Do challenge and threat evaluations predict netball performance and selection at trials in youth netball players?

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Abstract

In the current paper, we investigated the extent to which challenge and threat evaluations predicted the trials performance of youth netball players. This paper compared two theoretical frameworks, the Theory of Challenge and Threat States in Athletes (TCTSA) and the BioPsychoSocial Model (BPSM) of Challenge and Threat, in their prediction of trials performance. A field-based cross-sectional design was adopted, including self-report psychometric, and observational performance, data. Data were collected prior to the participants' trials performance. Youth female netball athletes (n = 92, Mage = 13.26 years, SD = 1.55) completed psychometrics concerning challenge and threat evaluations and emotions, in relation to upcoming trials performance. Performance was rated by 10 independent club coaches. Binary logistic and linear regression analyses revealed that BPSM-derived resource evaluations (general self-confidence, general perception of positive challenge, positive disposition) were related to trials performance, whilst TCTSA-derived resource evaluations (self-efficacy, perceived control, goal orientation) were not. Also, a greater perceived ability to cope with demands was positively related to trial outcome. The strongest and most consistent predictor of performance was number of previous trials. The greater number of previously attended trials, the better the participants performed in trials. The findings reveal the importance of BPSM-derived resource evaluations and the perceived ability to cope with demands in the prediction of performance outcomes, over and above the TCTSA-derived resource evaluations. The findings also have important implications for sports teams, athletes, and coaches, who should strive to maximise perceptions of resources and coping abilities in the face of pressure situations, such as trials.

Keywords: pressure; adolescents; resources; demands; emotions

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As part of many athletes' career progression they will frequently be required to attend trials, in which their performance is evaluated for the purposes of selection to, or deselection from, a sports team. Performing well at trials, also known as 'try-outs', is important for athletes because, based on their performance, they are either selected for the team, or they are not. This binary notion of being selected or not, together with the demands inherent in motivated performance situations (i.e., goal-relevant, task engaging situations that require instrumental cognitive and behavioral responses responses; Blascovich & Mendes, 2000), such as uncertainty, self and other expectations, requirement for effort, judgement or evaluation, criticism and social rejection, creates a potentially highly stressful situation for athletes (e.g., Baumeister, 1997). Research indicates that athletes who respond to or view these motivated performance situations with a challenge, rather than a threat state, achieve superior performance outcomes (Hase et al., 2018). In this study, we examine the contribution of challenge and threat evaluations to success at trials in a sample of youth netball players.

Trials have the potential to be a significant stressor for athletes, and a dominant paradigm in stress and coping literature that has been studied extensively is challenge and threat (see Behnke & Kaczmarek, 2018, for a meta-analysis). In line with Lazurus' cognitive appraisal theory (Lazarus, 1966; Lazarus & Folkman, 1984), the extent to which a motivated performance situation, such as trials, is perceived as stressful for athletes depends on their evaluation of the trials. In the cognitive appraisal theory, the concepts challenge (anticipated gain), threat (future damage), harm/ loss (damage to goals, values, or beliefs that has already occurred) were introduced (Lazarus, 1966). Challenge and threat are anticipatory states (Lazarus, 1999), that have been adopted by Blascovich and Mendes (2000) in the BioPsychoSocial model (BPSM) of challenge and threat (see Seery, 2011, for a detailed

discussion). The BPSM carries forward Lazarus' notion of demands vs. resources, rather than primary (goal relevance, and goal congruence) and secondary (problem focused coping, emotion focused coping) evaluations.

As well as building on the work of Lazarus, the BPSM of challenge and threat (Blascovich & Mendes, 2000), is also informed by the work of Obrist (1981) and Dienstbier (1989) in explaining two distinct ways that humans psychophysiologically respond to stressors; challenge and threat. Importantly, the BPSM proposes that challenge evaluations reflects a psychophysiologically adaptive response to a stressor, whilst threat reflects a psychophysiologically maladaptive response to a stressor. Importantly, in the BPSM, a challenge state is experienced when an individual facing a motivated performance situation evaluates sufficient resources to meet the evaluated demands of the situation. A threat state occurs when the individual evaluates insufficient resources to meet the appraised demands of the situation (Blascovich & Mendes, 2000). In addition, challenge and threat represent two anchors of a single bipolar continuum (Blascovich, 2008). In the BPSM presented by Blascovich and Mendes (2000), demand evaluations comprise perceptions of danger (esteem and physical), uncertainty, and required effort in a situation, and resource evaluations involve the assessment of knowledge and skills relevant to the situation. Blascovich (2008) suggests a number of bipolar factors that may have dynamic implications for resources and demands. For example, psychological and physical safety/danger, novelty/familiarity, skills, knowledge, and abilities, and required effort are all thought to be important for demands and resource evaluations (Seery, 2011). However, there is no comprehensive list of factors.

Furthermore, the BPSM does not provide specific details about the resource evaluations and indeed Blascovich & Mendes (2000) state that "we cannot specify an exact calculus for resource appraisals" (p. 63). However, resource evaluations are likely to include the assessment of knowledge and skills relevant to the situational performance (Blascovich & Mendes, 2000).

The BPSM-derived resource evaluations can be inferred by exploring the way in which they have been assessed in past research. To this end, in past measurement of resource evaluations (e.g., Mendes et al., 2001; Mendes et al., 2007), perceived resources have included questions pertaining to perceived abilities to perform well, the expectation of performing well, the importance of performing well, the perception that the situation is a positive challenge, and the perception that one is predisposed to performing well. Similarly, Lazarus (1999) is very broad in his conceptualization of the resources, suggesting that "intelligence, money, social skills, education, supportive family and friends, physical attractiveness, health and energy, sanguinity, and so on" (p. 71) are all personal resources.

Drawing heavily on the BPSM, the Theory of Challenge and Threat States in Athletes (TCTSA; Jones et al., 2009) was proposed, which outlines specific and well-defined resource evaluations. In the TCTSA, demand evaluations are taken from the BPSM, and the resources evaluations are drawn from the BPSM (Blascovich & Mendes, 2000), the model of adaptive approaches to competition (Skinner & Brewer, 2004), and the model of debilitative and facilitative competitive state anxiety (Jones, 1995). Resource evaluations comprise self-efficacy, perceptions of control, and goal orientation (Jones et al., 2009). High levels of self-efficacy, high perceived control, and a focus on approach goals, represent sufficient resources to cope in a motivated performance situation and are therefore indicative of challenge. Conversely, low levels of self-efficacy, low perceived control and a focus on avoidance goals, represent insufficient resources to cope in a motivated performance situation and are indicative of threat. In addition, the TCTSA predicts that a challenge state will typically be associated with emotions of a positive valence, and that a threat state will typically be associated with emotions of a negative valence. Importantly though, emotions experienced during challenge state will be perceived as helpful to performance, and emotions experienced during a threat state will be perceived as unhelpful to performance. It is possible to experience negatively

valenced emotions but perceive them to be helpful for performance in a challenge state. However, research has not been able to support these predictions (Meijen et al., 2014). But some research (e.g., Meijen., et al., 2013) indicates that threat is more related to negatively valenced emotions (anger and dejection), and that both challenge and threat could be related to anxiety. In addition, Moore et al. (2012) found that golfers in a challenge state reported lower anxiety than those in a threat state. Therefore, concerning emotion, research evidence offers mixed support for the TCTSA.

The TCTSA also proposes that challenge and threat states are marked by distinct physiological patterns of reactivity, a notion carried forward from the BPSM. Both challenge and threat states are associated with an increase in sympathetic adrenal medullary (SAM) activation, but a threat state is associated also with an increase in pituitary adrenal cortical (PAC) activation (Blascovich & Tomaka, 1996; Dienstbier, 1989). Increased PAC activation inhibits vasodilation that would take place in a challenge state (Blascovich & Mendes, 2000). Research generally uses cardiovascular reactivity markers to indicate physiological challenge and threat states. A challenge state is indicated by a decrease in total peripheral resistance (TPR; sum of the resistance of all peripheral vasculature in the systemic circulation), indicating vasodilation, and an increase from baseline in cardiac output (CO; litres of blood pumped from the heart per minute; Blascovich & Mendes, 2000). Cardiovascular challenge states facilitate cognitive and physical performance (e.g., Turner et al., 2012).

A detailed contemporary review of the TCTSA and its main hypotheses (Meijen et al., 2020) indicates that there is a preponderance of research evidencing the performance effects of challenge and threat states as measured using cardiovascular indicators, and less research illustrating that the resource evaluations can predict performance. To be clear, the TCTSA does not suggest that the resource evaluations should directly predict athletic performance, rather, that athletes will experience a challenge state if they perceive high self-efficacy, perception of

control and there is a focus on approach goals. This is supported by some research (Meijen et al., 2013; Turner et al., 2014), but the influence on performance of the resource evaluations per se has not received much research attention.

At the core of the TCTSA is the notion that some athletes excel in motivated performance situations while others fail to perform, and more specifically, an athlete approaching a competition in a challenge state is more likely to fulfil their potential than an athlete approaching a competition in a threat state. The importance of TCTSA derived resource evaluations over and above the BPSM derived resource evaluations is not clear. Some research literature has shown that the TCTSA derived resource evaluations are important in the experience of challenge and threat states (Turner et al., 2014), whilst other research suggests that BPSM derived resources are appropriate to assess challenge and threat states (Mendes et al., 2007).

Using the TCTSA as a framework, it is reasonable to suggest that trials may trigger a number of demand evaluations, as trials may elicit perceptions of high danger to esteem (due to evaluation and social rejection), high uncertainty (because success is dependent on coach perceptions), and high required effort (due to the competitive nature of trying to secure one of a limited number of places). Similarly, in line with the TCTSA, the extent to which an athlete is successful at trials or not will partially depend on their resource evaluations. Athletes approaching trials with high self-efficacy, high perceived control, and a focus on approach goals, indicative of challenge, are more likely to fulfil their potential (Jones et al., 2009). However, to date there is little research concerning athletes' psychological approach to trials, and therefore despite the clear predictions of the TCTSA with regards to competitive performance, it is not known if these predictions hold within the selection and deselection context of team sports trials.

The extant research demonstrates that self-reported challenge is predictive of superior athletic performance in some studies (see Hase et al., 2018 for a review), but significant variation in the measurement of challenge and threat states has made it difficult to draw meaningful conclusions. For example, some studies use a Demand Resource Evaluation Score (DRES) comprising two items (e.g., Moore et al., 2012), some use one dichotomous challenge-threat scale (e.g., Turner et al., 2012), and others use specific scales for each resource evaluation (e.g., Turner et al., 2013). It is clear, however, that to assess the predictions of the TCTSA, it is important to assess the resource evaluations separately from demand evaluations. In a study of elite cricketers, for example, Turner et al. (2013) found that greater performance approach goals and self-efficacy were positively related to higher scores in a pressured batting test. However, control and avoidance goals were unrelated to performance outcome. In contrast, a similar study of adult club netball athletes found that none of the resource evaluations were related to changes in shooting performance from baseline (Turner et al., 2012). However, in both studies, performance was determined by the execution of a specific skill that contributes to one aspect of performance in each sport, but neither study captured the broad performance outcomes that arise from trials, where multiple skills must be successfully demonstrated for a successful outcome. One recent study did capture broader performance outcomes by using coach- and player-rated performance scores in elite soccer (Dixon et al., 2019). Dixon et al. found that challenge cardiovascular reactivity, self-efficacy, and perceived control, was positively, and significantly, associated with greater performance. However, athlete data were collected prior to different competitions, rather than the same single event.

A number of research questions remain unanswered regarding the contribution of challenge and threat states to performance at trials, that the current study aims to address. For example, are challenge and threat evaluations predictive of selection at trials? Are self-reported challenge and threat evaluations predictive of coach perceptions of athlete performance? Is the

TCTSA an appropriate model for explaining the variance in performance in youth athletes, where experience and skills that contribute to resource evaluations are less developed? In essence, the validity of core predictions made in the TCTSA are yet to be tested in youth athletes, and therefore the current study offers an important and novel test of the TCTSA. This is important for theory development and refinement, for youth athletes, but also more widely for athlete populations. Within athletic settings such as trials, try-outs, and athlete testing en masse, it is not feasible or pragmatic to undertake CV testing of all athletes. Therefore, a greater understanding of how the self-report measurement of psychological aspects within the TCTSA can be achieved, and what this can tell us about performance outcomes, is important for the future real-world application, and validity testing of the TCTSA. We still have little understanding about the predictive ability of the resources on athlete performance, so greater insight in this regard will help to test, challenge, and refine theory. Importantly then, the current study offers a real-world, ecologically valid, test of some of the TCTSA's main assertions concerning the athletic performance of a seldom studied population of youth athletes.

In the current study we examined the extent to which challenge and threat, as indicated by assessing the demand and resource evaluations from the TCTSA, predicted the trials performance of youth netball players. In line with some past literature (e.g., Blascovich, 2008) suggesting that the term 'appraisal' could portray conscious and subconscious mechanisms, we use the term 'evaluations' as it more accurately reflects the self-report data we collect. Rather than focus on specific skill execution, as in past research (e.g., Turner et al., 2012), the current study used coach ratings of athlete performance to capture trials performance more holistically. First, we hypothesised that participants who were successful at trials would report greater TCTSA-derived resource evaluations (self-efficacy, perceptions of control, approach goals, avoidance goals), a greater perceived ability to cope with demands, and lower anxiety than unsuccessful participants. Second, we hypothesised that self-reported TCTSA-derived resource

evaluations would predict success at trials and explain a significant amount of variance in coach-rated performance at trials.

The first two hypotheses were derived from relevant theory (TCTSA; Jones et al., 2009) and were preregistered, reflecting the main purpose of undertaking this investigation from the outset. However, due to the data that were collected in order to test these two hypotheses, we were also able to test some exploratory hypotheses. Specifically, data included BPSM-derived resources, and thus our third hypothesis was that participants who were successful at trials would report greater BPSM-derived resources. Finally, we hypothesised that greater BPSM-derived resources would predict greater success at trials and explain a significant amount of variance in coach-rated performance at trials.

Methods

Participants

Participants were 92 female adolescents, aged 10-17 (mean age = 13.26 years, SD = 1.55), who were trialling for a place on an elite team at a netball club based in the United Kingdom (UK). The netball club is the largest in the county and competes at both county and regional level competitions in the Midlands, UK. The participant sample included all players trialling for a place in one of three elite (regionally competitive) squads within the club, representing the club's Elite Performance Pathway. Fifty-one participants trialled for the under 14's (U14) team, 32 trialled for the under 16's (U16) team, and nine participants trialled for the under 19's (U19) team. Previous trials experience ranged from zero past trials to four past trials (M = 0.99, SD = 1.13). A large proportion of participants (n = 39) had never trialled before, and very few participants (n = 4) had been to four trials. This sample reflects all athletes that attended trials at the club, that also consented to take part. Parents of players aged 15 and under provided informed consent via an opt out system, and players aged 15 and under provided

informed assent for their own participation. Players aged 16 and over provided informed consent to participate in the study.

Measures

Due to the age range of the sample, and the time limitations of the pre-trials phase at the club, we strove for short measures that were comprehensible for ages 10 to 17 years. The short measures for self-efficacy, perceived control, achievement goals, and emotions, have been used in similar past research with athletes (e.g., Turner et al., 2013). The mental readiness form (MRF; Krane, 1994) was selected because it is short and the language is simple for young athletes. Similarly, the DRES was used due to its prominence in challenge and threat research (Hase et al., 2018), and its ability to assess perceived coping briefly. To assess demands and resources evaluations, we used Mendes et al's. (2007) scale which again has the benefit of being short (11-items), and indicates demands separately to resources in line with the TCTSA, which allowed us to test the hypotheses. Finally, two versions of the trial questionnaire were used: (1) U14's; and (2) - U16's & U19's. Some language in the U14's questionnaire was adapted so that the questions were age-appropriate.

Demographics. Participants self-reported their age, number of years played at the club, and number of previous trials attended.

TCTSA measures. For self-efficacy, based on Turner et al.'s (2013) self-efficacy scale, participants who trialled for the U14s team responded to two items: "To what extent do you feel confident that you can play your best?" and "To what extent do you feel confident that you will be selected for the elite team?". Participants who trialled for U16s and U19s responded to 10 items, asking them to indicate how much they were able to, for example, "make accurate and rapid decisions when needed" and "respond well to mistakes". Participants indicated the extent to which they agreed with each statement using a visual

analogue scale from 0% to 100%. Responses were averaged to create a self-efficacy score. Cronbach's alphas for the U16s and U19s data in the current sample was .91.

For perceptions of control we used the adapted Academic Control Scale (Perry, Hladkyj, Pekrun, & Pelletier, 2001). Participants were asked to rate how much they agreed that "I think I can control how I play" on a 5-point Likert-scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

To measure achievement goals, we used the Achievement Goals Questionnaire (AGQ; Conroy et al., 2003) that assessed mastery approach goals ("It is important to me to perform as well as I possibly can", mastery avoidance goals ("I worry that I may not perform as well as I possibly can"), performance approach goals ("It is important to me to do well compared to others"), and performance avoidance goals ("I just want to avoid performing worse than others"). In-line with previous research (e.g., Turner et al., 2013), the AGQ was reduced to four items (one item for each subscale). Participants were asked how they felt about the upcoming trials on a 7-point Likert-scale ranging from 1 (*not at all true*) to 7 (*very true*). The two approach goal items were averaged to an approach score, and the two avoidance goals to an avoidance score.

The Mental Readiness Form-Likert (Krane, 1994) was used to measure state anxiety on two bipolar scales corresponding to cognitive anxiety ("My thoughts are…") and somatic anxiety ("My body feels…"). Participants rated the extent to which they felt worried (1 = *not worried* to 11 = *worried*), and tense (1 = *not tense* to 11 = *tense*).

Emotions were assessed using two items from the Sport Emotion Questionnaire (Jones et al., 2005): anxiety and excitement. Participants indicated the extent to which "right now" they felt "nervous" and "excited" on a 5-point Likert-scale ranging from 0 (*not at all*) to 4 (*extremely*). Although cognitive anxiety and somatic anxiety were indicated using the MRF, we felt that asking the athletes about their feelings of nervousness and excitement would

provide complimentary information from which we could more accurately understand participants' preparatory emotions.

BPSM measures. The participants' perceived ability to cope with demands was assessed using two items from the cognitive appraisal ratio (Tomaka et al., 1993); "How demanding do you expect the trials to be?" and "How able are you to cope with the demands of the trials?". The items were rated using a 6-point Likert scale from 1 (*not at all*) to 6 (*extremely*). A DRES was calculated by subtracting item 1 from item 2, giving a range from -5 to +5. More positive scores indicate a greater perceived ability to cope with demands, and is proposed to reflect a challenge evaluation (e.g., Vine et al., 2013).

To measure participants' demand and resource evaluations, we used the challenge and threat scale (Mendes et al., 2007), with regards to the trials, which included questions about perceived demands and perceived resources on a Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Six questions assessed demand evaluations (e.g., "the trials are stressful") and five questions assessed resource evaluations (e.g., "performing well is important to me"). We averaged responses to the demand questions and responses to the resource questions to create a demands score and a resources score. For the current sample, Cronbach's alphas for demand evaluations was .68 (acceptable) and for resource evaluations was .82 (robust; Taber, 2018).

Netball Performance. Participant performance was rated by 10 independent coaches from the club who were all experienced in trial selection. During each game participants were rated by at least 4 coaches, and each player was assessed by coaches who were familiar with them, and coaches who were not familiar with them. Therefore, we were able to somewhat mitigate bias by ensuring the objectivity of coach ratings. Coaches were briefed ahead of trials by the club's head coach. In the briefing coaches were instructed to rate participant performance on a scale of 1 to 5, where 1 = poor, 2 = marginal, 3 = good, 4 = excellent, and 5 = exceptional performance. The decision to use a single rating, rather than multiple ratings for

separate skills, such as defence and attack), was based on the practical experience of previous club trials with a high volume of players and the need to collate information quickly and succinctly. However, coaches were instructed to consider the execution of basic skills (passing, catching, footwork), defensive specific skills (tracking opposition, restricting attackers opponents movement and stage two defence) and attacking specific skills (getting free from a defender, shooting accuracy and technique, and spatial awareness), over and above the outcomes of the games. Coaches were also encouraged to base their ratings on the performance at the trial alone, and not to base their assessments on previous athlete performances. There were 14 games played over the day, and each participant played in at least two games. We calculated an average performance score over all games for each participant which captured all of the coach's ratings who had assessed them. Performance scores ranged from 1.36 to 4.58 (M = 2.97, SD = .70). We were unable to conduct inter-rater reliability because one of the assumptions of inter-rater reliability, that all players were rated by all coaches, was not met.

Procedure

This study was reviewed and approved by a University Research Ethics Committee. Trials and data collection took place over one day. Participants completed a short questionnaire 30 minutes before the trials began. Trial questionnaires are available from [Blinded for review]. Trials consisted of match play, and each player's performance was rated independently by 10 experienced coaches from the club. The athletes and parents were informed that their data would not be shared with coaches, and that therefore coaches could not use the data to form decisions about selection.

Planned Statistical Analysis

Prior to conducting inferential statistics, we tested for randomness of missing data using Little's MCAR test. All p-values were > .05, indicating that missing data was random (self-efficacy (U14s) = 0%; self-efficacy (U19s) = 1.2%; control = 1.1%; MAp = 1.1%; MAv =

1.1%; PAp = 2.2%; PAv = 2.2%; state anxiety = 2.2%; sport emotions = 4.3%; DRES = 4.3%; challenge and threat = 3.1%). We therefore imputed missing data using the estimation maximisation technique (Dixon et al., 2016). We used *z*-scores to identify outliers (greater that 2 SDs) and replaced them using the Winsorising technique (Smith, 2011; self-efficacy (U14s) = 1; self-efficacy (U19s) = 2; control = 4; MAp = 2; MAv = 2; PAp = 1; PAv = 2; state anxiety = 8; sport emotions = 6; DRES = 5; challenge and threat = 7), in which the smallest non-trimmed score replaced the scores trimmed from the lower tail of the distribution, and the largest non-trimmed score replaced the scores removed from the upper tail (Keselman et al., 2008). Descriptive statistics were examined on all observed measures. We examined group differences (selected vs not selected) in netball performance data using a *t*-test. Next, we used multivariate analysis of covariance (MANCOVA) tests to examine group differences (selected vs not selected) on the self-reported measures. Team (U14, U16 & U19) and number of previous trials attended were included in the analyses as covariates. Data from the U16 and U19 teams were combined because the players trialled together, and because of the low numbers in the U19 group (n = 9). All U19 trialists were selected for the elite team. Two MANCOVA tests were used to examine differences in reported resources (control, achievement goals, DRES, and self-efficacy) and emotions (anxiety, excitement, and mental readiness).

To address our second hypothesis, we constructed two regression models. The first was a logistic regression model with selected vs not selected at trials as the outcome. The following confounders and predictors were included in the model: team, number of previous trials, demand evaluations (from the challenge and threat scale), TCTSA-derived resource evaluations (self-efficacy, control, achievement goals), sport emotions (anxiety, excitement, mental readiness) and DRES. The second model was a linear hierarchical regression model, which tested predictions of coach-rated performance in line with the theory of challenge and

threat states in athletes (TCTSA; Jones et al., 2009). We constructed the model using the following steps: Step 1 – team and number of previous trials, Step 2 – demand evaluations, Step 3 - resource evaluations (self-efficacy, control, achievement goals), Step 4 – sport emotions (anxiety, excitement, mental readiness), Step 5 – DRES. This analysis plan has been pre-registered on the Open Science Framework (https://osf.io/4f87m/?view_only=c785746842094542b10e8236b5904657)

Exploratory Statistical Analyses

The previous models tested were based on the TCTSA (Jones et al., 2009) conception of how challenge and threat evaluations predict athletic performance, which rests on the endorsement of three specific resource evaluations (self-efficacy, control, and approach goals). However, the BPSM conception of challenge and threat does not include three specific resource evaluations, but instead proposes that high resource evaluations reflect high perceptions of ability, positive performance expectations, high task importance, and positive perceptions of the task (Mendes, 2007). These resources are reflected in the challenge and threat scale we used, but in our planned analyses we excluded the resources aspect of the challenge and threat scale in favour of the specific resource evaluations as posited in the TCTSA. In our exploratory analyses we include the resources aspect of the challenge and threat scale as proposed in the BPSM (e.g., Mendes et al., 2007), rather than the specific resource evaluations as posited in the TCTSA (Jones et al., 2009).

To address hypotheses three and four, we followed the same protocol as used for the planned analyses but replaced the three TCTSA resources evaluations with the BPSM resources. Also, similar to the planned analyses, we constructed two regression models controlling for team and number of previous trials. In both binary logistic and linear hierarchical regression analyses we included the BPSM resources in place of the three TCTSA

resource evaluations. The replacement of the three TCTSA resource evaluations with the BPSM resources was the only change to the planned analyses outlined above.

Results

Descriptive statistics

Descriptive statistics, self-report measures and coach-rated performance are displayed in Table 1, split by age group and by trial outcome (selected vs not selected). An independent samples *t*-test found that the performance score was higher for those participants who were selected for the elite teams ($M = 3.42$, $SD = .45$, $n = 51$) than participants who were not ($M = 2.41$, $SD = .45$, $n = 41$), $t_{(90)} = 10.68$, $p < .001$, Cohen's $d = 2.24$.

Planned analyses

Group (selected vs not selected) differences on psychological measures. We conducted two MANCOVA tests to examine group differences (selected vs not) on self-reported measures of resources (control, achievement goals, DRES, and self-efficacy) and emotions (anxiety, excitement, and mental readiness). The first MANCOVA found no main effect of self-reported TCTSA resources on trial outcome, $F(5,81) = 1.742$, $p = .134$, $\eta^2 = .097$. The second MANCOVA also found no main effect of participant's pre-trial emotions on trial outcome, $F(4,80) = 1.416$, $p = .236$, $\eta^2 = .066$.

Predicting performance using psychological variables. The results of the binary logistic regression, with trial result (selected vs not) as the outcome are presented in Table 2. At step 5, $\chi^2 = 31.486$, $df = 12$, $p = .002$, number of previous trials was significantly positively related to trial outcome ($\beta = .988$, $p = .004$) such that a greater number of previous trials predicted selection into the elite team. In addition, DRES was positively related to trial outcome ($\beta = .662$, $p = .049$). At step 5, none of the other variables included in the model were significant predictors of trial outcome (all p's > .05). Similarly, the results of the linear regression model (Table 3), $R^2 = .303$, $F(72) = 2.612$, $p = .006$, show that the only significant predictor of coach-

rated performance was the number of previous trials attended (β = .369, p = .002). All other variables included in the model were non-significant (p > .05). Post-hoc power analysis using G*Power revealed that a power of .81 was achieved.

Exploratory analyses

Group (selected vs. not) differences on psychological measures. We conducted one MANCOVA test to examine group differences (selected vs not) on self-reported measures of BPSM resources and DRES. The MANCOVA found no main effect of self-reported BPSM resources on trial outcome, $F(2,86) = 2.648$, p = .077, η^2 = .058.

Predicting performance using psychological variables. For the binary logistic regression analyses (Table 2), at step 5, χ^2 = 25.942, df = 12, p = 002, there was a significant positive relationship between number of previous trials and trial outcome (β = .847, p = .007), but none of the other variables included in the model were significant predictors of trial outcome (all p's > .05). The results of the linear regression model (Table 3), R^2 = .312, $F(77)$ = 3.884, p < .001, show previous trials (β = .348, p = .002) and BPSM resources (β = .241, p = .034) predicted coach-rated performance. All other variables included in the model were non-significant (p > .05). Post-hoc power analysis using G*Power revealed a power of .72. A correlation matrix including all variables can be seen in (Table 4).

Discussion

In the current study we examined the extent to which challenge and threat evaluations, as indicated by demands and resource evaluations and perceived ability to cope with demands, predicted trial performance of youth netball players. Based on past research (e.g., Dixon et al., 2019; Hase et al., 2018), it was hypothesised that participants who were successful at trials would report greater resource evaluations, greater perceived ability to cope with demands, and lower anxiety than participants who were unsuccessful at trials, and that TCTSA resource evaluations (self-efficacy, perceptions of control, approach goals, avoidance goals) would

predict success at trials. Results of planned analyses indicated that the TCTSA resource evaluations, and emotions, did not predict performance outcomes, but greater DRES did predict trial outcome. In exploratory analyses, resources as measured in line with the BPSM of challenge and threat did predict performance outcomes, such that greater resources were related to higher coach-rated performance scores.

In contrast to past research (Turner et al., 2014) and the postulations of the TCTSA (Jones et al., 2009), the three resource evaluations self-efficacy, control, and approach/avoidance goals did not predict performance outcomes (selected vs not selected, and coach ratings). In addition, emotions did not predict performance outcomes. This could be because emotion valence is not necessarily important for performance, rather, whether the emotion is interpreted as facilitative or debilitative may be more important, a proposition that is in line with the TCTSA (Jones et al., 2009). To be clear, participants' level of self-efficacy, their perceptions of control, and their levels of approach and avoidance goals, and also how participants felt (emotions), on approach to the trials performance was not related to trials selection or coach-rated trials performance. However, self-reported demands and resources as measured in line with the BPSM of challenge and threat did predict performance outcomes in some models in the analyses. When predicting selected vs not selected in binary regression analyses, demands were negatively related to trial outcome prior to the addition of resources (TCTSA, and BPSM). Also, higher DRES, indicating a greater perceived ability to cope with demands, was positively related to trial outcome when accounting for all other variables in the planned model. In the linear regression analyses, BPSM resources positively predicted coach performance ratings, whilst TCTSA resources did not account for a significant amount of variance. Together, planned and exploratory analyses reveal the importance the of BPSM-derived demands and resources, including the assessment of perceived coping as used in the DRES, in the prediction of performance outcomes, over and above the three resources

evaluations, and pre-performance emotions proposed within the TCTSA. Interestingly, whilst the DRES is considered by researchers to reflect demands vs. resources, item two of the DRES indicates coping rather than resource dominance. Some contemporary challenge and threat theory (such as the TCTSA) does not include coping in its Lazarusian form (i.e., emotion focused and problem focused coping). The current study, alongside other extant research (e.g., Brimmell et al., 2019), demonstrates that the DRES has utility in predicting performance and therefore theorists should more closely consider the role of coping in challenge and threat states. Indeed, the DRES has been shown to predict performance in a range of contexts in the laboratory (e.g., Vine et al., 2013), and in more ecologically valid settings similar to the current study, such as sport (Moore et al., 2013), aviation (e.g., Vine et al., 2015), and medicine (e.g., Roberts et al., 2016). In particular relevance to the current study, Moore et al. (2013), found that DRES taken immediately before a golf competition accounted for a significant proportion of variance in golf performance, such that a greater DRES was associated with better performance. Therefore, applied practitioners might consider using the DRES as a short measure to indicate coping with situational demands.

There are a number of potential reasons why TCTSA-derived resource evaluations did not predict performance in the current study, whilst BPSM-derived resource evaluations did. In the TCTSA the resource evaluations are separate constructs that are drawn from a variety of theories whose origins are not tied to the TCTSA. It might be that in proposing the three resource evaluations, Jones et al. (2009) excluded various other potential constructs that could determine challenge and threat states (e.g., irrational beliefs; Chadha et al., 2019). Indeed, after we planned and completed the current study, Meijen et al. (2020) reconceptualised the TCTSA (TCTSA-R) to include a greater focus on dispositional factors, primary evaluations, reappraisal, and additional resources such as social support. In the current study, we found that number of previous trials predicted performance outcomes, which could be considered a

dispositional factor, that could influence primary evaluations. This, although based on new theory, is conjecture because in the current study we did not measure Lazarusian evaluation components. But broadly, there may be a range of psychosocial factors (e.g., social support, social identification, irrational beliefs) that contribute to challenge and threat perceptions, not captured by the current resource evaluations featured in the TCTSA, that are now presented in the TCTSA-R. The BPSM-derived resource evaluations, whilst not drawn from specific theory, offer a wider set of psychological factors. Items assess self-confidence in general (e.g., "I have the expectations to perform well"), a general perception of positive challenge (e.g., "the trials are a positive challenge"), and also an indication of dispositional factors that could predict success (e.g., "I am the type of person who does well at trials"). Certainly, more research needs to be conducted to arrive at a comprehensive set of resource evaluations that can be measured via self-report scales without placing a heavy time burden on athletes.

Aside from the performance effects reported for cognitive and affective variables, the number of previous trials emerged as the most robust and consistent predictor of performance outcomes, both in terms of selection vs. non-selection, and coach rated performance. Analyses revealed that the greater number of trials participants had previously attended, the more likely they were to be selected for the elite team, and the higher their coach ratings were. In other words, participants past experience was more important in predicting performance outcomes than the cognitive and affective variables measured in the current study. There are a number of possible explanations for this finding. First, number of previous trials is by nature related to years of experience in the sport, such that greater years of experience in the netball club presumably relates to greater number of trials, since trials occur annually. Therefore, the notion that greater experience in trials and in the club would predict performance is logical, because the athletes will have been aware of the trials format and coach expectations and can, as a result, engage in more accurate and detailed preparatory behaviours (e.g., mental rehearsal). It

is perhaps unsurprising that number of previous trials was revealed to be important for trials performance considering the fact that past research has indicated competitive experience to have an influence on competitive anxiety (e.g., Hanton et al., 2008; Hanton et al., 2008). Hanton et al. (2007) investigated the competitive experience in relation to the interpretations of anxiety symptoms and found that gaining experience enabled performers to familiarize themselves with their competition anxiety. Athletes were able to rationalize their thoughts and feelings, allowing them to cope more competently by altering the direction of their interpretations. As unsurprising as the current findings might be, the TCTSA does not capture previous experience explicitly through its challenge and threat antecedents, and therefore we did not hypothesise this result. Researchers are tasked with developing more comprehensive theories of competitive (anticipatory) stress that capture the broad range of antecedents and mediators that are important for the stress-performance relationship. Frameworks such as the integrative framework of stress, attention, and visuomotor performance (Vine et al., 2016), and the binary theory of emotional distress (Turner et al., 2018) may be better integrated and applied.

It is also possible that greater number of trials was related to coach ratings due to bias in how the coaches rated athlete performance. For example, if the athlete is familiar to the coach due to repeated historic trials attendance, this may bias the coach's opinions of the athlete's ability and trials performance. In other words, it is possible that past number of trials could be a decision-making heuristic (Tversky & Kahneman, 1974). For example, the "hot hand" in basketball studied by Gilvoch et al. (1985), reflects the phenomenon in which basketball shooting performance during a particular period is better than expected on the basis of the player's overall record. Gilvoch et al. found that basketball fans and professional players expected players with a successful scoring record to be successful subsequently, whilst actual performance data revealed no such occurrence. In reference to the current study, coaches had

the opportunity to operationalise these expectations by subjectively scoring athletes' trials performance. Therefore, it is possible that athletes with past trials experience and trials success may have been scored more highly in the current trials due to inflated performance expectations from coaches. Future research could study these heuristics by obtaining coach's expectations prior to trials and controlling for this in the analyses.

The findings of the current study in part support the previous research that indicates that evaluations that reflect high perceived resources and a perceived ability to cope with demands are related to superior sports performance compared with threat (e.g., Hase et al., 2018). That is, greater athlete scores in BPSM-relevant resource evaluations were related to better coach-rated trials performance scores, and higher athlete DRES scores were related to trial outcome in the planned analyses that included TCTSA resource evaluations. On balance, a perception of greater resources predicted higher coach-rated trials performance, but did not predict trial outcome (selection vs. non-selection). The finding that greater resources did not predict trial outcome could be a symptom of two occurrences. First, with 92 participants the binary regression analyses may have lacked sufficient power to detect significant effects due the inclusion of a categorical outcome variable (Hsieh, 1989), compared to the linear regression analyses which used a continuous variable (Altman & Royston, 2006). Second, a continuous variable such as that used in the linear regression analyses retains more information, such that it more fully represents the variability in the data. Categorising the outcome variable into selected vs. not selected may underestimate the variation in outcome and variability may be subsumed within each category. Indeed, participants close to but on opposite sides of the cut-point are characterised as being very different rather than very similar (Altman & Royston, 2006).

The current study differs from most of the extant research examining the extent to which challenge and threat evaluations predict athletic performance. This study used coach

ratings as a performance outcome and used selection as an outcome criterion, whilst the majority of past research uses actual skill execution as the performance outcome, such as runs scored in a cricket batting test (Turner et al., 2013), or the movement kinematics of a golf putt (Moore et al., 2012). Of course, coach ratings are fallible to subjectivity and do not necessarily reflect actual performance. Future research could use more sensitive markers of netball performance such as forced errors or goals scored, depending on the position played. In addition, coaches could rate aspects of performance such as passing, movement off the ball, and goal shooting, to provide a more detailed and nuanced set of performance outcome data. Indeed, unlike past research we focussed on the outcome of a complete trials process rather than a single skilled performance event (e.g., batting test: Turner et al., 2013). This process involved participants performing a range of activities, and this could explain the lack of relationships between the TCTSA resource evaluations and performance. It is possible that participants evaluated certain aspects of their game as a challenge, and other aspects as a threat. For example, a player could perceive high self-efficacy in relation to the physical aspects of trials, whilst perceiving low self-efficacy in relation to the tactical aspects of trials. Therefore, by measuring how trials as a whole were evaluated, we may have missed important nuances in how certain aspects of trials were evaluated. Future research could assess how athletes evaluate components of trials performance, rather than the trial as a whole. Finally, much of the previous research that has found links between challenge and threat and athletic performance used physiological, rather than psychological, markers of challenge and threat (see Behnke & Kaczmarek, 2018, for a meta-analysis). So, future research could measure the CV reactivity of netball athletes approaching trials, adopting similar methods to past research conducted in athletic settings (e.g., Turner et al., 2013).

The present paper purports in its theoretical rationale and its findings that evaluations that reflect greater resources than perceived demands, and greater ability to cope with demands,

are facilitative for performance, whilst threat evaluations are debilitative for performance. This reflects a rather simplistic perspective on challenge and threat and extant research indicates that competent skilled performance is still possible following threat evaluations, so long negative emotions associated with threat are interpreted as facilitative (e.g., Neil & Woodman, 2019), and self-efficacy is maximised (Turner et al., 2013). Indeed, as posited in the TCTSA, precompetitive anxiety that could stem from threat evaluations can be perceived as facilitate for performance (see Jones, 1995), and can enhance performance via motivational and attentional mechanisms (see Woodman & Hardy, 2001). In addition, Turner et al. (2013) found that elite cricketers who evinced a threat state but also performed well in a pressured batting test, reported the extremely high self-efficacy. Therefore, future research should assess the interpretation of precompetitive emotions (e.g., Turner et al., 2012), particularly anxiety, as well the intensity of the emotions as reported in the current study.

It could be argued that the current study used a moderate sample size to detect the hypothesised effects, particularly in the binary regression analyses. However, the sample size represents the maximum number of participants possible for the club we sampled, and post-hoc power analyses indicates sufficient statistical power for the planned analysis (.81). It is important to test theory in field settings, with the sampling limitations inherent in live sporting environments. The findings of the current study have important implications for club trials with regards to the salience of resource evaluations for performance, and the importance of past trials on future performance. As scientist-practitioners, it is possible to make recommendations to netball clubs that can influence the experience and performance of local athletes, a goal that is informed by the high internal validity of the current study, although its external validity can be challenged. For example, on the basis of the current study, coaches and practitioners working with youth athletes should endeavour to help them develop high perceptions of resources and coping abilities. Indeed, past research indicates that challenge-oriented

instructions (Moore et al., 2012; Turner et al., 2014), rational language (Evans et al., 2018), and a strong connection with the leader (e.g., coach; Slater et al., 2018) can facilitate a challenge state. In addition, practitioners could apply imagery with youth athletes (e.g., Williams et al., 2010), and reappraisal (Sammy et al., 2017) to encourage a challenge state. Finally, given the findings that past trials experience is an important predictor of future trials performance, coaches could perhaps provide young athletes with opportunities to experience trial conditions throughout the season, under supportive conditions, for the purposes of providing positive experiences from which to draw from in future trials (e.g., Turner & Barker, 2013).

Should future researchers wish to address the limitations of the present study, they should adopt more sensitive performance and skill execution measures, and collect cardiovascular reactivity data to reduce the bias inherent within self-report evaluations measurement. Research could also repeat the data collection at multiple time points across different events, such as competitive games and tournaments, to examine the changing evaluations of netball athletes across different motivated performance situations (e.g., Cumming et al., 2017).

In summary, the results of the current study demonstrate that in predicting the trials performance of the youth netball athletes sampled, the number of previous trials attended, the perceived BPSM-derived resource evaluations, and perceived ability to cope with demands (DRES), explained the greatest proportion of variance. Specifically, a greater number of previous trials, higher self-reported resource evaluations, and greater perceived ability to cope with demands (higher DRES), were related to better trial performance. TCTSA-derived resource evaluations and self-report emotional states were not related to performance outcomes.

References

Altman, D. G., & Royston, P. (2006). The cost of dichotomising continuous variables. *BMJ (Clinical research ed.)*, *332*(7549), 1080.

Baumeister, R. F. (1997). Esteem threat, self-regulatory breakdown, and emotional distress as factors in self-defeating behaviour. *Review of General Psychology*, *1*, 145–174.

Behnke, M., & Kaczmarek, L.D. (2018). Successful performance and cardiovascular markers of challenge and threat: A meta-analysis. *International Journal of Psychophysiology*, *130*, 73-79. doi:10.1016/j.ijpsycho.2018.04.007.

Blascovich, J. (2008). Challenge and threat. In A.J. Elliot (Ed.), *Handbook of approach and avoidance motivation* (pp. 431-445). New York; Psychology Press.

Blascovich, J., & Mendes, W. B. (2000). Challenge and threat appraisals: the role of affective cues. In J. P. Forgas (Ed.) *Feeling and thinking: the role of affect in social cognition* (pp. 59-82). Paris: Cambridge University Press.

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology*, *28*, 1-51.

Brimmell, J., Parker, J., Wilson, M. R., Vine, S. J., & Moore, L. J. (2019). Challenge and threat states, performance, and attentional control during a pressurized soccer penalty task. *Sport, Exercise, and Performance Psychology*, *8*(1), 63-79.

Chadha, N., Turner, M. J., & Slater, M. J. (2019). Investigating irrational beliefs, cognitive appraisals, challenge and threat, and affective states in golfers approaching competitive situations. *Frontiers in Psychology*. doi: 10.3389/fpsyg.2019.02295.

Conroy, D. E., Elliot, A. J., & Hofer, S. M. (2003). A 2 x 2 achievement goals questionnaire for sport: Evidence for factorial invariance, temporal stability, and external validity. *Journal of Sport & Exercise Psychology*, *25*(4), 456–476.

Cumming, S., Turner, M. J., & Jones, M. V. (2017). Longitudinal changes in elite rowers' challenge and threat appraisals of pressure situations: A season-long observational study. *The Sport Psychologist*, 31, 217-226.

Dienstbier, R. A. (1989). Arousal and physiological toughness: Implications for mental and physical health. *Psychological Review*, *96*, 84-100.

Dixon, M., Turner, M. J., & Gillman, J. (2017). Examining the relationships between challenge and threat cognitive appraisals and coaching behaviours in football coaches, *Journal of Sports Sciences*, *35*(24), 2446-2452

Dixon, J., Jones, M., & Turner, M. J. (2019). A challenge mind-set on match day: Investigating cardiovascular reactivity in professional academy footballers. *European Journal of Sport Science*. doi: 10.1080/17461391.2019.1629179.

Evans, A. L., Turner, M. J., Pickering, R., & Powditch, R. (2018). The effects of rational and irrational coach team talks on the cognitive appraisal and achievement goal orientation of varsity football athletes. *International Journal of Sports Science & Coaching.* 13, 431–438. doi: 10.1177/1747954118771183

Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology, 17*(3), 295-314

Hanton, S. et al. (2007). Experience in sport and its relationship with competitive anxiety. *International Journal of Sport and Exercise Psychology*, *5*, 28–53.

Hanton, S., Neil, R., & Mellalieu, S. D. (2008). Recent developments in competitive anxiety direction and competition stress research. *International Review of Sport and Exercise Psychology*, *1*(1), 45-57, doi: 10.1080/17509840701827445

Hanton, S., Neil, R., Mellalieu, S., & Fletcher, D. (2008). Competitive experience and performance status: an investigation into multidimensional anxiety and coping. *European Journal of Sport Science*, *8*(3), 143–152.

Hase, A., O'Brien, J., Moore, L., & Freeman, P. (2018). The relationship between challenge and threat states and performance: A systematic review. *Sport, Exercise, and Performance Psychology.* DOI: 10.1037/spy0000132

Hsieh, F. Y. (1989). Sample size tables for logistic regression. *Statistics in medicine*, *8*(7), 795-802.

Jones, G. (1995). More than just a game: Research developments and issues in competitive anxiety in sport. *British Journal of Psychology*, *86*, 449-478.

Jones, M. V., Lane, A. M., Bray, S. R., Uphill, M., & Catlin, J. (2005). Development and validation of the Sport Emotions Questionnaire. *Journal of Sport & Exercise Psychology*, *27*, 407–431.

Jones, M., Meijen, C., McCarthy, P. J., & Sheffield, D. (2009). A theory of challenge and threat states in athletes. *International Review of Sport and Exercise Psychology*, *2*, 161–180. doi:10.1080/17509840902829331

Keselman, H. J., Algina, J., Lix, L. M., Wilcox, R. R., & Deering, K. N. (2008). A generally robust approach for testing hypotheses and setting confidence intervals for effect sizes. *Psychological Methods*, *13*, 110–129. http://dx.doi.org/10.1037/1082-989X.13.2.110

Krane, V. (1994). The Mental Readiness Form as a measure of competitive state anxiety. *The Sport Psychologist, 8*(2), 189-202.

Lazarus, R. S. (1966). *Psychological stress and the coping process*. New York: McGrawHill.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.

Meijen, C., Jones, M. V., McCarthy, P. J., Sheffield, D., & Allen, M. S. (2013). Cognitive and affective components of challenge and threat states. *Journal of Sports Sciences*, *31*(8). https://doi.org/10.1080/02640414.2012.753157

Meijen, C., Jones, M. V., Sheffield, D., & McCarthy, P. J. (2014). Challenge and threat states: Cardiovascular, affective, and cognitive responses to a sports-related speech task. *Motivation and Emotion*, *38*(2). https://doi.org/10.1007/s11031-013-9370-5

Meijen, C., Turner, M. J., Jones, M. V., Sheffield, D., & McCarthy, P. (2020). A theory of challenge and threat states in athletes: A revised conceptualisation. *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2020.00126.

Mendes, W. B., Blascovich, J., Major, B., & Seery, M. (2001). Challenge and threat responses during downward and upward social comparisons. *European Journal of Social Psychology, 31*(5), 477-497. doi: http://dx.doi.org/10.1002/ejsp.80

Mendes, W. B., Blascovich, J., Hunter, S. B., Lickel, B., & Jost, J. T. (2007). Threatened by the unexpected: physiological responses during social interactions with expectancy-violating partners. *Journal of personality and social psychology, 92*(4), 698-716.

Mendes, W. B., Gray, H. M., Mendoza-Denton, R., Major, B., & Epel, E. S. (2007). Why Egalitarianism Might Be Good for Your Health: Physiological Thriving During Stressful Intergroup Encounters. *Psychological Science*, *18*(11), 991–998. https://doi.org/10.1111/j.1467-9280.2007.02014.x

Moore, L. J., Wilson, M. R., Vine, S. J., Coussens, A. H., & Freeman, P. (2013). Champ or chump?: challenge and threat states during pressurized competition. *Journal of Sport & Exercise Psychology, 35*, 551–562. doi: 10.1123/jsep.35.6.551

Moore, L. J., Vine, S. J., Wilson, M. R., & Freeman, P. (2012). The effect of challenge and threat states on performance: An examination of potential mechanisms. *Psychophysiology*, *49*, (10), 1417-1425. doi: 10.1111/j.1469-8986.2012.01449.x

Neil, R., & Woodman, T. (2019). Performance anxiety, arousal, and coping in sport. In T. S. Horn & A. L. Smith. (Eds.). *Advances in sport and exercise psychology*. Champaign, IL: Human Kinetics.

Obrist, P. A. (1981). *Cardiovascular psychophysiology: A perspective*. New York: Plenum.

Perry, R. P., Hladkyj, S., Pekrun, R. H., & Pelletier, S. T. (2001). Academic control and action control in the achievement of college students: A longitudinal field study. *Journal of Educational Psychology*, *93*(4), 776–789. doi:10.1037/0022-0663.93.4.776

Roberts, M. J., Gale, T. C. E., McGrath, J .S. *et al.* (2016). Rising to the challenge: acute stress appraisals and selection centre performance in applicants to postgraduate specialty training in anaesthesia. *Advances in Health Science Education*, *21*, 323–339. https://doi.org/10.1007/s10459-015-9629-6

Sammy, N., Anstiss, P. A., Moore, L. J., Freeman, P., Wilson, M. R., & Vine, S. J. (2017). The effects of arousal reappraisal on stress responses, performance and attention. *Anxiety Stress Coping*, 30, 619–629. doi: 10.1080/10615806.2017.1330952

Seery, M.D. (2011). Challenge or threat? Cardiovascular indexes of resilience and vulnerability to potential stress in humans. *Neuroscience & Biobehavioural Reviews*, 35, 1603-1610. doi:10.1016/j.neubiorev.2011.03.003.

Skinner, N., & Brewer, N. (2004). Adaptive approaches to competition: Challenge appraisals and positive emotion. *Journal of Sport & Exercise Psychology*, *26*, 283-305.

Slater, M. J., Turner, M. J., Evans, A. L., & Jones, M. V. (2018). Capturing hearts and minds: the influence of relational identification with the leader on followers' mobilization and cardiovascular reactivity. *Leadership Quarterly,* 29, 379–388. doi: 10.1016/j.leaqua.2017.08.003

Smith, M. (2011). *Research methods in accounting* (2nd ed.). London: SAGE Publications Ltd.

Taber, K.S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science and Education*, *48*(6), 1273–1296

Tomaka, J., Blascovich, J., Kelsey, R. M., & Leitten, C. L. (1993). Subjective, physiological, and behavioral effects of threat and challenge appraisal. *Journal of Personality and Social Psychology*, *65*(2), 248.

Turner, M. J., & Barker, J. B. (2013). Resilience: Lessons from the 2012 Olympic Games. *Reflective Practice*, *14*(5), 622-631.

Turner, M. J., Jones, J., & Wood, A. G. (2018). Applying the REBT cognitive disputation technique to the binary theory of emotional distress. *Effective Scientist-Practitioner*, *1*(1), 46-64.

Turner, M. J., Jones, M. V., Sheffield, D., Barker, J. B., & Coffee, P. (2014). Manipulating cardiovascular indices of challenge and threat states using resource appraisals. *International Journal of Psychophysiology*, *94*, 9-18.

Turner, M. J., Jones, M. V., Sheffield, D., Slater, M. J., Barker, J. B., & Bell, J. (2013). Who thrives under pressure? Predicting the performance of elite academy cricketers using the cardiovascular indicators of challenge and threat states. *Journal of Sport and Exercise Psychology*, *35*(4), 387-397

Turner, M. J., Jones, M. V., Sheffield, D., & Cross, S. L. (2012). Cardiovascular indices of challenge and threat states predict performance under stress in cognitive and motor tasks. *International Journal of Psychophysiology, 86*, 48-57. doi:10.1016/j.ijpsycho.2012.08.004.

Turner, M. J., Jones, M. V., Sheffield, D., Barker, J. B., & Coffee, P. (2014). Manipulating cardiovascular indices of challenge and threat states using resource appraisals. *International Journal of Psychophysiology*, *94*, 9-18

Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science, 185*(4157), 1124-1131. Retrieved from http://www.jstor.org/stable/1738360

Vine, S., Freeman, P., Moore, L., Chandra-Ramana, R., & Wilson, M. (2013). Evaluating stress as a challenge is associated with superior attentional control and motor skill performance: Testing the predictions of the biopsychosocial model of challenge and threat. *Journal of Experimental Psychology: Applied*, *19*(3), 185-194. https://doi.org/10.1037/a0034106

Vine, S. J., Moore, L. J., & Wilson, M. R. (2016). An integrative framework of stress, attention, and visuomotor performance. *Frontiers in Psychology*, *7.* doi: 10.3389/fpsyg.2016.01671.

Vine, S.J., Uiga, L., Lavric, A., Moore, L. J., Tsaneva-Atanasova, K., & Wilson, M. R. (2015). Individual reactions to stress predict performance during a critical aviation incident, *Anxiety, Stress & Coping*, *28*(4), 467-477, doi: 10.1080/10615806.2014.986722

Williams, S. E., Cumming, J., & Balanos, G. M. (2010). The use of imagery to manipulate challenge and threat appraisal states in athletes. *Journal of Sport & Exercise Psychology*, *32*, 339–358. doi: 10.1123/jsep.32.3.339

Woodman, T., & Hardy, L. (2001). Stress and anxiety. In R. N. Singer, H. A. Hausenblas, & C. M. Janelle (Eds.), *Handbook of sport psychology* (pp. 290-318). New York: Wiley.

Table 1. Mean (SD) descriptive statistics of the sample self-report measures and coach-rated performance split by age group and by trial outcome (selected vs not selected)

	U14		U16/U19	
	Selected	Not selected	Selected	Not selected
Variable (scale)	(n=22)	(n=29)	(n=29)	(n=12)
Age	12.14 (0.64)	12.03 (0.87)	14.90 (0.90)	14.33 (0.65)
New to club	4 (18.2%)	11 (37.9%)	3 (10.3%)	0
Number of previous trials	0.77 (0.69)	0.45 (0.87)	1.86 (1.34)	0.67 (0.65)
Control (1 - 5)	4.41 (0.59)	4.31 (0.66)	4.21 (0.77)	4.50 (0.67)
Approach goals (1 - 7)	5.80 (0.78)	5.74 (0.88)	6.08 (0.73)	6.21 (0.66)
Avoidance goals (1 - 7)	4.02 (1.48)	4.90 (1.69)	4.79 (1.54)	4.88 (1.45)
Excitement (0 - 4)	3.14 (0.64)	2.95 (0.87)	2.60 (0.94)	2.25 (0.97)
Anxiety (0 - 4)	2.14 (1.06)	2.54 (1.17)	2.48 (1.01)	2.67 (0.98)
Self-efficacy (0 - 100%)	67.88 (10.03)	63.46 (10.16)	73.65 (11.17)	81.09 (14.43)
DRES (-5 - +5)	0.60 (1.05)	-0.14 (1.09)	0.11 (0.94)	0.14 (0.84)
Demands (1 - 7)	3.10 (0.50)	3.37 (0.62)	3.35 (0.66)	3.75 (0.46)
Resources (1 - 7)	5.15 (0.53)	4.84 (0.52)	5.07 (0.53)	4.99 (0.51)
Cognitive anxiety (1 - 11)	4.77 (2.43)	5.97 (2.40)	6.28 (2.03)	7.68 (1.61)
Somatic anxiety (1 - 11)	4.09 (2.24)	4.93 (1.65)	5.25 (2.05)	6.89 (1.24)
Coach-rated performance (1 - 5)	3.46 (0.41)	2.34 (0.48)	3.40 (0.51)	2.52 (0.48)

Table 2. Binary logistic regression with trial outcome (selected vs not selected) as the outcome variable, using TCTSA resource appraisals, and BPS resource appraisal in two separate models.

TCTSA Resources					BPS Resources				
Variables	*β*	Wald	*p*	Odd Ratio (Exp B)	Variables	*β*	Wald	*p*	Odd Ratio (Exp B)
Previous trials	.988	8.116	.004	2.687	Previous trials	.847	7.223	.007	.847
Team trialing for	1.385	3.548	.060	3.996	Team trialing for	1.012	2.814	.093	1.012
Demands	-.262	.152	.697	.769	Demands	-.371	.370	.543	-.371
Self-efficacy	-.025	.712	.399	.976	BPS resources	.245	.204	.651	.245
Control	-.837	2.404	.121	.433	Excitement	-.098	.081	.776	-.098
Approach	.322	.459	.498	1.380	Anxiety	.051	.030	.862	.051
Avoidance	.076	.095	.758	1.078	Cognitive anxiety	-.039	.046	.83	-.039
Excitement	.063	.029	.866	1.065	Somatic anxiety	-.205	1.469	.225	-.205
Anxiety	.039	.015	.902	1.040	DRES	.383	1.629	.202	.383
Cognitive anxiety	-.059	.079	.778	.942					
Somatic anxiety	-.199	1.276	.259	.820					
DRES	.662	3.870	.049	1.938					

Table 3. Linear regression model with coach-rated performance as the outcome variable, using TCTSA resource appraisals, and BPS resource appraisal in two separate models.

TCTSA Resources

Variables	*β*	*t*	*p*	Unstandardized B
Previous trials	.369	3.183	.002	.22
Team trialing for	.073	.53	.598	.099
Demands	-.013	-.089	.929	-.014
Self-efficacy	-.004	-.03	.977	0.00
Control	.001	.006	.995	.001
Approach	.153	1.211	.23	.133
Avoidance	.058	.439	.662	.024
Excitement	-.086	-.733	.466	-.064
Anxiety	-.07	-.533	.596	-.043
Cognitive anxiety	-.19	-1.104	.273	-.055
Somatic anxiety	-.006	-.043	.966	-.002
DRES	.128	1.069	.289	.082

BPS Resources

Variables	*β*	*t*	*p*	Unstandardized B
Previous trials	.348	3.167	.002	.209
Team trialing for	.056	.489	.626	.075
Demands	-.014	-.105	.917	-.015
BPS resources	.241	2.164	.034	.306
Excitement	-.118	-1.058	.293	-.086
Anxiety	-.066	-.545	.587	-.041
Cognitive anxiety	-.196	-1.276	.206	-.057
Somatic anxiety	.061	.465	.643	.02
DRES	.051	.441	.66	.033

Table 4. Pearson's correlation coefficients for all variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Demands	-											
2. Self-efficacy (U16s, U19s; N = 41)	-.05	-										
3. Self-efficacy (U14s; N = 49)	-.29*	NA	-									
4. Control	.02	.57**	.45**	-								
5. Approach goals	.09	.54**	.15	.33**	-							
6. Avoidance goals	.41**	-.10	.04	.13	.43**	-						
7. Resources	-.18	.52**	.56**	.39**	.48**	.11	-					
8. DRES	-.43**	.22	.43**	.15	.10	-.22*	.39**	-				
9. Cognitive anxiety	.59**	-.14	-.24	-.13	.11	.47**	-.15	-.18	-			
10. Somatic anxiety	.51**	-.03	-.32*	-.02	.06	.36**	-.25*	-.21*	.65**	-		
11. Excitement	-.37**	.26	.24	.13	.01	-.09	.26*	.26*	-.35**	-.33**	-	
12. Anxiety	.42**	-.09	-.20	.03	.06	.23*	-.04	-.05	.59**	.39**	-.14	-
13. Coach-rated performance	-.16	.16	.12	.18	.19	-.07	.30**	.12	-.24*	-.13	-.01	-.21

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
NA Cannot be computed because at least one of the variables is constant.