Introduction

I participate in athletics and 2 years ago I represented the north west of England in the U15 pentathlon. Since then I have been concentrating on shot putt much more because I find the skill that is required to perform a shot turn is immense; to gather the maximum momentum in a short distance but have the control not to fall out of the circle is a masterpiece of discipline and practice.

I shall investigate how arousal affects performance of a shot putter. "Arousal is a physiological state of alertness and anticipation which prepares the body for action" – Barbara Woods (2001).

However, it's true that over-arousal can be lethal to performance; it can lead to anxiety and incorrect performance. Arousal had influenced me negatively as overly low levels will lead to sloppy performance and being overanxious can lead to fouling out the front of the circle; as has happened in the past. Concluding the study I hope to understand anxiety better and learn to regulate it during competition to give me the best chance of performing well.

I must investigate:

- How cognitive and somatic anxiety affects arousal.
- If the catastrophe theory holds true for shot putt, and the level of effect on extroverts and introverts.
- Mental preparation and techniques used to control levels of arousal and anxiety.

The study will be conducted over 6 athletics meets. From it I will be able to conclude how arousal affects the performance of different types of person and personality.

In order to complete this research I have compiled a table of all the sources of information I plan on using.

Source of Info	**Obtained from**	**Topic**	**Deadline**	**Completion Date**
Textbooks	Obtain info from library and A Level textbook	Arousal.	On going	
Internet	Home or in school library	Definitions, any other information I cannot find in textbooks.		
People	School /Teachers	Any specific material.		
Athletes	Bournemouth Athletics Club	Arousal. Give out questionnaires. Main source of data		

The following table shows all the parts of this research, describes them and states the deadlines.

Section of Assignment	**Task**	**Deadline**
Introduction	Clear indication of the factor that will be improved. WHY it has been chosen. HOW the study will be carried out event.	Monday 17th September
Review of Literature	Present all relevant information from a variety of sources. Including other examples from different sports. Relate it to my chosen.	Monday 15 October
Application of Performance	Present the gathered data from field work carried out (over a period of 6 meets) and refer to the review of literature to highlight areas also related to my own experience.	Tuesday 4th December
Conclusions	Discuss the evidence found. Clear conclusions. Highlight what improvements have been made to performance.	
Completion date	Include bibliography and appendixes. Front cover page. Hand in!	Friday 14th December

Review of Literature

Somatic anxiety is "Anxiety demonstrated by actual physiological responses such as increased heart rate and sweating." Oxford University Press.
Cognitive anxiety is "Anxiety as perceived by the individual in terms of how the individual feels about a situation." Oxford University Press.

According to the **Optimum Arousal Theory** (Yuri Hanin, 1980) each athlete has an optimal arousal level at which he will perform best. Refer to appendix 5.

Yerkes-Dodson (1908) theory is given in appendix 5.

Woods 1998 disputed this theory and stated that it did not account for cognitive anxiety and "only applies to a performer who is not worried". Publius Syrus once said "The bow too tensely strung is easily broken." This can be directly applied to this theory when referring to over-arousal.

Drive Theory (Clark Hull 1943) which is explained in appendix 1. This can be seen in the professional world where the shot putter would usually be doing fast, jerky movements, pumping his arms and shouting or jeering; this is done to increase arousal, to get hyped up then all this tension is released in the effort of the putt.

The two above theories are too simplistic and so the **Multi-dimensional Anxiety Theory** (McGrath, 1970) was introduced; it relates to cognitive and somatic anxiety. Refer to appendix 5.
It implies that once I start putting the performance should improve as the event progresses as the performer gets more used to the action within the event; this is assuming the cognitive anxiety is constant. This theory was backed up by Richards (1995) (Appendix 4) for mountain biking, Dunn (1999) & later with Syrotuik (2003) who researched hockey players' cognitive anxiety.

The catastrophe theory relates cognitive anxiety, psychological arousal and performance; (appendix 3). This theory was applied by P. Schwenkmezger and L. Laux (1980) when investigating professional women's handball.

Techniques have been developed to establish a balance between over and under arousal, this is **Mental Imagery** is analyzed in appendix 5.

Another method used to reduce arousal is **Meditation for Relaxation**
A number of people involved in sports psychology believe that meditation can be useful in getting maximum performance from an athlete (Syer & Connolly, 1984). Refer to appendix 5 for definitions.

If the performer is under-aroused he would need to use self-talk to convince himself that he will succeed or get his coach to talk to him. Performing short sprints or jumps would excite the body and elevate heart rate and readiness; this tells the body to get ready for action.

Optimal levels of arousal and stimulation are central to Eysenck's (1967) theory of introversion – extraversion and Zuckerman's theory of sensation seeking (Zuckerman, 1969b, 1984a). Explanation follows in appendix 5.

Given that the optimal performance level for shot putt is high this theory suggests that the extrovert would need little arousal alteration as he is naturally highly aroused however the introvert would need more arousal alteration as his natural arousal levels are low. This can be seen in mountain biking for example (Richards 1995); where the performer also needs high arousal levels, the arousal alteration would be the same for shot putt.

Application to Performance

My research suggests that success in shot putt could be influenced by personality type (introvert / extrovert), skill and ability.

The section above mentions that introverts need a lower level of arousal in order to reach optimal performance levels and extroverts need a much higher level of arousal to reach the same level. However, because the event is a quick and simple one the arousal should be higher than most other events. My research implies that introverts need less arousal to reach optimal performance *in shot putt* and extroverts need more arousal even before the event, this is due to the recorded SCAT and STAI results.
I investigated cognitive anxiety as it has the greatest effect on performance; the way to decrease cognitive could be through calming techniques (relaxation/meditation), listening to favorite music, talking to friends or deep breathing.

I must consider how cognitive arousal is affected; it is affected by the importance of event to the athlete and their own self-confidence during the event. It was shown by Lowe (1973) in his study of baseball players that during an important game their heart rates were higher than usual; he found that the more important the event the higher the heart rate was. I have done state anxiety tests in non-competition and competition states which suggest this theory can also be applied to shot putt; results are in columns 2 and 3 of the results table, and explained there.

The second reason for high cognitive anxiety is their self-confidence and perception of self when considering anxiety. Hardy (1933) [who was supported by Jones (1996) on basketball] did a study that showed gymnasts who perceived anxiety as a good thing had levels which were perceived as lower (to the gymnast) and those who perceived it as being bad felt the opposite. So in shot putt I asked the athlete what they thought about anxiety levels and later compared the results to their extrovert / introvert test. (Refer to results page) This relates to Hanin (1980) who realized that personality is a factor when considering anxiety.

When considering Wiggins and Brustad (1996) who introduced the thought that cognitive state anxiety is dependant upon self-confidence; I can take into account STAI and SCAT tests (explained in appendix 3) and levels of arousal before and after a successful performance. The findings were linked to how extroverted the athletes were; the results were congruent with Eysenck's (1967) and (Zuckerman, 1969b, 1984a) theories. Where a sensation seeking extrovert is more inclined to have a higher arousal level prior to and during competition whereas with the introvert the opposite would be observed; this can be applied to shot putt and is shown in my results by extroverts having a higher SCAT result than introverts.

To assess whether a person has a high or low level of anxiety I will give out the STAI (student state trait anxiety inventory) (developed by Spielberger et al 1970) and the Student Sport Competitive Anxiety Test (SCAT) which will tell me the anxiety levels of athletes in general.

The findings obtained from this research can be applied to other aspects of my sport also, in all throwing and jumping events this should hold true. The elite power athlete needs relatively high arousal levels to perform well (relative to 3000m).

Conclusions and Evaluations

From my research I found that anxiety can be beneficial or detrimental to performance; it all depends upon the athlete. However, high cognitive anxiety can have a detrimental effect on performance if too high, this agrees with Catastrophe Theory (Hardy et al 1987). Somatic anxiety can be beneficial, however I must consider if the performer is introverted or extroverted; the extrovert will definitely benefit from a higher somatic anxiety (given that, when comparing, all other factors are kept the same). I can conclude this from my results. If the level of arousal rises too high the performance will decrease as stated Zuckerman (1991). Somatic anxiety cannot be controlled therefore I have to alter cognitive anxiety; Cox (1986) proved this also in the study on volleyball players. Some somatic anxiety is always good unless the player has very high cognitive anxiety levels.

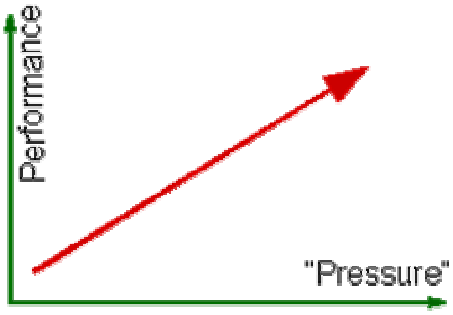
In order to decrease cognitive anxiety each player must consider the techniques that work for them and use those techniques when they begin to worry. The techniques would have to be experimented with, and the times of use determined, some athletes would need to have higher levels of cognitive anxiety at the start of the competition and others would need it higher at the end so they can put maximal effort into the last effort (e.g. sprint finish). For example, in my case (extrovert – SCAT score 26) I want to build up my levels of arousal and cognitive anxiety in order to be able to release it all at the end in the last two putts of the competition, if it goes well I feel relaxed finishing the event.

I began by trying to determine 3 objectives (page 1of the report); I have covered all 3 of them. The benefits to me follow: PB improved by 0.29m and now I know when regulate cognitive anxiety. Also since I can now analyze situations more accurately, I can control the level of anxiety and arousal a lot better. Also this research ties in directly with my A2 level curriculum and has re-enforced my knowledge about this subject.

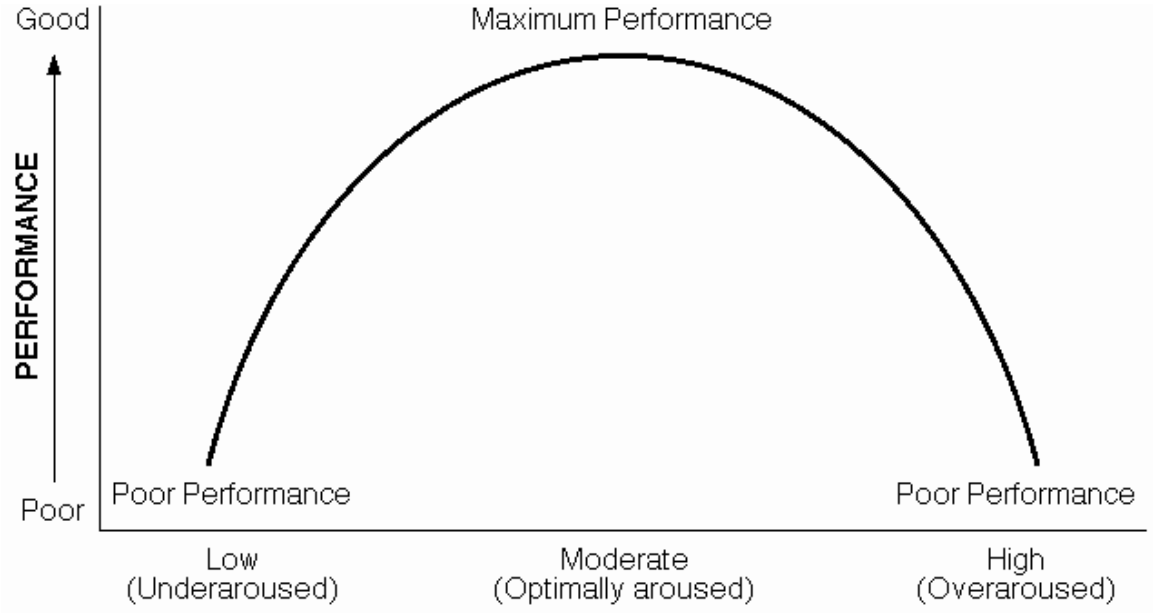
From my findings I can say that the more extroverted an athlete is the higher their necessary arousal for best performance. However everyone is different and they will need to experiment with arousal in order to achieve peak performance. The SCAT and STAI test can be used as guidelines.

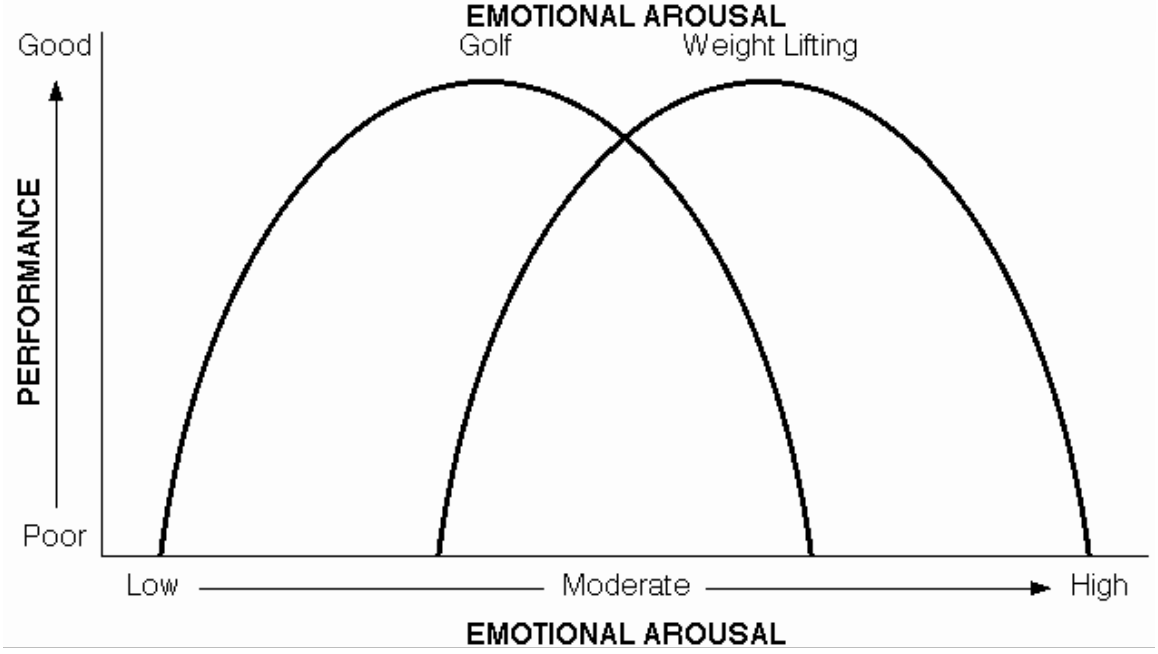
If I were to continue this research I would test more shot putters and perhaps athletes of similar disciplines (explosive and short e.g. weight-lifting, javelin and hammer). I would try to create better questionnaires with questions which challenged the athlete; in the sense that I will be able to distinguish better between the factors within the event that influence the athlete's anxiety and arousal levels. The word count has been a real hindrance for me in this project and the lack of time available restricted the magnitude of the conducted research.

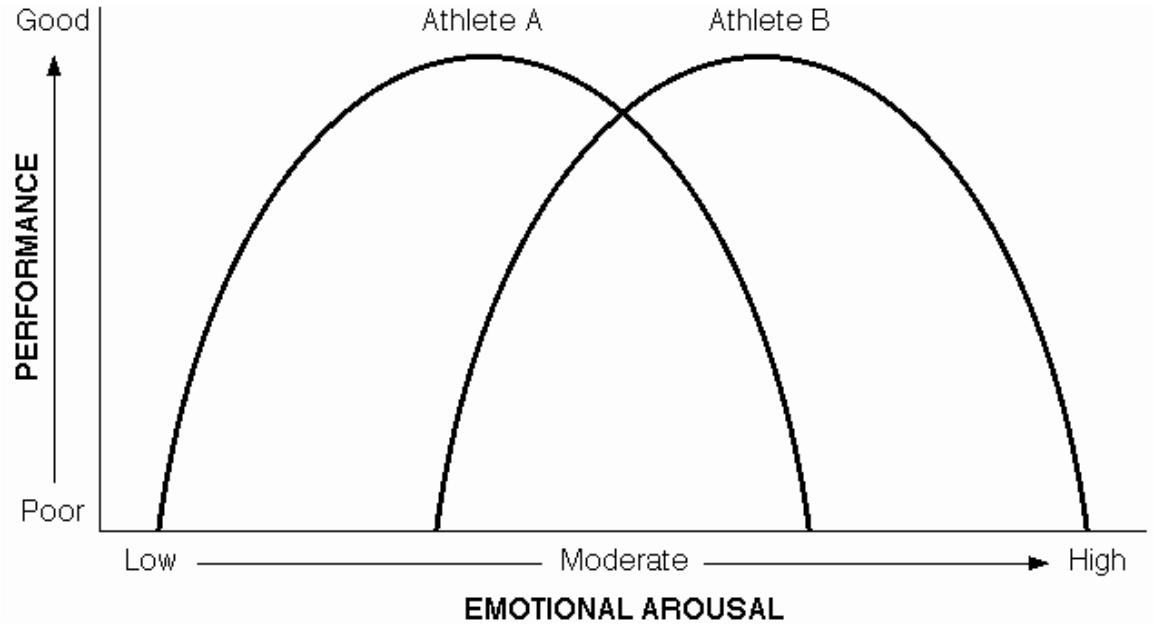
Appendix 1

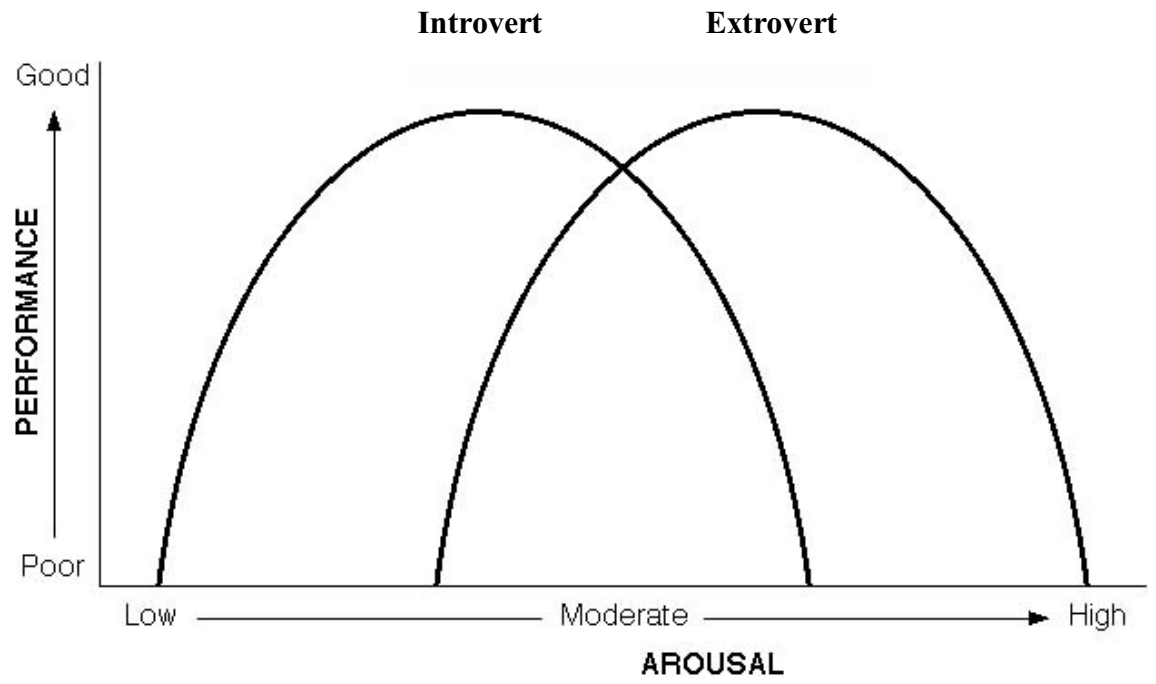


Drive Theory (Clark Hull 1943) if an athlete is appropriately skilled then it will help them to perform well if their drive to compete is aroused – they are "psyched up". The more skilled the athlete is, the higher arousal levels he can tolerate without infringing on performance levels.






Good
Athlete A
Athlete B
PERFORMANCE
Poor
Low
Moderate
High
EMOTIONAL AROUSAL


Introvert
Extrovert
Good
PERFORMANCE
Poor
Low
Moderate
High
AROUSAL

Appendix 2

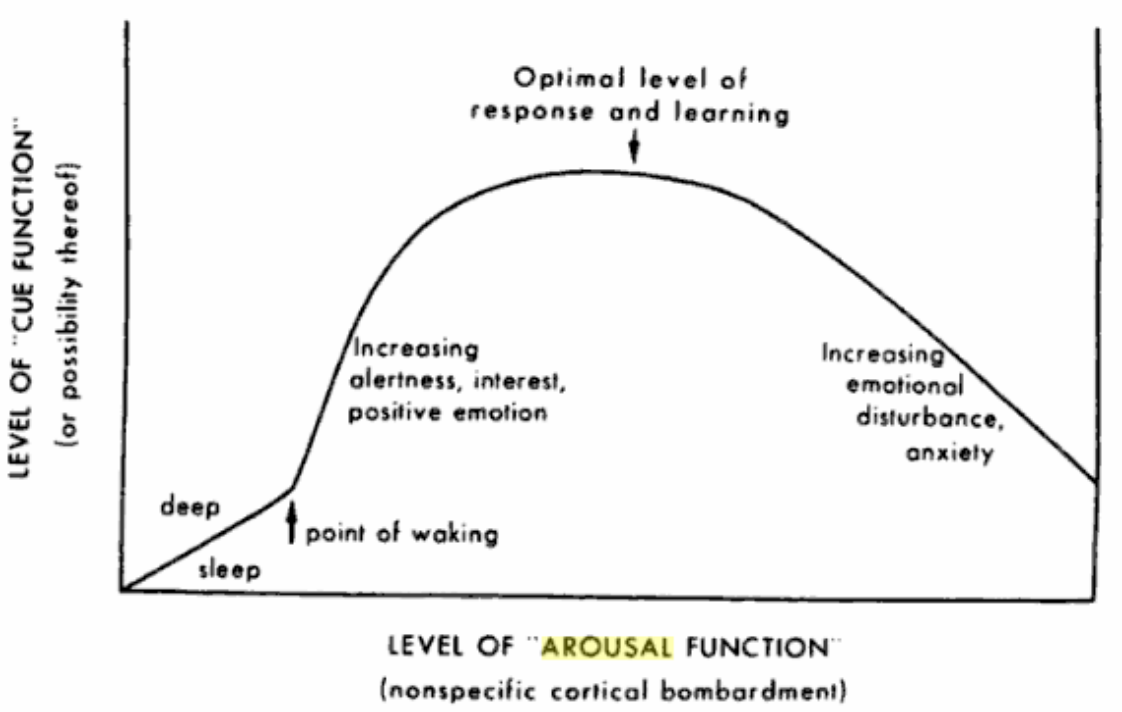


Fig. 6.1. The relationship between arousal and cue function. (From "Drives and the C. N. S. (conceptual nervous system)," by D. O. Hebb, 1955, *Psychological Review*, 62, pp. 243–254. Copyright 1955 by American Psychological Association.)

From Psychobiology of Personality By Marvin Zuckerman
Cambridge University Press (May 31, 1991)

Appendix 3

State-Trait Anxiety Inventory

Purpose: Designed to study anxiety.

Population: Grades 9-16 and adults.

Score: 2 scores: state anxiety and trait anxiety.

Time: (10-20) minutes.

Author: Charles D. Spielberger, Richard L. Gorusch, and Robert E. Lushene.

Publisher: Consulting Psychologists Press, Inc.

Description: The State-Trait Anxiety Inventory (STAI) was initially conceptualized as a research instrument for the study of anxiety in adults. It is a self-report assessment device which includes separate measures of state and trait anxiety. According to the author, state anxiety reflects a "transitory emotional state or condition of the human organism that is characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity." State anxiety may fluctuate over time and can vary in intensity. In contrast, trait anxiety denotes "relatively stable individual differences in anxiety proneness . . ." and refers to a general tendency to respond with anxiety to perceived threats in the environment.

Scoring and Norms: Scores on the STAI have a direct interpretation: high scores on their respective scales mean more trait or state anxiety and low scores mean less. Both percentile ranks and standard (T) scores are available for male and female working adults in three age groups (19-39, 40-49, 50-69), male and female high school and college students, male military recruits, male neuropsychiatric patients, male medical patients, and male prison inmates.

Reliability: The stability of the STAI scales was assessed on male and female samples of high school and college students for test-retest intervals ranging from one hour to 104 days. The magnitude of the reliability coefficients decreased as a function of interval length. For the Trait-anxiety scale the coefficients ranged from .65 to .86, whereas the range for the State-anxiety scale was .16 to .62. This low level of stability for the State-anxiety scale is expected since responses to the items on this scale are thought to reflect the influence of whatever transient situational factors exist at the time of testing.

Validity: Correlations are presented in the manual between this scale and other measures of trait-anxiety: the Taylor Manifest Anxiety Scale, the IPAT Anxiety Scale, and the Multiple Affect Adjective Check List. These correlations are .80,.75, and .52, respectively.

Suggested Uses: Recommended for studying anxiety in research and clinical settings.

Sport Competitive Anxiety Test

The Sport Competition Anxiety Test (SCAT) was developed by Rainer Martens and co-workers in 1990. They showed that by analyzing your responses to a series of statements about how you feel in a competitive situation it is possible to assess your level of anxiety.

Hardy & Fazey's (1987) Catastrophe Model

The Hardy & Fazey (1987) model presupposes that anxiety is comprised of two sub-components. In contrast however, rather than using somatic anxiety as the asymmetry factor, Hardy & Fazey (1987) chose to use physiological arousal. When measured by heart rate, both follow identical temporal patterns to, for example, a critical competitive event. Nevertheless, there are a number of differences between the two in relation to their effect on performance. It has been reasoned that physiological arousal may have a direct effect upon performance through the suppression of crucial cognitive and physiological resources (e.g. Hardy et al., 1994). Additionally, physiological arousal may also cause an athlete to interpret their physiological state as either negative or positive, inadvertently altering their performance (e.g. Bandura, 1977). Somatic anxiety, on the other hand, is believed to effect performance only if the extent of the somatic response is so large that the athlete becomes excessively concerned and distracted with their perceived physiological state (e.g. Martens et al., 1990).

Hardy & Fazey (1987) state, in their version, that physiological arousal follows the Inverted-U hypothesis in relation to performance. Nevertheless, that will only occur when the individual is exhibiting low cognitive state anxiety, e.g. they are not worried about their immediate performance, (see back face of fig. 3). Alternatively, a catastrophe will occur if the individual is exhibiting high cognitive anxiety (e.g. concern over their immediate performance). This is typified by an increase in physiological arousal that will reach a threshold point just over the cusp of optimal arousal. Thereafter follows a steep and expeditious deterioration in the individual's performance, i.e. a catastrophe (see right face fig. 3). Hardy (1990) further proposed that cognitive anxiety behaves as a splitting factor that causes the normal factor's (i.e. physiological arousal) effect on performance to be smooth and small, large and catastrophic, or alternatively falling somewhere within the two extremes. The model also predicts that if there is low physiological arousal present in the days leading up to an important event, cognitive anxiety will enhance the athlete's performance in relation to the baseline data that can be taken from his training session (see left face, fig. 3), (Parfitt, 1988). Additionally, Hardy (1990) goes on to state that the model will predict either positive or negative effects of physiological arousal upon performance when there is an elevation in cognitive anxiety. This depends upon how high the cognitive anxiety is at the time. This can be demonstrated by bisecting through fig. 3, parallel to the physiological arousal by performance plane.

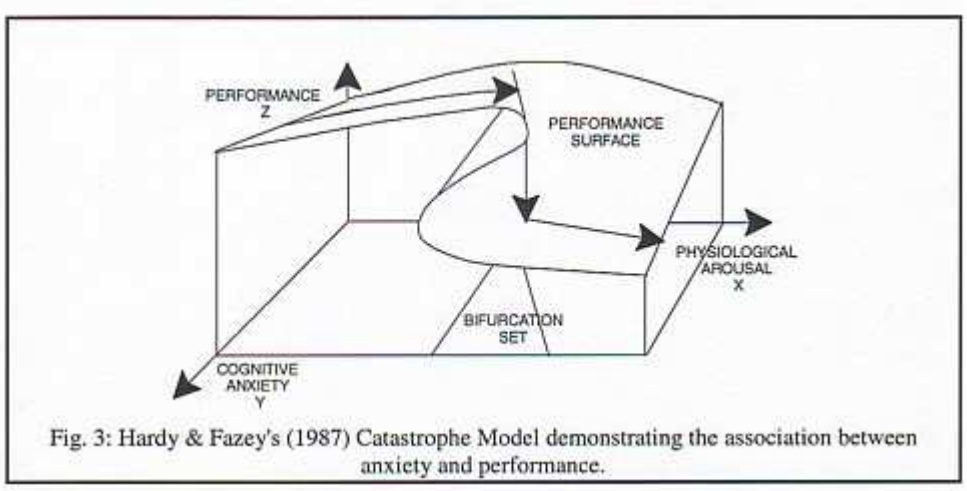


Fig. 3: Hardy & Fazey's (1987) Catastrophe Model demonstrating the association between anxiety and performance.

Fazey & Hardy (1988) suggested four additional proposals based upon their model:

1. Physiological arousal should (for the most part) only be deleterious to athletic performance when there is high cognitive anxiety.
2. Hysteresis will follow when high cognitive anxiety is present, and a bifurcation set will arise, i.e. the association of the same level of physiological arousal with two alternate levels of performance subject to the decrease, or increase, of the physiological arousal. To elucidate, it is predicted that there will be a negative correlation between performance and cognitive anxiety when physiological arousal is high, and a positive correlation when physiological arousal is low.
3. An average level of performance is unlikely to occur when high cognitive anxiety is present. Moreover, performance is likely to follow two distinct modes under conditions of high anxiety, as opposed to being uni-modal when cognitive anxiety is low.
4. Utilising a number of statistical methods (e.g. GEMCAT and the Dynamical Differences Method) it is conceivable that 'real-life data' be applied to cusp catastrophes.

Hardy, Parfitt & Pates (1992) stressed that the surface of the cusp catastrophe is 'tailored' to each individual, insofar as the model can be bent, stretched, rotated and transformed to fit an athlete's ability and experience in relation to their performance. Notably, and central to Thom's (1975) original theorem, the flexible properties of the cusp catastrophe can never be torn, i.e. it should always remain continuous, following the fundamental rule of hysteresis, and the discontinuous changes in performance under certain conditions.

Appendix 4

Richards (1995) conducted a study on mountain bikers and proved by meticulous testing and measurements of HR that as the competition progresses the heart rate seems to decrease and it was concluded that this was due to familiarity, as the bikers got more into the event they calmed down. At the start the subjects were anxious because they may not be familiar with their opponents or the course or for any other reason linked to uncertainty, but once the competition began they could analyze their immediate situation and adjust accordingly, as they began to understand the race they got more comfortable. This of course applies differently to expert and novice riders. The expert's HR anxiety decreases faster due to ability to process the input faster and greater ability to ignore irrelevant input from the environment; whereas, the novice would take much longer to decrease anxiety as they can only process information at a lower pace than the expert; this is due to lack of experience.

Appendix 5

Optimum Arousal Theory (Yuri Hanin, 1980) each athlete will perform at their best if their level of arousal or competitive anxiety falls within their optimum functioning zone. The challenge for the coach is to determine the athlete's zone and identify the techniques that will place the athlete in this zone prior to competition. It is also important for the athlete to know when they are at optimum arousal; the shot putter must realize that he needs a high level of arousal.

Yerkes-Dodson (1908): If the task is complex, requiring fine motor skill, the optimal level of arousal is low. Such as snooker where the skill is extremely fine. If the task is relatively simple, requiring gross motor skill, the optimal level of arousal is high. Such as the 100m sprint, where the skill is very simple and lasts a short time. This implies that in shot putt the optimal arousal level is high. It was also shown that for any skill a medium level of arousal is the best as too lower level will result in the athlete being unmotivated to perform and the task will be done half heartedly; however, if the athlete is over-aroused he will probably make mistakes in the performance, Appendix One

Multi-dimensional Anxiety Theory is based on the distinction between cognitive anxiety and somatic anxiety. The theory makes a series of predictions:

- There will be a negative but linear relationship between cognitive anxiety and performance
- There will be an inverted U relationship between somatic anxiety and performance
- Somatic anxiety should decline once performance begins but cognitive anxiety may remain high if confidence is low

Meditation and Relaxation: Engaging in meditation helps reduce stress before an event and with experience the athlete can learn to relax different muscle groups and appreciate subtle differences in muscle tension. If the shot putter has natural high levels of arousal, meditation would be a great choice to relax the mind the body and focus on the upcoming task.

Introvert: A term introduced by the psychologist Carl Jung to describe a person whose motives and actions are directed inward. Introverts tend to be preoccupied with their own thoughts and feelings and minimize their contact with other people. I.e. less outgoing, shy, unsociable and has thoughts which are focused inwards (Microsoft Encarta Dictionary).

Extrovert: A term introduced by the psychologist Carl Jung to describe a person whose motives and actions are directed outward. Extroverts are more prone to action than contemplation, make friends readily, adjust easily to social situations, and generally show warm interest in their surroundings. I.e. more outgoing, confident, sociable and with interests focused on the outside of self (Microsoft Encarta Dictionary).

Eysenck and Zuckerman theories: Introverts are said to function better in lower levels of stimulation and arousal whereas extraverts function better in conditions with higher levels of arousal. Thus both groups have different levels of optimal arousal. The introvert is more highly aroused in lower level conditions and needs to seek less stimulation in order to reach optimum performance levels whereas the extrovert needs more arousal in order to achieve his/her best performance.

Mental Imagery.
It is useful for:

- Developing self confidence.
- Helping the athlete to focus attention or concentrate on a particular skill he/she is trying to learn or develop.
- Comfort in the competition situation.

If we were to use relaxation procedures with an over excited athlete, we might be able to reduce arousal levels to an optimal level. This would have a positive effect on performance. However if we asked an under-excited athlete to use relaxation procedures it would only make it harder to reach the optimum level of arousal.

This is very applicable to shot putt as (a novice) wouldn't have mastered the technique so imagining the performance before would be helpful. The expert would do the action automatically and would only need to get "fired up" just before the putt.

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