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More than just a game: Research developments and issues in competitive anxiety in sport

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This paper provides a critical overview of developments and issues in competitive anxiety research. The discussion is divided into sections dealing with general arousal-based approaches, general anxiety-based approaches and, finally, multidimensional anxiety-based approaches. The major emphasis is on multidimensional anxiety-based approaches, in which a number of factors and issues surrounding the competitive anxiety response are addressed, including: conceptual and measurement developments; antecedents of competitive anxiety; temporal patterning of the response; and frequency of competition-related cognitive intrusions. Research which has examined the relationship between multidimensional anxiety and performance is considered in detail, including debilitative and facilitative competitive anxiety states and catastrophe models. A control model of debilitative and facilitative competitive anxiety is proposed. Finally, recommendations for future research are suggested.

The importance of sport in our culture is reflected in the national prestige and identity attached to sporting success. Top level sport is 'more than just a game'; events such as the Olympic Games and the World Cup of soccer are global media spectacles (Maguire, 1993*a*), which attract not only huge audiences but also massive financial investment and profit. For some cultures, success in such events is demanded and failure is unforgivable. Maguire (1993*b*) has highlighted numerous instances over the years when the crossover between sport and other aspects of national culture and identity have been very evident. An editorial in an English newspaper on the eve of the 1966 soccer World Cup Final between England and (West) Germany read 'if, perchance, on the morrow, Germany should beat us at our national game, let us take comfort from the fact that twice we have beaten them at theirs' (cited in Michener, 1976, p. 427). Cricket is another sport which has been at the centre of intense nationalistic passions. The infamous 'bodyline' controversy during the 1932–33 Test Series between England and Australia created a matter of national honour and identity in the form of a diplomatic dispute between the two nations. A more recent example highlighted by Maguire (1993*b*) is that of the 'Keating affair', which witnessed the Australian Prime Minister having the audacity

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to place his hand on the Queen of England's royal personage in public. To add insult to injury, Keating's wife refused to curtsey to the Queen, and Keating later delivered a speech questioning his country's ties with Britain. The subsequent cricket World Cup clash between Australia and England suddenly assumed a different mantle. England's victory in that match, largely due to Ian Botham's performance, was greeted in the English media with emotions which extended far beyond the boundaries of sport. Headlines included, 'To Keating from Botham with Love' and 'Oz-Zat: Royal Avenger Stuffs The Aussies' (cited in Maguire, 1993*b*, p. 303). Prime Minister John Major was also reported as interrupting a cabinet meeting to announce the result.

In acknowledging the significance of sport at the broadest level, the rapid growth of the relatively new discipline of sports science is understandable. At the applied level, elite sports performers have been supported by scientists in some other cultures for a number of years. The sporting ethic in Britain has meant that such support has been slower to be accepted and provided. However, at a time when sporting success appears to be more important than ever before, there has been a growing trend for sports scientists to be employed as part of the 'support team' of numerous national squads in an attempt to gain the maximum possible advantage over their adversaries. Although the role of psychology in sport has not always demanded the same attention as aspects of physical fitness and skill training, it is now widely acknowledged that sport psychologists can have an important role to play in the preparation of athletes. Indeed, top coaches have been reported as ranking sport psychology as the most important of the sport science disciplines (Gowan, 1979; see Bakker, Whiting & van der Brug, 1990).

Given that top level sport is characterized by a demand to perform to optimum levels in intense pressure situations, it is not surprising that a fair proportion of the consultant sport psychologist's efforts are devoted to enabling performers to better cope with the stress and anxiety which often accompanies their preparation and performance. The success of such work depends on the availability of a sound knowledge base founded on theory and research. Anxiety in sport has received a considerable amount of research attention. It will be evident in the following sections that early researchers leaned heavily on the educational and clinical psychology literatures on anxiety to build a theoretical underpinning for research in competitive anxiety. This influence still prevails, but recent advances mean that it is now a credible and accepted area of research in its own right. Indeed, it might be argued that research into the anxiety–sport performance relationship, in particular, has served to increase knowledge of a complex phenomenon which has sometimes proved somewhat elusive to examine in some other situational contexts.

Like anxiety researchers in other areas of psychology, sport psychologists have wrestled with the conceptual and methodological dilemmas surrounding examination of the anxiety response itself, and also identification of the anxiety–performance relationship. The following discussion examines the three major conceptual approaches which have been adopted in competitive anxiety research to examine such issues; general arousal-based, general anxiety-based and multidimensional anxiety-based approaches, with the major emphasis being on the multidimensional anxiety perspective.

General arousal-based approaches

The literature on the competitive anxiety–performance relationship has, until recently, been dominated by general arousal-based explanations in the form of drive theory and the inverted-U hypothesis. Drive theory, originally proposed by Hull (1943) and later modified by Spence & Spence (1966), hypothesizes that increases in drive (often used synonymously with arousal, stress and anxiety) are associated with a linear increase or decrease in performance, depending upon the dominant response. In the early stages of learning, the dominant response is incorrect and increases in arousal will impair performance; later in learning, when the dominant response is correct, increases in arousal will enhance performance. Drive theory has been most commonly employed in sport psychology to depict a positive linear relationship between arousal and performance. However, it has been criticized by sport psychologists on a number of grounds, including: the failure to find consistent support for the theory (Martens, 1971, 1974); the theory does not appear to accommodate effects of complex tasks (Martens, 1971; Tobias, 1980; Weinberg, 1979), and is thus too simple to explain motor/sport performance (Fisher, 1976); the difficulty in determining habit hierarchy of correct and incorrect responses in most motor skills (Martens, 1974; Neiss, 1988); and, from a cognitive psychological perspective, the failure to consider thought or appraisal (Gill, 1994).

Drive theory has largely been superseded by the inverted-U hypothesis and the notion of optimal arousal levels. The hypothesis has its origins in the early work of Yerkes & Dodson (1908) who examined the ability of mice to discriminate between stimuli of differing brightness as a function of differing intensities of electric shock. The major assumptions of optimal arousal theorists are that for every type of behaviour there exists an optimal level of arousal, usually of moderate intensity, that produces maximum performance. Furthermore, this optimum level decreases as performance complexity increases. Levels of arousal above and below this optimum amount are predicted to produce inferior performance. The intuitive appeal of the inverted-U hypothesis in predicting sports performance has meant that it has formed the focal point of discussions on anxiety and performance in virtually every sport psychology textbook. However, recent conceptual developments in this area have witnessed serious questioning of the validity of the hypothesis in the sporting context (Hardy & Fazey, 1987; Jones and Hardy, 1989; Kerr, 1987; Neiss, 1988). The major criticisms include: (*a*) the failure to explain why performance is impaired at arousal levels above and below the optimum (Eysenck, 1984; Landers, 1980); (*b*) the lack of clear empirical support (Hockey, Coles & Gaillard, 1986; Naatanen, 1973; Neiss, 1988), despite the fact that it is '...nearly impossible to disprove since it would be unrealistic to expect better performance at what has been defined as the extremes of low arousal (comatose state) or high arousal (i.e. panic attack)' (Landers, 1994, p. 127); (*c*) it only relates to general effects on global performance effectiveness rather than specific effects upon information-processing efficiency (Eysenck, 1984), and is therefore incapable of explaining the complexity of the relationship between arousal and subcomponents of performance (Hockey & Hamilton, 1983); (*d*) the face validity of the shape of the curve has been questioned on the grounds that it is unrealistic to assume that once performers become overaroused and performance

declines, then a reduction in arousal to previous levels will regain optimum performance (Fazey & Hardy, 1988; Hardy, 1990; Hardy & Fazey, 1987; see later discussion on catastrophe models); (*e*) recent approaches to the arousal–performance relationship are characterized by a general dissatisfaction with the use of arousal as a unitary concept (Hockey *et al.*, 1986) due to its incapacity to account for the highly differentiated pattern of arousal accompanying the primary emotions (Posner & Rothbart, 1986). Indeed, there is convincing evidence to demonstrate that arousal is multidimensional and not unidimensional, comprising cognitive, physiological and behavioural components (Lacey, 1967; see Jones, 1990); (*f*) the semantic confusion resulting from the often synonymous use of such constructs as arousal, activation, anxiety and stress, despite the numerous theoretical distinctions that have been made among them (Gould & Krane, 1992; Jones, 1990; Jones & Hardy, 1989; Krane, 1992); (*g*) cognitive psychologists have been concerned over its behaviouristic underpinning and failure to accommodate cognitive appraisal (Gill, 1994).

A rather different general arousal-based approach which has essentially evolved from dissatisfaction with the basic tenets of the inverted-U hypothesis is that of reversal theory (Apter, 1982). This approach provides a further perspective from which to view the anxiety–performance relationship (Kerr, 1987, 1989). Reversal theory postulates that 'metamotivational states' exist together in opposite pairs and are subject to sometimes quite rapid changes or reversals in one of two directions. Much of the work on reversal theory has focused on the telic–paratelic pair, in which the telic mode is characterized by its seriousness, orientation towards a goal and arousal-avoiding properties; the paratelic mode, on the other hand, is characterized by playfulness and an activity orientation, and is generally arousal seeking. This work has been particularly interesting in the context of how sports performers experience felt arousal and hedonic tone. It is proposed that levels of generalized arousal in particular metamotivational states may be interpreted in four different ways; low arousal can be experienced as relaxation (pleasant) or boredom (unpleasant), while high arousal can be experienced as excitement (pleasant) or anxiety (unpleasant). In the telic state (in which low arousal is preferred), low arousal will be experienced as relaxation and high arousal as anxiety. In the paratelic state (in which high arousal is preferred), low arousal will be experienced as boredom and high arousal as excitement. A reversal occurs when there is a change from telic to paratelic and vice versa.

Apter & Svebak (1990) have identified two types of stress in reversal theory: 'tension-stress' occurs when there is a discrepancy between preferred and actual level of arousal; and 'effort-stress' occurs as a consequence of attempting to reduce tension-stress. It should be clear that the intervention options for performance enhancement are not merely concerned with increasing or decreasing arousal levels. Instead, they include inducing reversals from paratelic to telic in the case of tension-stress caused by low arousal, and from telic to paratelic when tension-stress is caused by high arosual. Kerr (1987) has suggested that it is possible for sports performers to induce the necessary reversals via a cognitive restructuring or imagery strategy; however, to this author's knowledge, there has been no research carried out to date to examine these proposals.

Reversal theory also distinguishes between metamotivational 'dominance' and

'state'. Metamotivational dominance, measured via the Telic Dominance Scale (TDS) (Murgatroyd, Rushton, Apter & Ray, 1978), acknowledges individuals' preferences for one metamotivational state over another. A state version of the TDS, the Telic State Measure, has also been developed. Some research has been carried out to examine these factors in sport (Kerr & Cox, 1990), but this represents only preliminary work so that a comprehensive programme of sports-specific research is required to test the principles of reversal theory (Kerr, 1990).

Reversal theory represents an interesting, and also intuitively appealing, approach which has potentially important implications for psychological interventions in sport (see Kerr, 1993) and the anxiety–performance relationship. However, it is difficult to test which accounts for the scant amount of empirical support currently available. A conceptual limitation is that it is based upon unidimensional conceptualizations of arousal and anxiety, which, as emphasized in later sections, is a rather outdated approach.

General anxiety-based approaches

One of the early, and almost inevitable, developments in competitive anxiety research was the adoption of Spielberger's (1966) state-trait approach, together with his measuring instrument, the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch & Lushene, 1970). Empirical findings suggest that the STAI may have some utility in sports settings (e.g. Klavora, 1974; Martens & Gill, 1976; Rhodes, 1980; Tenenbaum & Milgram, 1978). Much of the early work adopting this approach in sport psychology employed the state version of the STAI as a measure of a generalized, undifferentiated anxiety state. The general conclusion was that both high and low levels of state anxiety interfere with performance, so that an inverted-U relationship would appear best to describe the relationship (Spielberger, 1989). The notion of optimal anxiety states is, of course, closely akin to the basic tenets of optimal arousal theory, and it is often quite difficult to distinguish between the two.

Work on optimal anxiety states is best exemplified by the approach of Russian sport psychologist, Yuri Hanin. Hanin's (1980, 1989) social psychological perspective on the anxiety–performance relationship adopts a person–environment interaction model and employs a Russian adaptation (Hanin & Spielberger, 1983) of Spielberger *et al.*'s (1970) STAI. Hanin proposed that, via repeated observations of individuals' performance levels and associated pre-competition and performance state anxiety levels, a zone of optimal functioning (ZOF) can be identified whereby the zone is defined as a performer's mean pre-competition state anxiety score plus or minus four points. This approach has important methodological implications since it is dependent upon a repeated measures design which emphasizes within-subject variation, a factor which will receive more detailed attention later in this discussion. Some empirical support for ZOF has been forthcoming (Hanin, 1980; Morgan, O'Connor, Ellickson & Bradley, 1988), and it does make relatively precise predictions about state anxiety levels at which optimum performance is likely to occur (Gould & Krane, 1992). At this level, therefore, it provides a useful practical tool for the athlete and applied sport psychologist.

However, several criticisms can be levelled at the ZOF approach: firstly, it offers no underlying explanation; secondly, it is based upon a unidimensional as opposed

to the currently favoured multidimensional conceptualization of anxiety (see following section), although Krane (1993) and Gould, Tuffey, Hardy & Lochbaum (1993) have recently employed the multidimensional approach in examining ZOFs; and thirdly, the central measuring instrument (i.e. the STAI) is not sport specific. The non-sport-specific nature of the STAI is important since evidence from other disciplines in psychology has suggested that anxiety is situation specific and that anxiety measures should be sensitive to the unique characteristics of different situations (e.g. Mandler & Sarason, 1952; Mellstrom, Cicala & Zuckerman, 1976; Paivio & Lambert, 1959; Watson & Friend, 1969).

Responding to this weakness, Martens (1977) developed the Sport Competition Anxiety Test (SCAT), a measure of competitive trait anxiety, which demonstrated impressive psychometric properties in both laboratory and field settings and which has been used extensively in subsequent competitive anxiety research. A sport-specific state anxiety scale, the Competitive State Anxiety Inventory (CSAI), was also developed (Martens, Burton, Rivkin & Simon, 1980), and subsequent research verified that this was a more sensitive scale in the sports context than the state version of the STAI. While the use of the CSAI has not been as extensive as that of the SCAT, a number of studies have provided evidence of the significant relationship between competitive trait and state anxiety in competitive situations (e.g. Cooley, 1987; Scanlan & Lewthwaite, 1984).

Research which has employed the SCAT to examine the anxiety–performance relationship has proved less encouraging. Laboratory studies have generally shown no difference between high and low trait anxious subjects on performance (e.g. Broughton & Perlstrom, 1986; Martens, Gill & Scanlan, 1976; Murphy & Woolfolk, 1987), a finding which has been attributed to lack of precision in the measurement of performance (Martens, Burton, Vealey, Bump & Smith, 1990). Much of the work has employed general performance outcome as the dependent variable, but the little work that has examined more qualitative, process-oriented variables has proved more promising. Weinberg (1978), for example, found that high trait anxious subjects used more EMG activity before, during and after performance on a competitive throwing task. Since this represented an inefficient movement pattern for this particular task, anxiety was deemed to have a negative effect on an important process underlying performance. Field studies have also provided equivocal results. Some studies have failed to find significant relationships (e.g. McKelvie, Valliant & Asu, 1985; Thirer & O'Donnell, 1980), while a few studies have claimed to provide weak support for the inverted-U hypothesis (Sonstroem & Bernardo, 1982; Weinberg & Genuchi, 1980).

The abundance of research which has adopted the SCAT, a measure of competitive *trait* anxiety, is surprising given the popularity and acceptance of the interactional paradigm. According to this perspective, competitive trait anxiety is not predicted to influence performance directly, since performance is the result of person *and* situation factors. State anxiety should, of course, be a better predictor of performance, but the sport-specific CSAI (Martens *et al.*, 1980) has been relatively underemployed and also discouraging in this context. This does not represent a very positive picture, but is perhaps not surprising given the rather vague conceptualization of anxiety which underlies this approach. Consequently, the following section examines whether the

multidimensional anxiety-based approach, more specifically the delineation of anxiety into cognitive and somatic components, can provide any stronger clues as to the specific nature of the competitive anxiety response and its relationship to performance.

Multidimensional anxiety-based approaches

The discussion of multidimensional anxiety-based approaches forms the major focus of this paper and is divided into two sections. The first section examines literature which has addressed the multidimensional competitive anxiety response itself, while the second section considers the relationship between multidimensional competitive anxiety and performance.

The multidimensional competitive anxiety response

This section focuses on the nature of the multidimensional competitive anxiety response and specifically examines: antecedents; temporal patterning; and frequency of cognitive intrusions.

Nature of the multidimensional competitive anxiety response. Although the developments traced in the previous sections helped to advance the area, there was still a failure to keep pace with the latest developments in educational and clinical psychology which demonstrated that anxiety could be conceptualized as multidimensional in nature, comprising cognitive and somatic components (Davidson & Schwartz, 1976; Liebert & Morris, 1967). Cognitive anxiety was defined by Morris, Davis & Hutchings (1981) as 'the cognitive elements of anxiety, such as negative expectations and cognitive concerns about oneself, the situation at hand and potential consequences' (p. 541); somatic anxiety was defined as 'one's perception of the physiological–affective elements of the anxiety experience, that is, indications of autonomic arousal and unpleasant feeling states such as nervousness and tension' (p. 541). Subsequent evidence (e.g. Barrett, 1972; Morris *et al.*, 1981; Morris, Harris & Rovins, 1981; Morris & Liebert, 1973; Schwartz, Davidson & Goleman, 1978) supported this distinction, and multidimensional state (e.g. Worry-Emotionality Inventory; Morris *et al.*, 1981) and trait (e.g. Cognitive Somatic Anxiety Questionnaire; Schwartz *et al.*, 1978) scales were developed.

Somewhat belatedly, sport psychology researchers finally moved towards a multidimensional conceptualization and measurement of competitive state anxiety, culminating in the development of the Competitive State Anxiety Inventory-2 (CSAI-2) (Martens, Burton, Vealey, Bump & Smith, 1982, 1990). The CSAI-2 was originally designed to measure cognitive and somatic components. However, during the extensive validation work on this scale, a third dimension emerged which was later identified as self-confidence. This scale has formed the major measuring instrument in competitive state anxiety research since the mid-1980s, but more recent work has been devoted to developing a trait measure of multidimensional competitive anxiety. This work has culminated in the Sport Anxiety Scale (SAS) (Smith, Smoll & Schutz, 1990), which measures the tendency to experience worry, somatic reactions and concentration disruption in competitive situations. Due to its relative infancy,

there is little published research to date which has employed this scale (e.g. Krane, Joyce & Rafeld, 1994). However, the relatively impressive psychometric properties of the SAS mean that it is likely to figure prominently in future competitive anxiety research.

Before moving on to specific aspects of multidimensional competitive anxiety, it is important to address Landers' (1994) recent criticism of the partitioning of anxiety into cognitive and somatic components. Landers stated:

> Although the partitioning... once sounded appealing (Landers, 1980), fundamental conceptual problems and the lack of empirical support have greatly reduced my enthusiasm. The multidimensional model, as it has been operationalized for use in our field, promotes the separation of mind (cognitive anxiety) and body (physiological or somatic arousal/anxiety). This Cartesian dualism is no longer viewed as consistent with the findings of contemporary neuroscience (Churchland, 1989, pp. 127–128).

In forwarding such a perspective, Landers fails to acknowledge a body of literature which has supported the utility of distinguishing between cognitive and somatic anxiety components. Admittedly, the two are not totally independent, and it would be unrealistic to expect them to be, but this is not a sufficiently sound reason to abandon this approach. Indeed, there is potentially a great deal to be learned from their interplay. Also, the alternative, 'physicalist' neuroscience approach is still in its infancy and without any model that explains behaviour (Churchland, 1989). As such, it is currently incapable of any more than serving to '... provoke educated speculation' (Churchland, 1989, p. 100). This approach is unlikely to be of significant help to sport psychologists in the near future.

Landers also criticizes the multidimensional anxiety model in the context of anxiety management. The 'matching hypothesis' (Davidson & Schwartz, 1976) proposes that mental and physical relaxation techniques should be matched to the dominant anxiety symptoms experienced. Landers' case for abandoning the multidimensional approach rests upon the citation of an unpublished study which did not support the matching hypothesis. This is hardly a convincing rationale! Some support has been found for the hypothesis (Maynard & Cotton, 1993; Schwartz *et al.*, 1978), although Burton (1990) argued that the hypothesis is an over-simplification and that a multimodal approach may be more appropriate. However, this in itself does not refute the usefulness of partitioning anxiety into cognitive and somatic anxiety components. Indeed, the following sections will illustrate the utility of the distinction between cognitive and somatic anxiety in competitive anxiety research.

Antecedents of multidimensional competitive anxiety. Research in this area has probably failed to receive the attention it deserves given the potential value of such information for interventions with sports performers. A considerable literature exists on stress management techniques in sport (e.g. Burton, 1990; Mace, 1990; Meichenbaum, 1985; Smith, 1980; Suinn, 1972) which are designed to alleviate the symptoms of competitive anxiety, commonly via various relaxation techniques. In many cases, however, it might be more productive to adopt some preventative strategy which would preclude the onset of the symptoms in the first place.

Research in this area can be traced back to the late 1960s and early 1970s (e.g. Hanson, 1967; Lowe & McGrath, 1971), with work on the sources of stress in young

athletes gathering pace towards the end of the 1970s and early 1980s (Gould, Horn & Spreeman, 1983; Pierce & Stratton, 1981; Scanlan & Lewthwaite, 1984; Scanlan & Passer, 1978, 1979). Recent research has adopted the multidimensional anxiety notion and provides a more detailed perspective since it has aimed to identify the antecedents of specific types of anxiety symptoms. The antedecents of cognitive anxiety, and also those of self-confidence, are hypothesized to be those factors in the environment which are related to the athlete's expectations of success, including perception of one's own and opponent's ability. Antecedents of somatic anxiety are thought to be non-evaluative, of shorter duration and consist mainly of conditioned responses to stimuli, such as changing room preparation and pre-competition warm-up routines (Gould, Petlichkoff & Weinberg, 1984; Martens *et al.*, 1990). Findings reported by Jones, Swain & Cale (1990) from a sample of elite middle distance runners suggest that cognitive anxiety and self-confidence do share some antecedents associated with performance expectations, but that there are also factors which are unique to each. Empirical findings also support the hypothesis that cognitive and somatic anxiety have different antecedents (Gould *et al.*, 1984; Jones *et al.*, 1990).

Further findings reported by Jones, Swain & Cale (1991) suggest that the antecedents of anxiety and confidence are also a function of sex. They found that predictors of cognitive anxiety and self-confidence in females tended to be associated with personal goals and standards, while predictors of these variables in males were associated with interpersonal comparison and winning. The most recent findings suggest that anxiety antecedents differ across sport (Hanton & Jones, in press) and also as a function of skill level (Hanton & Jones, 1995). The reliability of these findings requires examination, of course, but they do point to the need for potentially very interesting research into other individual differences in anxiety antecedents.

Recent qualitative studies of the sources of stress in elite athletes (Gould, Ecklund & Jackson, 1991; Jones & Hardy, 1990; Scanlan, Stein & Ravizza, 1991) have been particularly interesting since they have 'started to unearth some of the occupational and organizational stressors that confront elite performers' (Hardy & Jones, 1994, p. 69). Such stressors include: refereeing decisions and tournament organization; coach and team-mate influences; social support, etc. Since such factors appear to be important determinants of performance, Hardy & Jones (1994) identified this area as an important priority for future research.

Further detailed study of this area is likely to aid understanding at a theoretical level as well as providing knowledge of more practical significance which would enhance the mental preparation of sports performers. In this latter respect, many of the stress management intervention strategies employed in sport are aimed at emotion-focused coping styles (cf. Jones, 1993). Further research on anxiety antecedents might serve to encourage a broader perspective on stress management strategies, and to emphasize, in particular, the potential efficacy of problem-focused coping styles (Lazarus & Folkman, 1984).

Temporal patterning of multidimensional competitive anxiety. Early studies in this area used a variety of anxiety measurements (e.g. heart rate, questionnaires, interviews) to examine the potential of the temporal patterning of anxiety as a means of distinguishing between successful and less successful, and experienced and less

experienced performers (Fenz & Epstein, 1967; Highlen & Bennett, 1979; Mahoney & Avener, 1977; Meyers, Cooke, Cullen & Liles, 1979). The findings generally show that less experienced and non-elite performers experience a steady increase in anxiety right up to and even during performance; experienced and elite performers demonstrate a similar pre-event increase, but then a reduction just prior to and during performance.

Later investigators have examined the pre-competition temporal patterning of cognitive and somatic anxiety components, and also self-confidence. The findings have been fairly consistent in the cases of the two anxiety components, in that cognitive anxiety remains relatively stable prior to competition while somatic anxiety tends to increase rapidly close to the start of the event. The findings for self-confidence, on the other hand, have shown less consistency across studies (Gould *et al.*, 1984; Jones & Cale, 1989; Parfitt & Hardy, 1987). Recent research findings have shown, however, that the patterning of the multidimensional competitive state anxiety components differs as a function of individual difference variables, including type of sport (Krane & Williams, 1987; Martens *et al.*, 1990), skill level (Martens *et al.*, 1990), sex (Jones *et al.*, 1991), gender role (Swain & Jones, 1991) and competitiveness (Swain & Jones, 1992).

The dissociation of cognitive and somatic anxiety as the event approaches supports the partitioning of the two anxiety components. However, the majority of studies have shown moderate intercorrelations (Martens *et al.*, 1990), indicating, as expected, some covariance. Some research has been conducted to investigate this relationship as a function of the proximity of competition. These studies have generally found the intercorrelations to be moderate throughout the pre-competition period (Gould *et al.*, 1984; Karteroliotis & Gill, 1987), although Swain, Jones & Cale (1990) have reported the relationship between cognitive and somatic anxiety as being low and non-significant one week before competition but becoming progressively greater as the competition approached. Further research examining the interplay of cognitive and somatic anxiety during the pre-competition period is required.

These are interesting findings which have helped to further understanding of *pre-performance* emotional states. However, it is clear that similar advancements in knowledge of patterns of anxiety *during* performance have not been forthcoming. Studies which have attempted to monitor anxiety levels during performance via retrospective self-report (Martens *et al.*, 1990; McAuley, 1985*a*) have only limited utility in this respect. Thus, further advances in the measurement of the construct are required. This is particularly evident in the case of competitive state anxiety, where the self-report measurement instruments tend to be rather time consuming to complete and difficult to administer in the phase close to the onset of competition, as they are often an unwanted distraction for the performer who is immersed in both physical and psychological preparation. Furthermore, due to obvious practical problems, there is a dearth of empirical work, and hence relatively little knowledge, about the anxiety response during performance. Thus, there is a need for shorter and less intrusive self-report measures which might more easily lend themselves for use during the period immediately preceding competition, and also during performance in those sports where it might be possible. There have been some developments in this respect. Murphy, Greenspan, Jowdy & Tammen (1989) and Hardy (in press)

have developed single-item measures of cognitive and somatic anxiety, and also self-confidence. Murphy *et al.*'s instrument, the Mental Readiness Form (MRF), requires responses on a bipolar scale. Preliminary findings have revealed correlations ranging from .59 to .63 with corresponding subscales of the CSAI-2. A modified version of the MRF reported by Krane *et al.* (1994) has revealed higher relationships. Hardy (in press) reported validity coefficients for three monopolar scales which ranged from .73 to .85. Further psychometric testing of such scales is required, but the preliminary findings are encouraging. Such measures are amenable to administration much closer to performance initiation, and possibly even during performance, than the questionnaires employed to date, as demonstrated by Krane *et al.* with softball players and Hardy with golfers.

Psychophysiological work carried out in this area in studies adopting heart rate and EEG as their central measures (e.g. Boutcher & Zinsser, 1990; Collins, Powell & Davies, 1990, 1991) offers some further encouragement. Although this approach may be somewhat limited when measuring the *precise* nature of individuals' cognitions, recent research findings from autonomic nervous system (ANS) and cerebral asymmetry studies are showing consistent differences among general emotions (Davidson, 1992; Levenson, 1992). The question of specificity of ANS activity to different emotions has been debated since the latter years of the last century (James, 1894), but recent advances in psychophysiological measurement technology have been accompanied by findings which suggest that the notion of undifferentiated ANS activity in emotion is inappropriate. Levenson (1992) noted that '... to establish specificity does not require that *every* emotion has a unique ANS signature..., but that the *same* emotions differ from others in consistent ways' (p. 24). Relatively consistent differences have been particularly evident between the negative emotions of fear and anger, including differences in diastolic blood pressure (e.g. Roberts & Weerts, 1982), hand temperature (e.g. Graham, 1962) and head temperature (Stemmler, 1989). Research findings have also shown specificity of heart rate acceleration during fear (e.g. Waters, Bernard & Buco, 1989), anger (e.g. Cohen, Izard & Simons, 1986) and sadness (e.g. Waters *et al.*, 1989), and heart rate deceleration during disgust (e.g. Klorman & Ryan, 1980). The distinctions involving negative emotions appear to be more robust than those involving positive emotions (Levenson, 1992). However, differences between positive and negative emotional configurations have also been found for some indices, including heart rate acceleration and skin conductance (e.g. Levensen, Ekman & Friesen, 1990).

The literature on hemispheric substrates of emotion is similarly encouraging (Davidson, 1992). Davidson proposed that the anterior regions of the two cerebral hemispheres are specialized for approach (positive emotion – left) and withdrawal (negative emotion – right) processes. Using EEG, several studies have shown this selective regional cortical activation to exist as a result of experimental manipulations (e.g. Davidson, Ekman, Saron, Senulis & Friesen, 1990; Ekman, Davidson & Friesen, 1990). Furthermore, individual differences in baseline frontal activation, which appear to be present within the first year of life (Davidson & Fox, 1989), have been shown to be predictors of emotions in experimental manipulations (e.g. Tomarken, Davidson & Henriques, 1990).

Another line of inquiry might delve into the startle probe response (Lang, 1985)

area. The magnitude and latency of the startle response provides an indication of emotional valence and strength associated with a particular stimulus, usually in the form of unpleasant, pleasant or neutral scenes presented on a slide. Hale & Collins (1994) have used this particular technique, accompanied by self-report and behavioural indices, in a study of aggression levels in sports performers.

The basic principles and methods involved in these approaches offer some clues as to how sport psychologists might tackle the challenge of measuring anxiety during performance, and also gain a broader perspective than self-report measures alone will allow. Indeed, a fundamental question to be addressed is how ANS, cerebral asymmetry indices, and possibly startle probe responses, covary with self-report measures of competitive anxiety, and whether the degree of covariation differs between the two components of the multidimensional anxiety model. Such research will not be simple since these are complex questions. Furthermore, all of the methods available will involve some intrusion on the performers. Thus, real-life, non-contrived competitive situations may be beyond the bounds of such investigation at the present time, although researchers should strive to achieve as much ecological validity as possible in this work.

Frequency of cognitive intrusions. Jones and associates' (Jones, 1991, in press; Parfitt, Jones & Hardy, 1990; Swain & Jones, 1993) notion of 'cognitive intrusions' has thrown further light on pre-competition anxiety states. This work has emanated from these researchers' dissatisfaction with the intensity-alone approach which has characterized the anxiety literature. Jones and colleagues suggested that researchers attempting to gain a greater understanding of competitive state anxiety can benefit from examination of dimensions other than only the 'intensity' of the response (i.e. the amount or level of anxiety) which self-report measures of anxiety commonly assess. These authors argued, in particular, for the need to incorporate the dimension of 'frequency' of competition-related cognitive intrusions, conceived of in terms of the amount of time which cognitions about a specific competitive event occupy a performer's thoughts. The notion that cognitive anxiety remains stable during the pre-competition period (see previous section) has been the subject of particular research attention in this context since the implication is that cognitive anxiety should be at the same level at, say, one week prior to competition as it is one hour before. However, this merely refers to the same 'intensity' of the cognitive anxiety response on two separate occasions and is unlikely, according to Jones and associates, to represent the same cognitive state on both occasions.

Empirical findings reported by Swain & Jones (1993) have demonstrated that although the intensity of cognitive anxiety symptoms in a sample of track and field athletes remained relatively stable during the week preceding competition, the frequency with which they experienced the symptoms increased substantially and progressively during this period. Although the intensity of the symptoms may not change, a cognitive state in which 'worries' about an upcoming event are occurring 5 per cent of the time one week before is very different from one in which they are occurring 90 per cent of the time on the day of competition.

It is clear, therefore, that the intensity-alone approach which is prevalent in the anxiety literature provides only a limited perspective on the experience of pre-competition anxiety states. The notion of frequency of cognitive intrusions provides

an avenue for further work aimed at understanding the anxiety response, but also has important practical implications for sport psychologists performing a consultative role with sports performers. Research might focus, in particular, on individual difference variables, both person and situation, which influence frequency of cognitive intrusions. An important person variable in this respect is likely to be competitive trait anxiety, with high trait anxious performers scoring higher on frequency than low trait anxious performers (cf. Borkovec, Robinson, Pruzinsky & DePree, 1983). Influential situational variables which might be examined include event importance and degree of physical threat involved.

At a more fundamental level, an intriguing, but also very tentative, proposition is that the onset of increases in physiological arousal prior to competition may be the result of the frequency of competition-related cognitive intrusions reaching some critical threshold. This is an extremely difficult question to address, of course, since such issues form the basis of a long-term conceptual divide among behavioural and cognitive psychologists (Eysenck, 1992; Lazarus, 1982; Zajonc, 1980, 1984), but is, nevertheless, a fascinating one (cf. Swain *et al.*, 1990).

Multidimensional competitive anxiety and performance

The adoption of the multidimensional approach to anxiety has led to an increasing number of studies which have attempted to examine the relationship between performance and the specific components of the competitive state anxiety response. Theoretical predictions regarding the specific relationships are that cognitive anxiety is negatively related to performance while somatic anxiety forms an inverted-U relationship with performance. Since studies which have tested these hypotheses have employed the CSAI-2, they have also tested the hypothesis that self-confidence is positively related to performance.

Research findings have proved equivocal, with little evidence of the predicted relationships, and also little in the way of explaining much of the performance variance (e.g. Barnes, Sime, Dienstbier & Plake, 1986; Gould *et al.*, 1984; Krane & Williams, 1987; Martens *et al.*, 1990). At least three weaknesses have been identified in this research which may help to explain its failure to support the theoretical predictions, and even to detect any relationships at all in some cases. Firstly, investigators have tended to rely upon between-subject, cross-sectional designs as opposed to within-subject, longitudinal designs as first advocated within the competitive anxiety literature by Sonstroem & Bernardo (1982). Secondly, investigators have tended to explore the existence of linear as opposed to curvilinear relationships, thus precluding the possibility of support for the predicted somatic anxiety–performance relationship (Gould, Petlichkoff, Simons & Vevera, 1987; Parfitt *et al.*, 1990). Finally, the performance measures (e.g. win/loss, performance times) have tended to be rather global in nature and unlikely to be sufficiently sensitive to detect statistically significant anxiety effects (Parfitt *et al.*, 1990).

Using an intra-individual design and employing polynomial regression analyses in a study of swimmers over a number of events, Burton (1988) provided support for all three predictions concerning cognitive and somatic anxiety and self-confidence. Other studies using this approach have been less successful (e.g. Bird & Horn, 1990; Caruso, Dzewaltowski, Gill & McElroy, 1990), although Gould *et al.* (1987) did

provide support for the hypothesized inverted-U relationship between somatic anxiety and performance. Thus, the findings for the separate effects of cognitive and somatic anxiety on performance have been inconsistent, leading Landers (1994), in his refutation of the partitioning of cognitive and somatic components, to conclude that the examination of separate component effects is unhelpful in aiding understanding of the anxiety–performance relationship. Such a conclusion might be a little premature since a problem he did not consider in this research was that of the performance measures which have tended to be global and to vary widely between studies, thus possibly constituting an important source of the inconsistency.

Some research has tackled this third methodological weakness and has moved away from examining global sports performance, adopting Hockey & Hamilton's (1983) approach of examining anxiety effects on subcomponents of performance (e.g. Jones & Cale, 1989, in press; Jones, Cale & Kerwin, 1988; Parfitt & Hardy, 1987, 1993; Ussher & Hardy, 1986). While some negative effects of performance anxiety in cricket batsmen have been shown on, for example, the ability to discriminate rapidly and correctly between two similar stimuli, Parfitt & Hardy (1987) showed that improvements in pattern search were associated with elevated cognitive anxiety in a sample of basketball players. Jones & Cale (1989) also reported a positive relationship between perceptual-motor speed and somatic anxiety in hockey players. This line of research has demonstrated, therefore, that competitive state anxiety does not necessarily impair performance and can, in some circumstances, enhance it. Such findings have provided the impetus for researchers in competitive anxiety to distinguish between debilitative and facilitative anxiety states.

Debilitative and facilitative competitive anxiety states. The experience of competitive anxiety has, particularly in the North American sport psychology literature, been viewed as negative and to have debilitative consequences for performance. This view is, however, at odds with a body of literature which has emanated from other areas of psychology which suggests that anxiety can sometimes have positive consequences.

Investigators have commonly labelled the entire range of emotional responses to evaluation as 'anxiety' and have not distinguished between facilitative and debilitative states. Consequently, anxiety has been employed to describe what Sarbin (1968) and Sarason (1978) viewed as an extremely broad continuum of states, ranging from 'virtual immobilization in the face of potential criticism to exhilaration at the prospect of receiving accolades' (Sarason, 1978, p. 193). The labelling of internal states in such situations has been identified as being of crucial importance in predicting behaviour (Geen, 1980). As Schachter (1964) commented, 'it could be anticipated that precisely the same state of physiological arousal could be labelled "joy" or "fury" or any of a great diversity of emotional labels, depending upon the cognitive aspects of the situation' (p. 53). More recent work supports these proposals and demonstrates that positive (activation) and negative (anxiety) components of the stress response need to be differentiated (Apter, 1982; Carver & Scheier, 1986, 1988; Hardy & Whitehead, 1984; Mackay, Cox, Burrows & Lazzerini, 1978; Neiss, 1988; Thayer, 1967, 1978).

The notion of debilitating and facilitating dimensions of the anxiety response has been prominent in the text anxiety literature. Alpert & Haber distinguished between

debilitating and facilitating anxiety as long ago as 1960 and found that a scale which measured both types of anxiety (i.e. the Achievement Anxiety Test, AAT) provided a significantly stronger predictor of academic performance than a conventional debilitating anxiety scale. Subsequent investigations employing the AAT reported by, among others, Munz, Costello & Korabek (1975), Hudesman & Wiesner (1978), Gaeddert & Dolphin (1981), Couch, Garber & Turner (1983), and Carrier, Higson, Klimoski & Peterson (1984) are all examples of studies which demonstrate the value of distinguishing between debilitating and facilitating anxiety. Wine's (1980) bidirectional model of test anxiety further supports the notion of positive and negative dimensions in arguing for this greater specificity of the state anxiety response.

Following on from this work, the notion of 'direction' of anxiety has been introduced into the sport psychology literature (Jones, 1991, in press). This refers to assessing how sports performers label the cognitive and physiological symptoms they experience on a debilitative–facilitative continuum. For example, one performer might be very concerned about an upcoming event, to the extent that s/he is worried and in a near-panic, debilitative state. Another performer who is also 'very concerned' might view such a state as very necessary since it signals the importance of the event and means that she or he will invest effort in it (cf. Eysenck, 1984), thus constituting a motivated, facilitative state. Similarly, two performers experiencing almost identical symptoms of physiological arousal prior to competition might label those symptoms at completely opposite ends of the debilitative–facilitative continuum. This process may be viewed as a further level of cognitive appraisal which has the function of interpreting the meaningfulness of the cognitive and physiological symptoms experienced following earlier appraisal of the congruence between situational demands and ability to meet those demands.

Support for the distinction between 'intensity' and 'direction' of anxiety symptoms has been provided in several recent empirical investigations. Jones & Swain (1992) found no differences on intensity of cognitive anxiety or somatic anxiety, or on direction of somatic anxiety between high and low competitive groups. However, as hypothesized, the highly competitive group reported their cognitive anxiety as more facilitative and less debilitative than the low competitive group. Jones, Swain & Hardy (1993) examined relationships between intensity and direction dimensions of competitive state anxiety, and also relationships with beam performance in a sample of female gymnasts. The results showed no differences between good and poor performance groups on cognitive and somatic anxiety intensity scores, or on somatic anxiety direction scores. However, the good performance group reported their cognitive anxiety intensity as being more facilitating and less debilitating to performance than the poor performance group. Jones, Hanton & Swain (1994) reinforced the importance of performance level as an individual difference variable in a sample of elite and non-elite swimmers. Specifically, despite no differences in the intensity of cognitive and somatic anxiety between the two groups, the elite performers interpreted both anxiety states as being more facilitative to performance than the non-elite performers. Whether such a difference is a cause or result of achieving elite status is an interesting question for future research. A further question worthy of examination is how elite performers have

acquired the cognitive skills and strategies which enable an effective coping response in high pressure situations.

In another study, Swain (1992) has reported an in-depth investigation of intensity and direction dimensions of anxiety in a longitudinal study of individual players in a university basketball team. The findings showed that different players with the same anxiety intensity scores could experience very different emotions and cognitive states, thus supporting the findings reported above. Interestingly, it was also found that the same player could have the same score on somatic anxiety, for example, before two different games, but his affective experience could be positive on one occasion but negative on the other. The complexity of this latter type of finding was partially explained by data acquired via administration of Thayer's (1978) Activation-Deactivation Checklist. This showed that a positive perception was associated with high arousal and low stress, while a negative perception of the same anxiety intensity was associated with lower arousal and higher stress. Finally, Swain & Jones (in press) have compared the relative contributions of the intensity and direction dimensions of cognitive and somatic anxiety in predicting basketball performance. Their findings showed that cognitive anxiety direction was a better predictor of performance (25 per cent of the explained variance) than cognitive anxiety intensity (18 per cent), and also that somatic anxiety direction (18 per cent) was a better predictor than somatic anxiety intensity (2 per cent). While these data still do not account for very large proportions of the performance variance, they do provide further evidence of the importance of assessing performers' perceptions and interpretations of the symptoms they are experiencing. It is likely, of course, that a state in which cognitive and physiological symptoms, however intense, are perceived as being facilitative to performance does not represent 'anxiety' at all. Instead, it will probably be labelled by the performer as 'anticipatory excitement' or being 'psyched up'. This clearly has serious repercussions for the employment of conventional questionnaire measures of competitive anxiety. For the most part, they represent merely a measure of the intensity of certain cognitive and physiological symptoms which have been labelled as anxiety by the individuals who have developed them. However, the performer's own labelling of such symptoms appears to be more important.

As identified earlier, researchers in this area need to work towards developing a more harmonious synchrony between anxiety and performance measurements. The modified CSAI-2 does not easily lend itself to such aims so that, as with the intensity of the anxiety responses, single-item measures of direction require development and employment. This work is currently being undertaken by the author and colleagues. Furthermore, the recent developments referred to earlier, in identifying EEG (Davidson, 1992) and cardiac (Levenson, 1992) markers for positive and negative emotions offer exciting possibilities for future research in this area. A fundamental question requiring attention relates to whether there are consistent differences between performers debilitated by their cognitive and physiological symptoms and performers who are facilitated by them. If this is the case, then there is huge scope for future psychophysiological research in this area.

This distinction between debilitative and facilitative anxiety represents a fertile area for further investigation into the competitive anxiety–performance relationship. Future research might examine the mechanisms via which anxiety can have positive

performance consequences. Jones *et al.* (1993) and Swain & Jones (in press) suggested that elevated cognitive anxiety may, up to a certain level, enhance performance by increasing motivation and facilitating an appropriate attentional focus in some individuals. In others, performance might be impaired as a result of cognitive resources being consumed in task-irrelevant worry (cf. Eysenck, 1992; Wine, 1980). Eysenck (1984) earlier proposed that this positive effect of anxiety is a result of effort serving as a compensatory factor which increases the attentional resources allocated to performance. Eysenck argued that as anxiety effectively reduces working memory capacity due to task-irrelevant cognitive activity or worry, it impairs processing efficiency. However, he also argued that this reduction in effective capacity can be countered by an increase in effort so that, while processing efficiency is impaired, performance effectiveness may be maintained, or even enhanced, under conditions of elevated anxiety.

A further line of future research in this area is to examine those factors which predict debilitated and facilitated anxiety states in sports performers. As in other areas of competitive anxiety, the study of individual difference, both person and situation, variables offers some interesting avenues. At the person level, Jones *et al.* (1994) proposed that performers' directional interpretations of their anxiety symptoms may be predicted by positive-negative affect (Watson & Clarke, 1984; Watson & Tellegen, 1985), with individuals high on negative affect consistently perceiving their symptoms, irrespective of intensity, as debilitative, and performers high on positive affect interpreting them as more facilitative. Indeed, initial findings have supported these proposals (Jones, Swain & Harwood, 1995). Other, closely related, variables which are likely to be important sources of variance in directional interpretations are confidence and perception of control. It is hypothesized that it is those performers who have least confidence in their ability to control both themselves and the environment who will experience debilitative anxiety symptoms (cf. Borkovec, Metzger & Prusinsky, 1986; Carver & Scheier, 1986, 1988; Eysenck, 1992; Jones & Hanton, 1994).

These predictions are included in the model in Fig. 1, which represents a speculative modification and adaptation of Carver & Scheier's (1986, 1988) work. They proposed that anxiety is facilitative provided that the individual's expectancies of being able to cope and of goal attainment are favourable; expectancies which are unfavourable, on the other hand, are associated with debilitative anxiety. In the model below, control is broadly conceptualized as the cognitive appraisal of the degree of control the performer is able to exert over both the environment and the self. Jones & Hanton's (1995) findings offer some preliminary support for the model. They examined competitive swimmers' perceptions of their ability to achieve goals they had set in an important event. There were no significant differences in the intensity of anxiety levels prior to the event between those swimmers who had negative expectations and those who had positive expectations. However, those swimmers with positive expectations reported their anxiety, both cognitive and somatic, as being more facilitative than those who had negative expectations. Jones *et al.*'s (1995) findings that trait high positive/low negative affect performers reported their anxiety as more facilitative than trait low positive/high negative affect performers suggests the importance of individual differences in the model. An

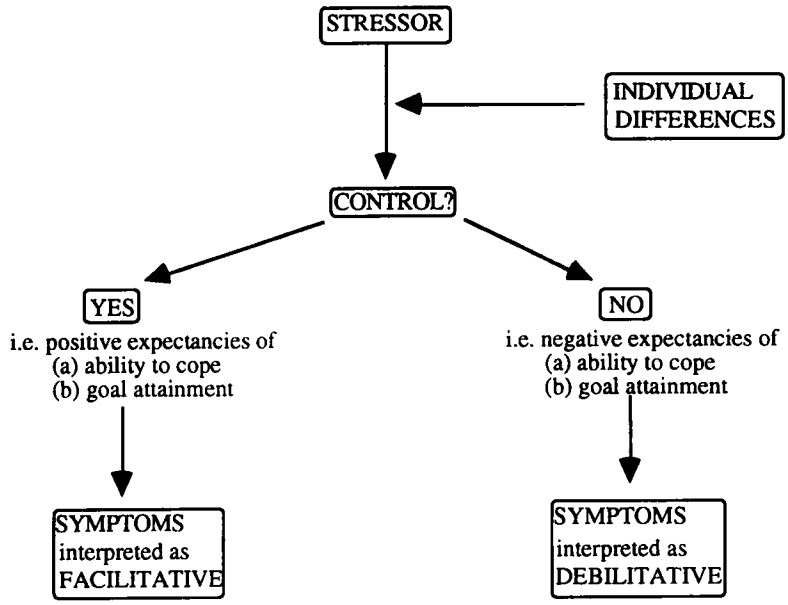

Figure 1. A control model of debilitative and facilitative competitive state anxiety.

important situational variable, or stressor, is likely to be the nature of the sport, with the likelihood being that high intensity symptoms will be interpreted as facilitative for short duration, explosive sports but debilitative for longer duration, more finely controlled skills. These proposals refer only to main effects, but the interaction of such variables represents a further question to be addressed in a programme of research in this area.

Another area of research is to examine the relationship between intensity, frequency and direction dimensions of the competitive state anxiety response. In particular, how does frequency mediate the relationship between intensity and direction? Do interpretations of symptoms change as a function of the proximity of competition? These are interesting questions which again present a stimulating challenge for sport psychologists.

Catastrophe models. The recent application to sports performance of catastrophe theory (Thom, 1975; Zeeman, 1976) by Hardy and colleagues (Fazey & Hardy, 1988; Hardy, 1990; Hardy & Parfitt, 1991) represents a further multidimensional anxiety approach and has opened up new avenues of research into the anxiety–performance relationship. They have proposed that a serious weakness with the way investigators have operationalized multidimensional anxiety theory in previous research has been the examination of separate effects of cognitive and somatic anxiety on performance, although they do not deny the existence of the two-component anxiety model. Hardy and co-workers argue, instead, that research in this area should concentrate on the interactive effects of the two modes of anxiety.

A two-dimensional catastrophe model was introduced into the sport psychology

literature by Hardy & Fazey (1987) as a result of concerns over the face validity of the predictions of the inverted-U hypothesis once arousal increases beyond the optimum level. According to the hypothesis, as arousal increases beyond the optimum level, performance declines in a symmetrical, curvilinear fashion. However, catastrophe theory, when applied to sports performance, hypothesizes that once a certain level of arousal is reached beyond the optimum level, performance will drop off in a sudden and dramatic manner onto a lower performance curve. A three-dimensional model was required to accommodate the predictions of an interactive two-component model of anxiety. Such predictions were best described using the cusp catastrophe model, which consists of a normal factor, a splitting factor and a dependent variable (Zeeman, 1976). The normal factor is the variable in which increases are associated with increases in the dependent variable. The splitting factor determines the effect of the normal factor on the dependent variable; thus, an interaction occurs between the normal and splitting variables. The bifurcation set represents an area in which two values of the dependent variable are possible, depending on whether the normal factor variable is increasing or decreasing.

In applying catastrophe theory to sports performance, Fazey & Hardy (1988) preferred to employ an objective operationalization of 'physiological arousal' as opposed to the perception of physiological arousal referred to as 'somatic anxiety'; physiological arousal represents the normal factor in the cusp catastrophe model. Cognitive anxiety represents the splitting factor and is hypothesized to mediate the effects of physiological arousal on the dependent variable, performance. The predictions of this three-dimensional model can be summarized as follows: (*a*) when cognitive anxiety is low, there will be a gentle inverted-U relationship between physiological arousal and performance; (*b*) when cognitive anxiety is very high, performance will improve as physiological arousal increases to a critical threshold, after which further increases in physiological arousal will result in a catastrophic drop from an upper to a lower performance curve. The performance curves representing the upper and lower performance surfaces are opposing curves, the upper one representing performance as physiological arousal increases and the lower one representing performance as physiological arousal decreases. This situation is referred to as 'hysteresis' and the result is a 'bifurcation set' where the same level of physiological arousal is associated with two different levels of performance, depending on whether physiological arousal is increasing or decreasing; (*c*) when physiological arousal is high, a negative correlation is predicted between cognitive anxiety and performance; (*d*) when physiological arousal is low, a positive correlation is predicted between cognitive anxiety and performance.

Although empirical investigation of the cusp catastrophe model in the sport domain is in its relative infancy, initial studies on basketball (Hardy & Parfitt, 1991), bowls players (Hardy, Parfitt & Pates, 1994) and softball players (Krane *et al.*, 1994) have offered support for some of these predictions. This perspective on the anxiety–performance relationship offers an innovative approach within the sport psychology literature and helps to account for some of the previous inconsistent findings in this area. It is particularly useful in helping to understand the positive effects of anxiety which have been found in some studies. Although the cusp catastrophe model is limited in that it does not incorporate how individuals interpret

their anxiety symptoms, the extension by Hardy (1990) of conceptual aspects to include speculation about the role of self-confidence and task difficulty in more complex, five-dimensional butterfly catastrophe models offers a possible insight. The role of self-confidence in the anxiety response and also the anxiety–performance relationship has been an issue of debate for some time. Bandura's original work on self-efficacy theory in 1977 also included proposals regarding the relationship between self-efficacy and anxiety. Specifically, Bandura argued that behavioural change is determined by efficacy expectations and that efficacy cognitions result in reduced anxiety. These proposals were in direct conflict with those of anxiety reduction theorists (Borkovec, 1976; Eysenck, 1978; Wolpe, 1978) who argued that the anxiety response is the direct cause of both efficacy expectations and behavioural change. Indeed, Eysenck (1978) referred to self-efficacy as merely an epiphenomenon or by-product of anxiety. Unfortunately, research which has compared the self-efficacy model with the alternative anxiety-based model in predicting behaviour has proved inconclusive, with neither model gaining clear support (Feltz, 1982; McAuley, 1985*b*).

Martens *et al.*'s (1990) validation work on the CSAI-2 led them to propose that self-confidence and cognitive anxiety represent opposite extremes of a cognitive evaluation continuum, thus echoing the basic principles of the debate described above but providing no hint as to any directional cause. However, Martens *et al.*'s proposal is questionable considering that the cognitive anxiety and self-confidence factors were derived from factor analyses with the purpose of identifying orthogonal factors. Also, studies which have reported correlations between these two factors generally demonstrate their relative independence, sharing less than 40 per cent common variance (e.g. Gould *et al.*, 1984; Jones & Cale, 1989; Martens *et al.*, 1990). Furthermore, recent work which has examined the pre-competition temporal patterning and antecedents of cognitive anxiety and self-confidence also suggest that these two factors are relatively independent (Jones *et al.*, 1990, 1991). Interestingly, Jones *et al.* (1993) showed that cognitive anxiety direction and somatic anxiety direction correlated more strongly with self-confidence intensity than did the intensity of cognitive and somatic anxiety. No causal or directional influences are possible, of course, but this finding does allow the intriguing proposition that self-confidence may, in some way, protect against potential debilitative anxiety effects (cf. Hardy & Jones, 1990).

While the butterfly catastrophe model supports the notion of the importance of self-confidence in determining the competitive anxiety–performance relationship, it is a very difficult model to test (see Hardy, in press). This is also true, to a lesser extent, of the (relatively) simpler cusp catastrophe model. Gill (1994) has recently expressed a lack of enthusiasm for the catastrophe model approach, criticizing its complexity and oversophistication. In arguing that the measures and procedures required to test the model are not yet available, or even imminent, Gill ignores the studies (referred to earlier) which have examined and found support for some of the predictions of the cusp catastrophe model. She further argues that it is 'incredibly limiting' (p. 24) in terms of its practical application in comparison to some other, more general models such as Lazarus' (1990, 1993) updated stress model. Gill is concerned that preoccupation with testing the complex catastrophe model could distract sport psychologists from 'real issues and behaviors of interest' (p. 24). Gill

is possibly quite correct at a practitioner level, but she fails to view the model from a more scientific perspective. Sport psychology is not merely about 'practical issues', important as they are. From an academic discipline, aetiological perspective, researchers need to develop and extend understanding of complex phenomena which often cannot be explained in simple terms. Indeed, a major problem in sport psychology until relatively recently has been a tendency to rely on general, vague and simple models which satisfy the criterion of being intuitively appealing, but are not very helpful in furthering understanding. Admittedly, unravelling and modifying the precise details of the catastrophe model approach will present a major challenge to future researchers in this area.

Conclusions

The preceding discussion may appear to have raised more questions than it has provided answers. It would be difficult to deny that this impression is, indeed, anything but true. However, such a situation serves to demonstrate that research in the area of competitive anxiety has reached an inevitable, and intriguing, stage in its development. As more knowledge and understanding has been acquired at a conceptual level, and as more advances have been made at a methodological level, so the questions being raised and addressed have become increasingly non-trivial and complex.

A primary issue in this particular area of anxiety research concerns the relative failure in predicting a substantial amount of performance variance. This is largely due to two major problems which have characterized research in competitive anxiety. The first relates to limitations of self-report anxiety measurements which stem from the relative imprecision with which competitive anxiety has been operationalized in the empirical sport psychology literature. This imprecision lies in the measurement of what are essentially cognitive and physiological symptoms which constitute a state which is deemed to reflect anxiety. However, as recent research has shown, the same symptoms can represent very different psychological states in different individuals. Thus, more work needs to be carried out to examine both the concept and the construct of competitive anxiety. This requires the development and refinement of self-report measures which more accurately reflect cognitions and emotions. Furthermore, the recent developments in identifying EEG and cardiac concomitants of positive and negative emotions should be pursued in competitive anxiety research. Such a multidimensional approach provides a source of optimism for future research. As Gill (1994) emphasizes, models are required which '... highlight *cognitive appraisal* in a *multidimensional system* of interrelated psychobiological variables' (p. 25).

The second problem is the fact that the anxiety and performance measurements have been non-synchronous. It is probably over optimistic to expect that performance will be predicted to any great extent by a measure of anxiety acquired perhaps 30 minutes previously. The major challenge confronting researchers in this area, therefore, is to develop methods of examining anxiety during performance. Again, the development and refinement of short self-report measures and employment of physiological indices offers some encouragement, although progressing beyond artificially contrived situations into real-life competitive situations will be a major challenge for researchers pursuing this psychophysiological methodology.

It is important to note, however, that it is unlikely that the achievement of the above recommendations alone will suffice, since it is also crucial to ensure that the measure of performance is a valid one. This is particularly important in the context that there are often minute distinctions (e.g. hundredths of a second) between performers. This issue has not been fully recognized or addressed within the competitive anxiety literature. Eysenck's (1984, 1992) proposal that anxiety affects processing efficiency to a greater extent than performance effectiveness means that global performance measures commonly employed may not be sufficiently sensitive to allow detection of anxiety effects. Thus, the development of standardized, reliable, ecologically valid and sensitive performance measures is required.

Also at a methodological level, there is a need for the adoption of both quantitative and qualitative research methodologies in order to provide a more detailed and clearer perspective on the experience of competitive anxiety and its effects upon performance. Qualitative methodologies have been underplayed in competitive anxiety research, although they are becoming more accepted and employed, and have provided some very informative insights (e.g. Gould, Finch & Jackson, 1993; Swain & Jones, 1993). Such an approach may be particularly valuable in the context that stress should be considered as a 'biopsychosocial' process, since everything takes place within a social context (Lazarus, 1993; Gill, 1994), as illustrated by the examples of social climate influences alluded to in the introduction to this paper. The social context in which competitive anxiety occurs has received little attention, but qualitative methods provide an important means of teasing out social influences involved in the process.

Finally, perhaps the most fundamental question of all relates to whether anxiety will ever predict a substantial portion of performance variance, or whether there are other emotions and cognitions which are more important in influencing performance (cf. Cockerill, Nevill & Lyons, 1991; Prapavessis & Grove, 1991). Tracing the changing emphasis of Lazarus' (1966, 1986, 1990, 1993) influential work is enlightening in this context. Lazarus has shifted emphasis from his early work on 'stress' to one on the more encompassing 'emotion'. According to Lazarus, examining the intensities, qualities, antecedents and processes of emotions will be more informative than focusing solely on stress (Gill, 1994). Future researchers may wish to examine the relative influence of various cognitions and emotions, such as control and confidence (Hardy & Jones, 1990; Jones & Hanton, 1995), evident in the competitive sport environment on performance. Clearly, researchers in this area view sport as more than just a game!

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References

Alpert, R. & Haber, R. N. (1960). Anxiety in academic achievement situations. *Journal of Abnormal and Social Psychology*, **61**, 207–215.

Apter, M. J. (1982). *The Experience of Motivation: The Theory of Psychological Reversals*. London and New York: Academic Press.

Apter, M. J. & Svebak, S. (1990). Stress from the reversal theory perspective. In C. D. Spielberger & J. Strelau (Eds), *Stress and Anxiety 12*. New York: Hemisphere/McGraw Hill.

Bakker, F. C., Whiting, H. T. A. & van der Brug, H. (1990). *Sport Psychology: Concepts and Applications*. Chichester: Wiley.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, **84**, 191–215.

Barnes, M. W., Sime, W., Dienstbier, R. & Plake, B. (1986). A test of construct validity of the CSAI-2 questionnaire in male elite college swimmers. *Journal of Sport Psychology*, **17**, 364–374.

Barrett, E. S. (1972). Anxiety and impulsiveness: Toward a neuro-psychological model. In C. D. Spielberger (Ed.), *Anxiety: Current Trends in Theory and Research*, vol. 1. New York: Academic Press.

Bird, A. M. & Horn, M. A. (1990). Cognitive anxiety and mental errors in sport. *Journal of Sport and Exercise Psychology*, **12**, 217–222.

Borkovec, T. D. (1976). Physiological and cognitive processes in the regulation of anxiety. In G. E. Schwartz & D. Shapiro (Eds), *Consciousness and Self-Regulation: Advances in Research*. New York: Plenum.

Borkovec, T. D., Metzger, R. L. & Pruzinsky, T. (1986). Anxiety, worry, and the self. In L. M. Hartman & K. R. Blankstein (Ed), *Perception of Self in Emotional Disorder and Psychotherapy*. New York: Plenum.

Borkovec, T. D., Robinson, E., Pruzinsky, T. & DePree, J. A. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behaviour Research and Therapy*, **21**, 9–16.

Boutcher, S. H. & Zinsser, N. W. (1990). Cardiac deceleration of elite and beginning golfers during putting. *Journal of Sport and Exercise Psychology*, **12**, 37–47.

Broughton, R. S. & Perlstrom, J. R. (1986). PK experiments with a competitive computer game. *Journal of Parapsychology*, **50**, 193–211.

Burton, D. (1988). Do anxious swimmers swim slower? Re-examining the elusive anxiety–performance relationship. *Journal of Sport and Exercise Psychology*, **10**, 45–61.

Burton, D. (1990). Multi-modal stress management in sport: Current status and future directions. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

Carrier, C., Higson, V., Klimoski, V. & Peterson, E. (1984). The effects of facilitative and debilitative achievement anxiety on notetaking. *Journal of Education Research*, **77**, 133–138.

Caruso, C. M., Dzewaltowski, D. A., Gill, D. L. & McElroy, M. A. (1990). Psychological and physiological changes in competitive state anxiety during noncompetition and competitive success and failure. *Journal of Sport and Exercise Psychology*, **12**, 6–20.

Carver, C. S. & Scheier, M. F. (1986). Functional and dysfunctional responses to anxiety: The interaction between expectancies and self-focused attention. In R. Schwarzer (Ed.), *Self-Related Cognitions in Anxiety and Motivation*. Hillsdale, New Jersey: Erlbaum.

Carver, C. S. & Scheier, M. F. (1988). A control-process perspective on anxiety. *Anxiety Research*, **1**, 17–22.

Churchland, P. S. (1989). From Descartes to neural networks. *Scientific American*, **261**, 100.

Cockerill, I. M., Nevill, A. M. & Lyons, N. (1991). Modelling mood states in athletic performance. *Journal of Sports Sciences*, **9**, 205–212.

Cohen, B., Izard, C. E. & Simons, R. F. (1986). Facial and physiological indices of emotions in mother–infant interactions. Paper presented at the meeting of the Society for Psychophysiological Research. Montreal, October.

Collins, D. J., Powell, G. E. & Davies, I. (1990). An electroencephalographic study of hemispheric processing pattern during karate performance. *Journal of Sport and Exercise Psychology*, **12**, 37–47.

Collins, D. J., Powell, G. E. & Davies, I. (1991). Cerebral activity prior to motion task performance: An electroencephalographic study. *Journal of Sports Sciences*, **9**, 313–324.

Cooley, E. J. (1987). Situational and trait determinants of competitive state anxiety. *Perceptual and Motor Skills*, **64**, 767–773.

Couch, J. V., Garber, T. B. & Turner, W. E. (1983). Facilitating and debilitating test anxiety and academic achievement. *The Psychological Record*, **33**, 237–244.

Davidson, R. J. (1992). Emotion and affective style: Hemispheric substrates. *Psychological Science*, **3**, 39–43.

Davidson, R. J., Ekman, P., Saron, C. D., Senulis, J. A. & Friesen, W. V. (1990). Approach/withdrawal

and cerebral asymmetry: Emotional expression and brain physiology. *Journal of Personality and Social Psychology*, **58**, 330–341.

Davidson, R. J. & Fox, N. A. (1989). Frontal brain asymmetry predicts infants' response to maternal separation. *Journal of Abnormal Psychology*, **98**, 127–131.

Davidson, R. J. & Schwartz, G. E. (1976). The psychobiology of relaxation and related states: A multiprocess theory. In D. I. Mostofsky (Ed.), *Behavioral Control and Modification of Physiological Activity*. Englewood Cliffs, NJ: Prentice-Hall.

Ekman, P., Davidson, R. J. & Friesen, W. V. (1990). The Duchenne smile: Emotional expression and brain physiology, II. *Journal of Personality and Social Psychology*, **58**, 342–353.

Eysenck, H. J. (1978). Expectations as causal elements in behavioural change. In S. Rachman (Ed.), *Advances in Behavioural Research and Therapy*. Oxford: Pergamon.

Eysenck, M. W. (1984). *A Handbook of Cognitive Psychology*. London: Erlbaum.

Eysenck, M. W. (1992). *Anxiety: The Cognitive Perspective*. Hove: Lawrence Erlbaum.

Fazey, J. A. & Hardy, L. (1988). The inverted-U hypothesis: A catastrophe for sport psychology. British Association of Sports Sciences Monograph 1. Leeds: The National Coaching Foundation.

Feltz, D. L. (1982). Path analysis and the causal elements in Bandura's theory of self-efficacy and an anxiety-based model of avoidance behavior. *Journal of Personality and Social Psychology*, **42**, 764–781.

Fenz, W. D. & Epstein, S. (1967). Gradients of physiological arousal in parachutists as a function of an approaching jump. *Psychosomatic Medicine*, **29**, 33–51.

Fisher, A. C. (Ed.) (1976). *Psychology of Sport*. Palo Alto, CA: Mayfield.

Gaeddert, W. P. & Dolphin, W. D. (1981). Effects of facilitating and debilitating anxiety on performance and study effort in mastery-based and traditional courses. *Psychological Reports*, **48**, 827–833.

Geen, R. G. (1980). Test anxiety and cue utilization. In I. G. Sarason (Ed.), *Test Anxiety: Theory, Research and Applications*. Hillsdale, NJ: Erlbaum.

Gill, D. L. (1994). A sport and exercise psychology perspective on stress. *Quest*, **46**, 20–27.

Gould, D., Ecklund, R. C. & Jackson, S. A. (1991). An in-depth examination of mental factors and preparation techniques associated with 1988 U.S. Olympic team wrestling success. Grant report to USA Wrestling.

Gould, D., Finch, L. M. & Jackson, S. A. (1993). Coping strategies used by national champion figure skaters. *Research Quarterly for Exercise and Sport*, **64**, 453–468.

Gould, D., Horn, T. & Spreeman, J. (1983). Sources of stress in junior elite wrestlers. *Journal of Sport Psychology*, **5**, 159–171.

Gould, D. & Krane, V. (1992). The arousal–athletic performance relationship: Current status and future direction. In T. Horn (Ed.), *Advances in Sport Psychology*. Champaign, Illinois: Human Kinetics.

Gould, D., Petlichkoff, L., Simons, J. & Vevera, M. (1987). Relationship between Competitive State Anxiety Inventory-2 subscale scores and pistol shooting performance. *Journal of Sport Psychology*, **9**, 33–42.

Gould, D., Petlichkoff, L. & Weinberg, R. S. (1984). Antecedents of temporal changes in and relationships between CSAI-2 components. *Journal of Sport Psychology*, **6**, 289–304.

Gould, D., Tuffey, S., Hardy, L. & Lochbaum, M. (1993). Multidimensional state anxiety and middle distance running performance: An exploratory examination of Hanin's (1980) Zone of Optimal Functioning Hypothesis. *Journal of Applied Sport Psychology*, **5**, 85–95.

Gowan, G. R. (1979). Bridging the gap between sport science and sport practice. In P. Klavora & J. V. Daniel (Eds), *Coach, Athlete and the Sport Psychologist*. Toronto: University of Toronto.

Graham, D. T. (1962). Some research on psychophysiologic specificity and its relation to psychosomatic disease. In R. Roessler & N. S. Greenfield (Eds), *Physiological Correlates of Psychological Disorder*. Madison: University of Wisconsin Press.

Hale, B. D. & Collins, D. J. (1994). A more objective measure of emotional response in sport: The startle probe response. *Journal of Sports Sciences*, **12**, 193.

Hanin, Y. L. (1980). A study of anxiety in sports. In W. F. Straub (Ed.), *Sport Psychology: An Analysis of Athlete Behavior*. Ithaca, NY: Movement Publications.

Hanin, Y. L. (1989). Interpersonal and intragroup anxiety in sports. In D. Hackfort & C. D. Spielberger (Eds), *Anxiety in Sports: An International Perspective*. New York: Hemisphere.

Hanin, Y. L. & Spielberger, C. D. (1983). The development and validation of the Russian Form of the

State-Trait Anxiety Inventory. In C. D. Spielberger & R. Diaz-Guerrero (Eds), *Cross-Cultural Anxiety*, vol. 12. New York: Hemisphere.

Hanson, D. L. (1967). Cardiac response to participation in Little League baseball competition as determined by telemetry. *Research Quarterly*, **38**, 384–388.

Hanton, S. & Jones, G. (1995). Antecedents of competitive state anxiety as a function of skill level in competitive swimmers. Manuscript submitted.

Hanton, S. & Jones, G. (in press). Antecedents of anxiety and confidence in elite competitive swimmers. *International Journal of Sport Psychology*.

Hardy, L. (1990). A catastrophe model of performance in sport. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

Hardy, L. (in press). A test of catastrophe models of anxiety and sports performance against multidimensional anxiety theory models using the method of dynamic differences. *Anxiety, Stress and Coping: An International Journal*.

Hardy, L. & Fazey, J. F. (1987). The inverted-U hypothesis – A catastrophe for sport psychology. Paper presented at the Annual Conference of the North American Society for Psychology of Sport and Physical Activity, Vancouver, June.

Hardy, L. & Jones, G. (1990). Future directions for research into stress in sport. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

Hardy, L. & Jones, G. (1994). Future directions for performance-related research in sport psychology. *Journal of Sports Sciences*, **12**, 61–92.

Hardy, L. & Parfitt, G. (1991). A catastrophe model of anxiety and performance. *British Journal of Psychology*, **82**, 163–178.

Hardy, L., Parfitt, G. & Pates, J. (1994). Performance catastrophes in sport: A test of the hysteresis hypothesis. *Journal of Sports Sciences*, **12**, 327–334.

Hardy, L. & Whitehead, R. (1984). Specific modes of anxiety and arousal. *Current Psychological Research and Reviews*, **3**, 14–24.

Highlen, P. S. & Bennett, B. B. (1979). Psychological characteristics of successful and unsuccessful elite wrestlers: An exploratory study. *Journal of Sport Psychology*, **1**, 123–137.

Hockey, G. R. J. & Hamilton, P. (1983). The cognitive patterning of stress states. In G. R. J. Hockey (Ed.), *Stress and Fatigue in Human Performance*. Chichester: Wiley.

Hockey, G. R. J., Coles, M. G. H. & Gaillard, A. W. K. (1986). Energetical issues in research on human information processing. In G. R. J. Hockey, M. G. H. Coles and A. W. K. Gaillard (Eds), *Energetics and Human Information Processing*. Dordrecht, The Netherlands: Martinus Nijhoff.

Hudesman, J. & Wiesner, E. (1978). Facilitating and debilitating test anxiety among college students and volunteers for desensitization workshops. *Journal of Clinical Psychology*, **34**, 485–486.

Hull, C. L. (1943). *Principles of Behavior*. New York: Appleton-Century.

James, W. (1894). What is an emotion? *Mind*, **9**, 188–205.

Jones, G. (1990). A cognitive perspective on the processes underlying the relationship between stress and performance in sport. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

Jones, G. (1991). Recent developments and current issues in competitive state anxiety research. *The Psychologist*, **4**, 152–155.

Jones, G. (1993). The role of performance profiling in cognitive behavioral interventions in sport. *The Sport Psychologist*, **7**, 160–172.

Jones, G. (in press). Anxiety and performance: Research issues and developments. In S. Biddle (Ed.), *Exercise and Sport Psychology: A European Perspective*. Champaign, Illinois: Human Kinetics.

Jones, G. & Cale, A. (1989). Relationships between multidimensional competitive state anxiety and cognitive and motor subcomponents of performance. *Journal of Sports Sciences*, **7**, 229–240.

Jones, G. & Cale, A. (in press). Goal difficulty, anxiety and performance. *Ergonomics*.

Jones, G., Cale, A. & Kerwin, D. (1988). Multidimensional competitive state anxiety and psychomotor performance. *Australian Journal of Science and Medicine in Sport*, **4**, 3–7.

Jones, G. & Hanton, S. (1995). Interpretation of anxiety symptoms and goal attainment expectations. Manuscript submitted.

Jones, G., Hanton, S. & Swain, A. B. J. (1994). Intensity and interpretation of anxiety symptoms in elite and non-elite sports performers. *Personality and Individual Differences*, **17**, 657–663.

Jones, G. & Hardy, L. (1989). Stress and cognitive functioning in sport. *Journal of Sport Sciences*, **7**, 41–63.

Jones, G. & Hardy, L. (1990). Stress in sport: Experiences of some elite performers. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

Jones, G. & Swain, A. B. J. (1992). Intensity and direction dimensions of competitive state anxiety and relationships with competitiveness. *Perceptual and Motor Skills*, **74**, 467–472.

Jones, G., Swain, A. B. J. & Cale, A. (1990). Antecedents of multidimensional competitive state anxiety and self-confidence in elite intercollegiate middle-distance runners. *The Sport Psychologist*, **4**, 107–118.

Jones, G., Swain, A. B. J. & Cale, A. (1991). Gender differences in precompetition temporal patterning and antecedents of anxiety and self-confidence. *Journal of Sport and Exercise Psychology*, **13**, 1–15.

Jones, G., Swain, A. B. J. & Hardy, L. (1993). Intensity and direction dimensions of competitive state anxiety and relationships with performance. *Journal of Sports Sciences*, **11**, 525–532.

Jones, G., Swain, A. B. J. & Harwood, C. (1995). Positive and negative affect as predictors of competitive anxiety. Manuscript submitted.

Karteroliotis, C. & Gill, D. L. (1987). Temporal changes in psychological and physiological components of state anxiety. *Journal of Sport Psychology*, **9**, 261–274.

Kerr, J. H. (1987). Structural phenomenology, arousal and performance. *Journal of Human Movement Studies*, **13**, 211–229.

Kerr, J. H. (1989). Anxiety, arousal and sport performance: An application of reversal theory. In D. Hackfort & C. D. Spielberger (Eds), *Anxiety in Sports: An International Perspective*. New York: Hemisphere.

Kerr, J. H. (1990). Stress and sport: Reversal theory. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

Kerr, J. H. (1993). An eclectic approach to psychological interventions in sport: Reversal theory. *The Sport Psychologist*, **7**, 400–418.

Kerr, J. H. & Cox, T. (1990). Cognition and mood in relation to the performance of a squash task. *Acta Psychologica*, **73**, 103–114.

Klavora, P. (1974). State anxiety and athletic competition. Unpublished doctoral dissertation, University of Alberta-Edmonton, Canada.

Klorman, R. & Ryan, R. M. (1980). Heart rate, contingent negative variation, and evoked potentials during anticipation of affective stimulation. *Psychophysiology*, **17**, 513–523.

Krane, V. (1992). Conceptual and methodological considerations in sport anxiety research: From the Inverted-U Hypothesis to Catastrophe Theory. *Quest*, **44**, 72–87.

Krane, V. (1993). A practical application of the anxiety–athletic performance relationship: The Zone of Optimal Functioning Hypothesis. *The Sport Psychologist*, **7**, 113–126.

Krane, V., Joyce, D. & Rafeld, J. (1994). Competitive anxiety, situation criticality and softball performance. *The Sport Psychologist*, **8**, 58–72.

Krane, V. & Williams, J. M. (1987). Performance and somatic anxiety, cognitive anxiety, and confidence changes prior to competition. *Journal of Sport Behavior*, **10**, 47–56.

Lacey, J. I. (1967). Somatic response patterning of stress: Some revisions of activation theory. In M. Appley & R. Trumbell (Eds), *Psychological Stress*. New York: Appleton.

Landers, D. M. (1980). The arousal/performance relationship revisited. *Research Quarterly for Exercise and Sport*, **51**, 77–90.

Landers, D. M. (1994). Performance, stress and health: Overall reaction. *Quest*, **46**, 123–135.

Lang, P. J. (1985). The cognitive psychophysiology of emotion: Fear and anxiety. In A. H. Tuma & J. D. Masen (Eds), *Anxiety and Anxiety Disorders*. Hillsdale, NJ: Lawrence Erlbaum.

Lazarus, R. S. (1966). *Psychological Stress and the Coping Process*. New York: McGraw-Hill.

Lazarus, R. S. (1982). Thoughts on the relations between emotion and cognition. *American Psychologist*, **37**, 1019–1024.

Lazarus, R. S. (1986). Stress: Appraisal and coping capacities. In A. Eichler, M. M. Silverman & D. M. Pratt (Eds), *How to Define and Research Stress*. Washington, DC: American Psychiatric Press.

Lazarus, R. S. (1990). Theory-based stress measurement. *Psychological Inquiry*, **1**, 1–13.

Lazarus, R. S. (1993). From psychological stress to the emotions: A history of changing outlooks. *Annual Review of Psychology*, **44**, 1–21.

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

Levenson, R. W. (1992). Autonomic nervous system differences among emotions. *Psychological Science*, **3**, 23–27.

Levenson, R. W., Ekman, P. & Friesen, W. V. (1990). Voluntary facial action generates emotion-specific autonomic nervous system activity. *Psychophysiology*, **27**, 363–384.

Liebert, R. M. & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports*, **20**, 975–978.

Lowe, R. & McGrath, J. E. (1971). Stress, arousal and performance: Some findings calling for a new theory. Project Report, AF 1161-67, AFOSR.

Mace, R. (1990). Cognitive behavioural interventions in sport. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

McAuley, E. (1985*a*). State anxiety: Antecedent or result of sport performance. *Journal of Sport Behavior*, **8**, 71–77.

McAuley, E. (1985*b*). Modeling and self-efficacy: A test of Bandura's model. *Journal of Sport Psychology*, **7**, 283–295.

McKelvie, S. J., Valliant, P. M. & Asu, M. E. (1985). Physical training and personality factors as predictors of marathon time and training injury. *Perceptual and Motor Skills*, **60**, 551–566.

Mackay, C. J., Cox, T., Burrows, G. C. & Lazzerini, A. J. (1978). An inventory for the measurement of self-reported stress and arousal. *Journal of Social and Clinical Psychology*, **17**, 283–284.

Maguire, J. (1993*a*). Globalization, sport development and the media/sport production complex. *Sport Science Review*, **2**, 29–47.

Maguire, J. (1993*b*). Globalization, sport and national identities: 'The empires strike back'? *Sport and Leisure*, **16**, 293–322.

Mahoney, M. J. & Avener, M. (1977). Psychology of the elite athlete: An exploratory study. *Cognitive Therapy and Research*, **1**, 135–141.

Mandler, G. & Sarason, S. B. (1952). A study of anxiety and learning. *Journal of Abnormal and Social Psychology*, **47**, 166–173.

Martens, R. (1971). Internal–external control and social reinforcement effects on motor performance. *Research Quarterly*, **42**, 107–113.

Martens, R. (1974). Arousal and motor performance. In J. H. Wilmore (Ed.), *Exercise and Sport Sciences Review*, vol. 2. New York: Academic Press.

Martens, R. (1977). *Sport Competition Anxiety Test*. Champaign, IL: Human Kinetics.

Martens, R. (1987). *Coaches Guide to Sport Psychology*. Champaign, IL: Human Kinetics.

Martens, R., Burton, D., Rivkin, F. & Simon, J. (1980). Reliability and validity of the Competitive State Anxiety Inventory (CSAI). In C. H. Nadeau, W. C. Halliwell, K. M. Newell & G. C. Roberts (Eds), *Psychology of Motor Behavior and Sport – 1979*. Champaign, IL: Human Kinetics.

Martens, R., Burton, D., Vealey, R. S., Bump, L. A. & Smith, D. E. (1982). Competitive State Anxiety Inventory-2. Symposium conducted at the Annual Conference of the North American Society for Sport and Physical Activity. College Park, Maryland, May.

Martens, R., Burton, D., Vealey, R. S., Bump, L. A. & Smith, D. E. (1990). Development and validation of the Competitive State Anxiety Inventory-2 (CSAI-2). In R. Martens, R. S. Vealey & D. Burton (Eds), *Competitive Anxiety in Sport*. Champaign, Illinois: Human Kinetics.

Martens, R. & Gill, D. L. (1976). State anxiety among successful and unsuccessful competitors who differ in competitive trait anxiety. *Research Quarterly*, **47**, 698–708.

Martens, R., Gill, D. L. & Scanlan, T. K. (1976). Competitive trait anxiety, success–failure and sex as determinants of motor performance. *Perceptual and Motor Skills*, **43**, 1199–1208.

Martens, R. & Landers, D. M. (1970). Motor performance under stress: A test of the Inverted-U hypothesis. *Journal of Personality and Social Psychology*, **16**, 29–37.

Maynard, I. W. & Cotton, P. C. J. (1993). An investigation of two stress management techniques in a field setting. *The Sport Psychologist*, **7**, 375–387.

Meichenbaum, D. (1985). *Stress Inoculation Training*. New York: Pergamon.

Mellstrom, M., Cicala, G. A. & Zuckerman, M. (1976). General versus specific trait anxiety measures in the prediction of fear of snakes, heights, and darkness. *Journal of Consulting and Clinical Psychology*, **44**, 83–91.

Meyers, A. W., Cooke, C. J., Cullen, J. & Liles, L. (1979). Psychological aspects of athletic competitors: A replication across sports. *Cognitive Therapy and Research*, **3**, 361–366.

Michener, J. (1976). *Sports in America*. New York: Random House.

Morgan, W. P., O'Connor, P. J. O., Ellickson, K. A. & Bradley, P. W. (1988). Personality structure, mood states, and performance in elite male distance runners. *International Journal of Sport Psychology*, **19**, 247–263.

Morris, L. W., Davis, M. A. & Hutchings, C. H. (1981). Cognitive and emotional components of anxiety: Literature review and a revised Worry-Emotionality Scale. *Journal of Educational Psychology*, **73**, 541–555.

Morris, L. W., Harris, E. W. & Rovins, D. S. (1981). Interactive effects of generalized and situational expectancies on cognitive and emotional components of social anxiety. *Journal of Research in Personality*, **15**, 302–311.

Morris, L. W. & Liebert, R. M. (1973). Effects of negative feedback, threat of shock and trait anxiety on the arousal of two components of anxiety. *Journal of Counselling Psychology*, **20**, 321–326.

Munz, D. C., Costello, C. T. & Korabek, K. (1975). A further test of the inverted-U relating achievement anxiety and academic test performance. *Journal of Psychology*, **89**, 39–47.

Murgatroyd, S., Rushton, C., Apter, M. J. & Ray, C. (1978). The development of the Telic Dominance Scale. *Journal of Personality Assessment*, **42**, 519–528.

Murphy, S. M., Greenspan, M., Jowdy, D. & Tammen, V. (1989). Development of a brief rating instrument of competitive anxiety: Comparison with the CSAI-2. Paper presented at the Association for the Advancement of Applied Sport Psychology conference, Seattle, September.

Murphy, S. M. & Woolfolk, R. L. (1987). The effects of cognitive interventions on competitive anxiety and performance on a fine motor skill accuracy task. *International Journal of Sport Psychology*, **18**, 152–166.

Naatanen, R. (1973). The inverted-U relationship between activation and performance: A critical review. In S. Kornblum (Ed.), *Attention and Performance IV*. New York: Academic Press.

Neiss, R. (1988). Reconceptualizing arousal: Psychobiological states in motor performance. *Psychological Bulletin*, **103**, 345–366.

Paivio, A. & Lambert, W. E. (1959). Measures and correlates of audience anxiety. *Journal of Personality*, **27**, 1–17.

Parfitt, C. G. & Hardy, L. (1987). Further evidence for the differential effect of competitive anxiety upon a number of cognitive and motor sub-systems. *Journal of Sports Sciences*, **5**, 62–63.

Parfitt, C. G. & Hardy, L. (1993). The effects of competitive anxiety on memory span and rebound shooting tasks in basketball players. *Journal of Sports Sciences*, **11**, 517–524.

Parfitt, C. G., Jones, G. & Hardy, L. (1990). Multidimensional anxiety and performance. In G. Jones & L. Hardy (Eds), *Stress and Performance in Sport*. Chichester: Wiley.

Pierce, W. J. & Stratton, R. K. (1981). Perceived sources of stress in youth sports participants. In G. C. Roberts & D. M. Landers (Eds), *Psychology of Motor Behavior and Sport – 1980*. Champaign, IL: Human Kinetics.

Posner, M. I. & Rothbart, M. K. (1986). The concept of energy in psychological theory. In G. R. J. Hockey, M. G. H. Coles & A. W. K. Gaillard (Eds), *Energetics and Human Information Processing*. Dordrecht, The Netherlands: Martinus Nijhoff.

Prapavessis, H. & Grove, J. R. (1991). Precompetitive emotions and shooting performance: The mental health and zone of optimal function models. *The Sport Psychologist*, **5**, 223–234.

Rhodes, D. L. (1980). Mens sana, corpore sano: A study of the effect of jogging on depression, anxiety and self-concept. Unpublished doctoral dissertation, Duke University. *Dissertation Abstracts International*, **41**, 1500A.

Roberts, R. J. & Weerts, T. C. (1982). Cardiovascular responding during anger and fear imagery. *Psychological Reports*, **50**, 219–230.

Sarason, I. G. (1978). The Test Anxiety Scale: Concept and research. In C. D. Spielberger & I. G. Sarason (Eds), *Stress and Anxiety*, vol. 5. Washington, DC: Hemisphere.

Sarbin, T. R. (1968). Ontology recapitulates philology: The mythic nature of anxiety. *American Psychologist*, **23**, 411–418.

Scanlan, T. K. & Lewthwaite, R. (1984). Social psychological aspects of competition for male youth sport participants: 1. Predictors of competitive stress. *Journal of Sport Psychology*, **6**, 208–226.

Scanlan, T. K. & Passer, M. W. (1978). Factors related to competitive stress among male youth sport participants. *Medicine and Science in Sport*, **10**, 103–108.

Scanlan, T. K. & Passer, M. W. (1979). Sources of competitive stress in young female athletes. *Journal of Sport Psychology*, **1**, 151–159.

Scanlan, T. K., Stein, G. L. & Ravizza, K. (1991). An in-depth study of former elite figure skaters: 3. Sources of stress. *Journal of Sport and Exercise Psychology*, **13**, 103–120.

Schachter, S. (1964). The interaction of cognitive and physiological determinants of emotional state. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology*, vol. 1. New York: Academic Press.

Schwartz, G. E., Davidson, R. J. & Goleman, D. J. (1978). Patterning of cognitive and somatic processes in the self-regulation of anxiety: Effects of meditation versus exercise. *Psychosomatic Medicine*, **40**, 321–328.

Smith, R. E. (1980). A cognitive-affective approach to stress management training for athletes. In C. H. Nadeau, W. R. Halliwell, K. M. Newell & G. C. Roberts (Eds), *Psychology of Motor Behavior and Sport*. Champaign, Illinois: Human Kinetics.

Smith, R. E., Smoll. F. L. & Schutz, R. W. (1990). Measurement and correlates of sport-specific cognitive and somatic trait anxiety: The Sport Anxiety Scale. *Anxiety Research*, **2**, 263–280.

Sonstroem, R. J. & Bernardo, P. (1982). Intraindividual pregame state anxiety and basketball performance: A re-examination of the inverted-U curve. *Journal of Sport Psychology*, **4**, 235–245.

Spence, J. T. & Spence, K. A. (1966). The motivational components of manifest anxiety: Drive and drive stimuli. In C. C. Spielberger (Ed.), *Anxiety and Behavior*. New York: Academic Press.

Spielberger, C. D. (1966). Theory and research on anxiety. In C. D. Spielberger (Ed.), *Anxiety and Behavior*. New York: Academic Press.

Spielberger, C. D. (1989). Stress and anxiety in sports. In D. Hackfort & C. D. Spielberger (eds), *Anxiety in Sports: An International Perspective*. New York: Hemisphere.

Spielberger, C. D., Gorsuch, R. L. & Lushene, R. L. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists.

Stemmler, G. (1989). The autonomic differentiation of emotion revisited: Convergent and discriminant validation. *Psychophysiology*, **26**, 617–632.

Suinn, R. (1972). Behavior rehearsal training for ski racers: Brief report. *Behavior Therapy*, **3**, 210–212.

Swain, A. B. J. (1992). Competitive state anxiety: Towards a clearer understanding. Unpublished doctoral thesis, Loughborough University, England.

Swain, A. B. J. & Jones, G. (1991). Gender role endorsement and competitive anxiety. *International Journal of Sport Psychology*, **22**, 50–65.

Swain, A. B. J. & Jones, G. (1992). Relationships between sport achievement orientation and competitive state anxiety. *The Sport Psychologist*, **6**, 42–54.

Swain, A. B. J. & Jones, G. (1993). Intensity and frquency dimensions of competitive state anxiety. *Journal of Sports Sciences*, **11**, 533–542.

Swain, A. B. J. & Jones, G. (in press). Explaining performance variance: The relative contribution of intensity and direction dimensions of competitive state anxiety. *Anxiety, Stress and Coping: An International Journal*.

Swain, A. B. J., Jones, G. & Cale, A. (1990). Interrelationships among multidimensional competitive state anxiety components as a function of the proximity of competition. *Perceptual and Motor Skills*, **71**, 1111–1114.

Tenenbaum, G. & Milgram, R. M. (1978). Trait and state anxiety in Israeli student athletes. *Journal of Clinical Psychology*, **34**, 691–693.

Thayer, R. E. (1967). Measurement of activation through self-report. *Psychological Reports*, **20**, 663–678.

Thayer, R. E. (1978). Toward a psychological theory of multidimensional activation (arousal). *Motivation and Emotion*, **2**, 1–34.

Thirer, J. & O'Donnell, L. A. (1980). Female intercollegiate athletes trait anxiety level and performance in a game. *Perceptual and Motor Skills*, **50**, 18.

Thom, R. (1975). *Structural Stability and Morphogenesis*. New York: Benjamin-Addison Wesley.

Tobias, R. (1980). Individual differences and the response to evaluative situations. In I. G. Sarason (Ed.), *Test Anxiety: Theory, Research and Applications*. Hillsdale, NJ: Erlbaum.

Tomarken, A. J., Davidson, R. J. & Henriques, J. B. (1990). Resting frontal brain asymmetry predicts affective responses to films. *Journal of Personality and Social Psychology*, **59**, 791–801.

Ussher, M. H. & Hardy, L. (1986). The effect of competitive anxiety on a number of cognitive and motor subsystems. *Journal of Sports Sciences*, **4**, 232–233.

Waters, W. F., Bernard, B. A. & Buco, S. M. (1989). The Autonomic Nervous System Response Inventory (ANSRI): Prediction of psychophysiological response. *Journal of Psychosomatic Research*, **33**, 347–361.

Watson, D. & Clarke, L. A. (1984). Negative Affectivity: The disposition to experience aversive emotional states. *Psychological Bulletin*, **96**, 465–490.

Watson, D. & Friend, R. (1969). Measurement of social-evaluative anxiety. *Journal of Consulting and Clinical Psychology*, **33**, 448–457.

Watson, D. & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*, **98**, 219–235.

Weinberg, R. S. (1978). The effects of success and failure on the patterning of neuromuscular energy. *Journal of Motor Behavior*, **10**, 53–61.

Weinberg, R. S. (1979). Anxiety and motor performance: Drive theory versus cognitive theory. *International Journal of Sport Psychology*, **10**, 112–121.

Weinberg, R. S. & Genuchi, M. (1980). Relationship between competitive trait anxiety, state anxiety and golf performance: A field study. *Journal of Sport Psychology*, **2**, 148–154.

Wine, J. D. (1980). Cognitive-attentional theory of test anxiety. In I. G. Sarason (Ed.), *Test Anxiety: Theory, Research and Applications*. Hillsdale, NJ: Erlbaum.

Wolpe, J. (1978). Self-efficacy theory and psychotherapeutic change: A square peg for a round hole. In S. Rachman (Ed.), *Advances in Behavioural Research and Therapy*. Oxford: Pergamon.

Yerkes, R. M. & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology and Psychology*, **18**, 459–482.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist*, **35**, 151–175.

Zajonc, R. B. (1984). On the primacy of affect. *American Psychologist*, **39**, 117–123.

Zeeman, E. C. (1976). Catastrophe theory. *Scientific American*, **234**, 65–82.

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