

Perceived Control of Anxiety and Its Relationship to Self-Confidence and Performance

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This study examined performers' retrospective explanations of the relationship between anxiety symptoms, self-confidence, and performance. Interviews were used to determine how the presence of symptoms and the accompanying directional interpretation affected performance in six elite and six subelite swimmers. Causal networks revealed that perceived control was the moderating factor in the directional interpretation of anxiety and not the experience of anxiety symptoms alone. Symptoms perceived to be under control were interpreted to have facilitative consequences for performance; however, symptoms not under control were viewed as debilitating. Increases or decreases in self-confidence were perceived to improve or lower performance. Findings reveal how cognitive and somatic information was processed, what strategies were adopted, and how this series of events related to performance.

Key words: debilitating, elite, facilitative, subelite

In recent years, the study of the relationship between competitive anxiety and sporting performance has received a considerable amount of research attention and theoretical refinement (see Woodman & Hardy, 2001 for review). This is hardly surprising on two related counts. First, elite sports men and women are required to produce optimal performances in anxiety-producing situations. Second, consultant psychologists' efforts are frequently devoted to designing interventions to aid coping under these circumstances. Therefore, it is critical that mental preparation strategies are based on a sound theoretical understanding of the relationship between anxiety and performance.

Arousal models in the form of drive theory and the inverted-U hypothesis (see Jones, 1995) dominated the early literature examining the anxiety-performance relationship. Subsequently, the division of anxiety into cognitive and somatic components (e.g., Davidson & Schwartz, 1976) led to a multidimensional approach and develop-

ment of the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump, & Smith, 1990). The anxiety-performance hypotheses generated following the CSAI-2's development predicted a negative linear relationship between cognitive anxiety and performance, an inverted-U with somatic anxiety, and a positive relationship with self-confidence (Martens et al., 1990). However, the empirical research examining the anxiety-performance relationship has provided inconsistent findings, resulted in lower than expected amounts of variance, and largely been unsuccessful in explaining *why* or *how* anxiety may influence performance. Indeed to date, researchers in sport psychology have devoted their attentions to identifying the "shape" of the relationship between anxiety and performance as opposed to why anxiety influences performance in a certain direction.

To elaborate briefly, initial studies investigating the anxiety-performance relationship encountered problems attributed to between-participant cross-sectional designs, and the use of global performance measures (Burton, 1988). Subsequently, researchers' adopted intraindividual designs with greater success (Burton, 1988; Edwards & Hardy, 1996; Swain & Jones, 1996) and pursued different theoretical approaches to gain a greater understanding of competitive anxiety, including, for example, catastrophe models (Hardy, 1990) and directional interpretations (Jones, 1991, 1995).

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Catastrophe models advocated that research should concentrate on the interactive and not additive effects of the subcomponents of anxiety on performance (e.g., see Hardy & Fazey 1987; Hardy, 1990, 1996a, 1996b). The cusp model proposes that under conditions of high physiological arousal elevated cognitive anxiety will debilitate sporting performance, whereas increases in cognitive anxiety under conditions of low arousal can be beneficial to performance. Indeed, Edwards and Hardy (1996), Hardy and Parfitt (1991), Hardy, Parfitt, and Pates (1994), and Krane, Joyce, and Rafeld (1994) provided empirical support for these predictions. A further development of the catastrophe approach was the introduction of the five dimensional butterfly model, which proposed that self-confidence moderates the effects of symptoms associated with competitive anxiety on performance (Hardy, 1996b).

One dimension not incorporated within catastrophe models is that of directionality. Jones (1991, 1995) proposed an important development when he highlighted that the CSAI-2 only measures the "intensity" of symptoms purported to signify the presence of anxiety and not individuals' interpretations of thoughts and feelings as being facilitative or debilitative to performance. Empirical studies examining competitiveness (Jones & Swain, 1992), performance (Jones, Swain, & Hardy, 1993; Swain & Jones, 1996), the antecedents of competitive anxiety (Hanton & Jones, 1997), gender differences (Perry & Williams, 1998), the temporal patterns of the anxiety response (Wiggins, 1998), and the use of psychological skills (Fletcher & Hanton, *in press*) have provided support for the distinction between intensity and direction. Research comparing elite and subelite performers is of particular relevance to this study (Jones, Hanton, & Swain, 1994; Jones & Swain, 1995). Although these studies have consistently revealed no significant differences between the groups in anxiety intensity, the elite performers have reported significantly more facilitative interpretations of cognitive and somatic symptoms. In addition, the elite performers reported significantly greater levels of self-confidence when compared to their subelite counterparts. Finally, in an attempt to highlight one possible antecedent of directional interpretations, Jones (1995) and Jones and Hanton (1996) argued that confidence and perceptions of control may be important variables and proposed a control model based on Carver and Scheier's (1986, 1988) work. The control model hypothesized that performers who have the most confidence in their ability to control themselves and the environment (e.g., goal attainment expectations) will experience facilitative interpretations, whereas those who have less control will experience debilitative interpretations of anxiety.

Despite these advances, research in this area still needs to address *why* anxiety appears to affect performance in a certain direction (i.e., by uncovering the underlying mechanisms involved) of which Eysenck and Calvo's (1992) processing efficiency theory offered one

possible explanation. This approach suggests the importance of motivation and effort in compensating for high cognitive anxiety in maintaining and improving task performance when individuals believe themselves to have a moderate probability of succeeding.

The purpose of this study, therefore, was to investigate elite and subelite swimmers' retrospective perceptions and causal beliefs about the link between anxiety symptoms and performance and the underlying mechanisms involved (e.g., perceived control and directional interpretations). Consistent with a number of recent studies advocating alternative approaches to establish detailed information (e.g., Gould, Eklund, & Jackson, 1993; Gould, Jackson, & Finch, 1993; Hanton & Jones, 1999a) the present study adopted a qualitative approach. Specifically, interviews were used to probe performers' perceptions of the relationship between anxiety and performance. The findings, which may provide an insight into how sports performers process cognitive and somatic information, the strategies they adopted in consequence, and the perceptions of how these affect confidence and performance, have implications for researchers and practitioners alike.

Method

Participants

Consistent with qualitative methodologies (Lincoln & Guba, 1985; Patton, 1990) purposive sampling was used to select study participants. Twelve male competitive swimmers were informed of the nature of the study and invited to take part, all of whom agreed. The participants, categorized as six elite and six subelite, ranged in age from 19 to 28 years (elite $M_{age} = 23.66$ years, $SD = 3.2$; subelite $M_{age} = 21.14$ years, $SD = 1.17$). The criteria for elite were that participants had competed internationally at major championships, such as the Olympic Games, European Championships, and World Championships. The subelite criteria defined that individuals could range from county to district standards (equivalent to state honors) but not exceed national standards. Written informed consent was obtained prior to participation, and confidentiality was assured throughout.

Interview Guide

Following procedures successfully adopted by Gould et al. (1993) and Hanton and Jones (1999a), an interview guide was developed for the study. Both open and closed sport-specific questions were generated from empirical findings examining the anxiety-performance relationship¹. The interview schedule was pilot tested on a sample of experienced swimmers ($n = 6$), and minor refinements were made.

The full interview schedule comprised four sections. The first included introductory comments, the purpose and definitions, and a declaration of the individual's rights. Two general instructions were then provided. First, questions were asked about competing at recent important events, but if recall was problematic participants were asked to take their time and, if they still could not remember, to tell the interviewer rather than guess². The second instruction explained that participants could draw on all aspects of their experience as a competitive swimmer to create an overall framework. To help establish the study parameters, Section 2 of the interview guide asked questions relating to the swimmers' training regimes, competitive history, and personal reasons for competing. The third and main section of the interview comprised general and specific questions related to the swimmer's thoughts and feelings prior to competition and the effects of these symptoms on performance. Here, participants were asked to identify, describe, and explain their cognitive and somatic experiences prior to competition and address issues such as perceived control and the direction of these symptoms for performance. Further, participants were asked to try to explain why the identified symptoms were perceived as positive or negative and how they influenced performance (i.e., provide a causal explanation). The final section discussed the interview experience and any issues that may have been overlooked.

Procedure

A copy of the interview guide was sent to each participant 1 week before the meeting time, and participants were asked to reflect on their answers in preparation for the interview. The interviews were conducted within 2 weeks of the swimmers' most recent important competition, which helped protect against possible training effects in that all participants were in low distance and intensity phases. A structured format was used for the interview schedule in which each participant was taken through an identical set of questions asked in a similar way.

All the interviews were conducted face-to-face and away from the competitive environment to minimize the possible situational influences such as the competition atmosphere. The interviewer, who was an international competitive swimmer, possessed the ability to converse at a sport-specific level and empathize with the participant. The interviews lasted approximately 60 min, were tape recorded in their entirety, and transcribed verbatim, yielding over 300 single-spaced typed pages.

Analysis

The swimmers' causal beliefs regarding the anxiety-performance relationship were displayed via causal networks, defined by Miles and Huberman (1994) as:

A display of the most important independent and dependent variables in a field study and of the relationships among them (shown by arrows). A causal network, to be useful, must have associated analytic text describing the meaning of the connections among factors (p.153).

Causal networks are, therefore, visual representations of the data that bring together the variables and, with accompanying narrative, explain the emerging relationships into a coherent picture. They contain streams, which are unbroken chains of variables, and consist of multiple channels that either lead in different directions or end up at the same place via a different route (Miles & Huberman, 1994).

The data analysis procedures adopted in this study incorporated a number of steps:

1. The authors studied the transcripts to ensure content familiarity.
2. They identified causal streams in the form of quotations from the transcripts, specifically identified and coded by sentiments (raw data quotations) such as: "When I experience self doubts I use certain strategies (e.g., rationalization) which blocks out the doubts. The result is more control, which is positive and leads to greater confidence and performance."
3. They developed separate deductive networks for each skill level group and recorded the frequency of each stream.
4. They conducted deductive analysis to verify that all themes were present.
5. Researcher bias was controlled using consensus validation. Each investigator independently identified the streams and discussed the networks until they reached agreement. An independent, experienced qualitative researcher, familiar with the competitive anxiety literature, was used for confirmation on all networks (i.e., that the maps reflected the sentiments contained within the transcripts).
6. The maps were sent to participants, whose comments regarding their accuracy were solicited. Participants all confirmed that the networks accurately reflected their precompetition experiences.

Results

Four causal streams were constructed from the transcripts for both skill level groups. The networks are presented by simultaneously examining the responses from both the elite and subelite performers for cognitive (see Figures 1 and 3, Streams A and C) and somatic symptoms (see Figure 2 and 4, Streams B and D). This resulted in four conceptual frameworks that depict the reported effects of the anxiety symptoms on performance³. The frameworks consist of two major elements: (a) a set of vari-

ables linked together by a series of arrows illustrating the relationship direction; and, (b) for each of the variables a percentage of the number of participants from each group who identified the symptoms and their perceived effects on performance⁴. Where two or more different symptoms led to an identical experience, the percentage is presented in bold text illustrating that the percentage emanated from more than one symptom. The networks are accompanied by a descriptive summary of the findings to enable the reader to compare between the two forms of display. Quotations from the transcripts are also included to clarify analysis points. For the purpose of the results, each causal stream for the elite group is compared to its counterpart for the subelite group.

Figures 1–4 display the data in a consistent pattern, suggesting an increase in symptom intensity within the last hour before competition (cognitive or somatic), identification of the actual symptoms experienced, the swimmer's personal explanation of these symptoms, the level of perceived control felt, the resultant directional interpretation of the symptoms (facilitative or debilitating), and, finally, the swimmer's belief of how these affected self-confidence and performance.

Network 1: Cognitive Symptoms and Increased Performance

Causal Stream A for Elite Swimmers. Cognitive symptoms believed to increase self-confidence and improve swimming performance are presented in Figure 1. These symptoms were appraised by the swimmers, perceived to be under control, interpreted as facilitative, which increased confidence and perceived to increase performance. The two explanations that emerged included the thoughts and concerns (e.g., "concerns about the competition," 67%) associated with previous good performances (33%), which increased focus and motivation (33%). One swimmer remarked, "I have these concerns every time I swim well; this motivates me to do the best I can and helps me to focus on what I need to do." The second explanation, unique to the elite group, resulted from thoughts that caused the individuals to adopt a strategy to overcome the negative cognitions. The symptoms were initially considered detrimental, but the consequences of experiencing them were ultimately interpreted as being facilitative to performance. "Self-doubts" (50%) and "worried about reaching your goal" (83%) resulted in the activation of learned strategies, such as rationalization and relaxation (50% and 83%, respectively) that blocked out the nega-

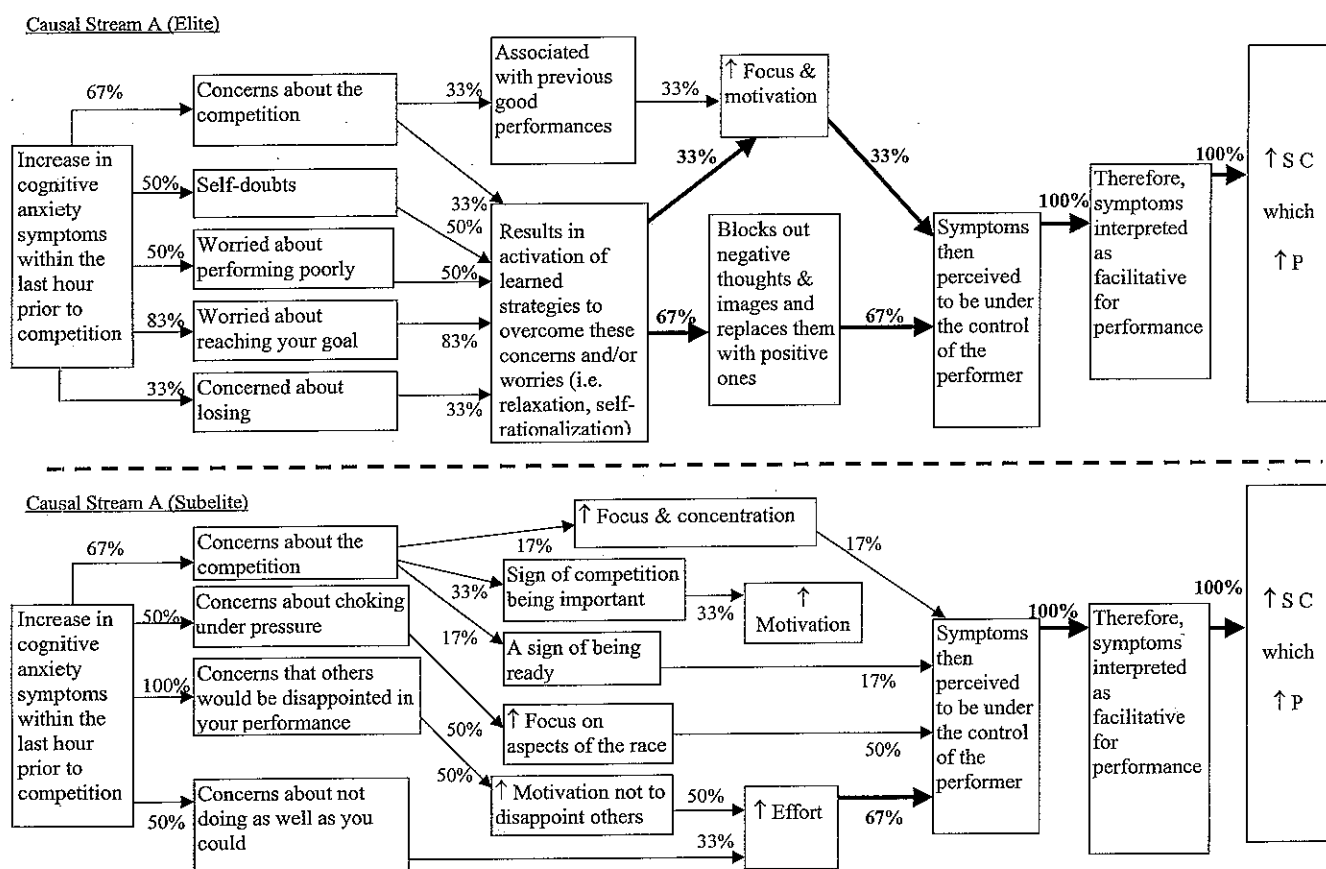


Figure 1. Causal network 1: Cognitive symptoms and increased performance.

tive thoughts and images, and replaced them with positive thoughts (67%). For example:

Having concerns or worries leads me to think, "Why am I sitting here and what am I doing here," this causes me to check to see that I am in the right mode to compete at my best. So if I am tense or something like that, then being concerned will help me notice that I am tense, and I will make myself relax or visualize the race in a relaxed manner, which helps me to relax.

Causal Stream A for Subelite Swimmers. Cognitive symptoms processed, deemed to be under control, and interpreted as positive by the subelite group leading to greater confidence and performance also resulted in two categories of reasoning. The first was seen as a sign that the swimmer perceived the competition as important. "Concerns about the competition" (67%) was taken as a sign that the competition was important (33%), which appeared to motivate the swimmer (33%) to perform well. These participants reported that the meaning of "concerns about the competition" was, "...it's important; you are concentrating and

motivated and not just jumping in there unprepared." Second, they explained that thoughts or worries caused them to be motivated to try harder so that they would not let themselves or others down. "Concerned that others would be disappointed in performance" (50%) appeared to increase motivation not to disappoint other individuals (50%), and this resulted in an increase in effort (50%). For example, one swimmer pointed out, "You don't want to let your parents, coach, team mates down, and these concerns cause me to take action so I won't let them down."

Causal Network 2: Somatic Symptoms and Increased Performance

Causal Stream B for Elite Swimmers. Figure 2 displays Stream B, where somatic symptoms within personal control were interpreted as facilitative and believed to improve confidence and swimming performance. Within this stream, two attributions emerged for the perceived increase in performance. First were the feelings explained physiologically. "Relaxed body" (100%) was interpreted as allowing the stroke to flow and the body to take over automatically (100%), thereby increasing efficiency (83%). One swimmer commented:

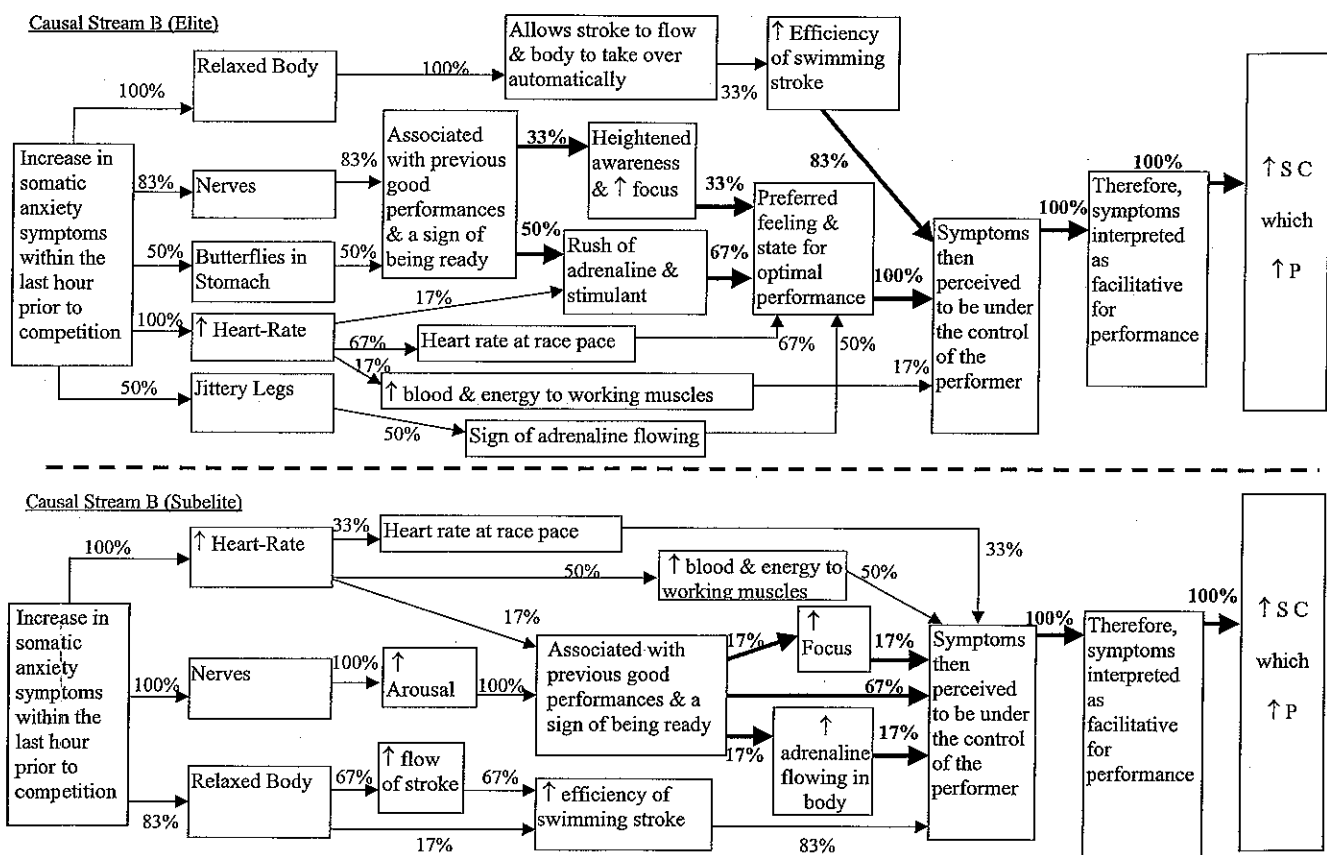


Figure 2. Causal network 2: Somatic symptoms and increased performance.

When your body is relaxed, you will have more energy in the last part of the race, because you will not have wasted it by forcing the stroke at the start of the race. So you swim more efficiently throughout the race.

Second, feelings that had been experienced in previous good performances were viewed as a sign that preparation had been successful. "Nerves" (83%) and "butterflies in the stomach" (50%) were associated with previous performance success and a sign of readiness (83% and 50%, respectively). This was considered to create either heightened awareness and increased focus (33%) or stimulate the performer with a rush of adrenaline (50%). In all cases, this was reported as the preferred state for optimal performance. For example, as one swimmer suggested, "I don't really know how they (i.e., "butterflies in the stomach") physically effect me, but in all my best swims I have experienced them, so I associate them with being ready to go."

Causal Stream B for Subelite Swimmers. Similar to the elite group, the subelite group disclosed two explanations for the somatic symptoms that were seen to be controlled, interpreted as facilitative, elevating confidence levels, and increasing performance. First, swimmers provided a physiological reason why certain feelings could be beneficial. "Increased heart rate" (100%) was identified and interpreted as raising blood and energy to the working muscles (50%) or elevating the heart rate to race pace (33%). As one swimmer described it:

You are looking to get your heart rate up to near maximum, and if your heart rate is already up there, then when you dive in to swim, you've only got 40 beats to go to get it to maximum. So it will get there faster and you will perform better by being at maximum speed quicker.

Second, feelings associated with previous good performances were viewed as a sign that performance would be successful. "Nerves" (100%) caused an increase in arousal (100%), which was associated with previous success and taken as a sign of readiness (100%). Explanations included, "It (i.e., the nerves) is just a feeling that I am ready for the race; it causes me to think about the race and so I get focused and wound up and alert."

Causal Network 3: Cognitive Symptoms and Decreased Performance

Causal Stream C for Elite Swimmers. Figure 3 presents the cognitive symptoms participants deemed to be outside their personal control, interpreted as debilitating, as resulting in lower confidence levels, and decreasing performance. The differing reasons for these events included

concerns or doubts that increased negative thoughts and images and, subsequently, decreased focus. For example, "self-doubts" (100%) was reported as causing an increase in negative thoughts and images (100%), which resulted in decreased focus (100%). A typical comment was:

It [self-doubts] puts the thought in your head that you are not going to reach your goal, and once there are any negative thoughts, then you under-perform. It shifts away from yourself and on to other things, distractions.

Also, symptoms that were seen to have an adverse physical effect on performance were perceived by the swimmers to cause them to think too much about specific aspects of the race. This forced them to mentally progress through these parts of the race, thereby not allowing the body to "take over automatically." "Concerns about choking under pressure" (83%) resulted in overthinking (83%), such as hitting the wall exactly. This caused the execution of these movements to be forced or restricted in some way (83%). One swimmer pointed out:

When I am concerned about getting a good finish, I think, which hand will I finish with.... I'm thinking too much about which hand should hit the wall, and I force my stroke and think about how to pull through the water. This causes me to try too hard, and my stroke slips.

Causal Stream C for Subelite Swimmers. Within Stream C, two reasons emerged for a perceived lack of control, a negative direction, lower confidence, and, ultimately, decreased performance. The first consisted of concerns, doubts, or worries causing the swimmers to think about factors that could go wrong, thereby increasing the possibility of a negative state. For example, "self-doubts" (100%), and "worried about performing poorly/reaching your goal" (83%) resulted in more negative thoughts and images (67%). A typical sentiment was, "I feel that if I am at my best then I wouldn't have self-doubts. Therefore, if I have self-doubts, then I am not at my best, and I believe it will effect my performance in a negative way."

Second, the swimmers suggested certain symptoms resulted in negative physical consequences for performance in that concerns led to thinking too hard about certain aspects of the race, resulting in other parts of the race being neglected and inhibiting automatic performance. "Concerns about choking under pressure" (67%) and "concerns about losing" (100%) resulted in thinking too intensely about specific race processes (67%). The swimmers saw the execution of these movements as forced or restricted in some manner (100%) or neglected other aspects of the race (33%). One swimmer claimed:

I usually try to concentrate on the whole race and not specific aspects, so thinking about hitting the turn on a 50 free correctly, causes me to think about not hitting it and makes me neglect other areas of my race.

Causal Network 4: Somatic Symptoms and Decreased Performance

Causal Stream D for Elite Swimmers. An adverse physical effect on performance was reported as the first attribution for lack of control, a negative interpretation, low confidence, and poor performance. Symptoms such as "body feeling tight or tense" (100%) was perceived as a lack of relaxation (100%). This appeared to restrict the swimming technique by causing the swimmer to overforce the stroke, therefore, not allowing natural movement (100%). One comment was:

If your body is tight, then it would restrict your stroke, and then you have to force your stroke rather than letting it flow. This wastes energy; your body knows what to do, and if it is tight then you are not letting it do that.

Feelings that the swimmers had not encountered in past performances were also offered as a sign that their preparation had not been successful. Participants felt this led them to think about what could have gone wrong with their preparation, causing negative thoughts to occupy their minds. "Stomach sinking" (83%) was a feeling the elite group felt was not associated with previous good performances (50%), and they perceived this caused an increase in negative thoughts and images (50%). One reason offered was, "It [stomach sinking] is something that is alien to me when I swim well, so if I get it, I know that I not going to swim well, things have gone wrong somewhere."

Causal Stream D for Subelite Swimmers. Similar to the elite group, the subelite swimmers provided two reasons for the relationship between somatic symptoms and decreased performance. The first reason they reported was inhibiting swimming performance, because they believed there was a physiological reason why certain feelings could lower performance. Among all the subelite swimmers interviewed, they thought feelings of "tension or tightness" (100%) caused the "shoulders to tighten" (67%) and and, as a result, restricted movement. A typical comment was, "It [body feeling tense] affects my flexibility, I lose it in my shoulders, so my agility in the water and around the turns,

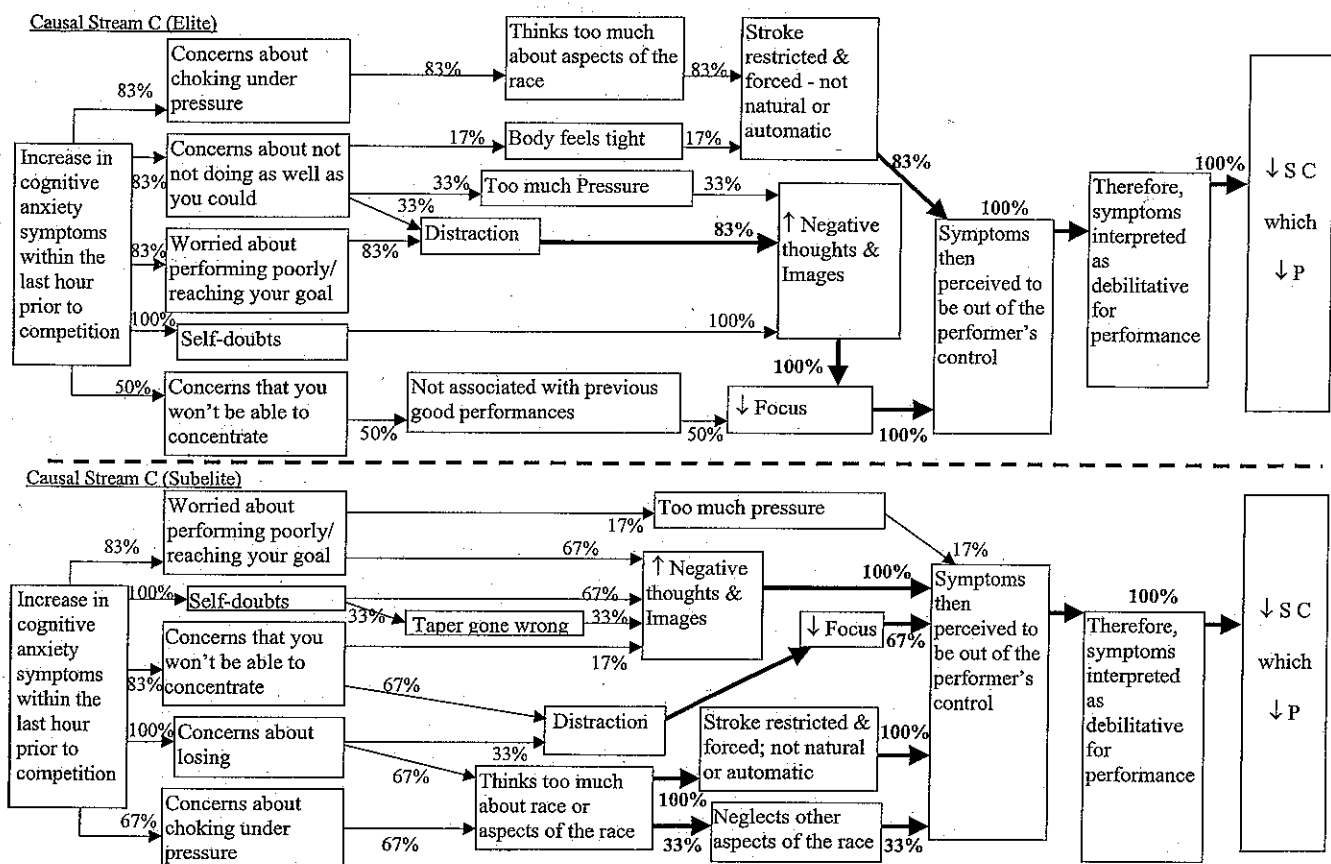
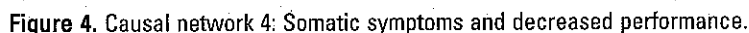


Figure 3. Causal network 3: Cognitive symptoms and decreased performance.

cilitative or debilitating toward performance. Cognitive and somatic symptoms deemed under personal control appeared to consistently lead to a positive directional interpretation, increased self-confidence, and, ultimately, a perception that performance would be enhanced. This was the case if the swimmers believed there was a rational reason why these thoughts or feelings could improve performance or if they associated the symptoms with previous sporting success. These symptoms resulted in an increase in positive thoughts, focus, and motivation that raised confidence levels and were seen to increase performance. In contrast, cognitive and somatic symptoms perceived to be outside the performers' control appeared to lead to debilitating interpretations and lower self-confidence and were viewed as having a negative effect on performance. The swimmers suggested that there was an explanation why certain thoughts and feelings hindered performance and viewed such symptoms as an indication that preparation had been flawed or unsuccessful in some manner.

Jones's (1995) control model proposed that symptoms are interpreted as positive, provided the individual's expectancies of ability to cope and goal attainment were favorable. Expectations that are unfavorable are associated with debilitating perceptions of anxiety. Jones and Hanton

The purpose of this study was to uncover performers' causal beliefs and explanations of the relationship between anxiety symptoms and sporting performance. Findings indicated that perceived control was a moderating variable in the resulting directional interpretations as fa-



(1996) offered support for this model and revealed that swimmers with positive expectations showed no significant differences in the intensity levels of anxiety compared to performers who had negative expectations prior to competition. However, swimmers who thought they could achieve their goals reported both cognitive and somatic anxiety components as being more facilitative than individuals with negative expectations. The findings from the present investigation support and extend Jones's (1995) control model by offering potential explanations of the underlying mechanisms involved. Specifically, symptoms can have a facilitative effect on performance, provided the individual develops attributions that result in heightened perceived control. In contrast, unwanted thoughts and feelings not associated with previous good performances or those that distract the individual result in low perceived control leading to a negative direction and finally lower confidence and performance. This finding has important applied implications for consultants regarding the content of interventions in pressure situations.

Control, in Jones's model (1995), was conceptualized as the cognitive appraisal of the degree of certainty the performer can exert over both the environment and the self. Swimming is an individually oriented, closed-skill task, and this may explain why perceived control over the anxiety symptoms was an important factor. Therefore, an individual who perceives control over thoughts and feelings that influence performance should have a greater expectancy of a successful outcome than an individual who perceives no control over his or her mental state prior to competition.

There is a growing body of literature suggesting that high anxiety intensities can be beneficial to sports performance (e.g., see Eysenck & Calvo, 1982; Hardy, 1996b). However, previous empirical "direction" studies have only reported the mean values for anxiety subcomponents and therefore, valuable data may have been lost, particularly with reference to facilitative interpretations in subelite groups. Accepting that direct causality cannot be inferred from a qualitative study of this nature, this design has allowed for a more "fine grained" insight into the anxiety-performance relationship and shed more light on how cognitive and somatic information is processed in performers of different skill levels. Specifically, both groups experienced anxiety symptoms that were perceived as facilitating performance by increasing focus, arousal, and motivation, or preparing the body to perform optimally (i.e., increased energy to the working muscles). Similarly, symptoms seen to debilitate performance were experienced by both the groups and perceived as causing an increase in self-doubts, negative thoughts, and images that decreased focus and self-confidence. A certain degree of caution should, however, be exercised in interpreting the study findings due to the retrospective nature of participants' responses and the sample size in this study.

Although both the elite and subelite groups perceived selected symptoms in a similar fashion, the effects

and explanations of others differed markedly. The subelite participants reported that thoughts and concerns about letting themselves or others down when under control improved performance by causing them to increase their effort to avoid disappointing themselves or others (e.g., parents, coaches, team mates). This explanation was unique to the subelite swimmers and supports Eysenck and Calvo's (1992) position, which proposed that worry can lead to increased motivation to improve performance to avoid adverse symptom effect (e.g., negative evaluation by others). The elite swimmers reported a unique attribution for positive interpretations of cognitive anxiety explaining how concerns, doubts, and worries perceived under control were viewed initially as negative but could trigger strategies such as rationalization and relaxation, allowing them to overcome the negative cognitions. Swimmers achieved this by blocking out the negative thoughts and images and replacing them with positive ones, a process perceived to enhance self-confidence and performance. These findings support Hanton and Jones (1999a), who discovered that elite swimmers developed strategies over time to interpret prerace symptoms as facilitative and also that they adopted a refined prerace routine to rationalize thoughts and feelings into a positive state. Further, implementing the findings into a single-participant design intervention study, Hanton and Jones (1999b) successfully restructured participants' debilitating interpretations, which led to an improvement in confidence and performance. Jones et al. (1994) suggested that "elite performers who do experience debilitating anxiety symptoms possess an effective cognitive strategy for maintaining confidence levels" (p. 662). The results of this study appear to support these sentiments; however, whether such skills are the cause or result of achieving elite status cannot be addressed in the context of the present study. Further, whether elite and subelite performers evaluate competitive performances differently, potentially due to experiential factors, is an uncertain issue. Future research needs to investigate the person and situational individual differences under which performers of all skill levels may interpret cognitive symptoms (e.g., concern) as facilitative on one occasion but in a negative manner on another. These areas, although conceptually and methodologically challenging, present researchers with avenues for future study.

Turning to the self-confidence findings within this study, it was interesting to note that, in support of Bandura (1982), self-confidence invariably followed an individual's interpretation of anxiety symptoms. Further, studies using the CSAI-2 have generally supported the hypothesized positive relationship between self-confidence and performance (e.g., Burton, 1988; Jones et al., 1993; Martens et al., 1990). The butterfly catastrophe model proposed by Hardy (1990) attempted to explain the role of self-confidence in the anxiety-performance relationship. According to Hardy (1990), self-confidence moderates the effects

of cognitive anxiety and physiological arousal on performance by increasing the probability that cognitively anxious performers will be able to tolerate higher levels of arousal before experiencing a decrement in performance. Indeed, offering support for catastrophe proposals, the participants in this study explained how symptoms combined interactively to result in either performance increases or decreases. The findings of Hardy's (1996a) study suggested that self-confidence may be one of the most powerful qualities elite performers possess. Additionally, Jones and Hanton (in press) maintain that participants who experience anxiety and confidence simultaneously may still perform successfully, while the presence of anxiety without the accompanying feelings of confidence may result in performance decrements. Interestingly, the present findings suggest that experiencing anxiety symptoms in conjunction with confidence was perceived to have a major influence on performance outcome. Elite and subelite swimmers consistently reported that experiencing symptoms but with control increased self-confidence and improved performance, while a reduction in confidence contributed to a decrease in performance.

Previous research on Jones's (1995) control model has not specifically addressed self-confidence; however, according to Carver and Scheier (1988):

The person who expects to be able to cope, who is sufficiently confident of being able to complete the action, responds to anxiety arousal with new renewed effort. When this person's attention is self-directed, the result is enhanced persistence and even enhanced performance. The person who has serious doubts about being able to cope and the expectation of a bad outcome, is likely not to persist in the face of anxiety arousal. This person is more likely to experience an impulse to disengage (p. 18).

The practical implications of this study emphasize that experiencing anxiety symptoms is not necessarily debilitating to performance. In addition, thoughts and feelings viewed as negative can, under certain conditions (i.e., perceived personal control), have a facilitative effect on performance. Consequently, it is important for athletes to learn to control prerace states through techniques such as cognitive restructuring, relaxation, and imagery as well as controlled activation or "psych-up" strategies. This would allow performers to precisely manipulate cognitive and somatic symptoms to individually preferred preevent states, thus maintaining high levels of control, facilitative directional interpretations, and enhanced self-confidence. It also appears that elite and subelite performers tend to respond to anxiety symptoms differently, and this needs to be taken into account by sport psychology practitioners and coaches (cf., Fletcher & Hanton, in press; Jones

et al., 1994). Further, an understanding of why and how specific symptoms influence performance would give greater insight into preparing individual athletes for important competitions.

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Notes

1. A copy of the interview guide is available from the author(s).
2. No participants experienced recall problems during the interviews
3. Due to the direction of the relationship, the maps are best interpreted from left to right.
4. For each network, the following abbreviations were used: ↑ = increased; ↓ = decreased; SC = self-confidence; and P = performance.

Authors' Notes

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EMG Power Frequency Spectrum Shifts During Repeated Isokinetic Knee and Arm Movements

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Key words: athletes, dynamic muscle fatigue

Currently, spectral alternations of the electromyogram (EMG) signal are used to study muscle fatigue. Under isometric conditions, the correlation of fatigue and shift of the power spectrum toward lower frequencies are well documented (Lindstrom, Magnusson, & Petersen, 1970). The work on assessing EMG power frequency spectral changes under dynamic situation has started. Gerdle, Elert, and Henriksson-Larsen (1989) investigated mechanical performance, EMG activity, perception of fatigue, and their relationships during repeated isokinetic shoulder flexion performed with maximal effort. They concluded that changes in the mean power frequency, for one muscle or several muscles together, parallel the mechanical fatigue. A number of studies concerning repeated maximal dynamic contractions of the shoulder muscles have demonstrated a steep parallel decrease in mechanical performance and mean power frequency during the initial 40–70 contractions (the fatigue phase) followed by a stable level (the endurance phase; Elert & Gerdle, 1989; Fugl-Meyer, Gerdle, Eriksson, & Jonsson, 1985; Gerdle et al., 1989). However, all these studies were done on nonathletes and to the author's knowledge, no similar studies have been done on well trained athletes who had received systematic muscle training to resist muscle fatigue.

Coaches and sports scientists had studied muscle fatigue response during repetitive dynamic contractions, as muscle fatigue might be one of the factors to limit sport

performance. Therefore, this study investigated the interrelationships of muscle mechanical performance and EMG power frequency spectrum (mean power frequency, MPF) during repeated isokinetic knee extension and elbow flexion performed with maximal effort in an athletic group.

Method

Participants

All participants were scholarship athletes at the Hong Kong Sports Institute, the elite training center in Hong Kong. Their sports were soccer, squash, rowing, and windsurfing. All were members of their respective national teams of Hong Kong during the testing period and had received systematic training for more than 3 consecutive years. A total of 18 athletes participated in this study (men: $n = 12$; M height = 168.8 cm, $SD = 3.6$; M body mass = 64.9 kg, $SD = 11.5$; M age = 22.8 years, $SD = 3.7$; women: $n = 6$; M height = 167.8 cm, $SD = 2.8$; M body mass = 58.5 kg, $SD = 9.1$; M age = 22.8 years, $SD = 2.6$).

Procedure

One week before testing, all participants had one session in the Human Performance Laboratory of Hong Kong Sports Institute to become accustomed to the testing procedures and try on the isokinetic loading dynamometer Cybex 6000 (Cybex Corporation, Ronkonkoma, NY). Torque and angle calibration of Cybex 6000 were done before each test session according to the manufacturer's recommendation. The Cybex 6000 provided the researcher and clinician with consistent measurement of peak torque, work, and power for knee extension and elbow flexion during isokinetic concentric contractions, as the intramachine correlation of Cybex 6000 was above 0.90 (Bandy & McLaughlin, 1993). Li, Wu, Maffuli, Chan, and

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