

Recall agreement between actual and retrospective reports of competitive anxiety: A comparison of intensity and frequency dimensions

OWEN THOMAS¹, GARETH PICKNELL², & SHELDON HANTON¹

¹Cardiff School of Sport, University of Wales Institute, Cardiff, UK and ²University College Plymouth St. Mark and St. John, Plymouth, UK

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Abstract

Using a mixed-method design, we compared athletes' abilities to recall intensity and frequency of competitive anxiety. In Phase 1, performers ($n=35$) completed the Competitive State Anxiety Inventory-2 (Martens, Burton, Vealey, Bump, & Smith, 1990) at four pre-competition and four post-competition intervals to compare actual and recalled responses. In Phase 2, follow up interviews ($n=6$) explored the perceived mechanisms underpinning the quantitative results. Limits of agreement (Bland & Altman, 1999) analysis on the quantitative data indicated that, compared with intensity, memory for frequency was generally more reliable, and recall ability of this dimension was less biased for symptoms that occurred earlier in the week. Inductive analysis of the qualitative interviews suggested athletes were more attuned to the frequency rather than the intensity of their competitive anxiety symptoms. These findings provide support for the notion that the frequency of symptoms may act as a precursor for increasing anxiety levels and this dimension may be a more accurate reflection of experienced symptoms when recalling emotional accounts. The implications are that researchers and practitioners need to consider frequency in addition to intensity when seeking to manage anxiety responses during the time preceding competition.

Keywords: *Memory, mixed-method design, limits of agreement*

Introduction

Within applied sport psychology, determination of intervention strategies relating to the treatment of affective states and emotions tends to occur through a triangulation of techniques (Vealey & Garner-Holman, 1998). This remains the case for the treatment of competitive anxiety related issues where athletes' symptoms are traditionally established through a combination of momentary assessments using validated inventories, and retrospective accounts in the form of semi-structured interviews (Hanton, Thomas, & Mellalieu, 2009). These methods have emerged from the applied literature where research has quantitatively investigated an individual's momentary anxiety responses prior to an event examining information pertaining to intensity (i.e. level of symptom) and, more recently, information relating to frequency (i.e. amount of time spent thinking about, attending to or experiencing symptoms) or both (see Mellalieu, Hanton, & Fletcher, 2006). This informa-

tion has been useful for practitioners when informing choice about the *timing* (i.e. onset of symptom increases) of stress management interventions during the period leading up to competition (Thomas, Mellalieu, & Hanton, 2009). This literature has been supplemented with several retrospective qualitative studies seeking to detail the *content*, and in some cases the *timing* of stress management interventions (see Thomas et al., 2009).

Despite advancing theoretical and applied understanding in the area, issues surrounding memory bias have been associated with the use of retrospective designs in the qualitative research cited and the associated application of these methods in consultancy settings (Hanton et al., 2009; Thomas et al., 2009). In short, there is a lack of research that has accounted for biases that may result when athletes are required to retrospectively recall the onset of symptoms related to previous competitions, and/or identify the prescriptive points where these anxiety symptoms may increase (Thomas et al., 2009). This

is a concern for a theory-to-practice driven discipline that encourages research reflective of real-life settings (Giacobbi, Poczwadowski, & Hager, 2005).

While limited empirical evidence exists regarding the accuracy of retrospective methods within competitive anxiety research, some preliminary findings are apparent. These initial attempts highlighted discrepancies between actual and remembered symptoms of anxiety when examining the recall congruency between different measures (e.g. Wilson, Raglin, & Harger, 2000), and as an alternative method for determining individuals' thoughts and feelings near to, during, and after competition (e.g. Imlay, Carda, Stanbrough, Dreiling, & O'Connor, 1995; Tenenbaum, Lloyd, Pretty, & Hanin, 2002). A limitation of this work was the sole use of an intensity scale for assessing individuals' symptoms, which failed to encapsulate the recent conceptual developments surrounding the use of symptom frequency.

The growing body of quantitative literature that supports the independence of competitive anxiety frequency suggests that it follows a divergent path to intensity during the time leading up to an event (Hanton, Thomas, & Maynard, 2004; Thomas, Maynard, & Hanton, 2004). Hanton et al. (2004) established that the intensity of cognitive and somatic anxiety fluctuated in the lead up to competition, whereas frequency increased successively throughout the week. Interestingly, the retrospective qualitative research that has considered intensity and frequency dimensions of competitive anxiety has noted equivocal findings with regard to the temporal patterns of these dimensions (e.g. Hanton, Mellalieu, & Young, 2002; Thomas, Hanton, & Maynard, 2007). Hanton et al. (2002) indicated support for existing theoretical predictions in that cognitive and somatic symptom intensities remained relatively stable, while symptom frequency increased nearer to competition. In comparison, Thomas et al. (2007) noted that both the intensity and frequency of cognitive and somatic anxiety increased substantially during three pre-performance time phases in the week leading up to competition. Collectively, this quantitative and retrospective qualitative research highlights similarities for increases of symptom frequencies, whereas the same research provides inconclusive information regarding the temporal patterning of symptom intensity. There would appear to be no theoretical reasoning in sport psychology to account for the relative congruency between "real-time" and retrospective assessment of symptom frequency and an apparent lack of consistency between actual and retrospective assessments for symptom intensity. However, these remain important issues with respect to stress management interventions and the information (i.e. dimensions) practitioners use to help inform intervention timing (Hanton et al., 2009; Thomas et al., 2009).

One possible explanation emanates from cognitive psychology where it has been suggested that discrepancies in remembering event-related emotions occur due to post-event appraisals (Safer, Bonanno, & Field, 2001), reconstruction of the past (McFarland & Alvaro, 2000), and the subsequent emotions experienced (Keuler & Safer, 1998). Typically, these variables influence how emotions related to a distinct event are experienced, encoded, and stored in long-term memory. More specifically, the ability to recall memories with emotional content is determined by how the emotional information is encoded into memory (Hasher & Zacks, 1979, 1984; Thomas & Diener, 1990), and/or the cognitive processes that impinge on the retrieval of such information (Dewhurst & Marlborough, 2003; Levine & Safer, 2002; Schimmack, 2002). Consideration of the encoding aspect is largely concerned with how this information is perceived and then subsequently stored. Hasher and Zacks (1979, 1984) proposed the *Automatic and Effortful* framework as a theoretical explanation to help account for emotional recall accuracy. The framework emphasized the relatively automatic nature of encoding and storing information related to emotion frequency, as opposed to the more effortful process of encoding and storing information surrounding emotion intensity suggesting that individuals can more easily recall the amount of times an event occurs.

Researchers exploring the Automatic and Effortful framework have concluded that individuals are more accurate at recalling frequency than intensity across the emotions of happiness, acceptance, sadness, anger, fear, and anxiety (e.g. Diener, Sandvik, & Pavot, 1991; Kardum, 1999; Keuler & Safer, 1998; Schimmack, 2002; Thomas & Diener, 1990). The inability of individuals to accurately remember the intensity of their emotional symptoms was emphasized in Keuler and Safer's (1998) study investigating the accuracy of students' anxiety symptoms before an academic exam. In an attempt to maintain emotional equilibrium, when aware of their results, and therefore no longer anxious about them, individuals tended to overestimate their pre-test anxiety intensities. This pattern is noted elsewhere within the emotion literature when recalling intensity-related information and is described as a mood-incongruent effect. The general consensus used to explain this overestimation in emotion intensity is that there is no natural system by which emotional levels can be defined and subsequently encoded by individuals (e.g. Dewhurst & Marlborough, 2003; Hedges, Jandorf, & Stone, 1985; Parkinson, Briner, Reynolds, & Totterdell, 1995). Thomas and Diener (1990) provided support for this position when examining the ability of individuals to accurately recall previously experienced emotions. They found

that differences between individuals' actual and recalled scores ranged from 8% to 10% for the percentage time they were happy (i.e. frequency), with relationships between actual and recalled scores correlating significantly ($r=0.77$). In comparison, individuals were less accurate in their ability to recall the intensity of their happiness, with differences between actual and recalled scores ranging from 26% to 92% displaying low correlations across all participants ($r=0.09$). Collectively, these lines of evidence from emotion research led Diener et al. (1991) to suggest that humans are biologically more prepared to store and retrieve information related to emotion frequency. These authors questioned our ability to clearly distinguish and calibrate levels (i.e. intensity) of emotion from one occasion to the next, suggesting these issues were not apparent when coding emotion frequency due to the discreteness of such information (i.e. people know whether they are happy or unhappy).

Research comparing the recall accuracy of intensity and frequency information is warranted within sport psychology to address the dichotomous findings that exist between the momentary quantitative literature and the retrospective qualitative investigations. Furthermore, this research is required to help inform practitioner choice as to the most applicable dimension (i.e. intensity, frequency or both) to use when asking athletes to retrospectively recall information that assists decisions regarding the timing of stress management interventions. This is an important consideration when the dominant dimension used by applied sport psychologist tends to be intensity; a potential issue given the findings of emotion recall research in other disciplines of psychology (e.g. Diener et al., 1991; Kardum, 1999; Keuler & Safer, 1998; Schimmack, 2002; Thomas & Diener, 1990). In response, in this study we assess the measurement agreement of actual and recalled anxiety symptoms during the time leading up to a competition across the dimensions of intensity and frequency. We suggest this research will help to determine whether athletes can accurately use retrospective approaches to assess their anxiety-related symptoms, or whether recalled symptoms are the potential artefacts of memory bias. Due to the limited research within sport psychology considering recall accuracy of intensity- and frequency-related information, hypotheses for the study were based upon Diener and colleagues' (1991) and Thomas and Diener's (1990) findings. Therefore, it was predicted that individuals would be more accurate in their ability to recall the frequency of their competitive anxiety symptoms than symptom intensity.

We adopt a mixed-method research design. This pragmatic approach of using two lines of enquiry is

suggested to be particularly suitable when investigating novel research questions (Giacobbi et al., 2005). Due to the limited research attention afforded to the accuracy of emotional recall within sport psychology, it was decided that combining quantitative and qualitative approaches would provide supporting or conflicting evidence regarding athletes' ability to recall their competitive anxiety symptoms. The first phase of the investigation was quantitative in nature and explored the total and proportion of agreement between actual and recalled anxiety responses for both intensity and frequency dimensions. The second phase adapted qualitative interviews to elucidate and verify any effects obtained within Phase 1 of the study, and explore the emergence of any potential perceived underlying mechanisms that may affect the recall accuracy of the two dimensions (cf. Hanton et al., 2002; Thomas et al., 2007). The forthcoming sections of the paper summarize in sequence the method, results, and discussion of each phase of the study. The paper concludes with a general discussion that synthesizes the overall findings of the investigation.

PHASE 1: QUANTITATIVE ASSESSMENTS

Methods

Participants

Phase 1 used 35 collegiate standard participants (21 males; 14 females), aged 19–31 years (mean = 23.8 years, $s=3.1$), from a range of sports (athletics, swimming, cycling and tennis). Initial meetings with the athletes identified an upcoming event within the seasonal calendar that they deemed their most important competition (e.g. national trials, regional championships). This personal importance indicator allowed for enhanced emotional attachments to the event, thus increasing the opportunity for retention of emotional memories (Schimmack, 2002). Furthermore, the participants were selected on the basis that they were not competing on a weekly basis so as to control for the emotional bias associated with collecting data close to previous and subsequent events (Jokela & Hanin, 1999). Following an explanation of procedures, participants provided written informed consent before taking part. One important consideration was ensuring participants were not aware the study was seeking detail about the accuracy of recalled responses when completing their initial actual symptom responses. Direct awareness of this by the participants would potentially change the way symptoms would be encoded and subsequently accessed and rehearsed during a recall phase. Therefore, participants provided initial informed consent to be involved in data collection for actual

responses before further informed consent was requested for the recall phase of the study. No participant refused to give further informed consent for the recall aspect of the study when informed of the procedures for this aspect of the design.

Instrumentation

The Competitive Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump, & Smith, 1990) modified to include scales for both intensity and frequency of intrusions (Swain & Jones, 1993) was used to calculate actual and recalled anxiety symptoms. The inventory consists of 27 items, 9 for each of the three components of multidimensional anxiety (cognitive anxiety, somatic anxiety, and self-confidence). Participants recorded their symptom intensity on a 4-point Likert scale (1 = *not at all*; 4 = *very much so*) and their symptom frequency on a 7-point Likert scale (1 = *never*; 7 = *all of the time*). Therefore, scores for intensity range between 9 and 36 and scores for frequency range between 9 and 63. Internal reliability coefficients (Cronbach alpha's) have been reported to range between 0.79 and 0.93 for the intensity scale and between 0.87 and 0.93 for the frequency scale, implying high internal consistency (Martens et al., 1990; Thomas et al., 2004).

Procedure

Pre-competition phase: Actual quantitative symptom assessment. Participants completed their *actual* symptom responses on the CSAI-2 at 7 days, 2 days, 24 h, and 1 h pre-competition in line with previous research on temporal anxiety. All questionnaires were distributed 7 days before competition when participants were briefed on how to complete the inventory. The standardized instructional guidelines of "how you feel right now in relation to your upcoming competition" were used for the intensity of responses (Martens et al., 1990), whereas the instructions for frequency asked participants to record the amount of time symptoms occurred since the point of previous measurement (Swain & Jones, 1993). For the 7-day pre-competition phase where no previous measurement had taken place, participants recorded the occurrence of symptoms experienced on that day.

Post-competition phase: Recalled quantitative symptom assessment. Participants completed the questionnaires at 1 h, 5 days, 6 days, and 7 days post-competition. Emphasis differed from the pre-competition phase, as individuals were instructed to *recall* their competitive anxiety symptoms as they were experienced at each of the pre-competition data collection points leading up to their event. Therefore, recalled reports

of anxiety relating to symptoms experienced 7 days pre-competition were obtained 1 h post-competition. This applied to each subsequent recall of anxiety until finally 1 h pre-competition symptoms were recalled 7 days post-competition. In line with the recommendations of previous research, the 7-day time delays between individuals reporting and subsequently recalling their symptoms were employed to minimize memory distortion of pre-competition anxiety states (Jokela & Hanin, 1999; Tenenbaum et al., 2002).

Data analysis

Non-parametric limits of agreement were used to assess agreement between actual and recalled responses (see Bland & Altman, 1999). Agreement for each anxiety component was quantified by calculating the differences between responses recorded on the two separate (i.e. actual vs. recalled) occasions (e.g. 7 days before and 1 h after competition). The use of non-parametric methods resulted from Bland and Altman's (1999) recommendation that a minimum sample size of 50 is needed when assessing agreement using parametric methods. In addition, data were pre-screened for assumptions regarding their distribution, which indicated that some of the data sets were not normally distributed due to the differences between actual recalled symptoms being discrete and categorical.

The first agreement analysis calculated total agreement (percentage of the sample who could recall their scores exactly) and systematic bias (the tendency of the sample to over- or underestimate their recalled scores) between actual and recalled scores. In line with Bland and Altman's (1999) recommendations, the 2.5th and 97.5th percentiles were determined by ordering the differences and recording the range of values that remained after 2.5% of the results were removed from both the lower and higher extremes of the samples scores. The remaining values allowed for the interpretation of total agreement and systematic bias between the pairs of observations within the study (Bland & Altman, 1999). Systematic bias scores rather than total agreement percentiles are the values of prime interest for the reader, as these indicate whether the sample tended to over- or underestimate their responses when recalling anxiety symptoms (Cooper, Hughes, O'Donoghue, & Nevill, 2007). Overestimation is apparent when the systematic bias score is below zero, underestimation is present when the bias score is above zero, and a systematic bias score of zero indicates exact agreement between actual and recalled scores (i.e. total agreement). Systematic bias was confirmed statistically by applying non-parametric median sign tests on the observed differences

between actual and recalled responses (Cooper et al., 2007).

The second agreement method involved determining the proportion of differences within a reference value chosen to equate to "no practically important difference" (Nevill, Lane, Kilgour, Bowes, & Whyte, 2001, p. 275). This procedure enabled conclusions regarding individuals' ability to recall intensity versus their ability to recall frequency information to be made in line with the main aim of the study. Specifically, the dimension with the higher proportion of differences within the reference value of no practically important difference (i.e. proportion of agreement) would indicate better agreement between actual and recalled responses. As the magnitudes of responses for each of the subscales of competitive anxiety differed (i.e. 9 to 36 for intensity and 9 to 63 for frequency), the reference values for each dimension needed to reflect the enhanced probability that differences between actual and recalled responses for frequency would be greater. This is due to the increased range of responses possible for the frequency dimension. Subsequently, standardized agreement reference values of no practical difference were calculated by dividing the maximum possible frequency scores for cognitive, somatic, and self-confidence responses by the maximum possible scores of intensity for each of the three subcomponents (Cooper et al., 2007). Therefore, the reference value for frequency differences was calculated as being 1.75 times greater than that for intensity. To explain how the reference values were determined, the differences between actual and recalled responses were ordered. These differences always generated whole numbers and therefore reference value integers had to represent whole values as well (e.g. $\pm 1, 2, 3 \dots n$). In this study, the lowest whole numbers were used, whereby the frequency reference value was 1.75 times greater than reference values for intensity. Thus, the standardized reference values for intensity and frequency dimensions were ± 4 and ± 7 respectively. The increased reference value for frequency accounts for the enhanced probability of larger differences, yet allows the proportion of observations within the ranges for both intensity and frequency to be directly compared.

Results

Separate agreement comparisons were conducted on all corresponding actual and recalled data collection points for each construct of competitive anxiety. This yielded 24 comparisons that furnished 24 non-parametric Bland and Altman plots (Bland & Altman, 1999). Proportions of agreement, determined by values within the respective reference values for intensity and frequency, were superimposed onto

the plots to aid interpretation (Bland & Altman 1999). From this analysis, insights were made regarding which dimension (i.e. intensity or frequency) showed better agreement between actual and recalled anxiety symptoms. The systematic bias scores, non-parametric median sign test scores, and comparisons of values for proportional agreement were used to draw these conclusions. An example of two completed plots, one for intensity and one for frequency, are presented in Figure 1. The outcomes of the non-parametric analyses are summarized in Table I. Due to space limitations, tabular representation of quantitative results are provided with accompanying description in the text. However, copies of all the Bland and Altman plots can be obtained from the corresponding author.

Cognitive anxiety symptoms

Intensity dimension. Median sign tests indicated no significant bias when recalling the intensity of cognitive symptoms. General trends indicated that when recalling symptoms further away from the competition (i.e. 7 days), the majority of the sample overestimated their intensity responses (median = -1.0; responses below 0 = 20; responses equal to

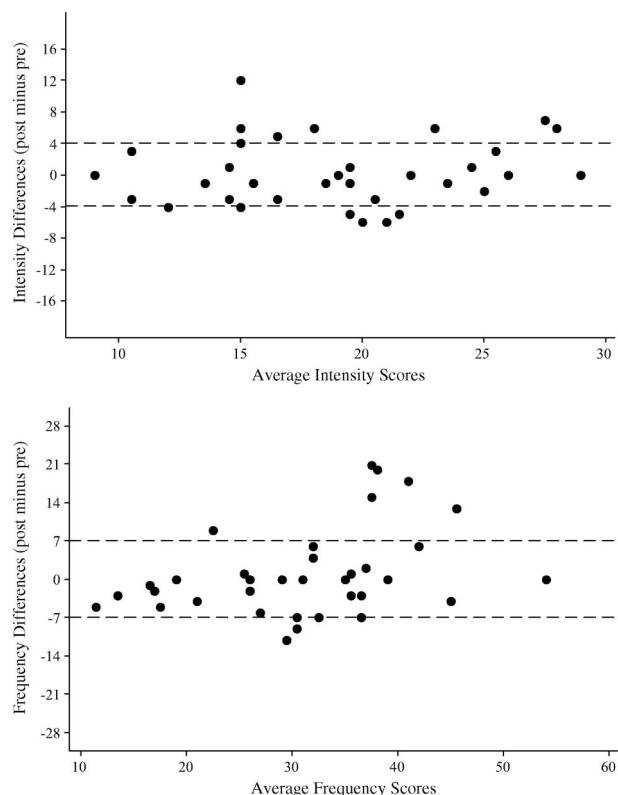


Figure 1. Example of Bland and Altman plot indicating the differences between actual and recalled cognitive anxiety symptoms (Recall 2) that fall within a reference value chosen to equate to no practically important difference for both intensity and frequency dimensions.

Table I. Summarized actual-recalled outcomes of the limits of agreement analysis for both intensity and frequency dimensions.

	Intensity				Frequency			
	Bias	Median (sign <i>P</i> test)	TA (%)	PA (= TA ± 4) (%)	Bias	Median (sign <i>P</i> test)	TA (%)	PA (= TA ± 7) (%)
<i>Cognitive anxiety</i>								
Recall 1	-1.3	-1.0 (0.30)	5.6	62.9	0.8	1.0 (0.12)	22.9	80.0
Recall 2	0.5	0.0 (0.86)	14.3	65.7	1.1	0 (0.57)	20.0	77.1
Recall 3	1.3	0.0 (0.86)	8.6	62.9	0.8	-1.0 (0.36)	14.3	74.3
Recall 4	1.7	2.0 (0.47)	11.4	54.3	-1.5	0 (0.71)	17.1	74.3
<i>Somatic anxiety</i>								
Recall 1	2.8	-1.0* (0.01)	11.4	68.6	1.3	0 (1.00)	14.3	74.3
Recall 2	2.2	-3.0* (0.04)	14.3	57.1	0.5	0 (0.71)	17.1	68.6
Recall 3	0.1	1.0 (0.38)	8.6	77.1	0.8	0 (0.85)	20.0	80.0
Recall 4	1.1	0 (0.72)	11.4	62.9	-0.1	0 (0.86)	8.6	80.0
<i>Self-confidence</i>								
Recall 1	1.4	2.0* (0.04)	0	62.9	1.3	0 (0.46)	17.1	68.6
Recall 2	2.5	3.0* (0.01)	5.7	60.0	0.5	2.0 (0.27)	17.1	71.4
Recall 3	-1.6	-1.0 (0.28)	11.4	51.4	0.8	0 (0.85)	20.0	65.7
Recall 4	-0.2	-1.0 (0.60)	8.6	68.6	-0.1	2.0 (0.10)	14.3	68.6

Note: TA = percentage of sample indicating total agreement, PA = percentage of sample falling within a reference value of no practically important difference (proportion of agreement). **P* < 0.05.

0 = 2; responses above 0 = 13; *P* = 0.30). However, time-to-competition trends altered during the week as the sample began to underestimate the intensity of the symptoms that occurred nearer to the competition (e.g. 1 h pre-competition: median = 2.0; responses below 0 = 13; responses equal to 0 = 4; responses above 0 = 18; *P* = 0.47). The proportion of agreement within the reference value of no practically important differences ranged from 54.3% to 65.7%, with recall deteriorating progressively from 2 days to 1 h pre-competition.

Frequency dimension. Median sign tests indicated no significant bias when recalling the frequency of cognitive symptoms. General trends indicated that when recalling symptoms further away from the competition (i.e. 7 days), the majority of the sample underestimated their frequency responses (median = 1.0; responses below 0 = 9; responses equal to 0 = 8; responses above 0 = 18; *P* = 0.12). However, time-to-competition trends altered progressively throughout the week as the sample began to overestimate the frequency of their symptoms at times close to competition (e.g. 1 h pre-competition: median = 0.0; responses below 0 = 16; responses equal to 0 = 6; responses above 0 = 13; *P* = 0.71). The proportion of agreement within the reference value of no practically important differences ranged from 74.3% to 80.0%, with recall deteriorating progressively from 7 days to 1 h pre-competition.

Somatic anxiety symptoms

Intensity dimension. Median sign tests indicated significant systematic bias when recalling the intensity of somatic anxiety symptoms that occurred

7 days (median = -1.0; responses below 0 = 23; responses equal to 0 = 4; responses above 0 = 8; *P* = 0.01) and 2 days (median = -3.0; responses below 0 = 21; responses equal to 0 = 5; responses above 0 = 9; *P* = 0.04) pre-competition. Specifically, the sample recalled significantly higher and, therefore, unreliable levels of symptoms than actual recorded responses. However, nearer to the competition trends altered as the sample began to underestimate the intensity of their symptoms (e.g. 1 h pre-competition: median = 0.0; responses below 0 = 14; responses equal to 0 = 4; responses above 0 = 17; *P* = 0.72). The proportion of agreement within the reference value of no practically important differences ranged from 57.1% to 77.1%, with recall deteriorating from 7 days before to the lowest agreement proportion obtained at 2 days before competition. Recall accuracy increased from 2 days to 24 h pre-event, yet deteriorated dramatically for symptoms occurring 1 h pre-competition.

Frequency dimension. Median sign tests indicated no significant bias when recalling the frequency of somatic symptoms. General trends indicated that when recalling symptoms up to 2 days pre-competition, the majority of the sample overestimated their frequency responses (e.g. median = 0.0; responses below 0 = 16; responses equal to 0 = 6; responses above 0 = 13; *P* = 0.71). However, nearer to the competition trends altered as the sample began to underestimate the frequency of their symptoms (e.g. 1 h pre-competition: median = 0.0; responses below 0 = 15; responses equal to 0 = 3; responses above 0 = 17; *P* = 0.86). The proportion of agreement within the reference value of no practically important differences ranged from 68.6% to 80.0%, with the

lowest agreement proportion being obtained for recalled symptoms that occurred 2 days pre-competition. Recall of symptoms subsequently increased from 2 days to 24 h pre-competition and remained stable up to the event.

Self-confidence symptoms

Intensity dimension. Median sign tests indicated significant systematic bias when recalling the intensity of self-confidence symptoms that occurred 7 days (median = 2.0; responses below 0 = 11; responses equal to 0 = 0; responses above 0 = 24; $P = 0.04$) and 2 days (median = 3.0; responses below 0 = 9; responses equal to 0 = 2; responses above 0 = 24; $P = 0.01$) pre-competition. Specifically, participants recalled significantly lower and, therefore, less reliable levels of symptoms than actual recorded responses. However, nearer to the competition trends altered as the sample began to overestimate the intensity of their symptoms (e.g. 1 h pre-competition: median = -1.0; responses below 0 = 18; responses equal to 0 = 3; responses above 0 = 14; $P = 0.60$). The proportion of agreement within the reference value of no practically important differences ranged from 51.4% to 68.6%, with recall deteriorating progressively from 7 days to 24 h pre-competition, while increasing dramatically from 24 h to 1 h pre-competition.

Frequency dimension. Median sign tests indicated no significant bias when recalling the frequency of self-confidence symptoms. General trends indicated that when recalling symptoms, the majority of the sample underestimated their frequency responses (e.g. 7 days pre-competition: median = 0.0; responses below 0 = 12; responses equal to 0 = 6; responses above 0 = 17; $P = 0.46$). Recalling symptoms that occurred 24 h pre-competition was the only occasion when the majority of the sample overestimated their frequency responses (median = 0.0; responses below 0 = 15; responses equal to 0 = 7; responses above 0 = 13; $P = 0.85$). However, the high P value indicates a reduced tendency for the frequencies of differences between actual and recalled responses to be mostly positive or negative, and therefore this overestimation is negligible. The proportion of agreement within the reference value of no practically important differences ranged from 65.7% to 71.4%, with recall remaining relatively stable throughout the pre-competition week.

Discussion

In general, results from the quantitative phase of the study indicated that athletes were better at recalling the frequency rather than the intensity of their competitive anxiety symptoms. There was only one

instance where the proportion of agreement for frequency was not higher than that for intensity (i.e. recalling self-confidence symptoms that occurred 1 h before competition). These findings support research within sport psychology (Harger & Raglin, 1994; Imlay et al., 1995; Wilson & Raglin, 1997) and on emotion (Diener et al., 1991; Keuler & Safer, 1998; Thomas & Diener, 1990) that suggests information regarding intensity is difficult to calibrate and effortful to retrieve, whereas frequency is a more salient dimension of emotion that is etched into long-term memory.

One benefit of employing agreement methods rather than a correlation analysis to assess recall accuracy surrounded the calculation of systematic bias within the limits of agreement. In short, using limits of agreement allowed consideration of whether the sample over- or underestimated recalled responses – a factor ignored within correlation designs (Bland & Altman, 1999). The findings indicated significant systematic bias was evident for symptom intensity, whereas no significant biases were observed for symptom frequency. Specifically, at 7 days and 2 days pre-competition, the sample overestimated the intensity of their somatic anxiety symptoms and underestimated the intensity of their self-confidence symptoms. This bias pattern has been found in other emotion research where individuals have recalled being more emotionally intense than actual on-line measurements would indicate (Thomas & Diener, 1990). Researchers have termed this overestimation a mood-incongruent effect, whereby individuals attempt to maintain emotional equilibrium once the event has passed and they are no longer emotional (i.e. anxious) about it (Parrott & Sabini, 1990).

PHASE 2: RETROSPECTIVE QUALITATIVE ASSESSMENT

Methods

Participants

Phase 2 of the study involved six participants (4 males; 2 females) aged 19–25 years (mean = 24.1 years; $s = 2.8$). All six participants were randomly selected from the sample involved in Phase 1 of the study. They were required to give further written informed consent to complete this aspect of the study and were not aware of the accuracy of their recall from the first phase of the study.

Instrumentation

A semi-structured interview guide was employed that explored three major areas (a copy of the guide can

be obtained from the corresponding author). The first section included questions and probes that aimed to generate data surrounding the accuracy and relevance of each dimension (intensity and frequency) as a representation of the actual symptoms experienced by the participants (e.g. “which dimension [intensity – level, or frequency – occurrence] do you believe was a more accurate indication of the symptoms that you were experiencing during the lead up to the competition?”). The second focused upon questions and probes seeking participants’ perceptions on the ease of recalling each dimension (e.g. “did you experience any differences in the ease of recalling information about the intensity [level] or frequency [occurrence] of your anxiety symptoms?”). The final section contained causal questions and probes (i.e. “why”-based questions) seeking any perceived explanations for the findings of the quantitative aspect of the study and/or the perceived explanations provided by participants’ within section two of the interview (e.g. “why do you think it was easier to recall [intensity – level or frequency – occurrence: as applicable] compared with [intensity – level or frequency – occurrence: as applicable?”). The interview guide was prepared to ensure the same basic lines of inquiry were pursued with each participant (Patton, 2002), and was cross-referenced with the guides of recent qualitative research within the competitive anxiety domain (e.g. Hanton et al., 2002; Thomas et al., 2007). The guide was pilot tested on a sample of participants ($n=3$) who were involved in Phase 1 of the study before actual data collection to allow for refinements.

Procedure

To maximize retrieval of information, the interview guide was sent to each participant before data collection to enhance familiarity with the questions and aid reflection on the quantitative stage of the study (Hanton et al., 2002; Thomas et al., 2007). To minimize memory distortion, interviews were conducted 7 days after the final post-competition questionnaire had been completed (Hanton et al., 2002). All interviews were conducted face-to-face, in a non-threatening setting away from the participants’ sporting environment (Patton, 2002). The interviews were tape-recorded and transcribed verbatim yielding 120 pages of text.

Data analysis

Interview data were inductively analysed based on methods outlined by Miles and Huberman (1994), which have recently been amended and adopted within sport psychology (Hanton et al., 2002;

Thomas et al., 2007). Specifically, given the noted descriptive nature of content analysis, and the inherent lack of scope for the identification of causal linkages between processes and outcomes, inductive causal networking was used to analyse the retrospective qualitative data (Hanton et al., 2002; Thomas et al., 2007). First, a within-case approach was adopted whereby each participant (case) transcript was analysed in its entirety and information and perceived explanations with regard to symptom experiences were elicited. Second, a cross-case analysis was conducted to ascertain the general explanations common across the group (Miles & Huberman, 1994; Thomas et al., 2007). The third step of the analysis involved a deductive approach to ensure that all themes were present in the raw transcripts. The perceived causal networks were validated following the procedures adopted by Thomas et al. (2007). First, the authors discussed the final cross-case network in a focus group until agreement was reached; second, all within-case and cross-case networks were sent to participants for member checking where agreement was forthcoming in relation to whether the networks represented a true reflection of the participant’s experiences.

Results

Inductive analysis produced six within-case causal networks that described each participant’s perceptions of experiencing and recalling anxiety intensity and frequency. These within-case networks were then collapsed to form one cross-case network. Due to space limitations, only the cross-case causal network is presented here (see Figure 2). However, copies of the within-case causal networks are available from the corresponding author on request. Section A of Figure 2 summarizes participants’ perceptions about the ease/difficulty of reporting *actual* intensity and frequency information. Section B highlights the reasons posited for *recall* ability of one dimension over the other and indicates which dimension the athletes’ felt was more reflective of their actual anxiety symptoms experienced. The network consists of two major elements: emergent variables linked together by a series of arrows that illustrate the direction of the relationship between the variables, and percentages, which represent those participants who identified the specific relationship between variables.

Encoding of actual competitive anxiety symptoms

The initial phase of the interview required participants to reflect on the ability to report their actual intensity and frequency of symptoms in the lead up to the competition (see section A of Figure 2). The

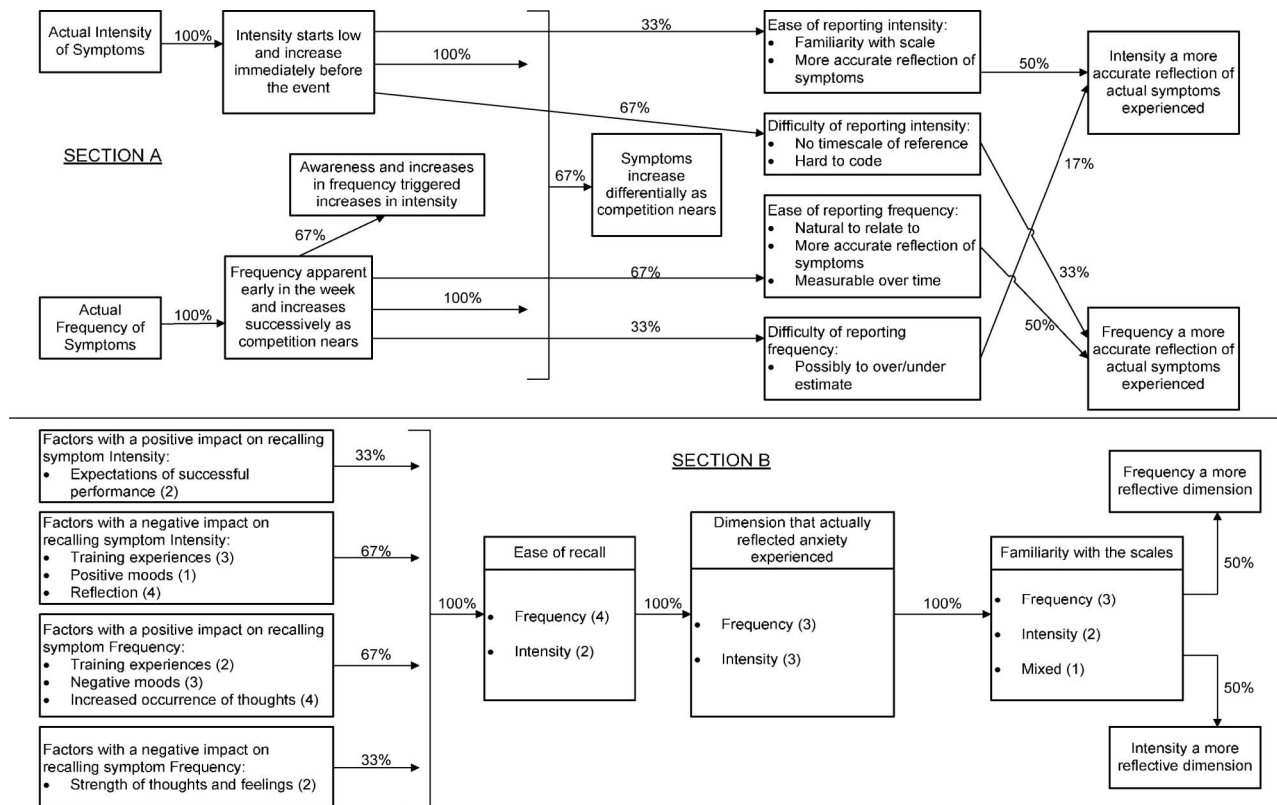


Figure 2. Causal network: Actual and recalled symptoms.

majority (67%) perceived that intensity was more difficult to report than frequency. The main reason cited for this was not having any reference point for the level of symptoms they experienced. This is in contrast to frequency, which was related to the proportion of time a thought or feeling occurred. For example, one participant stated:

Probably the intensity was the hardest; just because, with frequency you have something to gauge it on. Anytime you have a thought or feeling you know you have the thought or feeling, but with intensity you don't really know what one and four is. You're not sure how intense the feeling is, you've just got to go on what you perceive it to be.

A second reason posited for ease of reporting actual frequency related to how, and when, this information is stored into memory, evidenced through consideration of a time-to-competition related factor. Specifically, 100% of participants perceived that frequency increased early during the competition week and continued to increase successively as the event neared. In comparison, intensity of symptoms remained low during the week yet increased immediately before the event. Indeed, one participant who believed frequency was easier to report suggested, "Because you knew when you felt it (symptom frequency) rather than how you felt

about it (symptom intensity) it was easier to know when it (symptom frequency) changed". Actual intensity only seemed to be brought into consciousness as a result of increased occurrences of thoughts and feelings throughout the pre-competition phase. The majority of participants (67%) found that they only considered the intensity of their thoughts and feelings as a direct result of them occurring more often. For example:

You know that the intensity is getting stronger but only because you're thinking about it more often. So the intensity was harder to report. I think frequency was easier to report because that's all you are thinking about. You can measure the time you're thinking about it and when you're not thinking about it quite easily really.

Therefore, frequency information appeared to be calibrated and stored into memory before intensity information. Indeed, a participant who found reporting intensity easier than frequency suggested that he was experiencing higher levels of feelings as a result of thinking about them more often, suggesting frequency information could act as a precursor for increasing intensity.

While actual frequency was suggested to be easier to report, the sample were divided in their perception of which dimension provided a more accurate

indication of the anxiety they were experiencing (frequency = 50%; intensity = 50%). One participant, who found intensity easier to report, subsequently found it a better indication of their anxiety symptoms. Another participant who found both intensity and frequency difficult to report suggested that with frequency information, there may be a tendency to overestimate or underestimate time-based information rather than set criteria as indicated by intensity. The final individual who suggested intensity was more indicative of anxiety symptoms explained that while he found frequency easier to report, the level of negative thoughts and feelings was more in touch with his understanding of the concept of anxiety.

Recall of competitive anxiety symptoms

Post-competition, participants were required to reflect on the pre-competition phase and attempt to recall the intensity and frequency of their anxiety symptoms at specific intervals (this information is displayed in the bottom half of Figure 2). The ability to recall anxiety symptoms was attributed to a variety of influences that could be divided into experiences that occurred during the study process, and expectations regarding the event. In addition, these influences could be further separated into those that had a positive or negative impact on the participant's perceptions of their ability to differentiate between, and recall, the two dimensions. When probed into whether the intensity or frequency of symptoms was easier to recall, the majority indicated frequency. Indeed, four participants found frequency easier to recall, as they perceived it was easier to reflect and estimate the proportion of time that specific thoughts and feelings occurred. One individual indicated, "Frequency was a lot easier to recall. It was really specific to me. It really emphasized to me how much I was thinking about the competition beforehand and also the sorts of things that I was thinking about". In essence, reporting actual frequency information during the pre-competition phase had the impact of bringing into consciousness how focused they were regarding the upcoming event, and it was this information that the individuals specifically recalled. Indeed, the above-mentioned participant went on to say:

I don't think it's a bad thing that I'm thinking about those things all the time as long as I am able to take out the positives and stay focused. But because I was made aware of the frequencies of these thoughts and feelings it was a lot easier to recall.

Positive experiences for recalling intensity information were attributed to successful performances

($n = 2$). In such instances participants were happy to remember how they were thinking and feeling prior to the competition. For example, an individual who, when queried as to what influences helped him recall intensity information, suggested: "I suppose the outcome, as the competition went well I was happy to remember things about it ([competition]) and things before it, but if things had gone badly then I would have tried to forget about the thoughts and feelings quicker".

Following the recall phase, participants were asked to reflect on the study as a whole and give their opinion as to which dimension was a true reflection of the anxiety symptoms they had experienced. The sample was equally divided in their opinions (frequency = 50%; intensity = 50%). The 33% of the participants who found intensity easier to recall subsequently stated that it was a better indication. The individual who decided frequency was easier to recall, yet found intensity a better reflection, suggested that the reason he felt intensity was more difficult to recall was due to performing better than he expected. As a result, this individual felt that the successful performance might have resulted in him exaggerating the level of his previously experienced symptoms. However, he could still remember the specific thoughts and feelings experienced and how they had impacted on him.

Familiarity with the dimensions was highlighted as a determinant of whether the scales were reflective of the anxiety symptoms that were experienced during the study process. Three participants who found frequency more reflective mentioned that occurrence, or proportion of time, was specific to them. For example:

I wasn't thinking about the competition very much and then as it gradually got up to the competition I was thinking about it all the time up until an hour before when that's all I thought about pretty much. So it ([frequency of symptoms]) was more of an indication of what I was thinking and feeling.

Conversely, when intensity was regarded as a better reflection of the anxiety experienced, two participants mentioned a familiarity with intensity type scales as a perceived explanation. For example, one individual compared the intensity dimension to that of the Borg scale (Borg, 1982), a scale that he had previous experience of completing. The third individual reported that the novelty of reporting and recalling the level of anxiety symptoms resulted in the intensity dimension being brought into consciousness and highlighted in memory, whereas frequency information became distorted within the process of the questionnaires.

Discussion

The initial aspect of the qualitative study provided an insight into the perceptions of which dimension participants believed was easier to report, and thus better represented the actual symptoms they experienced (see section A in Figure 2). In general, participants found it easier to report the frequency with which their symptoms occurred. The primary reason perceived to account for this was that they found it easier to relate to the time-based properties of the frequency dimension (i.e. proportion of time symptoms were experienced). Consideration of Hasher and Zacks' (1979) Automatic and Effortful emotion framework is warranted to help explain this finding. Specifically, this framework indicated that information related to emotion frequency can be processed more easily than that of emotion intensity. Hasher and Zacks suggested that frequency information imposes less taxing demands on an individual's attentional capacity than emotion intensity and as such can be processed, encoded, and stored in a less *effortful* and *automatic* way. These automatic characteristics were associated with the notion that humans are biologically more prepared and tuned to frequency information due to the discrete properties of this dimension and the difficulties associated with calibrating emotion intensity. Hasher and Zacks concluded by suggesting that the operation of storing frequency information into memory, "drains minimal energy from our limited-capacity attentional mechanism" (p. 356), and as such individuals can more easily relate to frequency information from emotionally charged contexts as less cognitive effort and resource is required to process emotional content of this nature.

Perceived explanations for the enhanced recall ability of frequency information are provided from the second aspect of the retrospective qualitative study (see section B in Figure 2). Specifically, participants felt that compared with intensity, they were more able to remember the amount of time they experienced cognitive and somatic anxiety symptoms. Athletes attributed enhanced recall of frequency information to being more consciously aware of the sensitive nature of this dimension throughout the competition week. Furthermore, when providing perceived explanations for the quantitative findings of the study, it was suggested that the earlier increase in symptom frequency acted as a precursor for inducing anxiety levels. These findings corroborate and provide evidence for the suggestions offered by Hanton et al. (2004) and Thomas et al. (2004) when explaining the different temporal patterns observed for the frequency and intensity of competitive anxiety within their time-to-competition research. In addition, athletes reported that the ease of recalling

frequency information could be explained through familiarity to this dimension and referencing their responses to a specific time-based factor. This finding is in line with suggestions that individuals are more attuned to frequency information, as it provides a standardized guideline of their affective states (Diener et al., 1991; Schimmack, 2002).

General discussion

We examined the extent to which competitive anxiety can be reported and recalled from distinct periods in the lead up to events after relatively short-term delays. The general pattern of results across the two phases of the study indicate that symptom frequency displayed increased recall reliability, lower recall systematic bias, and was perceived as easier to recount than symptom intensity. These findings are in line with research in sport psychology that has indicated significant discrepancies between actual and recalled anxieties when only the intensity of symptoms has been measured (Harger & Raglin, 1994; Imlay et al., 1995; Wilson & Raglin, 1997). This incongruence between actual and recalled symptoms has typically been attributed to a weakening of memory through the passing of time. The current study indicates that memory decay is facilitated through the measurement dimension used and thus how the information is subsequently encoded in memory. Therefore, how memory is assessed is of crucial concern when determining the stability of retrospectively recalled reports related to emotions such as anxiety. Specifically, the findings of this study indicate that focusing on the proportion of time symptoms occur (i.e. symptom frequency) acts as a more accurate reference scale for aiding individuals' recall of anxiety symptoms rather than simply relying on the level of these responses (i.e. symptom intensity).

Recurring themes that emerged as reasons for the enhanced recall ability of frequency information were centred around the perceptions that participants: (a) felt that the time-based element of the frequency dimension was familiar to them; and (b) the information associated with the frequency dimension could be processed more naturally. To support these ideas, psychologists specializing in affective states have proposed a familiarity model that assumes the occurrence of emotionally stimulating events automatically activates memories of such experiences (Hintzman, 1988). Furthermore, this automatic activation is based on a feature-matching process: the more features or occurrences of intrusions that memory possesses, the greater the retrieval and recall of that memory will be. It is recognized that this automatic activation increases the memory traces of frequency information and produces an "echo",

which is subsequently experienced as a *feeling*, and is expressed as the *level* of the familiarity when recalling that experience (i.e. intensity; Hintzman, 1988). Therefore, it is the early and successive increases of frequency information that determine the intensity of the symptom experienced (Schimmack, 2002). The familiarity model extends to the current study and to Thomas and colleagues' (2004) suggestion regarding the primacy experience of frequency information acting as a trigger to increase the experience of symptom intensities.

Support for the notion that fluctuations of symptom frequency induce increases in intensity is not readily forthcoming from the sport psychology literature. However, possible supportive evidence could emerge from Fletcher's meta-model of stress, emotions, and performance (see Fletcher, Hanton, & Mellalieu, 2006). Specifically, the model assumes competitive anxiety symptoms are experienced as an initial consequence of a sequence of cognitive appraisals towards specific stressors. In relation to this model, it may be that, in the first instance, frequencies are closely tied to the primary appraisal of the stressor (i.e. the competitive demand), with secondary appraisals being more closely related to the athlete determining the level of his or her response. This notion appears to explain why frequencies of somatic and cognitive symptoms tend to increase earlier within the temporal period preceding competition, whereas augmented increases in intensity tend to occur in the latter stage (Hanton et al., 2004; Thomas et al., 2004). The model further assumes that each level of appraisal involves some consideration of the relevance of the stressor (Mellalieu et al., 2006). Initial increases of symptom frequency possibly signify the moment individuals appraise the relevance of what is happening with respect to its implications for well-being. Conversely, increases of intensity indicate the period at which fluctuations of symptom frequencies are considered as pertinent to the individual's preparatory feeling states.

The increased salience of symptom frequency when reporting and recalling anxiety-related events raises important applied implications. These implications primarily affect practitioners' attempts to build stress management interventions during the time leading up to competitive events. Traditionally, applied researchers and practitioners have relied upon information aligned to the intensity (i.e. levels) dimension when asking performers to retrospectively recount their pre-competition emotions. As such, information surrounding changes to symptom intensity has proved invaluable when assisting practitioners in their attempts to inform the timing of stress management interventions during the periods leading up to competitive events (Hanton et al., 2009;

Thomas et al., 2009). The general pattern of results from this study with regard to recall accuracy indicates that applied researchers and practitioners would be better served by asking performers to recount information related to how often (i.e. frequency) they were experiencing anxiety-related symptoms.

Although these findings raise important practical implications, there are some limitations to the study. Specifically, the authors recognize the lack of consideration to directional interpretations of competitive anxiety. The dimension of directional perceptions has received detailed research attention within recent competitive anxiety literature, contributing significantly to our understanding of the formulation of stress management interventions (Mellalieu et al., 2006). This study considered the dimensions primarily used to inform the *timing* of stress management interventions and those that have been directly compared in other psychology literatures when assessing the accuracy of reporting and recalling emotional events; namely, intensity and frequency. In future, researchers should explore the recall accuracy of directional perceptions given its influence over informing the *content* of stress management interventions and its prevalence within more recent competitive anxiety research (Hanton et al., 2009; Mellalieu et al., 2006; Thomas et al., 2009).

Limitations were also present surrounding the retrospective elements of the design through asking participants to recall and then reflect on their anxiety symptoms. Specifically, models of memory indicate that when recalling and reflecting on previously experienced emotional responses, encodings (i.e. memories) of the originally reported symptoms are likely to change following active recall (e.g. Delaney, Ericsson, & Knowles, 2004; for a review, see Eccles, in press). Delaney et al. (2004) suggested that these retroactive interference effects tend to occur when tasks and the information relating to them are similar. The present study required participants to report their actual anxiety symptoms on four occasions prior to a competition, recall these symptoms, and then reflect on this process. It is not unreasonable to assume that there may have been similarities in the actual symptoms reported at each of the original four precompetitive stages. Therefore, the potential similarity of the information encoded into memory may not have allowed individuals to differentiate between their memories when subsequently recalling and reflecting on this information. In future, researchers could consider a design whereby separate samples are used; one that reports symptoms and then reflects on the reporting process and the other that reports symptoms, later recalls them, and then reflects on the reporting process.

This type of design may overcome some of the possible interference effects within the approach of the current study. One final limitation related to the use of qualitative techniques to gauge participants' explanations surrounding content of an emotional nature. Using evidence from general psychology (e.g. Ericsson & Simon, 1980; Nisbett & Wilson, 1977), Eccles (in press) has recently raised concerns with the use of retrospective interview techniques when researching event-related emotions within sport psychology. Although this approach is now common practice within sport and other domains of psychology, the reader should be cognisant of Eccles' review when interpreting the general conclusions and implications of the study.

In summary, our findings indicate that frequency as opposed to intensity appears a more accurate dimension when recalling and reflecting on the anxiety symptoms associated with stressful events. These results raise important implications for consultants and applied researchers when using retrospective techniques to gauge athletes' reports of competitive anxiety-related symptoms. Specifically, the recommendation emerging from this study is that it would be inappropriate to rely solely on the traditional dimension of intensity when making decisions on the timing of stress management interventions. In future, researchers should attempt to extend this line of research into the directional perceptions dimension of the competitive anxiety response given that dimensions profile in helping determine stress management intervention content.

References

- Bland, J. M., & Altman, D. G. (1999). Measuring agreement in method comparison studies. *Statistical Methods in Medical Research*, 8, 135–160.
- Borg, G. A. V. (1982). Psychophysical bases of perceived exertion. *Medicine and Science in Sport and Exercise*, 14, 377–381.
- Cooper, S.-M., Hughes, M., O'Donoghue, P., & Nevill, A. M. (2007). A simple statistical method for assessing the reliability of data entered into sport performance analysis systems. *International Journal of Performance Analysis in Sport*, 7, 87–109.
- Delaney, P. F., Ericsson, K. A., & Knowles, M. E. (2004). Immediate and sustained effects of planning in a problem-solving task. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 30, 1219–1234.
- Dewhurst, S. A., & Marlborough, M. A. (2003). Memory bias in the recall of pre-exam anxiety: The influence of self-enhancement. *Applied Cognitive Psychology*, 17, 695–702.
- Diener, E., Sandvik, E., & Pavot, W. (1991). Happiness is the frequency, not the intensity, of positive versus negative affect. In F. Strack, M. Argyle, & N. Schwartz (Eds.), *Subjective well-being: An interdisciplinary perspective* (pp. 119–139). Elmsford, NY: Pergamon Press.
- Eccles, D. W. (in press). Verbal reports on cognitive processes. In G. Tenenbaum, R. C. Eklund, & A. Kamata (Eds.), *Handbook of measurement in sport and exercise psychology* (pp. 1–41). Champaign, IL: Human Kinetics.
- Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review*, 87, 215–251.
- Fletcher, D., Hanton, S., & Mellalieu, S. D. (2006). An organizational stress review: Conceptual and theoretical issues in competitive sport. In S. Hanton & S. D. Mellalieu (Eds.), *Literature reviews in sport psychology* (pp. 321–374). Hauppauge, NY: Nova Science.
- Giacobbi, P. R., Jr., Poczwadowski, A., & Hager, P. (2005). A pragmatic research philosophy for applied sport psychology. *The Sport Psychologist*, 19, 18–31.
- Hanton, S., Mellalieu, S. D., & Young, S. (2002). A qualitative investigation into temporal patterning of the precompetitive anxiety response and its effects on performance. *Journal of Sports Sciences*, 20, 911–928.
- Hanton, S., Thomas, O., & Maynard, I. (2004). Competitive anxiety responses in the week leading up to competition: The role of intensity, direction and frequency dimensions. *Psychology of Sport and Exercise*, 15, 169–181.
- Hanton, S., Thomas, O., & Mellalieu, S. D. (2009). Management of competitive stress in elite sport. In B. W. Brewer (Ed.), *Handbook of sports medicine and science: Sport psychology* (pp. 30–42). Chichester, UK: Wiley-Blackwell.
- Harger, G. J., & Raglin, J. S. (1994). Correspondence between actual and recalled precompetition anxiety in collegiate track and field athletes. *Journal of Sport and Exercise Psychology*, 16, 206–211.
- Hasher, L., & Zacks, R. T. (1979). Automatic and effortful processes in memory. *Journal of Experimental Psychology: General*, 108, 356–388.
- Hasher, L., & Zacks, R. T. (1984). Automatic processing of fundamental information: A case of frequency of occurrence. *American Psychologist*, 39, 1372–1388.
- Hedges, S. M., Jandorf, L., & Stone, A. A. (1985). Meaning of daily emotion measurements. *Journal of Personality and Social Psychology*, 48, 428–434.
- Hintzman, D. L. (1988). Judgements of frequency and recognition memory in a multiple trace memory model. *Psychological Review*, 95, 528–551.
- Imlay, G. J., Carda, R. D., Stanbrough, M. E., Dreiling, A. M., & O'Connor, P. J. (1995). Anxiety and athletic performance: A test of Zone of Optimal Functioning theory. *International Journal of Sport Psychology*, 26, 295–306.
- Jokela, M., & Hanin, Y. L. (1999). Does the Individual Zone of Optimal Functioning model discriminate between successful and less successful athletes? A meta-analysis. *Journal of Sports Sciences*, 17, 873–887.
- Kardum, I. (1999). Affect intensity and frequency: Their relation to mean level and variability of positive and negative affect and Eysenck's personality traits. *Personality and Individual Differences*, 26, 33–47.
- Keuler, D. J., & Safer, M. A. (1998). Memory bias in assessment and recall of pre-exam anxiety: How anxious was I? *Applied Cognitive Psychology*, 12, 127–137.
- Levine, L. J., & Safer, M. A. (2002). Sources of bias in memory for emotions. *Current Directions in Psychological Science*, 11, 169–173.
- Martens, R., Burton, D., Vealey, R. S., Bump, L., & Smith, D. E. (1990). Development and validation of the Competitive State Anxiety Inventory (CSAI-2). In R. Martens, R. S. Vealey, & D. Burton (Eds.), *Competitive anxiety in sport* (pp. 117–213). Champaign, IL: Human Kinetics.
- McFarland, C., & Alvaro, C. (2000). The impact of motivation on temporal comparisons: Coping with traumatic events by perceiving personal growth. *Journal of Personality and Social Psychology*, 79, 327–343.
- Mellalieu, S. D., Hanton, S., & Fletcher, D. (2006). A competitive anxiety review: Recent directions in sport psychology research. In S. Hanton & S. D. Mellalieu (Eds.), *Literature reviews in sport psychology* (pp. 1–45). Hauppauge, NY: Nova Science.

- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd edn.). Newbury Park, CA: Sage.
- Nevill, A. M., Lane, A. M., Kilgour, L. J., Bowes, N., & Whyte, G. P. (2001). Stability of psychometric questionnaires. *Journal of Sports Sciences*, 19, 273–278.
- Nisbett, R. E., & Wilson, T. C. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, 84, 231–259.
- Parkinson, B., Briner, R. B., Reynolds, S., & Totterdell, P. (1995). Time frames for emotion: Relations between momentary and generalized ratings of affect. *Personality and Social Psychology Bulletin*, 21, 331–339.
- Parrott, W. G., & Sabini, J. (1990). Mood and memory under natural conditions: Evidence for mood-incongruent recall. *Journal of Personality and Social Psychology*, 59, 321–336.
- Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd edn.). London: Sage.
- Safer, M. A., Bonanno, G. A., & Field, N. (2001). “It was never that bad”: Biased grief and long-term adjustment to the death of a spouse. *Memory*, 9, 195–204.
- Schimmack, U. (2002). Frequency judgments of emotions: The cognitive basis of personality assessment. In P. Sedelmeier & T. Betsch (Eds.), *Frequency processing and cognition* (pp. 189–204). Oxford: Oxford University Press.
- Swain, A., & Jones, G. (1993). Intensity and frequency dimensions of competitive state anxiety. *Journal of Sports Sciences*, 11, 533–542.
- Tenenbaum, G., Lloyd, M., Pretty, G., & Hanin, Y. L. (2002). Congruence of actual and retrospective reports of precompetition emotions in equestrians. *Journal of Sport and Exercise Psychology*, 24, 271–288.
- Thomas, D. L., & Diener, E. (1990). Memory accuracy in the recall of emotions. *Journal of Personality and Social Psychology*, 59, 291–297.
- Thomas, O., Hanton, S., & Maynard, I. (2007). Anxiety responses and psychological skill use during the time preceding competition. *Journal of Applied Sport Psychology*, 19, 379–397.
- Thomas, O., Maynard, I., & Hanton, S. (2004). Temporal aspects of competitive anxiety and self-confidence as a function of anxiety perceptions. *The Sport Psychologist*, 18, 172–188.
- Thomas, O., Mellalieu, S. D., & Hanton, S. (2009). Stress management in applied sport psychology. In S. D. Mellalieu & S. Hanton (Eds.), *Advances in applied sport psychology: A review* (pp. 124–161). London: Routledge.
- Vealey, R. S., & Garner-Holman, M. (1998). Applied sport psychology: Measurement issues. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 433–446). Morgantown, WV: Fitness Information Technology.
- Wilson, G. S., & Raglin, J. S. (1997). Optimal and predicted anxiety in 9–12 year-old track and field athletes. *Scandinavian Journal of Medicine and Science in Sports*, 7, 253–258.
- Wilson, G. S., Raglin, J. S., & Harger, G. J. (2000). A comparison of the STAI and CSAI-2 in five-day recalls of precompetition anxiety in collegiate track and field athletes. *Scandinavian Journal of Medicine and Science in Sports*, 10, 51–54.

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