11 (1.95) | .28** | .68** | | | | | |
| CWA | 6.41 (1.60) | .39** | .64** | .55** | | | | |
| MTI | 5.61 (.95) | .26** | .07 | .09 | .19* | | | |
| Psychoticism | 2.38 (1.84) | -.11 | -.10 | -.17* | -.02 | -.08 | | |
| Extraversion | 8.31 (3.26) | -.03 | -.07 | -.16* | -.05 | .28* | -.10 | |
| Neuroticism | 5.00 (3.18) | -.12 | -.04 | .01 | -.13 | -.40** | -.06 | -.23** |

CRMT = Coach Rated MT Behavior; CRTB = Coach Rated Training Behaviors; CRD = Coach Rated Distraction; CWA = Coach Rated Coping with Adversity; MTI = Mental Toughness Inventory

**Coach Rated Training Behaviors (CRTB)**

*Psychoticism x MT Interaction on CRTB*. We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Psychoticism; (2) MT; (3) Psychoticism x MT interaction. Psychoticism was not a significant predictor of CRTB ($R^2$ =.011, $F$ (1,146) = 1.66, $p$ = .19). MT also failed to significantly predict CRTB ($R^2_{cha}$ = .04, $F$ (1,145) =.53, $p$ = .46). However, a significant interaction between Psychoticism and MT occurred ($R^2_{cha}$ = .033, $F$ (1,144) = 4.95, $p$ < .05). The interaction shows that when psychoticism is low, increasing levels of MT has an adverse relationship with CRTB. However, when psychoticism is high, MT has a positive relationship with CRTB (see Table 2 and Figure 1).

Table 2

Moderated Hierarchical Regression Analysis Results: Psychoticism x MT interaction upon CRTB

| Variables entered | $R^2$ | $R^2_{cha}$ | $F_{cha}$ | *df* | β | *SE* | *t* |
|---|---|---|---|---|---|---|---|
| *Model 1* | | | | | | | |
| Psychoticism | .011 | .011 | 1.66 | 1,146 | | | |
| *Model 2* | | | | | | | |
| Psychoticism | | | | | | | |
| MTI | .015 | .004 | .532 | 1,145 | | | |
| *Model 3* | | | | | | | |
| Constant | | | | | 6.84 | .118 | 58.02 |
| Psychoticism | | | | | -.077 | .117 | -.658 |
| MT | | | | | .101 | .123 | .822 |
| P x MT | .048 | .033 | 4.95 | 1,144 | .269 | .121 | 2.22* |

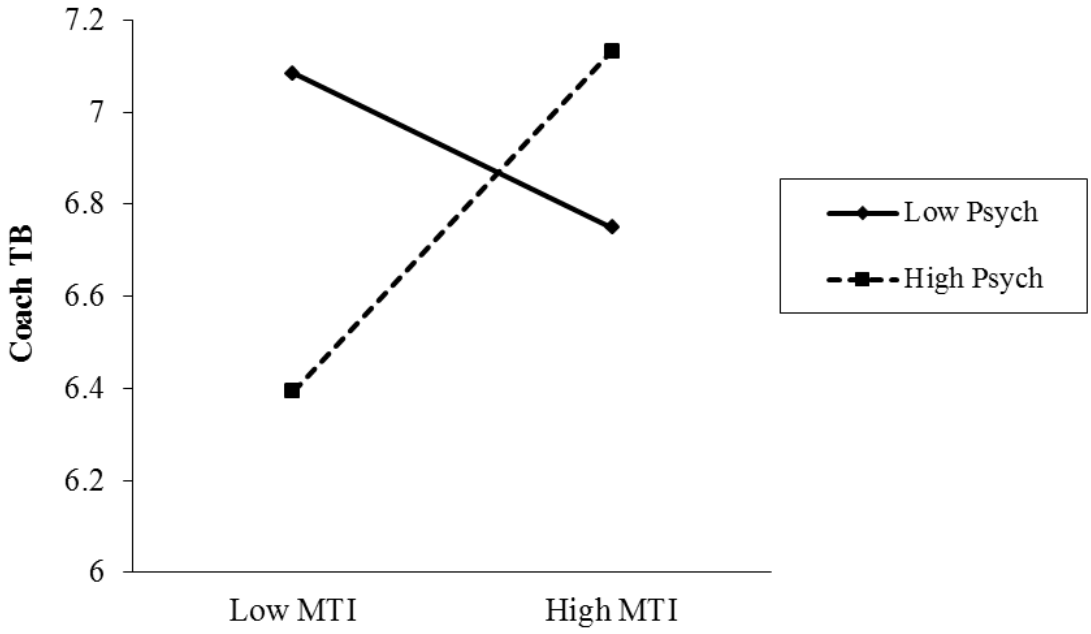



*Figure 1.* Regression slopes showing the interaction between Psychoticism and MT upon Coach Rated TB.

*Extraversion x Mental Toughness Interaction on CRTB.* We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Extraversion, (2) MTI, and (3) Extraversion x MT. Extraversion was not a significant predictor of CRTB (R2 = .006, F (1,146) = .84, p = .36). MT also failed to significantly predict CRTB (R2cha = .014, F (1,145) = 1.24, p = .26). Finally, the interaction between Extraversion and MT failed to significantly predict CRTB (R2cha = .015, F (1,144) = .1.24, p = .77).

*Neuroticism x Mental Toughness Interaction on CRTB.* We conducted a moderated hierarchical regression analysis with variables entered in the following order: (a) Neuroticism, (b) MT, and (c) Neuroticism x MT interaction. Neuroticism was not a significant predictor of training behaviors rated by coaches, $R^2$ = .002, $F$ (1,146) = .22, $p$ = .63. Also, MT was not a significant predictor of training behaviors rated by coaches, $R^2_{cha}$ =

.005, $F$ (1,145) = .48, $p$ = .48. Moreover, Neuroticism x MT interaction was not a significant predictor of training behaviors rated by coaches, $R^2_{cha}$ = .015, $F$ (1,144) = .001, $p$ = .97.

**Coach Rated Distractibility (CRD)**

*Psychoticism x Mental Toughness Interaction on CRD*. We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Psychoticism, (2) Distractibility, and (3) Psychoticism x CRD. Psychoticism significantly predicted CRD ($R^2$ = .028, $F$ (1,146) = 4.12, $p$ < 05). However, MT was not a significant predictor of training behaviors, ($R^2_{cha}$ = 0.20, $F$ (1,145) =.85, $p$ = .35). However, the Psychoticism x MTI interaction was significant ($R^2_{cha}$ = .065, $F$ (1,144) = 7.94, $p$ < .01). The interaction showed that when psychoticism was low increasing levels of MT had an adverse relationship with CRD. However, when psychoticism was high, increasing levels of MT had a positive relationship with CRD (see Table 3 and Figure 2).

Table 3

Moderated Hierarchical Regression Analysis Results: Psychoticism, MTI, and Psychoticism x MTI interaction upon CRD

| Variables entered | $R^2$ | $R^2_{cha}$ | $F_{cha}$ | *df* | β | *SE* | *t* |
|---|---|---|---|---|---|---|---|
| *Model 1* | | | | | | | |
| Psychoticism | .028 | .028 | 4.12 | 1,146 | | | |
| *Model 2* | | | | | | | |
| Psychoticism | | | | | | | |
| MT | .033 | .006 | .857 | 1,145 | | | |
| *Model 3* | | | | | | | |
| Constant | | | | | 5.22 | .926 | 5.64** |
| Psychoticism | | | | | -.192 | .154 | -1.24 |
| MT | | | | | .172 | .163 | 1.05 |
| P x MT | .084 | .051 | 7.94 | 1,144 | .449 | .159 | 2.81* |

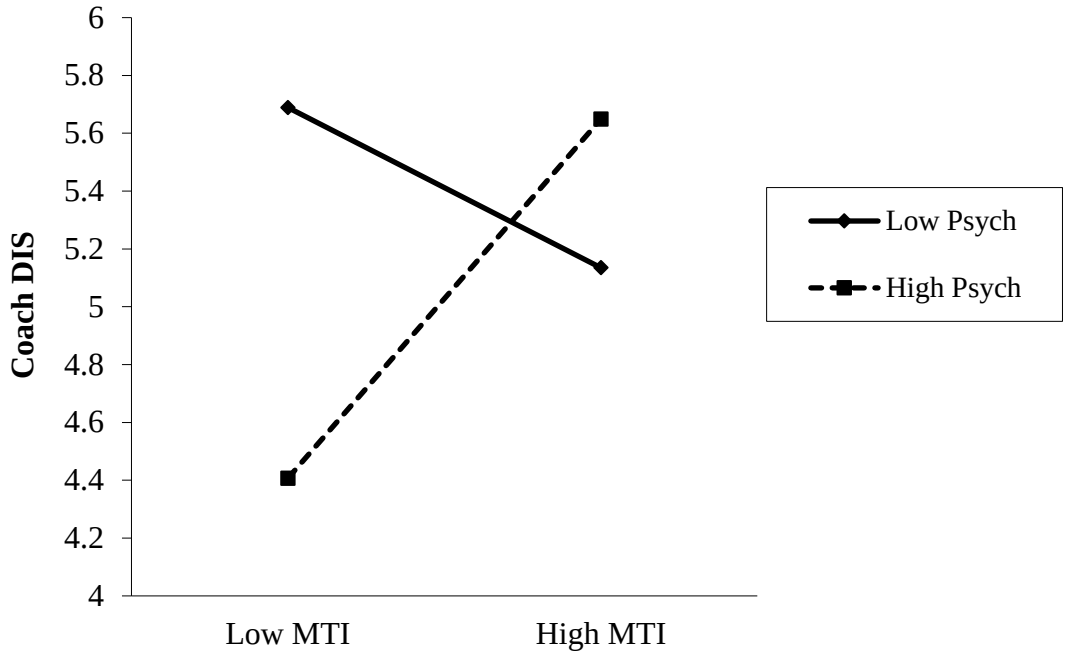



*Figure 2.* Regression slopes showing the interaction between Psychoticism and MT upon Coach Distraction.

*Extraversion x Mental Toughness Interaction on CRD*. We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Extraversion, (2) MT, and (3) Extraversion x MT interaction. Extraversion was close to a significant predictor of CRD ($R^2$ = .025, $F$ (1,146) = 3.71, $p$ = .056). However, MT was not a significant predictor of CRD ($R^2_{cha}$ = .018, $F$ (1,145) = 2.79, $p$ = .097). Finally, the interaction between extraversion and MT was not significant ($R^2_{cha}$ = .00, $F$ (1,144) = .002, $p$ = .965).

*Neuroticism x Mental Toughness Interaction on CRD*. We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Neuroticism, (2) MT, and (3) Neuroticism x MT interaction. Neuroticism was not a significant predictor of CRD ($R^2$ = .00, $F$ (1,146) = .017, $p$ = .89). Furthermore, MT was not a significant predictor of CRD ($R^2_{cha}$ = .010, $F$ (1,145) = 1.51, $p$ = .22). Finally, Neuroticism x MT interaction failed to significantly predict CRD ($R^2_{cha}$ = .001, $F$ (1,144) = .100, $p$ = .75).

**Coach Rated Coping with Adversity (CWA)**

*Psychoticism x Mental Toughness Interaction on CWA.* We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Psychoticism, (2) MT, and (3) Psychoticism x MT interaction. Psychoticism was not a significant predictor of CWA ($R^2$ = .001, $F$ (1,146) = .083, $p$ = .77). However, MT was a significant predictor CWA ($R^2_{cha}$ = .035, $F$ (1,145) = 5.22, $p$ < .05). The Psychoticism x MT interaction approached significance ($R^2_{cha}$ = .025, $F$ (1,144) = 3.75, $p$ = .055). The interaction showed that under conditions of low psychoticism, MT had a slight positive relationship with CWA. However, when psychoticism was high, increasing levels of MT had a stronger positive relationship with CWA (see Table 4 and Figure 3).

Table 3

Moderated Hierarchical Regression Analysis Results: Psychoticism, MTI, and Psychoticism x MTI interaction upon CWA.

| Variables entered | $R^2$ | $R^2_{cha}$ | $F_{cha}$ | *df* | β | *SE* | *t* |
|---|---|---|---|---|---|---|---|
| *Model 1* | | | | | | | |
| Psychoticism | .001 | .001 | .083 | 1,146 | | | |
| *Model 2* | | | | | | | |
| Psychoticism | | | | | | | |
| MT | .035 | .035 | 5.22 | 1,145 | | | |
| *Model 3* | | | | | | | |
| Constant | | | | | 4.61 | .776 | 5.94** |
| Psychoticism | | | | | .048 | .129 | .373 |
| MT | | | | | .325 | .137 | 2.37* |
| P x MT | .060 | .025 | 3.75 | 1,144 | .259 | .134 | 1.93 |

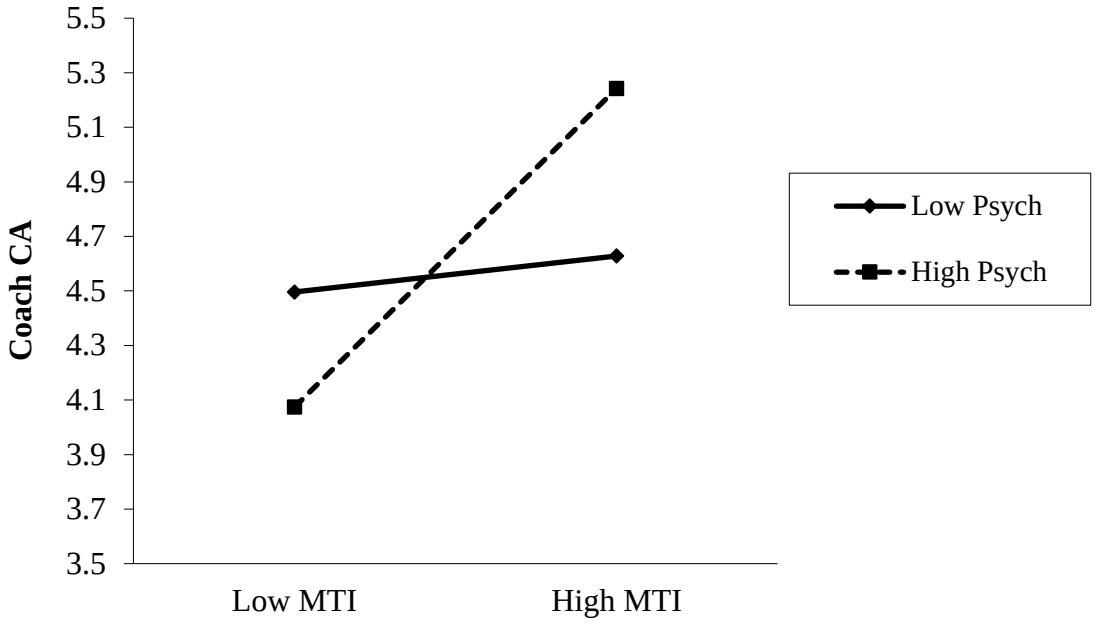



*Figure 3.* Regression slopes showing the interaction between Psychoticism and MT upon coach rated Coping with Adversity.

*Extraversion x Mental Toughness Interaction on CWA.* We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Extraversion, (2) MT, and (3) Extraversion x MT interaction. Extraversion was not a significant predictor of CWA ($R^2$ = .003, $F$ (1,146) = .45, $p$ = .50). However, MTI was a significant predictor of CWA ($R^2_{cha}$ = .044, $F$ (1,145) = 6.72, $p$ < .05). Further, the Extraversion x MT interaction was not significant ($R^2_{cha}$ = .047, $F$ (1,144) = .00, $p$ = .99).

*Neuroticism x Mental Toughness Interaction on CWA.* We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Neuroticism, (2) MT, and (3) Neuroticism x MT interaction. Neuroticism was not a significant predictor of CWA ($R^2$ = .019, $F$ (1,146) = 2.81, $p$ = .096). Further, MTI was not a significant predictor of CWA ($R^2_{cha}$ = .021, $F$ (1,145) = 3.16, $p$ = .077). Finally, there was no significant interaction between Neuroticism x MT ($R^2_{cha}$ = .000, $F$ (1,144) = .007, $p$ = .93).

**Coach Rated Mentally Tough Behavior (CRMT)**

*Psychoticism x Mental Toughness Interaction on CRMT*. We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Psychoticism, (2) MT, and (3) Psychoticism x MT interaction. Psychoticism did not significantly predict CRMT ($R^2$ = .014, $F$ (1,151) = 2.12, $p$ =. 14). However, MT significantly predict CRMT ($R^2_{cha}$ = .067, $F$ (1,150) = 10.7, $p$ < .01). Finally, the Psychoticism x MT interaction was significant ($R^2_{cha}$ = .036, $F$ (1,149) = 6.06, $p$ < .05). The interaction showed that under conditions of low psychoticism, MT had a slight positive relationship with CRMT. However, when psychoticism was high, increasing levels of MT had a stronger positive relationship with CRMT (see Table 5 and Figure 4).

Table 5

Moderated Hierarchical Regression Analysis Results: Psychoticism, MT, and Psychoticism x MT interaction upon CRMT.

| Variables entered | $R^2$ | $R^2_{cha}$ | $F_{cha}$ | *df* | β | *SE* | *t* |
|---|---|---|---|---|---|---|---|
| *Model 1* | | | | | | | |
| Psychoticism | .014 | .014 | 2.12 | 1,151 | | | |
| *Model 2* | | | | | | | |
| Psychoticism | | | | | | | |
| MTI | .080 | .066 | 10.7 | 1,150 | | | |
| *Model 3* | | | | | | | |
| Constant | | | | | 3.58 | .368 | 9.75 |
| Psychoticism | | | | | -.038 | .061 | -.621 |
| MTI | | | | | .221 | .065 | 3.42** |
| P x MTI | .116 | .036 | 6.06 | 1,149 | .157 | .064 | 2.46* |

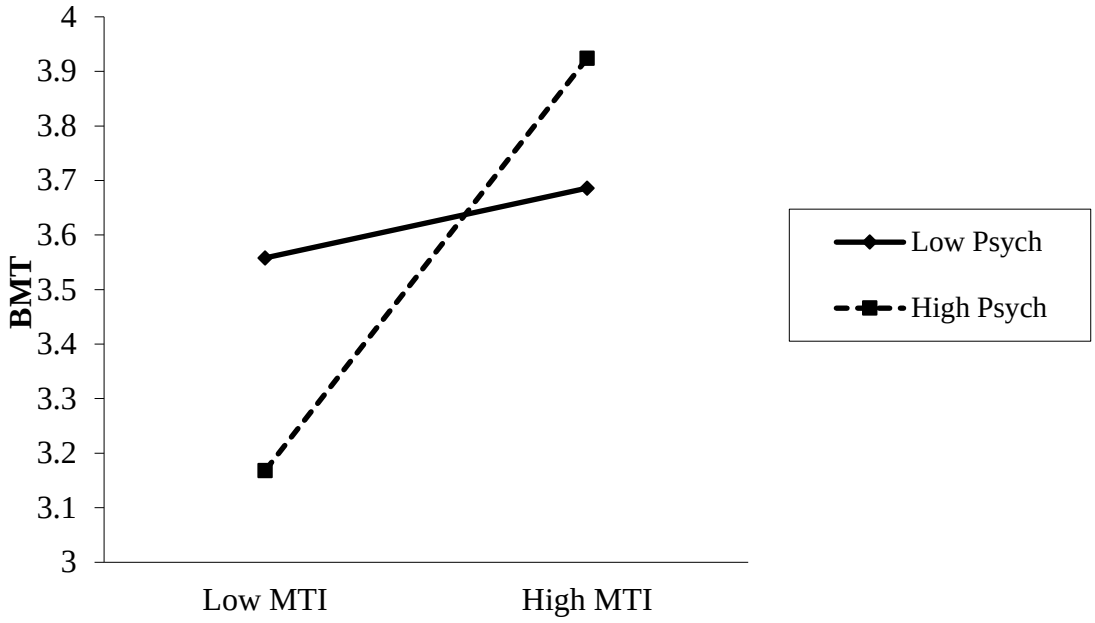



*Figure 4*. Regression slopes showing the interaction between Psychoticism and MT upon CRMT

*Extraversion x Mental Toughness Interaction on CRMT*. We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Extraversion, (2) MT, and (3) Extraversion x MT interaction. Extraversion was not a significant predictor of CRMT ($R^2$ = .001, $F$ (1,151) = .219, $p$ = .64). However, MTI was a significant predictor of CRMT ($R^2_{cha}$ = .072, $F$ (1,150) = 13.57, $p$ < .001). Finally, the interaction between Extraversion and MTI was not significant ($R^2_{cha}$ = .000, $F$ (1,149) = .007, $p$ = .93).

*Neuroticism x Mental Toughness Interaction on CRMT*. We conducted a moderated hierarchical regression analysis with variables entered in the following order: (1) Neuroticism, (2) MT, and (3) Neuroticism x MT interaction. Neuroticism was not a significant predictor of CRMT ($R^2$ = .015, $F$ (1,151) = 2.33, $p$ = .12). However, MT was a significant predictor of CRMT ($R^2_{cha}$ = .071, $F$ (1,150) = 8.95, $p$ < .05). Finally, the Neuroticism and MT interaction was not significant ($R^2_{cha}$ = .000, $F$ (1,149) = 1.29, $p$ = .25).

## Discussion

The aim of present study was to investigate possible interactions between psychoticism and extraversion with MT upon training and MT behavior. That is, three studies have shown direct support for the interaction between punishment and reward sensitivity upon MT behavior (e.g., Beattie et al., 2017; Hardy et al., 2014). However, it is unclear what separate effects psychoticism, neuroticism and extraversion (that devise punishment and reward sensitivities) have upon coach rated training behaviors, coach rated quality of training (distraction and coping with adversity) and coach rated MT behavior among swimmers.

In terms of our correlational analyses, results revealed that both psychoticism and extraversion had significant negative correlations with coach rated distraction (implying that higher levels of these personality types related to higher distraction in training). These results support the findings from Woodman et al. (2010) who also found that higher levels of extraversion related to higher distraction in training. There was also a significant positive correlation between extraversion and self-rated MT, and a significant negative correlation between neuroticism and MT. The finding that extraversion is positively correlated with MT whereas neuroticism is negatively correlated with MT also supports previous research (e.g., Horsburgh et al., 2009). However, it is interesting to note that psychoticism had no relationship with self-report MT, which fails to support the somewhat anecdotal link between toughmindedness and psychoticism (e.g., Eysenck & Eysenck, 1985). Further, as psychoticism seems to share similar characteristics with some of the Dark Triad traits (e.g., impulsiveness, risk taking, and aggression) the present study findings seem to contradict those of Onley et al. (2013) and Sabouri et al. (2016) who found positive and significant relationships between the Dark Triad traits and MT among young adults. The explanation regarding the differences between the present study results compared to Sabouri et al. (2016) and Onley et al. (2013), are that these studies assessed MT by using the MTQ-48 (Clough et

al., 2002) while the present study utilized the MTI (Gucciardi et al., 2014). One other potential reason that psychoticism did not relate to MT is that the scale reliability (Cronbach's alpha level = 0.56) was relatively low.

Results partially supported our hypothesis in that psychoticism moderated the relationship between MT and swim training and MT behavior. Specifically, MT had a positive relationship with training and MT behavior when psychoticism was high. MT had no or a negative relationship with training and MT behavior when psychoticism was low. Further, extraversion only had a main effect with the training behavior of coach rated distraction.

It is interesting to note that psychoticism consistently had a positive relationship with all outcome variables (MT behavior, coping with distraction, coping with adversity, and training behavior) when self-report MT was high. These results seem to suggest that training and MT behaviors are perhaps not surprisingly best predicted by a combination of trait and state factors. However, it was surprising that self-rated MT did not interact with extraversion. Perhaps extroverts do not make good competitive swimmers. For example, extroverts have been associated with being irresponsible, dominant, show lack of reflection, sensation seeking, impulsive, risk taking and seek social settings. It is unlikely that these characteristics are beneficial in a context such as swim training. Furthermore, extraverts showed a higher level of coach rated distraction in training. Perhaps the individual nature of the training environment and long arduous unsociable hours in the pool may not be conducive to such personality traits (regardless of their own perceptions of MT). Psychoticism has been associated with being aggressive, assertive, egocentric, unsympathetic, manipulative, achievement orientated, dogmatic, and toughminded. One may expect that to endure long arduous hours of individual training, then some these characteristics associated with

psychoticism may be beneficial for training, especially if the swimmer has a high perception of MT.

Although the present study found that individuals with high levels of psychoticism and MT show higher levels of training and MT behavior, similar findings between personality and the use of psychological skills has been shown in other performance settings. That is, Roberts, Woodman, Hardy, Davis, and Wallace (2013) found that narcissism moderated the relationship between the use of psychological skills of relaxation, self-talk and emotional control upon performance in a sample of figure and dance ice skaters. Specifically, the psychological skill use of relaxation was associated with better performance for high narcissists and had little impact upon performance for low narcissists. The psychological skill use of self-talk had no impact upon performance for high narcissists and was associated with significantly lower levels of performance for low narcissists. The psychological skill use of emotional control had no impact upon performance for high narcissists but had a significant and positive relationship with performance when narcissism was low. If one agrees with the work of Gucciardi et al. (2014), in that, MT is a 'resource caravan', then clearly psychological skills use falls under this umbrella. If this is indeed the case then the interaction between personality and psychological skills, MT, training and performance is clearly more complicated than first thought.

We are unaware of previous studies that have examined the interactive effect of MT skills and psychoticism in relation to training behaviors. As stated above, our research supports previous findings conducted in the context of personality and training behaviors. Woodman et al.'s (2010) findings illustrated that athlete personality interacted with performance strategies to predict training behaviors in British gymnasts. However, one difference between the present study and Woodman et al. (2010) is that Woodman and

colleagues had examined the personality constructs of extraversion, emotional stability, and conscientiousness. They did not examine psychoticism.

Regarding the vital role of self-regulated training behaviors, Jonker, Gemser & Visscher, (2010) investigated whether self-regulatory skills could differentiate between athletes at international and national levels of competition, as well as between individual and team sports. The authors investigated several skills that linked to self-regulation, namely, planning, self-monitoring, evaluation, reflection, effort, and self-efficacy. Findings demonstrated that the skill of reflection played a vital role in distinguishing between international and national levels of competition regardless of whether the athletes performed in individual or team sports. More precisely, international athletes reported better reflection skills than national athletes; also, athletes within individual sports reported higher levels of planning and effort than athletes within team sports. This latter finding seems very pertinent to the context of swimming. That is, as noted above, extroverts tend to be irresponsible, show lack of reflection, risk takers, and impulsive. These are not good characteristics to have when trying to devise and stick to long term training plans that would appear to be a necessity in the context of training environments in swimming.

One limitation of previous research is that both Jonker et al. (2010) and Woodman et al. (2010) examined training behaviors in their study through self-report measurement. In this case, athletes' scores may be influenced by self-presentation and high ego pressure. This was not a problem in the present study as we specially developed coach rated assessments to overcome the limitations associated with self-report training behavior. The issue of the trustworthy nature of self-reported training behaviors has received some recent research. For example, in an unpublished study conducted by Schonwetter (2012), training behaviors positively influenced swimming performance when the swimmers utilized the skill of self-monitoring by using boards (at each end the end of the lane) to score their session laps with

an observer present. Furthermore, swimmers reported that they found the self-monitoring boards helpful. However, Schonwetter (2012) also pointed out that a number of swimmers failed to complete their laps when the observer was absent. In a similar vein, Young and Starkes (2006b) found that swimmers who showed higher levels of self-regulatory training behaviors (i.e., higher levels of on-task behaviors) missed significantly less swim volume in training. However, when examining the relationship between self-report workout volume and actual workout volume, all swimmers over-reported the volume of work they actually did, regardless of on-task behaviors. The most obvious explanation of this finding is that swimmers were influenced by social desirability, hence the use of coach assessed training behaviors in the present study. Therefore, any future research examining training behaviors would do well to obtain observer ratings.

One of the strengths of the present study was that we combined the perspectives of both the coaches and athletes. That is, athletes self-reported their personality profiles and their use of MT skills assessed by the MTI (Gucciardi et al., 2014). These skills reflected the characteristics of; self-belief, attention regulation, emotion regulation, success mindset, context knowledge, buoyancy, optimism, being able to execute appropriate skills when challenged. However, the lack of correlational findings between the MTI and coach rated MT behaviors cast some doubt on the complete usefulness of single factor assessments of MT.

With regard to the applied implications of the current findings, if required, coaches need to be made more aware of individual differences in relation to MT, personality and training. That is, some hardy or tough personalities may not fully respond to MT interventions. For example, emotional control when used by high narcissists is unbeneficial and slightly detrimental to performance (Roberts et al., 2013). Further, Wallace and Baumeister (2002) pointed out that narcissists tend to perform well under pressure. However, they also tend to perform poorly when the pressure is off. Other athletes with less robust

personalities may require additional MT training. It would be helpful for psychologists to help coaches assess their athlete's personality by using relevant personality tests, in order to tailor any MT interventions to meet individual needs. In the context of the specific details of the present study, swimming coaches should be made aware of the crucial role that personality and MT skills measured by the MTI (self-belief, attention regulation, emotion regulation, success mindset, context knowledge, buoyancy, optimism, being able to execute appropriate skills when challenged) might have on training and MT behavior. One important finding in the present study is that such skills may only have a significant effect for athletes who are relatively high in psychoticism. Thus, when coaches deliver mental skills interventions in a swimming environment, they may not observe any enhancement in the training or MT behaviors of swimmers who are high in psychoticism (or extraversion, neuroticism or indeed narcissism). Whether this is because athletes with differing personality characteristics need to be taught different skills to those measured by the MTI, or because such athletes need a completely different approach to enhancing their training and MT behaviors, is not clear from the present findings. Further, the present results also have implications not for coaches but for parents. For example, due to the differing nature of personality types, not all athletes will react in a positive manner from parental support.

As identified above, the most immediate need of future research is to identify more appropriate approaches to help swimmers characterized with different personality types to engage in more adaptive training behavior's. Furthermore, we conducted the present study within an individual sport as opposed to a team sport. It may be that the pivotal role of psychoticism identified in the present findings with regard to training and MT behavior's may not generalize to other sports with quite different training demands. It is clear that future research replicating the current findings across sports is required.

# Chapter 5

# General Discussion

## General discussion

To date, several quantitative and qualitative approaches have investigated the context of MT (e.g., Clough, Earlem, & Sewell, 2002; Connaughton, Hanton, & Jones, 2010; Connaughton, Wadey, Hanton, & Jones, 2008; Crust, 2009; Hardy, Bell, & Beattie, 2014; Jones, Hanton, & Connaughton, 2002; Jones, Hanton, & Connaughton, 2007; Kaiseler, Polman, & Nicholls, 2009). MT has been defined as a concept where an athlete can consistently maintain performance and goal directed behavior under a range of different stressors (e.g., Gucciardi, Hanton, & Mallett, 2012; Hardy, Bell, & Beattie, 2014). Qualitative research has shown that MT development is initiated via early childhood experiences influenced in part by the child's parents (e.g., Bull et al., 2005), and continues to develop throughout the athletes career where the role of the coach and the training environment influence athlete MT (Connaughton et al., 2008). Finally, it appears that if MT is not maintained (via having an insatiable and internalized strong desire and motivation to succeed, having access to sporting and non-sporting personnel support networks, and effective use of basic and advanced psychological skills), then it is assumed that its usefulness dissipates (Connaughton et al., 2008). Further, due to the inherent problems associated with self-report MT (e.g., Hardy et al., 2014), the thesis (where possible) assesses MT and training behaviors via informant ratings (i.e., coach assessed). Finally, as MT is generally shown to be a stable trait-like factor (Clough et al., 2002; Hardy et al., 2014), the thesis examined MT from state (self-report) and trait (personality) perspectives.

### Overview of the major thesis findings

The purpose of the thesis was to investigate the relationships between personality, MT, self-regulated training behaviors, and performance in a swimming environment. The purpose of Chapter 2 was to replicate and extend the somewhat controversial research that showed that cricketers, regarded as being MT by their coach, were sensitive to punishment

and insensitive to reward (Hardy et al., 2014). The findings were controversial in that, Hardy et al. had hypothesized that cricketers with high levels of reward and low levels of punishment sensitivity would show higher levels of MT behavior compared to athletes with high levels of punishment and low levels of reward sensitivity. Further, as Hardy et al. used a specific population, i.e. elite level 15-19-year-old cricketers, it was not clear whether these findings would or indeed should transfer to other populations.

To re-examine these findings, the first purpose of Chapter 2 was to validate an informant rating of MT behavior in a competitive swimming environment. Results supported Hardy et al.'s (2014) findings that a significant interaction between punishment and reward sensitivity occurred where increasing levels of punishment sensitivity led to an increase in MT behaviors when reward sensitivity was low. However, when reward sensitivity was high, an increase in punishment sensitivity led to a decrease in MT behaviors.

Due to a lack of research examining a direct relationship between MT and objective levels of athlete performance, Chapter 2 also examined the relationship between punishment and reward sensitivities in relation to swimming performance. It may be expected that if swimmers who are rated as being MT under pressure by their coach, have high sensitivity to punishment and low sensitivity to reward profiles, then swimmers with these personality profiles should swim faster. In support of this hypothesis, results did show that swimmers with low reward sensitivity and high punishment sensitivity on average swam quicker in their opening heats across their three opening races. Surprisingly, results showed there was no significant correlation between coach ratings of MT and swimming performance. However, it was noted that as opening heats can be a formality for most swimmers and is a low stressful event, it may not be surprising that there was no relationship between MT and race times. By examining race times in more stressful heats such as the semi-finals or the finals would clarify this finding.

The purpose of Chapter 3 was to investigate the relationship between self-regulated training behaviors (self and coach assessed), self-report MT and coach rated MT behavior. The rational for this study was that as swimmers spend the majority of their time in training, and as training has been associated as a source MT (e.g., Bull et al., 2005; Jones et al., 2002), then quality training (i.e., self-regulated training behaviors) should be positively related to self-report MT and coach rated MT behavior. Further, an athlete's self-perception of MT should also manifest itself into observational behaviors in competition. Therefore, we would expect to see a positive relationship between self-report MT and coach rated MT behavior. Finally, if MT is partly developed through training behaviors, then training behaviors should moderate the relationship between self-report MT and coach rated MT behavior. Results supported these hypotheses.

The purpose of Chapter 4 was to examine the relationship between state and trait assessments of MT. That is, as psychoticism, neuroticism and extraversion define punishment and reward sensitivity, and that punishment and reward sensitivity are associated with MT behavior (e.g., Hardy et al., 2014; Chapter 2 of this thesis), then it would be prudent to examine the separate effects of these three types of personality upon training and MT behavior. For example, recent research has examined three distinct sets of personalities that may be associated with MT, namely, narcissism, Machiavellianism, and psychopathy (Paulhus & Williams, 2002). Further, there are some commonalities between psychopathy and psychoticism (e.g., lack of empathy, aggressive, and risk taking). Furthermore, there seems to be a link between extraversion and MT, in that individuals who categorized with extraversion trait tend to show higher levels of MT (Toegel & Barsoux, 2012). Due to research showing that individuals with high levels of psychoticism are characterized with being tough-minded, and extraversion being related to MT, we set out to explore if personality and self-assessed MT had additive or interactive effects upon training and MT

behavior. Results revealed that swimmers who had high levels of both psychoticism and self-reported MT demonstrated better quality training behavior and exhibited higher levels of MT behavior than swimmers who had either lower levels of psychoticism or MT. However, there was a limited effect for extraversion and no effect for neuroticism upon training and MT behavior.

**Self-presentation issues and MT**

As reported in the introduction, a multitude of measures have been developed in the context of MT: the Mental Toughness Questionnaire 48 (MTQ-48; Clough et al., 2002); the Cricket Mental Toughness Inventory (CMTI; Gucciard & Gordon, 2009); the Australian football Mental Toughness Inventory (AfMTI; Gucciardi et al., 2009); the Psychological Performance Inventory (PPI; Loher, 1986); the Psychological Performance Inventory - Alternative (PPI-A; Golby et al., 2007); the Sport Mental Toughness Questionnaire (SMTQ; Sheard., et al 2009). Loher (1986) generated a MT measure called the Psychological Performance Inventory (PPI). However, these measures seem to add confusion in the assessment of MT. That is, the above questionnaires assess MT in a number of ways e.g. self-confidence, negative energy control, attention control, visualization and imagery control, motivation, positive energy, attitude control, determination, self-belief, positive cognition, visualization, challenge, commitment, emotional control, life control, confidence in abilities, interpersonal confidence, confidence, constancy, thrive through challenge, sport awareness, desire success, and tough attitudes. Although they all may be valid assessments of MT, it would be very problematic to ask an athlete to complete all the questionnaires to examine their levels of MT. Therefore, one issue that seems unresolved in the research literature, is which, or how many assessments of MT should be used? As the self-report assessments of MT keep rolling off the conveyer belt (with the most recent coming from Gucciardi et al.,

2014), perhaps it is time that researchers consolidate existing measures rather than add to the mire.

In the meantime, to overcome the potential social desirability and self-presentation issues that could be associated with the self-report measures of MT described above, and to avoid assessing a multitude of factors, we used Hardy et al.'s (2014) format of assessing MT behavior. When using this measure, coaches observe and rate the MT behavior of their athletes under several different stressors that they normally face in their competition environment. Chapter 2 successfully developed an informant rating of MT behavior in a swimming competitive environment. Results displayed acceptable statistical fit for an 11-item inventory in Chapter 2 and further confirmatory factor analysis revealed a good fit for the inventory in Chapter 3. The fact that some of the items from the SMTI were also used in Hardy et al.'s (2014) cricket study suggests that these behaviors may be transferable across sports.

**Punishment and reward sensitivities**

As Hardy et al. (2014) state that MT could be seen as a rather stable disposition, they utilized a relevant personality theory that could explain such behaviors, i.e. revised Reinforcement Sensitivity Theory (rRST; Gray& McNaughton, 2000). Results in Chapter 2 supported the findings from Hardy et al. (2014) that a significant interaction between punishment and reward sensitivity occurred. That is, increasing levels of punishment sensitivity led to an increase in MT behaviors when reward sensitivity was low. In contrast, when reward sensitivity was high, an increase in punishment sensitivity led to a decrease in MT behaviors. These findings add to the view of Hardy et al. (2014) that interactive effects of punishment and reward profiles should be considered in future research. Further, one possible explanation that swimmers displayed MT behaviors when they had higher levels of punishment sensitivity is that they detect upcoming threats earlier, therefore they engage with

early coping strategies to overcome upcoming threats (e.g., Bell, Hardy, & Beattie, 2013; Hardy et al., 2014; Manley et al., in press). One area where early threat detection is dealt with is in the training environment. We explored this possibility in Chapters 3 and 4.

Results in Chapter 2 also showed that swimmers swam faster when they had higher levels of punishment sensitivity and low reward sensitivity profiles. This is the first study to examine sport performance with regards to rRST (Gray & McNaughton, 2000). Furthermore, results indicated there was no significant relationship between MT behavior and swimming performance in the first heat. Our explanation for this point is that the first heat in a swimming competition was not necessary a stressful event. Clearly, further research is warranted in this area.

**Training behaviors and MT**

In Chapter 3, results showed that self-rated training behaviors mediated the relationship between all four subscales of the PPI-A (determination, self-belief, positive cognition, and visualization); all three subscales of the SMTQ (confidence, constancy, and control) and the single factor MTI. In contrast, coach rated assessment of training behaviors only mediated the relationship between two subscales of the PPI-A (determination, visualization and marginally, positive cognition); one subscale of the SMTQ (constancy) and the single factor MTI.

One explanation for the difference in these results is that coaches might not be able to directly observe some of the subscales in the above measures as a behavior, such as self-belief, positive cognitions, control and confidence within their athlete. Although one would expect that the coach would have a generally good opinion of their athlete's self-belief, perhaps the training environment could potentially explain this. As we conducted the present study within a swimming environment there may not be too many interactions where the coach could read the athletes cognitions. For example, it is difficult to read a swimmers body

language in a pool. However, the most likely rational explanation for the above finding is just due to a difference in opinion. That is, in subsequent analyses not reported in the thesis, a third of the swimmers rated their training behaviors lower than the coach, about a third of the sample agreed on the quality of training behaviors, and a third of the sample showed that athletes reported higher levels of training behaviors than the coach did. Therefore, disagreement over quality of training is the most likely rational explanation for the discrepancies shown in Chapter 3. Perhaps a combination of the coaches and the athletes perspective on training behaviour should be used in future research.

It would also appear that the role of psychological skills (i.e., goal setting and emotional control) is also important in determining training behaviors. For example, Woodman et al. (2010) investigated the relationship between personality, performance strategies (psychological skills), upon training behaviors in British Gymnasts. Findings showed that athlete personality interacted positively with performance strategies to predict training behavior. One of their more consistent findings is that extroversion and goal setting significantly interacted upon distractibility. That is, extroverts were generally more distractible unless they engaged with a high level of goal setting. Further, emotional stability was more strongly related to coping when emotional control was high. The use of goal setting and emotional control have also been highlighted as characteristics of MT in some of the research noted above. That is, the psychological skill of emotional control is akin to emotional regulation that is also assessed in MT measures (e.g., Gucciardi et al., 2014). Therefore, Woodman et al.'s study could be a proxy assessment of personality interacting with a component on MT.

The results of Chapter 3 support previous research assessing the relationship between self-regulation, MT, and performance. For example, Mutz, Clough, Kostas, & Papageorgiou, (2017) found that MT was positively correlated with cognitive reappraisal and emotion

regulation but negatively correlated with expressive suppression emotional regulation. As emotional self-regulation forms part the umbrella of self-regulation, and Chapter 3 found that high MT swimmers showed high self-regulated training behaviors, it would seem apparent (although not directly tested) that swimmers would also require some form of emotional regulation to keep their behavioral regulation in check. Further, Toering, Gemser, Jordet, and Visscher, (2009) examined the relationship between self-regulation and performance among elite and non-elite youth soccer players. To assess self-regulation, the participants completed questionnaires assessing planning, self-monitoring, evaluation, reflection, effort, and self-efficacy. Findings revealed that elite players scored high in aspects of reflection and effort, and that these characteristics were associated with high level of performance compared to non-elite athletes.

Research has also shown that self-regulatory skills could differentiate between athletes at international and national levels of competition, as well as between individual and team sports. While re-examining Toering et al. (2009) results, Jonker, Gemser, and Visscher, (2010) also found that the skill of reflection played a vital role in distinguishing between international and national standard athletes, regardless of whether they performed in individual or team sports. Further, athletes in individual sports reported higher levels of planning and effort than athletes within team sports. One limitation to these studies is that self- regulation was assessed by self-report questionnaires, whereas in Chapter 3 we analyzed the viewpoints of both the swimmers and coaches.

Within the context of swimming, Anshel and Porter (1996) examined the difference between psychological attributes and self-regulation as a function of skill level and gender among competitive Australian swimmers using Kirschenbaum and Wittrock (1984) self-regulation model. This model comprising of problem identification, commitment, execution, environmental management, and generalization. Findings revealed that elite swimmers

engaged and displayed higher levels of self-regulation than non-elite swimmers. Regarding the differences between gender, authors pointed out that male swimmers engaged with higher intensity training after poor performance than female swimmers. The results of Chapter 3 support these findings and provided further evidence that self-regulation positively influences MT. Furthermore, an unpublished study conducted by Schonwetter (2012) showed that training behaviors positively influenced swimming performance when the swimmers utilized the skill of self-monitoring by using boards to score their session laps with an observer present (coach). That is, swimmers reported that they found the self-monitoring boards helpful in training. However, Schonwetter (2012) also pointed out that several swimmers failed to complete their laps when the observer (coach) was absent.

In relation to the above research findings, Young and Starkes (2006b) also found that swimmers who showed higher levels of self-regulatory behaviors (i.e., higher levels of on-task behaviors) missed significantly less swim volume in training. Furthermore, when examining the relationship between self-report workout volume and actual workout volume, all swimmers over-reported the volume of work they actually did, regardless of on-task behaviors. Clearly the role of self-regulation and training warrants further research in relation to team and individual athletes and what role they play in developing MT. Further, the results of the thesis again clearly show the importance of informant ratings when assessing MT and training behaviour.

Regarding the research highlighted above, it is perhaps not surprising that self-regulated (as opposed to non-regulated) training behaviors are a strong source of self-report MT and coach rated MT behaviors. Therefore, one conclusion from Chapter 3 is that MT can be developed through the quality of training behaviors. However, even though the present study and that of previous research examined self-regulated training behaviors, it can be seen that these behaviors are rather generic in nature. To this point, it is still unclear exactly what

types of training behaviors influence MT. For example, it is well know that competition simulation can help an athlete prepare for upcoming competition (Jones & Hardy, 1990). Furthermore, practicing under anxiety also appears to help to improve performance under stressful situation (Lawrence, Cassell, Beattie, Woodman, Khan, Hardy, & Gottwald, 2014). The current set of studies did not set out to test exactly what types of training influence MT behaviors. However, one study may at least provide a guiding light on future research endeavors. For example, Driska et al. (2012) interviewed high experience swimming coaches who illustrated eight attributes and four subcomponents or sources of MT in swimming training. These four subcomponents are, using long-term goals to motivate, controlling the environment, pushing yourself to the limit, and retaining psychological control on poor training days.

**Personality**

A current theme throughout the thesis was to examine what role personality has with MT. Chapter 2 examined the interactive role of punishment and reward sensitivities in relation to MT behavior. Punishment and reward sensitivities are derived from Eysenck's (1967) extraversion-introversion and neuroticism-stability dimensions. These three dimensions are rotated by approximately 30° to form more causally efficient axes that were biologically aligned to neural networks underpinning punishment sensitivity and reward sensitivity (Corr, 2001). Thus, Chapter 4 examined to what extent the separate effects that the three distinct personality types that define punishment and reward sensitivities (i.e., psychoticism, neuroticism, & extraversion) had upon MT behavior and training behaviors.

In Chapter 4 we were specifically interested in the relationship between psychoticism and training for several reasons. For example, Eysenck and Eysenck (1985) indicated that people who are characterized with high levels of psychoticism tend to be aggressive, impulsive, and tough-minded. Egan and Stelmack (2003) pointed out that psychoticism was

associated with high-level risk takers (i.e., climbers at Mount Everest base camp were generally higher than norms on psychoticism). Further, Kirkcaldy (1982) found that international standard male athletes were associated with higher levels psychoticism than national level athletes.

With regards to the results of Chapter 4, it was found that MT was positively correlated with extraversion, negatively correlated with neuroticism, but had no relationship with psychoticism. The finding that psychoticism and MT were not positively correlated fails to support previous research examining the darker side of personality (e.g., Onley et al., 2013). That is, Onley et al. (2013) found that psychopathy was significantly but negatively correlated with control, commitment and confidence as assessed by the MTQ-48 (Clough et al., 2002). Sabouri et al. (2016) revealed all MTQ48 constructs associated positively with all Dark Triad traits (which includes psychopathy). However, Sabouri and colleagues did not report the individual relationships between the separate subscales of the MTQ-48 and psychopathy.

The fact that psychoticism was not related to MT is perhaps surprising given the fact that Perkins and Corr (2006) found a significant negative correlation between psychoticism and the Fear Survey Schedule (FFS; Wolpe & Lang, 1977; $r = -.17$). Therefore, one would expect that if people with high levels of psychoticism are less fearful, they may be more MT. Further, Perkins and Corr (2006) also found that individuals with high levels of psychoticism were generally more insensitive to threat. This latter finding seems of pertinent interest. For example, if individuals high in psychoticism are insensitive to threat, then they may not suffer from negative emotional experiences that comes with threat detection (e.g., Eysenck et al., 2007). In fact, it was found in Chapter 4, that higher levels of psychoticism were associated with lower levels of distraction. In other words, individuals with higher levels of psychoticism may perform better under stress. However, if they do not detect threat early

(e.g., Hardy et al., 2014), then they are unlikely to be able to do anything about it, until perhaps it is too late. This may have a detrimental effect upon their MT behavior (inability to detect and deal with upcoming threat). The results of Chapter 4 however, do suggest that individuals with high levels of psychoticism do see threat early and train better because the use MT as a caravan resource to deal with negative emotional experiences.

It has been noted in the research literature that the personality trait of psychoticism and the clinical condition of psychopathy are related constructs, and lie on the same continuum (e.g., Corr, 2010). That is, psychopathy lies at the extreme end of psychoticism. Therefore, research is unlikely to reveal the true extent between MT and psychopathy/psychoticism unless both personality perspectives are taken into consideration. For example, one may want to partial out psychopathy when examining the relationship between psychoticism and MT and vise versa.

The main analysis revealed that swimmers who were characterized with high levels of both psychoticism and MT, displayed more adaptive training behaviors and MT behavior than swimmers characterized with high level of extraversion and MT, or swimmers characterized with high levels of neuroticism and MT. In other words, psychoticism seems to have a beneficial effect upon training when individuals have high levels of MT. Maybe this is not surprising given that individuals with high levels of MT seem to benefit from a host of cognitive resources (e.g., Gucciardi et al., 2014). Perhaps a degree of MT is what is required for individuals with high levels of psychoticism to channel their aggression and interpersonal hostility.

The above findings seem to be to some extent supported by that of Woodman et al. (2010). They found that athlete personality interacted with performance strategies to predict training behavior. However, these authors only investigated the personality profiles of extraversion, emotional stability, and conscientiousness. Interestingly, Woodman et al. (2010)

showed that extroverts were less distracted if they used high levels of goal setting. In support of this, our findings also demonstrated that higher levels of extraversion was associated with lower levels of coach rated distraction control. Therefore, coaches should be aware of the potential benefits of certain psychological skills in relation to athletes with different personality profiles. For example, athletes who are characterized with high level of psychoticism should benefit more from MT interventions than those lower in psychoticism.

**Applied implications**

There are some applied implications regarding the current findings of the thesis. Although not directly tested in the current thesis, results from Chapter 2 (where athletes with high levels of punishment and low level of reward sensitivities were rated as being MT) suggests that to help combat against poor training habits and increase MT, coaches may be able to develop their swimmers MT by delivering training with a mix of punishment/consequences. However, such punishments and consequences should be delivered in a transformational manner, by explaining to the athletes exactly why they are being punished and subsequently providing coping strategies to deal with poor training habits (e.g., Bell, Hardy, & Beattie, 2013).

Although, the term “punishments” may be frowned upon by coaches and positive psychology, “real consequences” exist in sport that has the potential to ruin an athletes career. Further, part of learning, is learning through one’s mistakes. It is also apparent, that we as humans often learn quicker when the mistakes that we make carry large consequences. It stands to reason that being more consciously aware of potential consequences and punishments associated with poor training or performance, will alert the athlete to better prepare in advance to deter such outcomes. Consequences or punishments do not need to be severe, they could include, extra laps of the pool, extra dry land training, or cleaning the

poolside. This may in part help to sensitize the athlete to threat (external and internal threats), where they detect it early and put into place strategies to overcome such threats.

Another potential technique that encourages both the athlete and coach to detect possible threats are 'what-if' scenarios. Using this technique, athletes prepare for some of the worse possible scenarios that they could face during competition (Miller, 1997). Further, training under pressure (e.g., Lawrence et al., 2014) also appears to protect an individual from subsequent stressful events. An important aspect of this training is that at some stage, the athletes should be able to train under pressure where their use of coping strategies become autonomous in helping them deal with pressure (Bell et al., 2013).

Chapter 3 results demonstrated a positive relationship between self-regulated training behaviors with self-report MT and coach rated MT behavior. From an applied perspective, coaches need to consider the crucial role of training that can influence MT behavior. As swimmers spend a long time in training sessions, coaches should be able to use the self-regulated training behaviors inventory developed within this thesis, as a quick checklist in assessing any weaknesses in their swimmers self-regulation. Although self-regulated training behaviors are relatively easy to observe, self-regulation of emotion is perhaps slightly trickier. For example, emotional self-regulation is the ability to respond to the ongoing task demands with a range of emotions that are sufficiently flexible to permit spontaneous reactions, as well as the ability to delay spontaneous reactions as needed (e.g., Cole, Michel, & Teti, 1994). It may be easier for an athlete to hide emotional responses rather than behavioral ones. As self-regulation training behaviors are considered a source of MT, coaches could also help the athlete internalize training behaviors by encouraging swimmers to utilize self-monitoring by registering their laps and warm up volume on boards or to complete training diaries (Schonwetter, 2012).

Applied implications from Chapter 4, would suggest that coaches should be helped to understand that athletes with different personalities may require specific psychological skills training (e.g., Woodman et al., 2010). In the context of the present study, swimming coaches should be made aware of the crucial role that the MT skills measured by Gucciardi et al. (2014) MTI (confidence, attention control, emotion regulation, motivation, persistence, coping with adversity, dealing with pressure, and positive cognitions) might have on training behaviors and MT behavior. However, with regards to the present set of findings, such skills may only have a significant effect for athletes who are relatively high in psychoticism. Thus, when coaches deliver mental skills interventions to their swimmers, they may not observe any enhancement in the training or MT behaviors of swimmers who are low in psychoticism. Whether this is because athletes low in psychoticism need to be taught different skills to those measured by the MTI, or because such athletes need a completely different approach to enhancing their training and MT behavior is not clear from the present findings.

**Conclusion**

The present thesis investigated the relationship between mental toughness, self-regulated training behaviors, and personality in a swimming environment. The thesis findings further support Hardy et al.'s (2014) findings that MT behaviors can be predicted by revised Reinforcement Sensitivity Theory (rRST- Gray& McNaughton, 2000). That is, as levels of punishment sensitivity increased MT behavior increased but only when reward sensitivity was low. Perhaps more interestingly, this interaction also predicted race time performance in identical fashion to MT behaviour. The thesis also pointed out that, the essential role of self-regulated training behaviors is a strong source of MT. Further, self-regulated training behaviors mediated the relationship between self-report MT and coach rated MT behaviours. Finally, this thesis found evidence to suggest that psychoticism is a beneficial personality trait for training behaviors, but only for swimmers who have a high degree of MT.

**Limitations**

There are number of limitations associated with this thesis. Data took a long time to collect due to nature of heavy training loads with swimmers training twice a day. Further, swimmers training in the morning needed to rush off to school, and swimmers training after school just wanted to get home. We wanted to collect more data with regards to observer ratings of training behaviors from the coach. That is, the coach only completed 4 items from the quality of training inventory, two on distraction and two on coping with adversity (Woodman et al., 2010). However, if we overloaded the coaches, they may have declined to participate in the study. Further, the coach was also assessing several items regarding the assessment of MT behavior. Therefore, we reduced items to try to maintain a higher sample.

In Chapter 2, examining performance was somewhat of an afterthought. We had to go back to the swimmers and collect further data. This led to a drop out of over 50% of the participants. In hindsight, we should have collected performance data at the same time we collected personality data. A further limitation of this approach is that in the opening heat, swimmers did not face competitive pressures. Therefore, we were unable to examine the relationship between MT and performance under pressure. However, at least the thesis made an attempt to examine MT and performance which seems to be an area which lacks research. In Chapter 3, we only examined self-regulated training behaviors even though self-regulation contains several components (e.g., emotional self-regulation). Finally, it is not too clear exactly what specific training behaviors are related to MT. Although the current thesis examined a list of training behaviors related to self-regulation, we assessed them as a single factor construct. For example, we did not assess how training under pressure relates to MT or how emotional regulation relates to training or performance. Neither did we specifically examine the role of psychological skills in training in relation to MT. Finally, in Chapter 4 we investigated three personality traits, psychoticism, extraversion, and neuroticism (PEN).

Although, examining PEN may be considered as a dated approach (i.e., recent studies have focused on classifications of Dark Triads traits and Big Five), we wanted to examine whether the three personality traits that define punishment and reward sensitivities, could separately account for MT behavior. Finally, caution may be required with regards to the current findings. That is, the subscale of control from the SMTQ questionnaire and the personality trait of psychoticism showed low scale reliability (Alpha < .06).

**Strengths**

This thesis has several strengths. First, we significantly add to previous research (e.g., Hardy et al., 2014) by showing that punishment and reward sensitivities can predict MT behavior and athletic performance. Due to the nature of how performance is assessed in swimming (race times), we were able to get an accurate measure of performance which was missing in previous research (e.g., Hardy et al., 2014). In fact, there generally appears to be a lack of research examining the relationship between MT and actual objective performance in sport competitions. This lack of research seems rather strange as MT is linked to high levels of performance under pressure.

Another significant strength is that Chapter 3 has a rich source of data where opinions of both the coach and the athlete were taken. Research in MT generally tends to be limited to examining single source data sets where correlational analysis are paramount. Although such studies provide invaluable information for practitioners and researchers, they tend to focus on main effects rather than interactions. It is clear in the present set of studies that examining interactions provides a richer source of information.

The thesis also examined a wider array of athletes than previous studies examining punishment and reward upon MT (e.g., Bell et al., 2013; Hardy et al., 2014). A particular strength is that even when controlling for age, gender, stroke type, distance and the role of the

coach in Chapter 2, punishment and reward sensitivities interacted to predict performance. Interactive effects tend to disappear when controlling for multiple covariates.

In Chapter 3, we also examined multiple assessments of MT including the PPI-A (Golby et al., 2007), the SMTQ (Sheard et al., 2009) and the MTI (Gucciardi et al., 2014). When devising the method for Chapter 3, it was not easy to choose which assessment of MT we should use. The MTQ-48 (Clough et al., 2002) is one of the most wider used assessments of MT. However, we were put off using the MTQ-48, due to the potential cost of its use by AQR International (£325-£340 for user training).

This thesis pointed out the vital role of behavioral self-regulation as an important source of MT in Chapter 3. Self-regulated training behaviors predicted all three assessments of self-report MT and coach rated MT behaviors. This study will help guide swimming coaches (especially inexperienced coaches) to better assess swimmers who may have motivational issues in training. This knowledge may also help coaches to develop MT in their athletes.

Chapter 4 recognizes the importance of examining both MT and athlete personalities in relation to training behaviors and MT behavior. Perhaps previous research has tended to focus upon correlational analysis whereas Chapter 4 focuses upon exploring possible interactions. If a correlational analysis was the only analysis conducted in Chapter 4, then the interaction between personality and MT would have gone unnoticed. That is, we may have assumed that psychoticism was not related to MT behaviour.

Finally, the candidate utilized several statistical methods across the thesis including confirmatory factor analysis (via Mplus version 7; Muthén & Muthén, 2012), hierarchical linear modelling (HLM Version 7; Raudenbush & Bryk, 2002), mediation analyses via Process (Hayes, 2012) and moderated hierarchical regression analysis via SPSS (version 22). Therefore, the candidate has developed a broad array of statistical knowledge to take forward.

Additionally, this thesis provides the opportunity to further experience the peer review process in order to submit and publish Chapters 3 and 4.

## Future Directions

Below is a list of some future research insights from the thesis.

### General questions

1- Can future research replicate the thesis findings in other sports?

2- What is the relationship between other MT measurements for example, MTQ48 (Clough et al. 2001) with swim training, performance and MT behaviour?

### Research questions from Chapter 2

3- What is the relationship between the MTQ-48 and MT behaviour?

4- What is the relationship between mental toughness, rRST and attention control theory? Are punishment sensitive swimmers better able to shift attention or use MT resources more than high punishment sensitive tough swimmers?

5- What is the relationship between MT and swimming performance under pressure? Pressure situations may include factors such as, large crowds, pressure to win, pressure to break his or her record, pressure to qualify for national team level.

6- When dealing with early threat detection to maximize performance under pressure, what type of psychological strategies are important for swimmers to utilize?

7- As punishment sensitivity is positively related with MT when reward sensitivity was low, would punishment-based interventions such as Bell et al. (2013) transfer across to a swimming environment?

8- What is the relationship between MT and effort? Do MT swimmers put more or less effort into performing under pressure and how does that enable them to

perform optimally under pressure? Or, can they invest less effort if MT is associated with lower levels of anxiety?

**Research questions from Chapter 3**

9- Although training behaviors per se was related to MT, future research may want to further examine specifically what types of training behaviors (e.g., training under pressure) are likely to develop MT?

10- How exactly does past experiences influence MT?

11- As self-regulation for training behaviors play vital role in the development of MT, specifically what kind of self-regulated behaviors influences MT?

12- What is the role of emotional regulation in related with MT behaviours among swimming? Do the swimmers with high emotional regulation display higher levels of MT behaviour?

**Research questions from Chapter 4**

13- As high psychoticism is significantly related MT behavior, what are appropriate strategies to support swimmers who are low in psychoticism to help improve adaptive training behaviors?

14- What is the relationship between coping strategies with psychoticism, extraversion, and neuroticism? Do swimmers with high levels of psychoticism utilize coping strategies to (detect threat earlier) more than extraversion and neuroticism athletes?

15- What role do other personality traits (e.g., Big Five factor and Dark Triad traits) have upon training and MT behaviors within swimming?

16- What is the relationship between MTQ48 and separate personality traits: psychoticism, extraversion, and neuroticism upon self-regulation on swimming?

## Summary

The thesis has taken some important steps at addressing previous research findings that highlight the beneficial use of punishment sensitivity to threat. Although being sensitive to threat may sound counterintuitive to performing under high threat situations, it appears to be a very beneficial strategy to use if one has the relevant coping strategies to deal with early threat detection (i.e., MT resources). The thesis has also found that the training environment plays a strong role as a source of MT and MT behaviour. More importantly, if the athlete has poor self-regulated training behaviors, then their MT may suffer consequently. Finally, the role of personality throughout the thesis has shown that it has a complex relationship with MT and MT behaviour. That being said, the thesis has opened the door on more question and future research endeavors.

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# Appendix

**Appendix**

**Chapter 2 (A)**

The Eysenck Personality Questionnaire–Revised Short version (EPQR-S; Eysenck, Eysenck, & Barrett, 1985).

Please answer each question by putting a **circle** around **only** 'YES or 'NO'.

| | | |
|---|---|---|
| 1. Does your mood often go up and down? | YES | NO |
| 2. Do you take much notice of what other people think? | YES | NO |
| 3. Are you a talkative person? | YES | NO |
| 4. Do you ever feel 'just miserable' for no reason? | YES | NO |
| 5. Would being in debt worry you? | YES | NO |
| 6. Are you rather lively? | YES | NO |
| 7. Are you an irritable person? | YES | NO |
| 8. Would you take drugs which may have strange or dangerous effect? | YES | NO |
| 9. Do you enjoy meeting new people? | YES | NO |
| 10. Are your feelings easily hurt? | YES | NO |
| 11. Do you prefer to go your own way rather than act by the rules? | YES | NO |
| 12. Can you usually let yourself go and enjoy yourself at a lively party? | YES | NO |
| 13. Do you often feel fed-up? | YES | NO |
| 14. Do good manners and cleanliness matter much to you? | YES | NO |
| 15. Do you usually take the initiative in making new friends? | YES | NO |
| 16. Would you call yourself a nervous person? | YES | NO |
| 17. Do you think marriage is old-fashioned and should be done away with? | YES | NO |
| 18. Can you easily get some life into a rather dull party? | YES | NO |
| 19. Are you a worrier? | YES | NO |
| 20. Do you enjoy co-operating with others? | YES | NO |
| 21. Do you tend to keep in the background in social occasions? | YES | NO |
| 22. Does it worry you if you know there are mistakes in your work? | YES | NO |
| 23. Would you call yourself tense or 'highly-strung'? | YES | NO |
| 24. Do you think people spend too much time safeguarding their future with savings and insurances? | YES | NO |
| 25. Do you like mixing with people? | YES | NO |
| 26. Do you worry too long after an embarrassing experience? | YES | NO |
| 27. Do you try not to be rude to people? | YES | NO |
| 28. Do you like plenty of bustle and excitement around you? | YES | NO |

29. Do you suffer from 'nerves'? YES NO
30. Would you like other people to be afraid of you? YES NO
31. Are you mostly quiet when you are with other people? YES NO
32. Do you often feel lonely? YES NO
33. Is it better to follow society's rules than go your own way? YES NO
34. Do other people think of you as being very lively? YES NO
35. Are you often troubled about feelings of guilt? YES NO
36. Can you get a party going? YES NO

**Chapter 2 (B)**

Swimming Mental Toughness Inventory (SMTI)

| COMPETITION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Swimmer Number** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **Swimmer's Initials** | | | | | | | | | | | | | | | |
| **Swimmer X is able to maintain a high level of performance in COMPETITIVE MEETS even when:** | **NEVER SOMETIMES ALWAYS 1 - - - - - - - - - 4 - - - - - - - - - - 7** | | | | | | | | | | | | | | |
| **1. People are relying on him/her to perform well.** | | | | | | | | | | | | | | | |
| **2. The conditions are difficult (Slippery blocks/walls/not efficient lane ropes).** | | | | | | | | | | | | | | | |
| **3. S/he has to perform at a high level all day.** | | | | | | | | | | | | | | | |
| **4. It's a very important meet in the competition season.** | | | | | | | | | | | | | | | |
| **5. Going into the race the competition is particularly tight.** | | | | | | | | | | | | | | | |
| **6. There are a large number of spectators present.** | | | | | | | | | | | | | | | |
| **7. S/he preparation has not gone to plan.** | | | | | | | | | | | | | | | |
| **8. S/he has to qualify for a final by swimming near their best in the heat.** | | | | | | | | | | | | | | | |
| **9. Parental pressure and expectation on him/her is high.** | | | | | | | | | | | | | | | |
| **10. S/he has to perform consistently well during a busy competition phase.** | | | | | | | | | | | | | | | |
| **11. S/he has a number of events during a competition.** | | | | | | | | | | | | | | | |
| **12. S/he is swimming up an age group and/or against a national squad member.** | | | | | | | | | | | | | | | |
| **13. S/he has to achieve a National qualifying time.** | | | | | | | | | | | | | | | |
| **14. S/he has underperformed after swimming several races during a meet.** | | | | | | | | | | | | | | | |
| **15. S/he has to reach more than one final.** | | | | | | | | | | | | | | | |

## Chapter 2 (C)

Performance measure form

Dear swimmer (name),

In order to complete the study you recently participated in, we would like to know some performance details from you. We would like to know your current **British** ranking and your swimming performance in your **MAIN** event across the last 4 races. Please could you provide the following information?

Coach name _____

Your British ranking in 200m IM _____Main event Y / N

Your British ranking in 200m freestyle _____Main event Y / N

If the above events are NOT your main

event please write below what that is?

My main swim event is _____

My British ranking in my main event is _____

Now with reference to your **MAIN SWIM EVENT NOTED ABOVE** please tell us what your race times were in the **FIRST** heat of that event across your last 4 competitions

**Competition 1**

Event name _____

Date _____

Race Time in the FIRST heat _____

**Competition 2**

Event name

_____

Date

_____

Race Time in the FIRST heat

_____

**Competition 3**

Event name _____

Date _____

Race Time in the FIRST heat _____

**Competition 4**

Event name

_____

Date

_____

Race Time in the FIRST heat

_____

**Remember the race times above must be from the same event across all four races. If you have not competed in 4 races please record as many as you can.**

**Chapter 3 (D)**

Swimming Mental Toughness Inventory (SMTI)

| COMPETITION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Swimmer Number** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **Swimmer's Initials** | | | | | | | | | | | | | | | |
| **Swimmer X is able to maintain a high level of performance in COMPETITIVE MEETS even when:** | **NEVER SOMETIMES ALWAYS 1 --------- 4 ---------- 7** | | | | | | | | | | | | | | |
| **1. The conditions are difficult (Slippery blocks/walls/not efficient lane ropes).** | | | | | | | | | | | | | | | |
| **2. S/he has to perform at a high level all day.** | | | | | | | | | | | | | | | |
| **3. It's a very important meet in the competition season.** | | | | | | | | | | | | | | | |
| **4. S/he has to qualify for a final by swimming near their best in the heat.** | | | | | | | | | | | | | | | |
| **5. Parental pressure and expectation on him/her is high.** | | | | | | | | | | | | | | | |
| **6. S/he has to perform consistently well during a busy competition phase.** | | | | | | | | | | | | | | | |
| **7. S/he has a number of events during a competition.** | | | | | | | | | | | | | | | |
| **8. S/he is swimming up an age group and/or against a national squad member.** | | | | | | | | | | | | | | | |
| **9. S/he has to achieve a National qualifying time.** | | | | | | | | | | | | | | | |
| **10. S/he has underperformed after swimming several races during a meet.** | | | | | | | | | | | | | | | |
| **11. S/he has to reach more than one final.** | | | | | | | | | | | | | | | |

**Chapter 3 (E)**

Psychological Performance Inventory-Alternative (PPI-A; Golby et al., 2007).

| | Almost never | Seldom | Sometimes | Often | Almost always |
|---|---|---|---|---|---|
| 1-The goals I've set for myself as a swimmer keep me working hard. | 1 | 2 | 3 | 4 | 5 |
| 2- I don't have to be pushed to swim or practise hard. I am my own best igniter. | 1 | 2 | 3 | 4 | 5 |
| 3- I'm willing to give whatever it takes to reach my full potential as a swimmer. | 1 | 2 | 3 | 4 | 5 |
| 4- I lose my confidence very quickly. | 1 | 2 | 3 | 4 | 5 |
| 5- I can keep strong positive emotion flowing during competition. | 1 | 2 | 3 | 4 | 5 |
| 6- I am a positive thinker during competition. | 1 | 2 | 3 | 4 | 5 |
| 7- My self-talk during competition is negative. | 1 | 2 | 3 | 4 | 5 |
| 8- I can clear interfering emotion quickly and regain my focus. | 1 | 2 | 3 | 4 | 5 |
| 9- Swimming gives me a genuine sense of joy and fulfilment. | 1 | 2 | 3 | 4 | 5 |
| 10- I can change negative moods into positive ones by controlling my thinking. | 1 | 2 | 3 | 4 | 5 |
| 11- I can turn crisis into opportunity. | 1 | 2 | 3 | 4 | 5 |
| 12- I mentally practise my physical skills. | 1 | 2 | 3 | 4 | 5 |
| 13- Thinking in pictures about my sport comes easy for me. | 1 | 2 | 3 | 4 | 5 |

## Chapter 3 (F)

Sport Mental Toughness Questionnaire (SMTQ; Sheard et al., 2009).

| | Not at all true | | | Very true |
|---|---|---|---|---|
| 1-I can regain my composure if I have momentarily lost it. | 1 | 2 | 3 | 4 |
| 2- I worry about performing poorly. | 1 | 2 | 3 | 4 |
| 3- I am committed to completing the tasks I have to do. | 1 | 2 | 3 | 4 |
| 4- I am overcome by self-doubt. | 1 | 2 | 3 | 4 |
| 5- I have an unshakeable confidence in my ability. | 1 | 2 | 3 | 4 |
| 6- I have what it takes to perform well while under pressure. | 1 | 2 | 3 | 4 |
| 7- I get angry and frustrated when things do not go my way. | 1 | 2 | 3 | 4 |
| 8- I give up in difficult situations. | 1 | 2 | 3 | 4 |
| 9- I get anxious by events I did not expect or cannot control. | 1 | 2 | 3 | 4 |
| 10- I get distracted easily and lose my concentration. | 1 | 2 | 3 | 4 |
| 11- I have qualities that set me apart from other competitors. | 1 | 2 | 3 | 4 |
| 12- I take responsibility for setting myself challenging targets. | 1 | 2 | 3 | 4 |
| 13- I interpret potential threats as positives opportunities. | 1 | 2 | 3 | 4 |
| 14- Under pressure, I am able to make decisions with confidence and commitment. | 1 | 2 | 3 | 4 |

**Chapter 3 (G)**

Mental Toughness Index (MTI; Gucciardi et al., 2014).

| | False | | | | | | True |
|---|---|---|---|---|---|---|---|
| 1-I believe in my ability to achieve my goals. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2- I am able to regulate my focus when performing tasks. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3- I am able to use my emotions to perform the way I want to | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4- I strive for continued success. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5- I effectively execute my knowledge of what is required to achieve my goals. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6- I consistently overcome adversity. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7- I am able to execute appropriate skills or knowledge when challenged. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8- I can find a positive in most situations. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Chapter 3 (H)**

Self-Rated Training Behaviours (SRTB)

Think about how you usually train over the past few months. Below is a list of training behaviours that we would like you to rate yourself.

Please rate how well you agree with the following statemen

| | Strongly Agree | | | | | | | | Strongly Disagree |
|---|---|---|---|---|---|---|---|---|---|
| 1) I attend all training practices. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2) I am continuously active and engaged in warm-up | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 3) I always complete the prescribed swim volume in warm-up. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4) I often fail to complete the prescribed swim volume because I miss repetitions or get out early. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 5) Sometimes I am unable to recall my pace times. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 6) I am often unfocussed in dry-land training. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 7) I always achieve the prescribed pace times. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 8) I am always one of the last to make it on to the pool deck. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 9) I always challenge myself during kick sets. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10) I often fail to attend to the technical aspects of the stroke during stroke sets. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 11) I am often reminded by my coach to be more In to my training. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

**Chapter 3 (I)**

Coach-Rated Training Behaviours (CRTB)

| COMPETITION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Swimmer Number** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **Swimmer's Initials** | | | | | | | | | | | | | | | |
| **Swimmer X_____generally demonstrates** | **Strongly Agree 1……9 Strongly Disagree** | | | | | | | | | | | | | | |
| **1.** Is continuously active and engaged in warm-up. | | | | | | | | | | | | | | | |
| **2. Always completes the prescribed swim** volume in warm-up. | | | | | | | | | | | | | | | |
| **3. Often fails to complete the prescribed swim.** volume because they miss repetitions or get out early. | | | | | | | | | | | | | | | |
| **4.** Is often unfocussed in dry-land training. | | | | | | | | | | | | | | | |

**Chapter 4 (J)**

Coach-Rated Training Behaviours (CRTB), Distractibility (CRD), and Coping with Adversity (CWA).

| COMPETITION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Swimmer Number** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **Swimmer's Initials** | | | | | | | | | | | | | | | |
| **Swimmer X_____generally demonstrates** | **Strongly Agree** 1……9 **Strongly Disagree** | | | | | | | | | | | | | | |
| 1. Is continuously active and engaged in warm-up. | | | | | | | | | | | | | | | |
| 2. **Always completes the prescribed swim** volume in warm-up. | | | | | | | | | | | | | | | |
| 3. **Often fails to complete the prescribed swim.** volume because they miss repetitions or get out early. | | | | | | | | | | | | | | | |
| 4. Is often unfocussed in dry-land training. | | | | | | | | | | | | | | | |
| 5. Always achieves the prescribed pace times. | | | | | | | | | | | | | | | |
| 6. Is easily distracted by other people in training. | | | | | | | | | | | | | | | |
| 7. **When training, nothing distracts them from their** training program. | | | | | | | | | | | | | | | |
| 8. **Finds it hard to keep trying if they make a mistake** in training. | | | | | | | | | | | | | | | |
| 9. Is good at dealing with problems during training. | | | | | | | | | | | | | | | |