Analysis of cusp catastrophe model

Social Psychology of Sport

Critical discussion on cusp catastrophe model and using its principles of anxiety on an athlete’s performance.

Introduction

The ability to cope with pressure and anxiety under strenuous conditions such as a large sporting event is an essential skill to have, especially for an elite level athlete. Anxiety can be associated with an unpleasant state of mind, which can have different effects on performance. There have been many reported situations among athletes relating the feeling of being anxious or stressed in different sporting events. Dias et, al (2009) have participated in a research reporting 550 results among different level athletes linking to stress and anxiety to an important event. Some research have been shown that there were decrease in performance in correlation to anxiety such as memory, complex motor tasks such as shooting into the hoop in basketball () or indoor rock climbing (). However, there have also been positive anxiety correlations on performance regarding rebound shot in basketball and () have shown to have improvement in motor tasks skills such as anagram-solving.

However, the relationships between anxiety and performance have been difficult to explain. Things such as methodological flaws, lack of operational definitions and unclear theoretical construction all conjunct within different theories (). Hardy’s (1990) cups catastrophe model (CCM) has been attempting to explain the contradicting effects of anxiety on performance, using multidimensional construct model.

Cuspcatastrophe model

The catastrophe theory was originally proposed by a mathematician Rene Thom (1975). Rene developed the model geometrically explaining all naturally discontinuities in the world. Hardy (1990) has then developed a model of anxiety and performance (), attempting to explain the contradicting findings that have been previously reported regarding anxiety on performance.

The model is based on the view on anxiety performance as a multidimensional construct; it combines the cognitive components “ interactive effects of anxiety-performance relationship, the facilitative effects of cognitive anxiety and hysteresis”(), and physiological arousals ‘ the organism’s natural physiological response to anxiety-including satiations’(). Cups catastrophe model shows an interactive, three-dimensional model predicting the effects for cognitive anxiety in a form of worry and physiological arousal on performance.

Cups catastrophe model proposes that there are a series of four relationships which exists between cognitive anxiety, physiological arousal and performance. Cognitive arousal (CA) components are explained as expectations and cognitive concerns about one self, their situation and potential consequences (). Physiological arousal (PA) component is regarded as physiological response to anxiety, such as pain, feeling sick or feeling uncomfortable ().

The first predictor suggests that cognitive anxiety has a positive connection with performance, when physiological arousal is at the lower end of the

spectrum. The second predictor shows to have a negative relationship with performance, when physiological arousal is high. Third, is when the CA is low, the PA is shown to have an inverted U-shaped relationship on performance. The final predictor suggests that, when CA is high and physiological arousal is increasing a break in the wave of performance surface occurs. The split factor suggests that there will be a catastrophic drop in performance from the upper performance surface to lower performance surface. Moreover, when the catastrophic drop has occurred, with the large reduction in physiological arousal it is possible to bring performance back to the upper performance surface (). The change that occur when cognitive anxiety is high and physiological arousal increases is called hysteresis, which occurs under the condition of high cognitive anxiety but not low cognitive anxiety.

Hysteresis can be explained as the condition within the model where performance can catastrophically decrease from the upper performance surface to the lower performance surface. However, with the decrease in PA levels below the level at which the catastrophic drop occurred performance of the athlete may increase.

Analysing one of the quotes made by Jessica Ennis, (2011) who is a professional 100 meter hurdler, have said: “ I’m really, really nervous before every event,” she admits. “ There are different levels of nerves. Before the hurdles I’m particularly nervous as it’s the first event and, once that’s out of the way, I relax a little bit”. Using cups catastrophe model it can be seen that Jessica experience signs of anxiety, having different levels of nervousness throughout the event. It can be expected that her cognitive and physiological

arousals are pretty high, as the pressure from an Olympic event such as crowd, competition, winning the gold medal or podium position could have an effect on her performance. So before the event Jessica's anxiety levels are high, with cognitive anxiety being high and physiological arousal decreasing the hysteresis effect may occur with Jessica feeling the pressure. However, her personal coping strategies could help reverse that effect, bringing her back to the upper performance surface when the competition begins. Balancing the high cognitive state and physiological arousal may help increase performance during the event. Straight after the event it can be seen that she may relax, so her cognitive anxiety and physiological arousal decrease straight after the event leaving her of being more stress-free. Moreover, if she had to perform the hurdles after a certain amount of time, cognitive anxiety could be in at the middle and physiological arousal being low, to maintain the concentration for her to progress on to the next tier.

Critical discussion

The cups catastrophe model can handle complex linear and nonlinear relationship simultaneously in a three-dimensional manner, with the use of high-order probability density within the model, the functions have the advantage of being able to integrate sudden changes within behavioural jumps in the hysteresis(). Researches by Hardy et al, 2010 have applied the theory behind the cusp model over two experiments, supporting the process and the theory behind performance catastrophes and anxiety by using it with high levels of trait anxiety with competitive environment. The second study was social pressure and ego within the competitive environment which

suggest that the cups catastrophe model is plausible. Hardy at al, 2007 have also found that hysteresis did occur in high CA condition, with the significant drops in performance with the increase in PA and CA. Another study by Marshall et al. 2005 looked into how interaction effects of cognitive anxiety and physiological arousal on have an effect on golf performance. The research did confirm that using the model, it had a positive relationship in regards of different situations and how anxiety is coped. However, the research also indicated that even though the methodology is plausible other factors needed to be assessed, as the theory is multidimensional it is very complex.

Edwards et al, 2002 on the other hand, implemented that the theory of cusp catastrophe model may be plausible; however other factors such as confidence could appear to play a significant part in the catastrophic performance. Also () has implemented that other models such as endogenous learning-by-doing (ELBD), supports similar fundamentals of anxiety literature.

All of the studies and theories suggest that anxiety does have different effects on physiological arousal and on anticipation timing performance during competition and practice. Also most of the models do tend to support the hysteresis theory and the catastrophe phenomenon.

Most of the literature supports the different implementation of anxiety which occurs within the human mind, however it is very complex and needs to be further investigated to find a greater explanation on how anxiety affects sporting performance.

Conclusion

Determining the effects on anxiety on performance is still ripe at this stage; there are plenty of implementations which could be added to all of the models and theories. However, with the use of combined theories it may help further explanation and elimination of how there are relationships within understanding of anxiety, and how potentially it could increase and decrease performance of the athletes. With the cups catastrophe model being one of the most used in the research, it cannot be overlooked that other factors may affect the relationship between anxiety and performance. With the implementation of cups catastrophe model researchers could use other models or theories to round up the conclusion.

Reads

Anxiety-induced performance catastrophes: Investigating effort required as an asymmetry factor

1. Lew Hardy [*],
2. Stuart Beattie and
3. Tim Woodman