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Abstract

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.

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) who 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. Neural circuits that mediate responses to reward, punishment and goal conflict underpin these systems. First, rewarding appetitive stimuli (e.g., money or food) activate the behavioural approach system (BAS) where 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), avoid 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 would be associated with higher levels of MT behaviour, whereas higher levels of punishment sensitivity 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. studies 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 Mental Toughness 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 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.

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 χ^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, χ^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, χ^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 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 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 (β_1 = -.11, p = .17) or punishment sensitivity (β_2 = -.10, p = .15) upon MT. However, there was a marginally significant punishment by reward sensitivity interaction (β_3 = -.17, p = .06) upon MT. In the second analysis, we controlled for the effects of age and gender. Neither age (β_1 = -.06, p = .32) nor gender (β_2 = .08, p = .63) were significantly related to MT. As above, neither reward sensitivities (β_4 = -.11, p = .16) or punishment (β_3 = -.10, p = .16) were related to MT. However, the punishment by reward interaction was now significant (β_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)[1].

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

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

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.

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.

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 group 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 (β_1 = -.09, p = .21), punishment sensitivity (β_4 = -.17, p = .24) or reward sensitivity (β_3 = -.13, p = .29) were related to swimming race time. However, there was a significant punishment sensitivity x reward sensitivity interaction (β_5 = .28, p = .04; see Table 4 and Figure 2). 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).

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 in the stress condition only when early threat warning was given; 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 characterised 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 detect threat early. If this is the case, then 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 behaviors seems an opportune environment where athletes could self-regulate their training behaviors 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 pressure, 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 interventions seems to be able to mitigate such responses (e.g., Bell et al., 2013).

In summary, the present study supports previous research (e.g., Hardy et al., 2014) where athletes high in punishment and low in reward sensitivity 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.

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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 in Study 1

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

Table 3

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

Step	β	*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

*$p < .05$

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

*$p < .05$

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

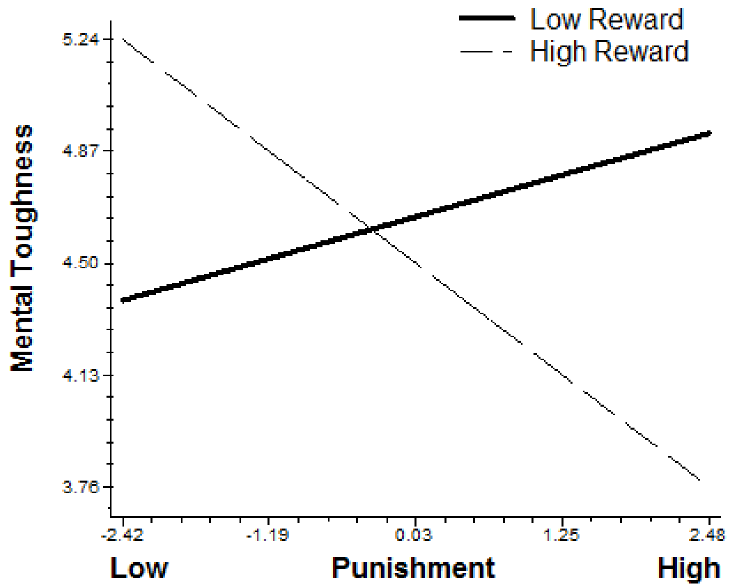

Figure 2. Regression slopes (±1 *SD*) showing the moderating effect of reward sensitivity upon punishment sensitivity and swimming performance.