Abstract

Challenge cognitive appraisals are associated with superior performance compared to threat (Jones, Meijen, McCarthy, & Sheffield, 2009). However, research has not examined longitudinal temporal patterns of challenge and threat appraisals. In this study, 14 (five female) elite rowers (*M*age = 25.79 years, *SD* = 2.67) provided self-reported appraisals data at four time points (baseline; before national trials; before the second world rowing cup regatta; and before the world rowing championships). The rowers' predisposed appraisal style predicted subsequent appraisals. Challenge and self-efficacy increased while loss and avoidance appraisals decreased over time. The rowers were highly predisposed to challenge, becoming more challenged through events of increasing magnitude. This suggests that athletes' predisposed appraisal style can predict their approach to competition. Future studies could identify protocols for encouraging challenge states in athletes, observe the physiological indicators of challenge and threat longitudinally, and could consider the interaction between challenge and threat appraisals.

Keywords: elite athletes; rowing; self-report; cognitive appraisal

Longitudinal Changes in Elite Rowers' Challenge and Threat Appraisals of Pressure Situations: A Season-Long Observational Study

Pressure is ubiquitous in competitive elite sport and the ability to deal with pressure is vital for successful performance (Gould, Eklund, & Jackson, 1993). A key element of the response to pressure situations is how the upcoming competition is cognitively appraised. Theory suggests that through cognitive appraisals, individuals can perceive personally meaningful situations as either a challenge, a threat, or with a potential for loss (Lazarus & Folkman, 1984). The associated challenge or threat states arising from these appraisals carry their own distinct physiological and psychological markers, which in turn have a beneficial (challenge state) or inhibitory (threat state) impact on subsequent performance (Blascovich & Mendes, 2000; Jones, Meijen, McCarthy, & Sheffield, 2009).

The biopsychosocial (BPS) model of challenge and threat (Blascovich & Mendes, 2000) built on Lazarus' notion of cognitive appraisal by positing that individuals' interpretations of pressure situations as a challenge or a threat are dependent on how situational demands compare to personal resources. Specifically, in motivated performance situations, demand appraisals (i.e. perceptions of danger, uncertainty, and required effort) are weighed against the individual's resource appraisals (i.e. ability to cope, skills, knowledge, self-esteem, control, external support). The resultant state is one of challenge if the resources are deemed sufficient to meet or exceed the demands. If the demands outweigh the resources, the resultant state is that of threat (Blascovich & Mendes, 2000). The theory of challenge and threat states in athletes (TCTSA; Jones et al., 2009) extends the BPS model to focus specifically on the appraisals that underlie challenge and threat states in sport competition.

While the TCTSA retains the demand appraisals as proposed in the BPS model, three specific resource appraisals are proposed; self-efficacy, perceived control, and achievement goal orientation (approach vs. avoidance). High self-efficacy, high perceptions of control and

a focus on approach goals are associated with a challenge state, while low self-efficacy, low perceptions of control and a focus on avoidance goals are associated with a threat state (Jones et al., 2009). Due to the psychophysiological reactions associated with challenge and threat, performance is differentially affected. In a threat state potential mechanisms proposed to negatively affect performance in sport settings include slower decision-making, greater conscious control over physical movements, poorer self-regulation, a task-avoidance focus and potentially poorer anaerobic performance, compared to challenge (Jones et al., 2009). In addition, threat leads to emotions that are perceived as debilitative for performance. The hypothesis that challenge leads to superior performance compared to threat is supported by the extant literature in elite and sub-elite athletes (e.g., Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004; Moore, Vine, Wilson, & Freeman, 2012; Skinner & Brewer, 2002; Turner, Jones, Sheffield, & Cross, 2012; Turner, Jones, Sheffield, Barker, & Coffee, 2014; Turner, Jones, Sheffield, Slater, Barker, & Bell, 2013).

Limited research has focussed on changes in challenge and threat states over time. An improved understanding of the nature of these temporal changes is important, so that it is possible to determine whether there are specific periods that practitioners should target to encourage challenge states in athletes, whether coaches and practitioners should be advised to interact differently with athletes at different points in the season, and whether athletes' challenge and threat responses to high pressure situations can be predicted. Psychological and emotional states have been shown to change in the lead-up to competition. For example, there is an increase in the intensity of somatic state anxiety; whereas cognitive state anxiety remains largely stable (Cerin, Szabo, Hunt, & Williams, 2000; Mabweazara, Andrews, & Leach, 2014; Martens, Vealey & Burton, 1990). With a focus on challenge and threat states, individuals with a predisposition for threat appraisals ('threat-trait') showed increasing threat-related cognitive appraisals as the event drew closer, while 'challenge-trait' individuals

reported increasing challenge-related cognitive appraisals (Skinner & Brewer, 2002). Thus, as an event draws closer, cognitive appraisal becomes more intense (cf. Lazarus & Folkman, 1984). To date no study has focussed on how elite athletes' cognitive appraisals of meaningful competitive situations develop over the course of an actual competitive season. Understanding the experience of elite athletes, as a psychologically distinctive group (Gan & Anshel, 2006), is important as to date the majority of research exploring challenge and threat within sport has used novice, varsity, or club athlete samples (i.e. non-elite samples; e.g., Moore et al., 2012; Turner et al., 2012).

To provide a novel and valuable addition to the literature, the present study took a longitudinal approach to investigate how elite athletes' self-reported cognitive appraisals, in line with the TCTSA, were experienced over the course of a competitive season. In line with past research (e.g.,Cerin et al., 2000; Mabweazara et al., 2014; Skinner & Brewer, 2002), it was expected that as the season progressed towards competitions of a greater magnitude the intensity of rowers' appraisals of high pressure situations would increase in the direction of their predisposed appraisal style (i.e. challenging or threatening). Specifically, it was hypothesized that where baseline challenge or threat ratings were high (indicating a predisposition for this appraisal style), there would be an increase in these types of appraisal throughout the season as event magnitude increased. For example, if a predisposition for a high challenge cognitive appraisal style was recorded, challenge, self-efficacy, control and approach goal orientation appraisals would increase over the season. We also explored how cognitive appraisals changed at each event, as event magnitude increased but made no specific hypothesis in this regard.

Method

Participants

Fourteen (nine male and five female) elite rowers (*M*age = 25.79 years, *SD* = 2.67; *M*international rowing experience = 5.72 years, *SD* = 2.88) volunteered to take part in the present study. This group had represented their nation in rowing at a number of world rowing cups (*M* = 4.21, *SD* = 4.17) and world rowing championships (*M* = 3.50, *SD* = 2.14) and included three Olympic medallists. The sample represented an entire squad within a national rowing federation and thus showed significant external validity in a population which is small and difficult to access. Previous longitudinal research has been carried out on similarly small samples where access is challenging (McNally, Eisenberg & Harris, 1991). Access to this squad was granted with permission and support of the national federation's management (therefore representing a convenience sample). However, for ethical reasons, it was made clear to all that their participation and any information shared as part of the study would have absolutely no impact on their squad selection. No inducement was offered to the rowers for their participation, other than the explanation that an enhanced understanding in this area could assist in their preparations for the Rio Olympics. Ethical approval was granted by the University ethics panel prior to data collection.

Design & Procedure

This study followed a within-subjects repeated measures cross-sectional design across four time points throughout a competitive season. After providing informed consent an online questionnaire was completed by participants at four time points (baseline; time 1 - before national trials; time 2 - before the second world rowing cup regatta; time 3 - before the world rowing championships). Once the data at time 3 had been collected the participants were fully debriefed about the nature of the study.

Contextual Information

Elite rowers' baseline cognitive appraisals were assessed and then measured at three international competitive events over the course of the season; national trials (time 1), the

second world rowing cup regatta (time 2), and the world rowing championships (time 3). These particular events were chosen as they were spread evenly across the season, and each represented significant performance situations for the rowers. An important distinction is drawn between event importance and event magnitude; importance is defined by the participant and therefore relates to the perceived importance of the event with specific reference to the individual, a required precedent for the experience of challenge and threat states (Blascovich & Mendes, 2000; Lazarus, 1991). Magnitude is defined as the significance of the event by agreed consensus in the context of the sport. The following descriptions of each event demonstrate their increasing magnitude: Successful performance at the national trials (time 1) is a requirement for selection to the national squad and the results have implications for which boat the rower is selected to for the forthcoming season. The world rowing cup (time 2) is a series of international competitive regattas which are used to further test and select crews ahead of the culmination of the competitive rowing season; the world rowing championships (time 3). The world championships are described by rowing's international governing body as the "biggest annual world rowing event and the most important of the season" (world rowing, n.d.). This has the greatest media coverage, highest spectators (with a total 157,000 spectators in attendance at the 2013 world rowing championships; world rowing, 2013) and is seen as the biggest stage in rowing beyond the Olympic Games (in pre-Olympic years the championships are used as the Olympic qualification regatta). Therefore it is seen that while each event may be personally important (performance at each race will have an impact on the rowers' selection to compete at the subsequent events) the magnitude of these events increases throughout the season to the pinnacle of the world rowing championships.

Measures

An online questionnaire (using the Google Forms application; Google Inc., n.d.) was developed which included items to assess indicators of challenge and threat in accordance with the TCTSA (Jones et al., 2009).

Achievement goals questionnaire for sport (AGQ-S). The AGQ-S has been individually validated and used in previous studies to identify appraisals of goal orientation (Adie, Duda, & Ntoumanis, 2008; Conroy, Elliot, & Hofer, 2003; Turner et al., 2014). The AGQ-S consists of twelve items (three each for performance approach; PAp, performance avoidance; PAv, mastery approach; MAp, and mastery avoidance; MAv) related to general experiences (baseline) or specific events (times 1 to 3) which participants were asked to rate on a seven-point Likert scale from 1 (*not at all true*) to 7 (*very true*). Cronbach's alpha (α) for the AGQ-S ranged from 0.84 to 0.91 across the four measurement points, indicating consistently high internal consistency (George & Mallery, 2003).

Self-efficacy and control scale (SEC-scale). Bandura (2006) emphasized the importance of tailoring scales of perceived self-efficacy to the particular domain of interest in order to maximize explanatory and predictive value (i.e. Self-Efficacy Scale developed by Turner et al., 2014). Therefore the SEC-scale was developed according to the suggested guidelines of Bandura (2006) to comprise of 10-items relating to successful performance in rowing. Participants responded by rating how confident they felt in their ability to execute certain aspects of their performance as a percentage between 0 (*not at all confident*) and 100 (*extremely confident*) in general circumstances (baseline) or in relation to a forthcoming event (times 1 to 3). A self-efficacy score was then calculated by averaging the 10 scores in line with previous research (Turner et al.,2014; Turner et al.,2012). Control was also rated in the same way for each item. Bandura (1997) suggested that control and self-efficacy are closely associated, because in order for self-efficacy to develop individuals must believe that they have sufficient control to intentionally execute their actions. Cronbach's alpha (α) for

self-efficacy ranged from 0.83 to 0.94 across the four measurement points, indicating consistently high internal consistency (George & Mallery, 2003), while Cronbach's alpha (α) for control ranged from 0.68 to 0.94 across the four measurement points. In the data analysis the fifth question ('to what extent do you have control over your ability to step up to perform if you have to?') at the second measurement point was removed to ensure at least questionable to high levels of internal consistency (George & Mallery, 2003), as Cronbach's alpha (α) was 0.46 when this item was included.

Appraisal of life events scale (ALE-scale). The ALE-scale, previously validated by Ferguson, Matthews and Cox (1999), is made up of 16 adjectives which participants were asked to rate in relation to their perceptions of their general circumstances (baseline) or in relation to a forthcoming event (times 1 to 3) on a six-point Likert scale from 0 (*not at all*) to 5 (*very much so*). Mean scores of the sums of specific items were used to determine challenge, threat and loss. Cronbach's Alpha (α) for the ALE-scale ranged from 0.61 to 0.84 across the four measurement points, indicating questionable to high levels of internal consistency (George & Mallery, 2003).

Event importance. A measure of event importance was included to assess the extent to which rowers felt that each event was important to them. Participants were asked to rate the importance of each event on a six-point Likert scale from 1 (*not at all important*) to 6 (*very important*). Importance has been used previously as an indicator of task engagement, cited as a pre-requisite for challenge and threat states which occur in situations that are personally meaningful to the individual (Blascovich & Mendes, 2000; Lazarus, 1991).

Analytic Strategy

Prior to main analyses, Shapiro Wilks tests were performed and six items were found to be significantly non-normally distributed (MAp at baseline and times 1, 2 and 3; self-efficacy at time 3 and control at time 2). Following the indication of the presence of

significant ($p < .05$) outliers, z scores for these significant outliers were assessed. Data-points with z scores greater than two were Windsorized following guidelines for small sample sizes (Smith, 2011). Data from one participant was entirely removed from analyses after an injury prevented them from completing half of the questionnaires. Simple mean imputation (replacing missing data with the variable's mean score) was used to replace two missing data points.

The main analyses followed five steps. First, a one samples *t*-test was performed to ensure the perceived importance of each pressure event was above zero. Perceived importance is a prerequisite for examining challenge and threat appraisals. Second, to understand the athletes' predisposed cognitive appraisal style at a group and descriptive level, predisposed cognitive appraisal style was subjected to 'tripartite splitting' in order to rank responses (e.g., Cole & Gonyea, 2010; Setterlund & Niedenthal, 1993). Third, correlation analyses were conducted to examine the hypothesized associations between predisposed (baseline) challenge, threat, and resource appraisals (self-efficacy, control, and achievement goals), and state challenge, threat, and resource appraisals (averaged across times 1, 2, and 3). Fourth, two multiple regression analyses were conducted to determine whether predisposed challenge, threat, loss, and resource appraisals (baseline) predicted future state challenge and threat appraisals (averaged across times 1, 2, and 3). Finally, Multivariate Analysis of Covariance (MANCOVA) was carried out to examine the longitudinal changes of each dependent variable (all appraisal variables) from baseline at each time point using change scores. Vasey and Thayer (1987) described this as a suitable approach for designs similar to the present study, even with a small sample size. Change scores for each dependent variable were calculated by subtracting the baseline score from timepoints 1, 2, and 3, in order to examine changes in appraisals while taking into account predisposed appraisal style. Gender and international rowing experience were included as covariates to account for the effects of

rowing experience and gender on the changes from baseline at each timepoint. All multicollinearity, homogeneity, normality and outlier checks met the assumptions necessary for all data analyses.

Results

Perceived importance

One samples *t*-tests revealed that rowers felt the competitive events at time 1 (M = 5.85, SD = .38, t = 56.13, df = 12), time 2 (M = 5.62, SD = .51, t = 39.98, df = 12), and time 3 (M = 5.85, SD = .38, t = 56.13, df = 12) were important (all $p < .001$). In addition, a repeated-measures ANOVA revealed no significant effect for time on importance, $F(2, 11) = 2.51$, $p > .05$, $\eta_p^2 = .17$, suggesting no differences in participants' ratings of event importance between time 1, time 2, and time 3. Therefore, despite increasing magnitude, rowers felt that all events were as important as each other.

Predisposed cognitive appraisal style

The participants' responses to the initial questionnaire were used as a baseline to assess their predisposed cognitive appraisal style. The process of tripartite splitting to rank responses has been used in previous psychological research literature (e.g., Cole & Gonyea, 2010) and the same process was used in the present study. The responses to each of the three measures used in the present study (AGQ-S, SEC-scale and ALE-scale) were transformed into percentages where 100% represented 'very much' and 0% represented 'not at all'. Scores from 0.00% to 33.33% were identified as showing a low predisposition, scores from 33.34% to 66.66% were identified as showing a moderate predisposition, and scores from 66.67% to 100.00% were identified as showing a high predisposition. The tripartite splitting results are presented in Table 1, and provide a descriptive overview of the athletes' predisposed appraisal style. Overall, athletes were predisposed to high challenge (including challenge

appraisal, self-efficacy, control, and approach goals) and moderate threat (including threat appraisal, loss appraisal, and avoidance goals).

Associations between predisposed and state appraisals

Correlation coefficients can be seen in Table 2. The results revealed that predisposed challenge and threat appraisals and resource appraisals were linearly associated with corresponding state challenge and threat appraisals and resource appraisals, in the directions hypothesized.

Predicting future state appraisals

With the correlation analyses taken into consideration where hypothesized relationships emerged, regression analyses were used to assess whether predisposed challenge, threat, and resource appraisals were able to predict subsequent state challenge, threat, and resource appraisals at times 1, 2, and 3 (averaged). Predisposed challenge, threat and resource appraisals (baseline) were used as the independent variables in two multiple regression analyses to predict subsequent state challenge, threat and resource appraisals. Time 1, 2, and 3 state cognitive appraisals were averaged to create a single dependent variable for each state cognitive appraisal (average challenge appraisal, threat appraisal, loss appraisal, self-efficacy, control, Pap, PAv, MAp, MAv; required for multiple regression). The first regression analysis concerned challenge-related variables (challenge appraisal, self-efficacy, control, PAp, and MAp), and the second regression analysis concerned threat-related variables (threat appraisal, loss appraisal, PAv, and MAv).

In the challenge-related regression analyses, predisposed challenge appraisal, self-efficacy, control, PAp, and MAp, accounted for a significant proportion of variance, $\Delta R^2 = .60$, $p < .03$, in state challenge appraisal (averaged across time 1, 2, and 3). Co-efficients showed that predisposed challenge appraisal ($\beta = .95$, $p < .01$) and PAp ($\beta = .79$, $p < .03$) were significantly positively associated with state challenge appraisal.

In the threat-related regression analyses, predisposed threat appraisal, loss appraisal, PAv, and MAv, accounted for a significant proportion of variance, $\Delta R^2 = .56$, $p < .05$, in state threat appraisal (averaged across time 1, 2, and 3). Co-efficients showed that predisposed threat appraisal ($\beta = .75$, $p < .03$) was significantly positively associated with state threat appraisal.

Challenge and threat appraisals across time

The MANCOVA revealed a significant effect for timepoint on appraisal variables, Wilks Lambda = .449, $F(3, 46) = 1.77$, $p = .03$, $\eta_p^2 = .23$. There were significant between-subjects effects for challenge, $F(3, 46) = 8.53$, $p < .001$, $\eta_p^2 = .36$, loss, $F(3, 46) = 2.96$, $p < .05$, $\eta_p^2 = .16$, and self-efficacy, $F(3, 46) = 3.17$, $p = .03$, $\eta_p^2 = .35$, and a marginally significant effect for avoidance goals, $F(3, 46) = 2.76$, $p = .053$, $\eta_p^2 = .15$. There were no other significant effects (see Table 3 for all values across time).

Post-hoc Bonferroni pairwise comparisons showed that challenge was significantly greater at time 2 ($M = 4.24$, $SD = 0.61$; $p < .01$) and time 3 ($M = 4.46$, $SD = 0.46$; $p < .001$) than at time 1 ($M = 3.05$, $SD = 1.17$), suggesting that as the season progressed, the rowers' challenge appraisals increased. In addition, self-efficacy at time 3 ($M = 93.59$, $SD = 2.40$) was significantly greater than at baseline ($M = 83.55$, $SD = 2.40$; $p < .05$), suggesting that as the season progressed, the rowers' self-efficacy appraisals increased. Also, loss was significantly smaller at time 3 ($M = .98$, $SD = .86$) than at baseline ($M = 1.73$, $SD = .72$, $p = .02$) and Time 1 ($M = 1.75$, $SD = .82$, $p < .02$). Finally, avoidance goals from baseline ($M = 4.37$, $SD = 1.47$) were smaller at time 2 ($M = 3.10$, $SD = 1.28$, $p < .03$) and time 3 ($M = 3.00$, $SD = 1.51$, $p < .02$), suggesting a reduction as the season progressed.

Discussion

Elite rowers' predisposed cognitive appraisal style was associated with, and further predicted, subsequent cognitive appraisals, such that predisposed challenge was associated

with event-specific state challenge across three timepoints, and predisposed threat was associated with event-specific state threat across three timepoints. Challenge and self-efficacy increased over time while loss and avoidance appraisals decreased over time. Also, the athletes demonstrated high predisposed challenge and moderate predisposed threat. Collectively these results suggest that in general the sample of elite rowers are highly predisposed to challenge, becoming more challenged as the season progressed through events of increasing magnitude. The findings of the present study support the notion proposed by Skinner and Brewer (2002) that predisposed cognitive appraisal style can predict subsequent cognitive appraisals. However, the present study extended this finding; hypothesising that the rowers' ratings of high pressure situations as a challenge or a threat would increase or decrease in accordance with their predisposed cognitive appraisal style (measured at baseline).

The predisposed cognitive appraisal style scores in Table 2 indicate that in general the rowers showed a predisposition for high levels of challenge, self-efficacy, control, and approach and avoidance goals, and moderate levels of loss and threat. As such it was anticipated that as the higher magnitude events of the season approached, the intensity of the rowers' predisposed cognitive appraisal styles would increase and they would therefore rate higher levels of challenge, self-efficacy, control, and approach goals, and stable or decreasing levels of loss, avoidance goals and threat. The results of the present study partially supported these hypotheses, with significant increases recorded in challenge and self-efficacy ratings, significant decreases in loss ratings and marginally significant decreases in avoidance goal ratings. It should be noted that some of the Cronbach's α for the ALE-scale and the Control scale across time fell within the 'questionable' range (George & Mallery, 2003) and therefore the results should be viewed with some caution.

The notion that cognitive appraisals can change over time was initially investigated by Skinner and Brewer (2002) who, in their work on participants' temporal patterns of appraisal and emotion in the run up to a single event, found that as an event approached 'threat trait' individuals showed more intense levels of threat, while 'challenge trait' individuals showed more intense levels of challenge. What we see here longitudinally is what Skinner and Brewer see temporally. That is, events increasing in magnitude were appraised as increasingly more challenging over a season. This goes some way to support the notion that appraisals can increase in intensity over the course of a season in accordance with predisposed cognitive appraisal style. Following Skinner and Brewer's (2002) work, and the research on temporal patterning from a Multidimensional Anxiety Theory perspective (Cerin et al., 2000; Mabweazara et al., 2014; Martens et al., 1990), the reported increase of challenge appraisals throughout the season can be explained by the high levels of challenge reported by the rowers at baseline compared to threat (suggesting a predisposition for more challenge-focussed appraisals). As the season progressed towards events of a higher magnitude the intensity of this predisposition for challenge appraisals increased, evidenced by rowers' increased challenge and self-efficacy appraisals (indicating the increased experience of these high pressure situations as challenging, rather than threatening).

The findings relating to loss are of particular interest as appraisals of loss have received little attention in the recent challenge and threat literature. Although Table 2 shows a predisposition for moderate levels of loss, loss has been linked to a threat state in previous research (Ferguson et al., 1999; Lazarus, 1991; Tomaka, Blascovich, Kelsey, & Leitten, 1993; Seery, Weisbuch, & Blascovich, 2009). The present study's finding of significantly decreased loss over time may have occurred as loss-framed situations (e.g. potential to lose one's place in the team at time 1) encouraged avoidance goals and the associated negatively valenced appraisals related to threat, whereas gain-framed situations (e.g. potential to win a

medal at times 2 and 3) promoted approach goals and the positively valenced appraisals related to challenge (Seery et al., 2009). In other words, the finding of decreased loss ratings over time in the present study may have been related to increased challenge appraisals. That is, as the rowers appraised fewer opportunities for loss and more for gain, their approach goals and positively valenced appraisals increased, leading to the appraisal of the motivated performance situations as increasingly challenging. The TCTSA suggests that this pattern would subsequently positively impact performance via increasing attention, improved decision-making, and physical effort and functioning (Jones et al., 2009). The suggestion that the observed significant decrease in loss is the result of links between loss and threat is also supported by the marginally significant decrease in avoidance goals, which further points to a decreased threat state (Jones et al., 2009). Seery et al. (2009) stated that loss-framed situations encourage avoidance goals and are thus related to threat states (Seery et al., 2009).

Loss has received little attention in the challenge and threat literature, but the research of Lazarus and colleagues (i.e., Folkman & Lazarus, 1985; Lazarus, 1991; Lazarus, 1993; Lazarus & Folkman, 1984) identified loss as one of the four basic dimensions underlying primary appraisal alongside threat, challenge and benefit by Folkman and Lazarus (1985). It should be noted that whilst benefit has been found to be pertinent in the sporting context, particularly when considering past-oriented appraisals (e.g. Miles, Neil, & Barker, 2016), for the purposes of the present study the authors used a measure of challenge and threat that did not differentiate between challenge and benefit as in the validation of the scale these variables were found to be not significantly distinguishable (ALE-Scale; Ferguson et al., 1999). A 'loss environment' carries potential for suffering and sadness (compared to a threat environment which has potential for harm and anxiety), and is negatively correlated to challenge and positively related to threat (Ferguson et al., 1999). The tendency to focus on the likelihood for loss is indicative of a threat state, whereas in a challenge state, individuals

are more likely to reframe this notion as the difficulty of attaining gains (Lazarus, 1991; Tomaka et al., 1993). In the current study it possible that, as the pinnacle of the season and the event with the highest magnitude (world rowing, n.d.), the rowers felt as though they had less to lose at the world rowing championships (time 3); thus helping to encourage the observed increase in challenge ratings. Put another way, there may have been more to gain (e.g., medals) in later competitions whereas in earlier events such as selection there was more to lose (e.g., opportunity to compete throughout the season).

The present study represents a valuable observation of the temporal changes in elite athletes' challenge and threat appraisals throughout a competitive season and also emphasizes the importance of understanding athletes' predisposed cognitive appraisal styles. This understanding can allow practitioners to predict athletes' cognitive appraisals for future high pressure situations and inform targeted interventions to exploit the benefits of challenge appraisals and minimize the inhibitive influence of threat appraisals. A protocol for measuring athletes' ability to face pressure could easily be applied in the field. Using the three measurement scales (AGQ-S, SEC-scale and ALE-scale) we were able to identify that the highly elite athletes involved in the present study showed predisposition for high challenge and low threat appraisals. Using the tripartite split it may be possible to identify athletes who are able to face pressure in a challenge state, and support those who present with dispositional threat appraisals towards a challenge state. At the time of data collection there was no bespoke challenge and threat appraisal measure for the sporting population. However, after the present study was completed the Challenge and Threat in Sport (CAT-Sport) Scale (Rossato, Uphill, Swain & Coleman, 2016), was developed, which will be of great value to practitioners and researchers wishing to develop this area further. The value of the present study for practitioners is that it is possible to predict how an athlete may cognitively appraise an imminent competition using predisposed appraisal style. This would

enable practitioners to both predict athlete coping, and to more accurately target interventions. The performance advantages of challenge states have been clearly identified (Jones et al., 2009; Moore et al., 2012; Skinner & Brewer, 2002; Turner et al., 2012; Turner et al., 2013), therefore a protocol for encouraging challenge states would be of great applied value. Practitioners could further develop the work of Williams and Cumming (2012) in their use of imagery to promote challenge states, for example. The finding that the cognitive appraisals of high pressure situations change over time, coupled with Turner et al., (2014) facilitation of challenge states in athletic tasks through the delivery of challenge-framed instructions, shows great potential for further applied research into the intentional manipulation of cognitive appraisals. There are a number of additional aspects that future research could develop further to strengthen this area. The longitudinal nature of the present study was also of value and further longitudinal studies, particularly with a physiological measurement of challenge and threat states, would help to better understand the development of these states over time. Comparisons between elite and non-elite populations would also provide a relative gauge for the predisposition level (i.e. high or low) of each group. Performance was not measured in the present study and therefore it was not possible to draw definitive conclusions over the impact of challenge and threat appraisal on the rowers' subsequent performance. This decision was made for practical reasons (it was difficult to find a comparative measure of performance when the rowers competed individually and in different combinations throughout the study) as well as ethical reasons (with such a small population it would have been easy to identify who had taken part in the study with the inclusion of specific performance data). The authors recognise that this would further validate the findings of the study and therefore would encourage a specific performance measure (i.e. perceived success in each event) to be included in future studies. Finally, whilst the present study focussed on the change in appraisals over time, it would be interesting for

future research to carry out an interaction analysis on the challenge and threat appraisals on approach to particular situation, to examine how challenge and threat interact to determine performance.

The present study showed that the appraisals of high-pressure competitive sporting situations by elite athletes change over time. Challenge and self-efficacy increased while loss and avoidance appraisals decreased over time. The rowers were highly predisposed to challenge, becoming more challenged through events of increasing magnitude. Whether an increase in the intensity of the rowers' experience of their predisposed appraisal styles ahead of high-magnitude competitions resulted in increased challenge appraisals, or an initial experience of adversity at the national trials resulted in the development of resilience (and therefore subsequent increases challenge appraisals), is unclear and worthy of further investigation.

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Table 1

Predisposed cognitive appraisal style scores.

Table 2

Pearson's correlation coefficients for all predisposed and state appraisal variables.

Table 3

Scores for all appraisals variables (M ± SD) across Baseline, and three competition timepoints.