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THE EFFECT OF STATE ANXIETY UPON A MOTOR TASK: AN APPLICATION OF THE CUSP CATASTROPHE MODEL

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BY

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Abstract

The present study was designed to investigate the relationship between state anxiety and performance of a motor task. The purpose of this study was twofold. First, it explored the theoretical foundations of state anxiety by utilizing a paradigm that is based on the multidimensional nature of competitive anxiety. Secondly, this study examined a performance phenomenon that is related to situations where high levels of performance are quickly followed by low levels of performance (i.e., a catastrophic decrement in performance), and vice versa. Specifically, it has been often reported that catastrophic performance decrements are commonly associated with the effects of state anxiety levels.

In this study, participants (N=60) played a dart throwing game. State anxiety was manipulated by changing the distances that the participants threw from. Distances ranged from five feet to 15 feet, at one foot intervals. All participants threw from each of the 11 distances. In addition, one-half of the participants proceeded in order

from the closest distance (five feet) to the farthest distance (15 feet), and vice versa. Further, the participants were categorized into high or low cognitive state anxiety levels. Therefore, this was a 2 x 2 x 11 (cognitive state anxiety x order [far to close or close to far] x score) repeated measures design. Results indicated that participants with low cognitive state anxiety had changes in performance which were gradual. While participants with high cognitive state anxiety, had changes in performance which were more catastrophic in nature. These results confirm that cognitive state anxiety is an important factor when evaluating one's performance, especially for a motor task. Further, the Cusp Catastrophe model is adequate for assessing performance outcomes in motoric domains.

A model of cognitive state anxiety during a motor task can contribute to the understanding of the catastrophizing aspects experienced during motoric performance. An awareness of cognitive state anxiety during a motoric task might help athletes monitor and reflect on their own perceptions, cognitions, and subsequent performance, and might increase a athlete's ability to persevere in adverse conditions.

THE EFFECT OF STATE ANXIETY UPON A MOTOR TASK: AN APPLICATION OF THE CUSP CATASTROPHE MODEL

We have all witnessed at one time or another the catastrophic changes that can occur in a competitive setting. Perhaps you may have experienced this phenomenon personally. For example, while golfing, one may be performing well, and then, oops--off into the woods you go. It may take a few holes to recover. From the opposite perspective, one may seem to be having a horrendous round when--wow, what a break!--the ball returns to the green, inches from the hole, as it deflects off of a nearby Poplar tree. Just then, the round seems to have improved from that incident. This study is an investigation into such phenomena. Some major theoretical approaches to the anxiety-performance relationship that are currently employed to explain such catastrophic phenomena are introduced. Next, the current study is explained and evaluated.

Sport competition can generate much cognitive anxiety and worry, which in turn can affect physiological and thought processes so dramatically that performance often deteriorates. There are many theories, or hypotheses, that have been advanced in an attempt to explain the relationship between arousal, or anxiety, and its effect(s) upon performance. Within the domain of sport performance, the theoretical approaches based on: a) arousal (including both drive and inverted-U explanations), b) the Zone of Optimal Functioning (ZOF), c) reversal theory, d) the multidimensional approach (including both cognitive and somatic anxiety), and e) catastrophe models have been advanced and evaluated.

The following will describe the aforementioned theories/ hypotheses, the advantages and disadvantages of each, and will conclude with an analysis of the Cusp Catastrophe model. It is believed here that the Cusp Catastrophe model is the strongest approach in describing the relationship between arousal/anxiety and performance in competitive sport.

Arousal-Based Approaches

Early sport researchers leaned heavily on literature from educational and clinical psychology to build a theoretical underpinning for research on competitive anxiety. Until quite recently, arousal-based models have represented the simplest and most common interpretations of the relationship between anxiety and performance. These explanations focus on the assumption that performance changes associated with anxiety are due to changes in a single underlying dimension of arousal. Many researchers have debated the merits of two general arousal approaches, drive theory and the inverted-U hypothesis, in this context.

Drive Theory

Originally proposed by Hull (1943), and later modified by Spence and Spence (1966), it was believed that increases in drive (often used synonymously with arousal and anxiety) were associated with a linear increase or decrease in performance, depending on the dominant response. Further, drive theory predicted that increased arousal could be detrimental during skill acquisition. However, later in the learning process, performance could show improvement.

One advantage of drive theory is that the arousal-performance relationship has been shown to exist for gross motor activities involving strength, endurance, and speed. However, it appears that even among weight lifters, sprinters, and long- or middle-distance runners, there are limits to the amount of arousal an athlete can tolerate without suffering performance decrements. Drive theory has been criticized for: a) its failure to find consistent support for the theory (Martens, 1971, 1974); b) failure to accommodate for the effects of complex tasks (Martens, 1971; Tobias, 1980; Weinberg, 1979), its oversimplification in explaining motor or sport performance (Fisher, 1976); c) its inherent difficulty in determining habit hierarchies of correct and incorrect responses for most motor skills (Martens, 1974; Neiss, 1988); and d) from a cognitive perspective, its failure to consider thought or appraisal processes (Gill, 1994).

Inverted-U Hypothesis

The inverted-U hypothesis has its origins in the work of Yerkes and Dodson (1908) who examined the ability of mice to discriminate between stimuli of differing brightness, as a function of differing intensities of electric shock. Yerkes and Dodson found that on more complex tasks the decrement of performance under increasing arousal conditions occurred earlier than it did for the less complex tasks. Higher levels of arousal can be tolerated on less complex tasks before performance is curtailed. To determine how much arousal is optimal, some factors (decision, perception, and motor act) must be considered. Tasks with higher decisional demands require lower arousal levels for optimal performance compared to tasks with lower decisional demands. The effects of arousal impair one's performance through a loss of perceptual sensitivity by interfering with one's capacity to process information (Landers & Boutcher, 1998). The optimal level of arousal for a particular task is also dependent upon factors that are unique to the individual. Landers (1985) indicated that subtle changes in habit patterns might lead to "disregulations." Disregulations are defined as a physiological measure of arousal that either negatively correlates with performance or creates some degree of discomfiture for the performer. For example, an archer who squints the nonsighting eye may cause a headache and thusly affect performance. The two most relevant personality variables affecting one's optimal arousal level are trait anxiety and where one lies on the dimension of introversion/ extroversion (Landers, 1985).

Additionally, Duffy (1932) noted that increased muscular tension leads to poorer performance of a muscular activity and that high muscular tension can decrease response flexibility. Hebb (1955) developed the inverted-U hypothesis further when he suggested that there was an optimal level of arousal, that is, a level of arousal at which an individual would perform at their maximum potential, neither overaroused nor underaroused. Klavora (1977) found that separate inverted-U curves exist for low- and high-trait anxious athletes (although, Klavora claims that this hypothesis is merely a general prediction). The inverted-U hypothesis predicts that performance improves as arousal increases to a moderate, optimum level, after which further increases in arousal result in performance decrements. In addition, the optimal level of performance decreases as performance complexity increases. Gould and Krane (1992) have questioned the validity of the inverted-U hypothesis. Equivocal findings in these studies are often explained by citing individual differences, task characteristics, or imprecise measurement of performance.

The inverted-U hypothesis has the advantage of being intuitive and impossible to disprove; it is descriptive and not explanatory (Neiss, 1988). Further, the relationship is found to exist for measures of somatic anxiety, but not for measures of cognitive anxiety (Landers & Boutcher, 1998). Another criticism is that the inverted-U hypothesis fails to explain why performance is impaired at arousal levels above and below the optimum (Eysenck, 1984; Landers, 1980). Again, a lack of clear empirical support exists (Hockey, Coles & Gaillard, 1986; Naatanen, 1973; Neiss, 1988; Jones, 1995). Although laboratorybased studies do not generally support an inverted-U relationship, support has emerged from field studies of arousal and motor behavior (e.g., Klavora, 1978; Martens & Landers, 1970), yet these too produce inconsistent findings. Further, the inverted-U hypothesis only relates to general effects on global performance rather than specific effects upon information processing efficiency (Eysenck, 1984) and is, therefore, incapable of explaining the complexity of the relationship between arousal and the subcomponents of performance (Hockey & Hamilton, 1983). Additionally, 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 restore optimum performance (Fazey & Hardy, 1988; Hardy, 1990; Hardy & Fazey, 1987). Lastly, like drive theory, the inverted-U hypothesis fails to accommodate for cognitive appraisals (Gill, 1994).

Recent approaches of the arousal-performance relationship express a general dissatisfaction with the use of arousal as a unitary concept (Hockey et al., 1986) due to its inability 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 (Jones, 1990; Lacey, 1967). A further problem with both drive theory and the inverted-U hypothesis is that they have been adopted to explain arousal, activation, anxiety and stress effects on performance. The use of such constructs, without clearly differentiating between them, has tended to preclude significant developments in this area. However, recent theorists have moved away from general arousal-based explanations (Jones, 1995).

Zone of Optimal Functioning (ZOF) Hypothesis

The social psychologist Hanin (1980, 1989) has adopted a person-environment interaction model. It is unlikely that one specific optimal level of state anxiety exists that leads to best performance. Hanin has assessed three aspects of state anxiety that are considered to influence performance. These are: interpersonal state anxiety (S-Aint), referring to the performer's involvement with a particular partner; intragroup state anxiety (S-Agr), referring to the performer's involvement as a member of a group or team; and, performance state anxiety, referring to one's own level of state anxiety. Using this approach, a "zone of optimal functioning" can be identified whereby the zone is defined as a performer's mean pre-competition state anxiety score, plus or minus 4 points.

The zone of optimal functioning notion has the advantage of being intuitively appealing and making relatively precise predictions concerning which state anxiety levels are likely to produce optimum athletic performance (Gould & Krane, 1992). There are a few disadvantages to using the zone of optimal functioning hypothesis. First, it offers no underlying explanation; second, the central measuring instrument (State-Trait Anxiety Inventory; Spielberger, Gorsuch, and Lushene's STAI, 1970) is not sport specific; and third, it is based upon a unidimensional conceptualization of anxiety. Also, it is limited in that it does not allow for directional perceptions of anxiety symptoms to be taken into account. That is, it does not allow for the athlete's perception that a certain situation may be perceived either as debilitative or facilitative to performance. Further, as previously mentioned, anxiety is situation specific and anxiety measures should be sensitive to the unique characteristics of different situations, which the STAI does not provide. Like the inverted-U hypothesis, it is also conceptually limited to hypothesis status, because no explanation has been forwarded to explain why state anxiety influences performance in and out of the zone of optimal functioning.

Reversal Theory

The application of reversal theory (Apter, 1982) to the sport environment (Kerr, 1987, 1989, 1990, 1993) provides a further perspective from which to view the anxiety-performance relationship. According to reversal theory, "metamotivational states" are postulated to exist together in opposite pairs and are subject to sometimes quite rapid changes or reversals in one of two directions. One's interpretation of affect as pleasant or unpleasant is also known as "hedonic tone." The "telic-paratelic" pair has been the focus of much of the work on reversal theory and is particularly interesting in the context of how sports performers perceive their arousal levels. The distinction between the telic and the paratelic states is as follows: "in the paratelic state, behavior tends to be spontaneous, playful and present-oriented, with a preference for high arousal; while in the telic state, behavior tends to be serious and planning-oriented, with a preference for low arousal" (Kerr, 1990). Alternatively, the telic mode is characterized by its seriousness, orientation towards a goal, and has arousal avoiding properties. The paratelic mode is characterized by playfulness, an activity orientation, and is generally arousal seeking. Kerr (1990) postulated that the experience of felt arousal and hedonic tone (interpretation of affect as pleasant or unpleasant) are particularly relevant to sports performance.

Specifically, it is proposed that levels of arousal in particular metamotivational states may be interpreted in one of four different ways: low arousal can be experienced as relaxation (pleasant) or boredom (unpleasant); and, high arousal can be experienced as excitement (pleasant) or anxiety (unpleasant). Further, in the telic state, which low arousal is preferred, low arousal will be experienced as relaxation and high arousal as anxiety. In the paratelic state, on the other hand, 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 and Svebak (1990) have identified two types of stressors in reversal theory: tension stress, which occurs when there is a discrepancy between preferred and actual level of arousal; and, effort stress, which occurs as a consequence of attempting to reduce tension stress. Some intervention options include inducing reversals. Kerr (1987) has suggested that it is possible for sports performers, after the required training, to induce the necessary reversals through either a cognitive restructuring or imagery strategy. Metamotivational dominance is when one prefers one state (telic/paratelic) over the other.

It is true that psychological reversals can and do take place, and result in striking changes in emotional states. The strengths of reversal theory are its intuitive appeal and the important distinction it places on the athlete's interpretation of arousal states. However, it is difficult to test, which accounts for the scant amount of empirical support currently available. Also, it is unidimensional and it lacks clarity and precision concerning how reversals can be brought about for intervention purposes (Jones, 1995).

Multidimensional Approach

The multidimensional approach has adopted a more precise definition and terminology. This line of research stems from the work of Borkovek (1976) and Davidson and Schwartz (1976), who differentiated between cognitive and somatic anxiety. Anxiety should be conceptualized as multidimensional in nature, comprising of both cognitive and somatic components. The cognitive elements of anxiety can be described as negative expectations and cognitive concerns about oneself and the situation at hand, and the potential consequences.

Somatic anxiety can be defined as "one's perception of physiological-affective elements of the anxiety experience; that is, indications of autonomic arousal and unpleasant feeling states such as nervousness and tension". A third dimension is self-confidence.

A disadvantage is proposed by Landers (1994), who has criticized the partitioning of anxiety into cognitive and somatic components. Landers' case for abandoning the multidimensional approach rests upon the citation of an unpublished study and he fails to acknowledge a body of literature which has supported the utility of distinguishing between cognitive and somatic anxiety components (Jones, 1995). It has become increasingly clear from this line of research that competitive state anxiety does not necessarily impair performance and can, in some circumstances, enhance it. The "matching hypothesis" (Davidson & Schwartz, 1976) proposes that mental and physical relaxation techniques should be matched to the dominant state anxiety symptoms experienced. This intraindividual approach is one advantage to the multidimensional concept.

Perhaps the most difficult of the approaches to understand is the Cusp Catastrophe model. This model has been proposed as an alternative to the inverted-U hypothesis as a result of Fazey and Hardy's (1988) concerns over the face validity of the inverted-U curve once arousal levels increase above the optimum. When applied to sports performance, the Cusp Catastrophe model is used to predict 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, and vice versa.

Catastrophe Approach: Overview and Background

It is beyond the purpose and scope of this investigation to give a detailed description of catastrophe models. Therefore, an overview that is sufficient to give the reader an intuitive feel for the relevant issues of catastrophe modeling will be provided (Oliva, Day & MacMillan, 1988). Those who desire an in-depth treatment of catastrophe models are referred to Thom (1975), Fararo (1978), Zeeman (1976, 1977), Poston and Stewart (1978a), Oliva, DeSarbo, Day, and Jedidi (1987), Woodcock and Davis (1978), Flay (1978), Stewart and Peregoy (1983) and Allen and Carifio (1995).

Numerous nonlinear phenomena that exhibit discontinuous jumps/drops in behavior have been modeled using a catastrophe model. The rapid changes in perception of ambiguous figures have been noted in Poston and Stewart (1978b), in Stewart and Peregoy (1983), and in Ta'eed, Ta'eed and Wright (1988). Zeeman (1977) has modeled rapid changes in mood, the sudden crashes and surges in the stock market, prison disturbances, the influence of public opinion on the policy adopted by an administration, anorexia nervosa, and censorship in a permissive society. A model of problem solving in which the solver exits from the problem-solving process either with or without the solution can be found in Boles (1990), and Boyes (1988) modeled misconceptions in science education. Some other catastrophe models include the following: attitude with respect to an election survey (Anderson, 1985), research in higher education (Staman, 1982), attitudes and social behavior (Flay, 1978), birth rates throughout nations (Cobb, 1978), attitude change and behavior (Cobb & Watson, 1980), psychoanalytic phenomenon (Callahan, 1990), the emergence of urban slums (Dendrinos, 1979), patterns of blaming nurses for incidents of aggression (Carifio & Lanza, 1992), nonresponse in surveys (Carifio, Biron & Shwedel, 1991), personnel selection, therapy, and policy evaluation (Guastello, 1982), motivation in organizations (Guastello, 1987), and accidents within an organization (Guastello, 1988). For a more complete list of catastrophe models over a wide range of applications, see Guastello (1987).

From a historical perspective, it was Rene Thom (1975) who developed a formal approach to structurally stable models (i.e., catastrophe models) that can account for diverse forms of (competitive) outcomes. But, it was Zeeman who popularized the approach in the mid- to late 1970's. Since that time, the approach has vacillated in popularity. By 1978, Behavioral Science dedicated an entire issue to catastrophe models. In that same issue, however, there was an indictment of the approach by Sussman and Zahler (1978). Their principal criticisms were that applications, particularly in the social sciences, were inappropriate and that one could never formally test such models. These indictments, along with no effective methods for empirically testing such models, were damaging. Ultimately, these objections were shown to be no more limiting than those normally faced by behavioral researchers testing new models (Oliva, Day & MacMillan, 1988). Key articles countering Sussman and Zahler's criticisms were written by Oliva and Capdevielle (1980), Woodcock and Davis (1978), and Stewart and Peregoy (1983). The Oliva and Capdevielle article is probably the most important because it showed that Sussman and Zahler's mathematical arguments were equally true for regression analysis. Therefore, if one rejects catastrophe modeling on Sussman and Zahler's grounds, one must also reject regression analysis and a host of other multivariate modeling techniques for the same reasons. Thus, the issues surrounding the use of the catastrophe approach for modeling dynamics of all sorts are the same as those that must be addressed for any modeling technique. Namely, making sure the conditions and assumptions of the model are met by the situation.

Since 1981, a number of empirical methodologies and tests of the catastrophe approach have appeared (e.g., Cobb, 1987; Cobb & Zachs, 1985; Guastello, 1981, 1982a, 1982b; Oliva et al., 1981; Oliva et al., 1987a; Sheridan, 1985; Sheridan & Abelson, 1983). Most notably, Cobb's work, enhanced by Guastello, led to using standard regression techniques to test such models. This method works best when measures for the key variables are univariate, as typically found in what he calls "the hard sciences." Unfortunately, in behavioral science, where key variables typically are multivariate, the data must be collapsed into univariate indices with a concomitant loss in information. Oliva et al. (1987b) developed a method that solves the problem and avoids collapsing the data. Their procedure treats catastrophe model dimensions (variables) as latent, unobservable constructs that can accommodate either univariate or multivariate measurements for each type of dimension. In addition to methodological advances, more fruitful and rigorous theoretically-based applications are being developed. Most recently, Allen and Carifio (1995) describe Cobb's Cusp Surface Analysis Program (CUSP), which provides a way to empirically estimate and test a nonlinear cusp catastrophe model. Further, CUSP is designed to assess whether the relationship between the variables can be modeled as a nonlinear cusp surface. This has resulted in the catastrophe model regaining some of its original popularity with those trying to investigate complex social and behavioral science problems.

Cusp Catastrophe Requirements

As with most new applications of the catastrophe approach, the model known as Cusp Catastrophe will be used because, although it is not a particularly complex model, it captures the key characteristics of competitive performance. Specifically, it can accommodate the various ways in which differing values of cognitive state anxiety can affect motoric performance.

Structurally, the model posits a three-dimensional response surface that can be described mathematically as a function with one dependent and two independent variables. In behavioral cases these typically are multivariate constructs. The function generates the surface, as shown in Figure 1 (a smooth sheet with a fold or pleat in it). System behavior is recorded by vertical movements along the response dimension (dependent variable), and it is the result of changes in its two control dimensions (independent variables). Independent Dimension #1 is called the splitting factor because as its value is increased (movement from back to front in this figure), a point is reached where the surface bifurcates (splits). By contrast, Independent Dimension #2, the horizontal movement contained within the diagram, is called the normal factor because reversals in the variable predicts reversals in the behavior. The name "cusp model" is derived from the shape resulting from projecting the pleated surface onto what typically would be viewed as the xy-plane.

Although the theory of structural stability is mathematically based and includes sweeping statements about the structural typology of certain classes of systems, it is the qualitative nature of the surface that is most interesting to modelers of "misbehaving" phenomena. More specifically, a situation must exhibit five properties (assumptions) in order to be appropriately modeled by the Cusp Catastrophe (Thom, 1975). Zeeman (1977) identified these properties as bimodality, divergence, catastrophe, hysteresis, and inaccessibility. Their relationships to one another and location on the model are shown in Figure 2.

Bimodality. This is the area defined by the overlap in Figure 1. For a given set of values (defined mathematically by a cusp) of the model's two control dimensions (the independent variables or constructs), the response dimension (the dependent variable or construct) can take on two possible values. This is characteristically different from standard response surfaces that are required to be single valued. From a measurement standpoint, the current state of the system (i.e., its behavior) is ultimately determined by its previous state within this area; hence, it is a state-determined system.

Divergence. As the magnitude of Independent Dimension #1 (the splitting factor) is increased, small initial differences in the Independent Dimension #2 can result in totally different trajectories (opposite directions or values) along the response dimension. Thus, a slight difference in the initial starting point can result in quite different forms of system behavior. Notice that points F and G begin fairly close together but move to different parts of the surface in Figure 1 as values of the Independent Dimension #1 are increased.

Catastrophe. Sudden, discontinuous changes along the response dimension are possible. These occur when the values of the independent dimensions are within the area of bimodality (the cusp) and the normal factor is increased such that it exceeds the boundary of the cusp in the direction that supports values of the response dimension that are opposite the current one. More simply put, travel on the folded part of the surface can result in a sudden shift from one part of the pleat to the other. This is examined by following the trajectories from Point C to Point D to Point E in Figure 1. Beginning at Point C, with increasing values of Independent Dimension #2, the value of the response dimension "falls up" to Point D as the edge is reached. Likewise, beginning at Point D, with decreasing values of Independent Dimension #2, the value of the response dimension "falls down" to Point E as the edge is reached.

Hysteresis. Once a transition is made in the area of the pleat from one part of the surface to another, small decreases in the control dimension will not reverse the process. That is, the system's response will not suddenly shift back as it would if a step function were modeling the process. This is evidenced by reexamining Points C, D, and E in Figure 1. Once the shift up to Point D occurs, there must be a significant reduction in Independent Dimension #2 to get back to Point E, which has dependent values similar to Point D.

Inaccessibility. The mathematical representation of the surface has a middle sheet that completes the pleat. Yet, in terms of catastrophe modeling, it represents the area of minimal potential (i.e., its least likely state). Therefore, it is inaccessible. That is, the response dimension does not take on these values as the result of changes in the independent dimensions. Table 1 (adapted from Oliva et al., 1981) demonstrates this phenomenon. By holding one independent variable constant (Industrial Inertia: Y = 3) and increasing the other independent variable (Relative Competitive Force: X), this dynamic is easily seen. Travel is along the bottom surface until it reaches a value of 2.00, where it shifts to the top surface (Relative Competitive Position: from -1.00 to 2.00).

Within the sport domain, Cusp Catastrophe predictions have been supported by studies on basketball (Hardy & Parfitt, 1991) and "bowls players" (Hardy, Parfitt & Pates, 1994). The model is particularly useful in helping to understand the positive effects of state anxiety, which have been found in some studies. Yet, it is limited in that it does not incorporate how individuals interpret (the direction of) their state anxiety symptoms. A very complex 5-dimensional butterfly catastrophe model also exists. The Cusp Catastrophe model approach to the anxiety-performance relationship is innovative in that it examines the combined influence of cognitive anxiety and physiological arousal on performance. Hardy (1990) has speculated about the role of self-confidence and task difficulty in more complex versions of catastrophe theory, like the 5-dimensional butterfly catastrophe model. The main criticism is the drawback that the theory has a complex nature that makes it difficult to test some of its predictions.

As for the superiority of using the Cusp Catastrophe model, again, research is sparse. However, Krane et al. (1994) have bravely tried to investigate catastrophe models. They hypothesized that somatic anxiety would differentially relate to performance in high versus low criticality situations. Indeed, they found that somatic anxiety did differentially relate to performance under different conditions of situation criticality. Consistent with Hardy's prediction, when a runner was not on third base (low situation criticality), somatic anxiety showed a significant curvilinear relationship with performance.

The Cusp Catastrophe model, which may be selected as being one approach superior to the others, is a multidimensional approach. However, such multidimensional approaches are not themselves theories. For instance, the Cusp Catastrophe model utilizes and makes predictions based upon the differing components of cognitive and somatic anxiety states. Also, the Cusp Catastrophe model incorporates the two anxiety states and predicts how they will affect self-confidence. Further, the self-system as a whole may be affected.

Two studies have aided in the design of this investigation. Within the achievement motivation area, Atkinson and Feather (1966) conducted a study in which they manipulated task difficulty to measure goal setting (level of aspiration). The manipulation of task difficulty was accomplished simply by varying the distances in a ring toss game, from one to 15 feet. In the aforementioned Poston and Stewart (1978b) study involving the perception of multistable figures, the participants viewed figures that were anchored by a male's face and by a female in a kneeling position (see Figure 3). Intermediate figures were more ambiguous nearer to the center. Participants viewing the sequence of drawings from right to left began by responding, "looks like a woman," and continued to report the woman until that response was no longer tenable; then they jumped to the response, "looks like a man." A similar phenomenon occurred when going from left to right (man to woman). The predicted jumps occurred at different places even though the stimuli are the same; this illustrates the phenomenon of hysteresis described earlier. These two studies were methodologically important because they provided for analogous procedures utilized in the current study.

The current investigation assessed the effect state cognitive anxiety has on a motor task. It provides a unique measure of how state cognitive anxiety mediates individual responses to changes in context (or distance in this study). The multidimensional approach to arousal theory suggests that individuals differ in levels of both cognitive and somatic state anxiety, which are manifested in distinct ways of responding to changes in context. Thus, it is hypothesized that there will be a significant relationship between levels of cognitive state anxiety and the effects of changes in context (or distance) upon performance. More specifically, it is hypothesized that, as previously evidenced in the literature, there will be little or no difference initially between the performance of individuals with high or low levels of cognitive state anxiety (see Divergence section above, and points F and G of Figure 1). It is predicted that following an increase in state anxiety, or distance, those who are high in cognitive state anxiety levels will show a "catastrophic" decrement in performance (going from point D to point E of Figure 1) relative to low cognitive state anxiety individuals, who will show a more gradual decrement in performance (going from point B to point A of Figure 1; see also the Catastrophe section above). Further, it is predicted that following a decrease in state anxiety, or distance, those who are high in cognitive state anxiety levels will show a "catastrophic" jump/improvement in performance (going from point C to point D of Figure 1) relative to low cognitive state anxiety individuals, who will show a more gradual (going from point A to point B of Figure 1) increase in performance.

Previous studies have noted that many phenomena of human behavior involve sudden "catastrophic" changes, bimodality, hysteresis, and divergence. This study further explores the nature of these Cusp Catastrophe characteristics.

Method

Participants

Participants consisted of 60 undergraduate male (n = 33) and female (n = 27) students from the University of Oklahoma. Participants received academic credit or extra credit for their participation as one option for fulfilling the requirements of undergraduate psychology courses. The age of the participants ranged from 18 years to 42 years (mean age = 19.78 years).

Apparatus

A dart throwing task was employed to test participants. This task was chosen as an analogy to the Atkinson and Feather (1966) ring toss manipulation. It provided for an easy way to manipulate distances in a small space with relative inexpense. That is to say, state cognitive anxiety was manipulated within an 11 foot area and, without much financial burden. Each participant tossed 3 soft (plastic-) tipped darts at a modified (for scoring purposes) non-electric soft tip dartboard (see Figure 4), from each of the 11 distances, from five feet to 15 feet; 33 total darts thrown. Throwing distances were marked with "Official Throw Lines". Due to the frequent breakage of the dart tips, experimental assistants were supplied with replacement points (tips) and a broken-tip removing tool, which allowed for the removal of the broken tip from the dart board. Further, the experimental assistants were supplied with copies of the data collection sheets, the Competitive State Anxiety Inventory-2 (CSAI-2: Martens, Vealey & Burton, 1990; see Appendix A for the cognitive subscale used in this study), the consent forms, debriefing statements and the post-experiment questionnaires (see Appendix B).

Procedure

The participants were assigned to one of four conditions: high cognitive state anxiety-far to close distances (HF); high cognitive state anxiety-close to far distances (HC); low cognitive state anxiety-far to close distances (LF); and, low cognitive state anxiety-close to far distances (LC). Regarding the partitioning of the distance variable, "close to far" means that the participants started at the five foot distance, threw three darts, moved back to the six foot distance, threw three darts, and so on until they reached the 15 foot distance. On the other hand, those participants who were in the "far to close" condition, went from the 15 foot distance, threw three darts, then moved to the 14 foot distance, threw three darts, and so on until they reached the five foot distance. Participants were selected based on pre-screening values (upper and lower 14.5%; N = 427) obtained from the CSAI-2 inventory to pre-select high and low cognitive state anxiety performers (see Table 2 for normative information and a comparison of samples). Regarding the partitioning (determined with a median-split) of the participants for this study, the low cognitive state anxiety (n=30) range of scores on the Cognitive subscale of the CSAI-2 was from 9-12; while for the high cognitive state anxiety participants (n=30), their scores ranged from 14-36. Also, during the prescreening, the participants filled out an activity questionnaire (see Appendix C). Therefore, this was a 2 x 2 x 11(cognitive state anxiety by distancing order by repeated factor-score) repeated measures design. The dependent variables were number of dart hits/misses and (modified) score values. Further, for use with the Cobb CUSP program (see below), we also used as dependent variables: "the location of greatest change," which was determined as the distance at which an individual participant obtained the greatest change in scoring; and, the "perceived line of improvement," which was determined by the participant's answer to item number 4 of the Post-Experiment Questionnaire. All participants were contacted by telephone call to set up appointment times. Upon arrival, the participants completed the CSAI-2. The second collection of the CSAI-2 (prescreening and pre-participation) was to provide for a quick validation check to see if mass testing and individual testing would provide for consistency of the measure. The CSAI-2 has been shown to be both a valid and reliable measure (see Tables 3-5). The participants then completed a consent form and read instructions for participation. All participants were required to qualify for the experiment by successfully landing, anywhere on the dartboard, three darts from the 5 foot distance. This was to ensure a minimal level of skill, as well as for describing the scoring system to the participants. There was a total of 11 "Official Throw Lines" marked at one foot distances, ranging from 5 feet to 15 feet. A number was marked on the floor next to each line. Again, by varying the throwing distances, state anxiety levels were manipulated.

The participants were told: "Today you are going to play a dart throwing game. You will be required to throw three darts from each of the lines marked on the floor. You will proceed in order from 1 to 11 (5 feet to 15 feet), or from 11 to 1 (15 feet to 5 feet), depending on your assignment. An assistant will record scores based on your throws. We want to see how good you are at this. Further, there is a number line on the wall ranging from 1 to 10, with 1 indicating the lowest level of anxiety, and 10 indicating the highest level of anxiety. So, before you throw your first dart from each of the numbered lines, we will ask you to indicate your level of anxiety from that distance." Also, each participant was instructed to place both of their feet on the number line so as to reduce variance (due to leaning, one could reach ahead and in essence be throwing from a different distance) and to control for the throwing distances. Each participant completed the task individually so as to reduce any social facilitation effects. The experiment concluded with a post-experiment questionnaire and participants were then debriefed. The duration of the experiment lasted for approximately 30 minutes.

Results and Discussion

With regard to descriptive information, no significant differences were expected. The range for all participants for total score was from 270 points to 650 points. The mean total score (three throws from each of the 11 lines--33 total darts; See Table 6 for cell means) for all participants was 450.67. For females, the mean score was 398.52; for males, the mean score was 493.33. This difference was significant, $t_{(58)} = 2.54$, $p < 0.05$. However, regarding gender differences with regard to accuracy, there was not a significant difference. Females' percentage of hits was 72%; while for males it was 85% ($t_{(58)} = 0.43$, $p > 0.05$).

Overall, the total percentage of hits (darts that actually scored points) was 79%. There was, however, a significant difference with respect to cognitive state anxiety levels and hits, $t_{(58)} = 3.40$, $p < 0.001$. The low cognitive state anxiety participants averaged 84% hits, while the high cognitive state anxiety participants averaged 75% hits. By the way, Item #7 of the post-experiment questionnaire asked whether or not the participant cared about the task, all participants responded with a "yes" with the exception of one person, whose data was included nonetheless.

As for the hypothesis with regard to initial differences, there were no significant differences evidenced between the low cognitive state anxiety participants' scores and the high cognitive state anxiety participants' scores at the 5 foot distance (Line # 1), $t_{(58)} = 0.89$, $p > 0.05$. This suggests that there were few differences initially between the performance of individuals with high or low levels of cognitive state anxiety, as previous research has shown.

A repeated measures MANOVA (2 x 2 x 11: Cognitive State Anxiety x Order [close to far vs. far to close] x Score) was performed to determine the impact of the order factor. There was a significant main effect for score. This result implies that scores varied significantly as distances changed. People had higher scores from the closer distances, $F_{(10, 560)} = 85.13$, $p < 0.05$. There was a significant main effect for cognitive state anxiety. This result implies that cognitive state anxiety varied significantly as distances changed. People had higher levels of cognitive state anxiety from the farther distances, $F_{(1,56)} = 11.73$, $p < 0.05$. Incidentally, there was a significant correlation between one's pre-tested CSAI-2 cognitive subscale and one's mean Pre-Throw anxiety, $r = 0.64$, $p < 0.05$. There was a significant main effect for order. This result implies that the scores varied significantly as a result of order. People who went from close to far scored less points than those who went from far to close, $F_{(1,56)} = 5.18$, $p < 0.05$. There was not a significant interaction between cognitive state anxiety and order, $F_{(1,56)} = 0.23$, $p > 0.05$. There was a significant interaction between score and cognitive state anxiety (see Figure 8). People with lower levels of cognitive state anxiety performed significantly better than those with higher levels of cognitive state anxiety, $F_{(10,560)} = 2.42$, $p < 0.05$. There was a significant interaction between score and order (see Figure 9). People who went from far to close score more points at the closer distances; while those who went from close to far scored more points at the farther distances, $F_{(10, 560)} = 3.55$, $p < 0.05$. Finally, there was a significant 3-way interaction: $F_{(10, 560)} = 2.29$, $p < 0.05$ (see Figure 5). In order to clarify the 3-way interaction, multiple comparison procedures were employed to determine where the difference lied within the significant 3-way interaction. Toothaker (1993) suggests tests on cell means because they are easier to interpret, they deal with hypotheses that are closer to the original hypotheses tested by most researchers, and they contain the total impact on the participants of both main effects and the interaction. The Cicchetti (1972) approach was employed for these post-hoc comparisons. In a comparison between the cells of LC-Line 5 and HC-Line 5, a significant difference was detected, $t_{(560)} = 4.32$, $q'_{(5,560)} = 3.86$ (q' is the critical value), $p < 0.05$ (see Figure 6). Also, in comparison between the cells of HF-Line 7 and HF-Line 8, a significant difference was determined to exist, $t_{(560)} = 5.42$, $q'_{(5,560)} = 3.86$, $p < 0.05$ (see Figure 7). All other comparisons were not significantly different ($p > 0.05$). To restate, these post-hoc analyses are important to perform because they allow one to identify were the significant differences are located within a 3-way interaction.

Finally, a nonlinear analysis was employed, using Cobb's CUSP surface analysis program (1992), as described by Allen and Carifio

(1995). This analysis was performed to determine the existence of Cusp Catastrophe model characteristics (bimodality, divergence, catastrophe, hysteresis, and inaccessibility) by providing for a comparison between a linear model (based on multiple regression equations) and the Cusp Catastrophe model (based on the canonical cusp surface--a cubic polynomial equation). Briefly, when the program "converges" (see below), this suggests that the characteristics of a Cusp Catastrophe are evident. There were many convergences, however four are of value to this experiment. Allen and Carifio (1995) recommend that one report the asymptotic chi-square statistic, the degrees of freedom, and the significance level from comparing the likelihood of the cusp model to the likelihood of the linear model. Further, it is informative to know how much more of the variance is explained by the cusp model than by the linear model. So, one should report the delay r^2 (the variance explained by the cusp model) and the linear r^2 values. Also, CUSP performs three separate statistical tests to assess whether the estimated cusp model is superior to the linear model. The first test compares the previously mentioned likelihoods. Second, CUSP assesses whether the estimated model is actually a cusp surface, by performing a t-test between the cubic term and the linear term. Thirdly, CUSP requires that at least 10% of the data points fall in the bimodal region of the estimated model.

The first convergence to be mentioned was for the three factors of: a) location of greatest change (in scoring; i.e., from Line 1 to Line 2; which is synonomous with the Poston & Steward (1978) participants' changes in perception), b) order and, c) cognitive state anxiety for the High Cognitive State Anxiety (n=30) participants. The factor of location of greatest change was determined by the repeated measure. That is, an analysis was made to determine at which point the participant showed the greatest change in scoring, depending on the assigned order (far to close vs. close to far). In cases of a tie, the location of greatest change was determined by the participants response to either Item #3 (decrease) or Item #4 (increase) of the post-experiment questionnaire. CUSP showed the asymptotic chi-square to be significant, $\chi^2_{(6)} = 36.35$, $p < 0.001$. The t-test was significant, $t_{(21)} = 2.48$, $p < 0.025$ for this group of factors. Sixty-seven percent of the data points were in the bimodal region. The CUSP model explained 28.04% more of the data than did the multiple regression model. The convergence here suggests that there was a difference for the order effect. Specifically, the location of greatest change for the participants who went from close to far differed from the location of greatest change for the participants who went from far to close.

The second convergence to be mentioned was for the factors of cognitive state anxiety, order and perceived line of improvement in scoring (Item #4 from Post-Experiment Questionnaire) for the High Cognitive State Anxiety participants. CUSP showed the asymptotic chi-square to be significant, $\chi^2_{(6)} = 18.73$, $p < 0.01$. The t-test was significant, $t_{(21)} = 2.62$, $p < 0.01$ for this group of factors. One hundred percent of the data points were in the bimodal region. The CUSP model explained 27.89% more of the data than did the multiple regression model. The convergence here suggests that there was a difference for the high cognitive state anxiety participants only. Specifically, the perceived line of improvement for the high cognitive state anxiety participants who went from close to far differed from the perceived line of improvement for the high cognitive state anxiety participants who went from far to close.

The third convergence to be mentioned was for the factors of line of greatest change and perceived line of improvement in scoring for the Far to Close Ordering (n=30) of participants. CUSP showed the asymptotic chi-square to be significant, $\chi^2_{(4)} = 24.83$, $p < 0.001$. The t-test was significant, $t_{(25)} = 2.97$, $p < 0.005$ for these factors. One hundred percent of the data points were in the bimodal region. The CUSP model explained 11.98% more of the data than did the multiple regression model. The convergence here suggests that there was a difference for the far to close participants only. Specifically, the line of greatest change was different from the line of perceived improvement.

The fourth convergence to be mentioned was for the factors of cognitive state anxiety and perceived line of improvement in scoring for the Far to Close Ordering of participants. CUSP showed the asymptotic chi-square to be significant, $\chi^2_{(4)} = 22.72$, $p < 0.001$. The t-test was significant, $t_{(25)} = 2.83$, $p < 0.025$ for these factors. One hundred percent of the data points were in the bimodal region. The CUSP model explained 11.63% more of the data than did the multiple regression model. The convergence here suggests that there was a difference for the far to close participants only. Specifically, the high cognitive state anxiety participants who went from far to close differed from the low cognitive state anxiety participants who went from far to close with regard to the perceived line of improvement.

It should be added that the Cobb's CUSP program employed here is not necessarily set up for the use of repeated measures designs. However, by determining the "location of greatest change," or the point (i.e., as a dependent variable) at which performance changed the greatest, we were able to use the program in a more efficient manner (B. Allen, personal communication, April 7, 1999).

Conclusions

This study has shown, as hypothesized, that there were few differences initially between the performance of individuals with high versus those with low levels of cognitive state anxiety. This study also has presented evidence that following an increase in state anxiety, or distance, those who were high in cognitive state anxiety levels showed a "catastrophic" decrement in performance relative to the low cognitive state anxiety individuals, who were shown to have a more gradual decrement in performance. Further, it was shown that following a decrease in state anxiety, or distance, those who were high in cognitive state anxiety levels showed a "catastrophic" jump (improvement) in performance relative to low cognitive state anxiety individuals, who showed a more gradual increase in performance. These findings were all supported by the MANOVA results.

The multiple comparison tests and the CUSP analyses showed support for the idea that when one's state anxiety was manipulated by distance, as was the case here, one's performance may be better explained by the Cusp Catastrophe model. To sum up, there was a significant difference at Line # 5 (the 10 foot distance) between the high cognitive state anxiety participants and the low cognitive state anxiety participants, with the high cognitive state anxiety participants' performance catastrophically changing at that distance. Further support for the catastrophic changes that the high cognitive state anxiety participants experienced was seen at Line #7. Here the high cognitive state anxiety participants who went from far to close (HF's) had a significant increase in performance from Line #8 to Line #7.

To clarify the convergent results of the CUSP program, the evidence lends support to the fact that the variance of the data are better explained by a nonlinear Cusp Catastrophe model rather than by a multiple regression, linear model. It could be that, for motoric performance, when one experiences a catastrophic drop in performance, one might be able to use catastrophe modeling for intervention purposes. From the early golfing example, if one can determine their cognitive state anxiety level when catastrophe occurs, then one can adjust appropriately their level of cognitive state anxiety so as to supercede the catastrophe through movement along the appropriate control dimension(s), similar to the induction of a reversal.

To give another example, you are the coach of a basketball team, and you have great insight to your players and their individual differences with regard to state anxiety, so you could use the Cusp Catastrophe model to assist you in certain game situations. Say Player 1 is relatively low in state anxiety and Player 2 is relatively high in state anxiety, and they are fairly equal regarding three point percentages. Yet, you are aware that Player 1 is more consistent throughout the game, while Player 2 excels early in most games. The end of the game is near (10 seconds remaining), and your team is down by three points. Player 1 has been performing steadily all game.

Based on the Cusp Catastrophe model, history is important, so one should have Player 1 shoot for the three-point basket.

This investigation may be one step in the right direction for the utilization of Cusp Catastrophe modeling. Previously, the value of catastrophe models was highly debated. There was much concern that catastrophe modeling was not empirically supported. The MANOVA results here, combined with the use of Cobb's (1992) program, shows support for the fact that catastrophe modeling is a valuable approach for explaining many forms of behavioral phenomena. Researchers should take a longer look at the evaluative options that are made available to them, and employ them.

Some future directions for this area of research may be to utilize a task specific CSAI-2 for dart throwing. For example, rewording Item #1(see Appendix A) as "I am concerned about this dart throwing task" and so on. Also, one could subject the CSAI-2 and similar measures to the fundamentals of Item Response Theory (Hambleton, Swaminathan & Rogers, 1991). Further, one could investigate the impact of distractions upon the anxiety-performance relationship within a competitive domain. Lastly, it would be interesting to see if the results and implications of this investigation were supported in a group competitive setting (to add a social facilitation effect), as well as in a true competitive (i.e., tournament) situation.

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Table 1
Inaccessibility Example

Relative Competitive Force	Industry Inertia	Relative Competitive Position
0.00	3.00	0.00
0.73	3.00	-0.25
0.87	3.00	-0.35
1.38	3.00	-0.50
1.58	3.00	-0.60
1.83	3.00	-0.75
2.00	3.00	-1.00
2.00	3.00	2.00
18.00	3.00	3.00

Note. Adapted from "A Preliminary Empirical Test of a Cusp Catastrophe Model in the Social Sciences" by Oliva, T., Peters, M. and Murthy, H., 1981. Behavioral Sciences, 26, p. 156.

Table 2
Comparison of CSAI-2 Cognitive Norms

Sample	N	M	SD
Martens et al. (1990)			
College Males	158	17.68	4.84
College Females	220	18.40	5.99
Ingurgio (1999)			
College Males	208	22.19	5.61
College Females	218	23.30	5.54

Table 3 Internal Consistency of CSAI-2 Subscales (Form D)

Sample	N	CSAI-cog	CSAI-som	CSAI-sc
1	57	0.79	0.82	0.88
2	40	0.83	0.82	0.87
3	54	0.81	0.83	0.90

Table 4 Correlations of Trait Scales With the CSAI-2 (Form D)

Scale	N	CSAI-cog	CSAI-som	CSAI-sc
SCAT	151	0.45	0.62	-0.55
TAI	54	0.50	0.37	-0.46
AAT-CD	40	0.35	0.06	-0.34
AAT-CF	40	-0.22	0.04	0.33
I-E Control	57	0.09	0.11	-0.17

Table 5 Correlations of State Scales With the CSAI-2 (Form D)

Scale	N	CSAI-cog	CSAI-som	CSAI-sc
WEI-W	49	0.74	0.37	-0.62
WEI-E	49	0.57	0.82	-0.40
CSAQ-C	54	0.69	0.48	-0.57
CSAQ-S	54	0.47	0.75	-0.46
SAI-1	57	0.65	0.78	-0.66
SAI-2	49	0.66	0.69	-0.77
AACL	40	-0.63	-0.66	0.66

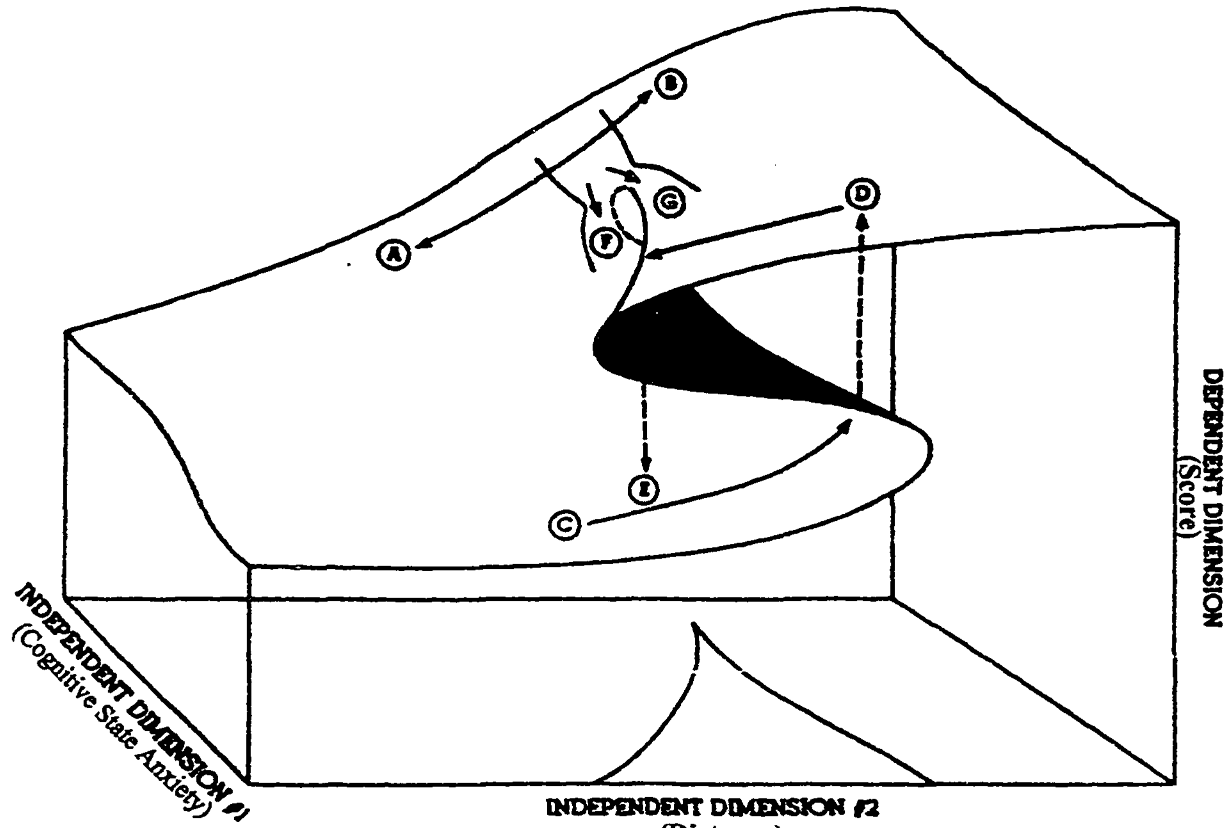
Table 6 Table of Cell Means

			Condition		
Distance	Line #	Low-Close	High-Close	High-Far	Low-Far
5 Feet	# 1	62.00	58.80	65.70	62.70
6 Feet	# 2	51.30	51.30	56.40	62.70
7 Feet	# 3	54.00	51.30	55.70	58.00
8 Feet	# 4	48.70	46.30	48.60	54.00
9 Feet	# 5	50.70	32.50	52.10	50.00
10 Feet	# 6	39.30	31.30	46.40	46.00
11 Feet	# 7	37.30	33.10	46.40	43.30
12 Feet	# 8	32.00	23.80	23.60	36.00
13 Feet	# 9	30.70	21.30	22.90	34.70
14 Feet	# 10	32.00	22.50	17.90	30.70
15 Feet	# 11	26.70	20.00	10.00	22.70

Note. The scores above reflect the average of three darts thrown at each line/distance.

Figure 1. The Cusp Catastrophe Model, which includes the variables for the present investigation.

Figure 1

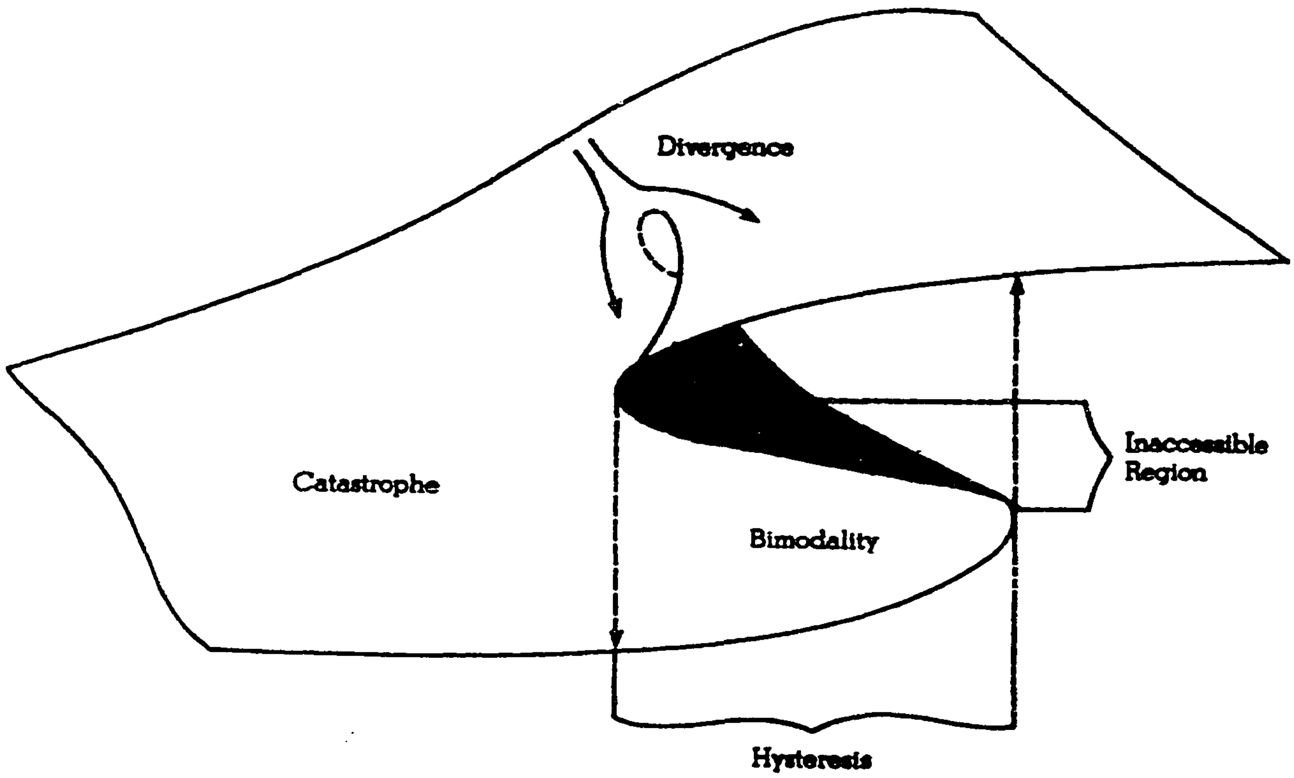


<u>The Cusp Catastrophe Model</u>

Note. Adapted from "A Generic Model of Competitive Dynamics" by Oliva, T.A., Day, D.L. and MacMillan, I.C., 1988, <u>Academy of Management Review, 13,</u> p. 376.

Figure 2. The five requirements needed for a Cusp Catastrophe: Bimodality, Catastrophe, Divergence, Hysteresis, and an Inaccessible Region.

Figure 2

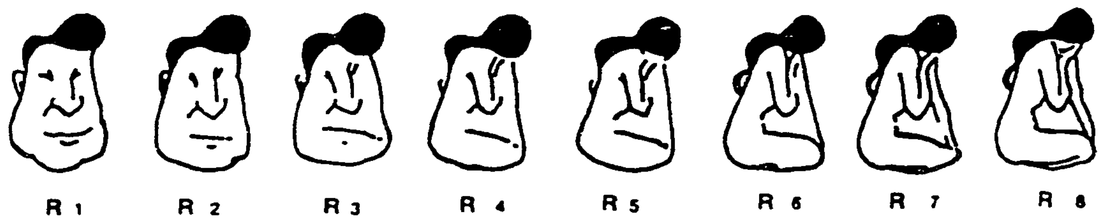


A Cusp Catastrophe's Five Requirements

Note. Adapted from "A Generic Model of Competitive Dynamics" by Oliva, T.A., Day, D.L. and MacMillan, I.C., 1988, Academy of Management Review, 13, p. 377.

Figure 3. The perception of multistable figures. One perceives a male's face on the left, and a female sitting on the right.

Figure 3

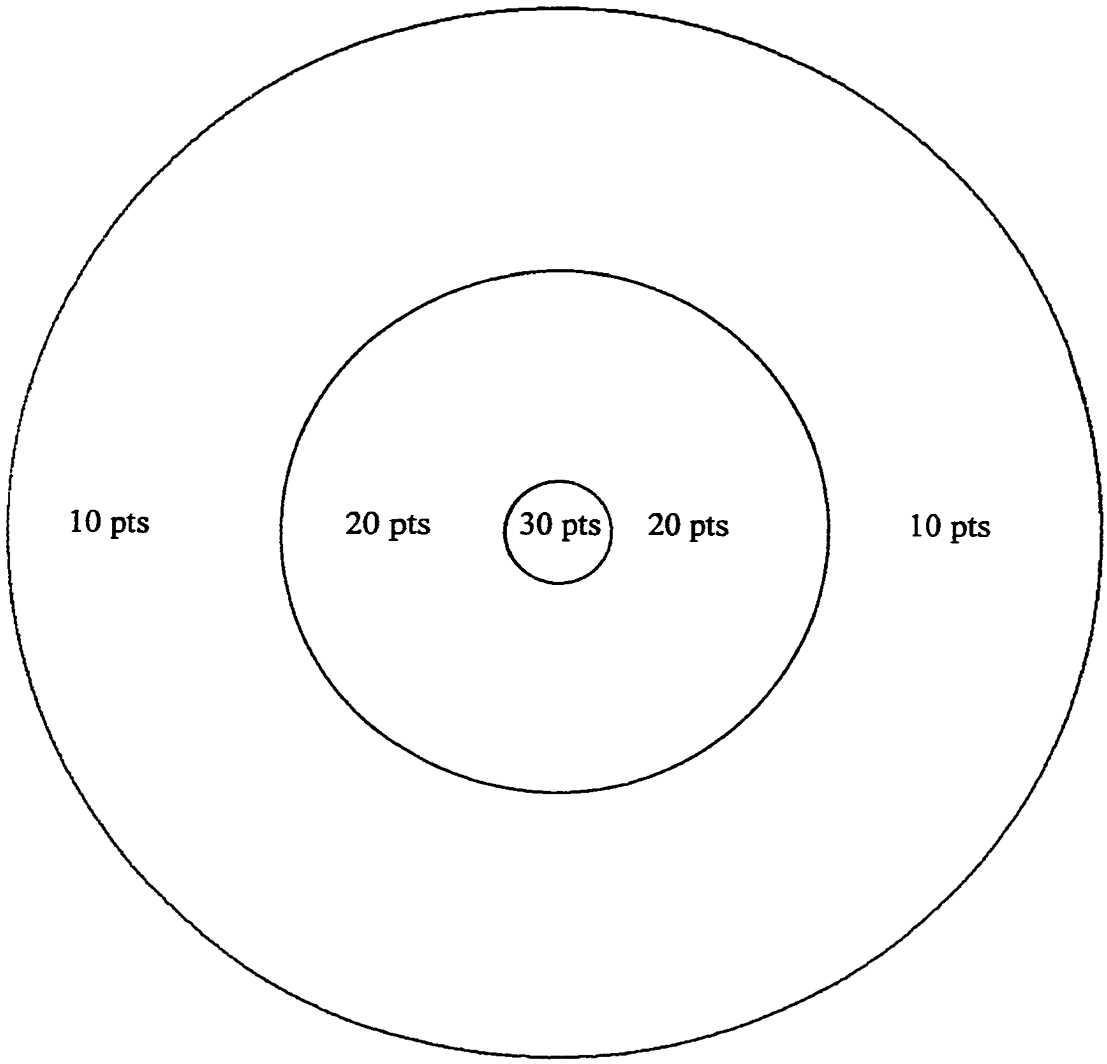


Perception of Multistable Figures

Note. Adapted from "Catastrophe Theory Modeling in Psychology" by Stewart, T. and Peregoy, I. N. (1983). Psychological Bulletin, 94, p.341.

Figure 4. The modified dartboard for scoring purposes: the bull's eye are was worth 30 points; the area from the bull's eye to the first inner circle was worth 20 points; the rest of the are was worth 10 points; and, off the board scored no points.

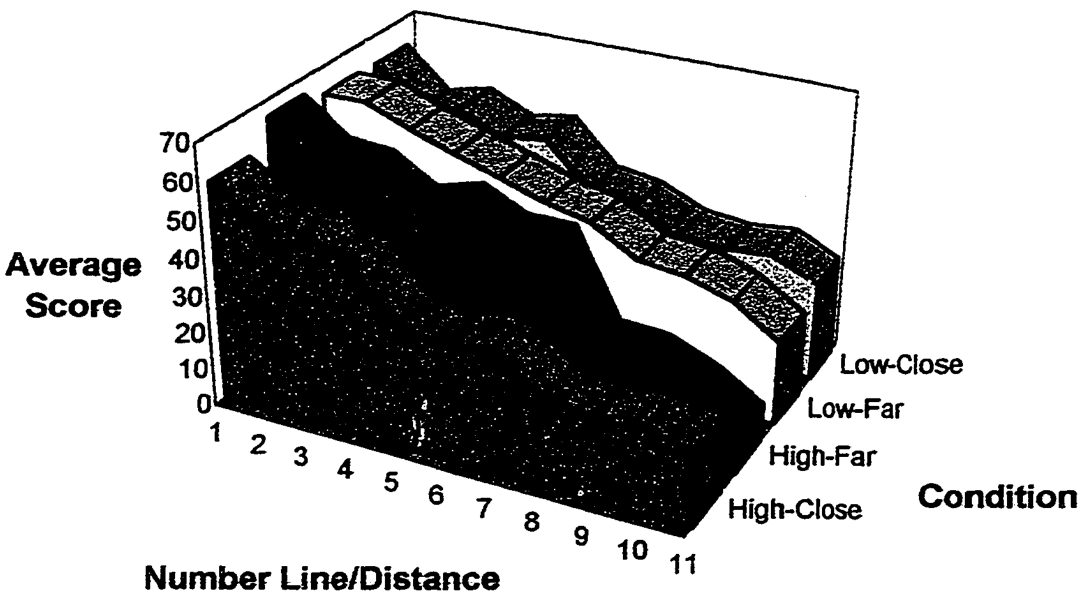
Figure 4



Score - Modified Dartboard

Figure 5. The 3-way interaction of average score, number line/distance, and condition.

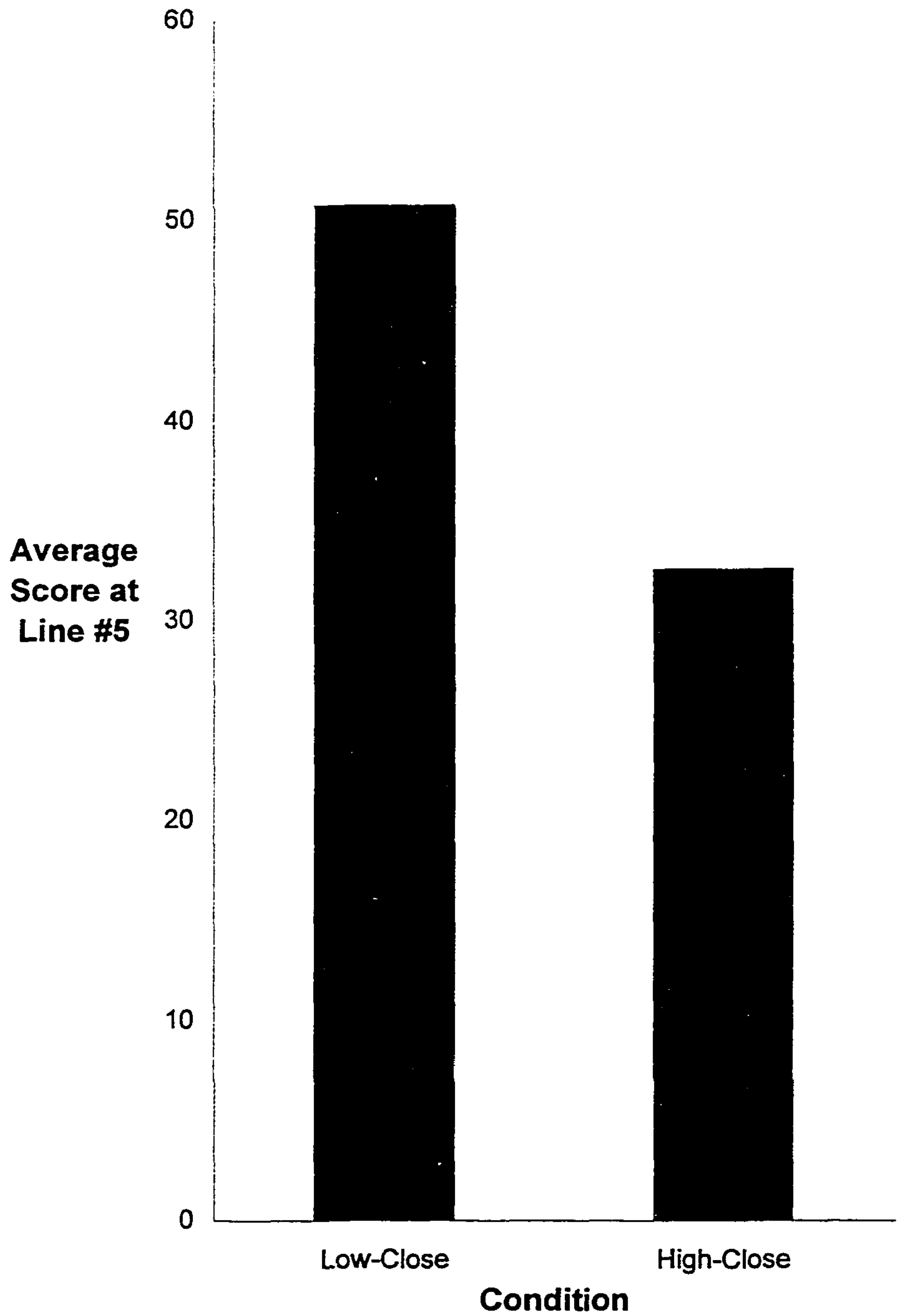
Figure 5



70
60
50
Average Score
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
Number Line/Distance
Low-Close
Low-Far
High-Far
High-Close
Condition

Figure 6. The significant scoring difference between the Low-Close (50.7) and the High-Close (32.5) conditions, at Line #5.

Figure 6



60
50
40
30
20
10
0
Average Score at Line #5
Low-Close
High-Close
Condition

Figure 7. The significant difference in scores for the High-Far condition from Line #7 (46.4) to Line #8 (23.6).

Figure 7

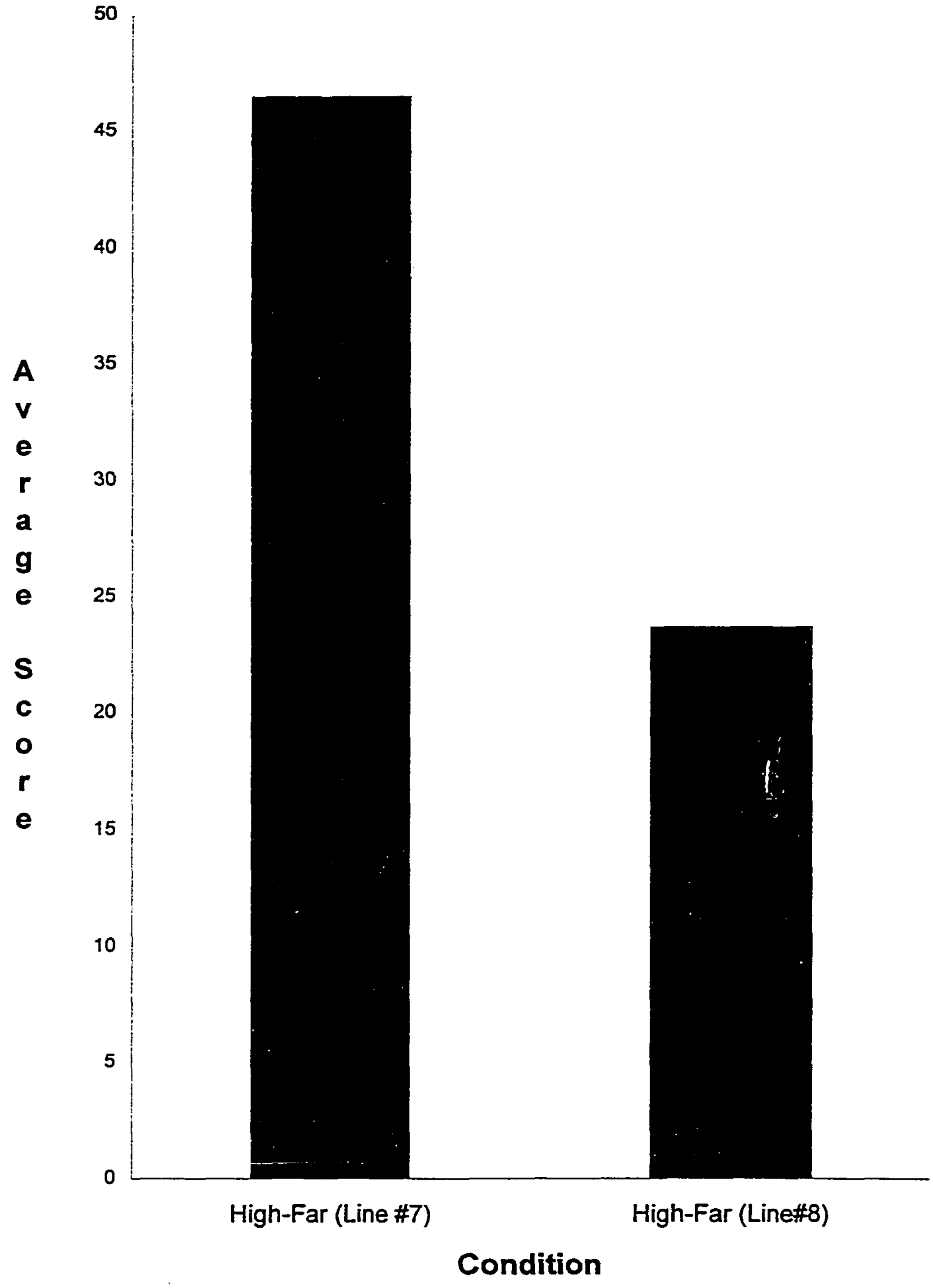

Average Score
50
45
40
35
30
25
20
15
10
5
0
High-Far (Line #7)
High-Far (Line#8)
Condition

Figure 8. The significant interaction between Score and Cognitive State Anxiety; Participants with lower levels of cognitive state anxiety performed significantly better than those participants with higher levels of cognitive state anxiety.

Figure 8

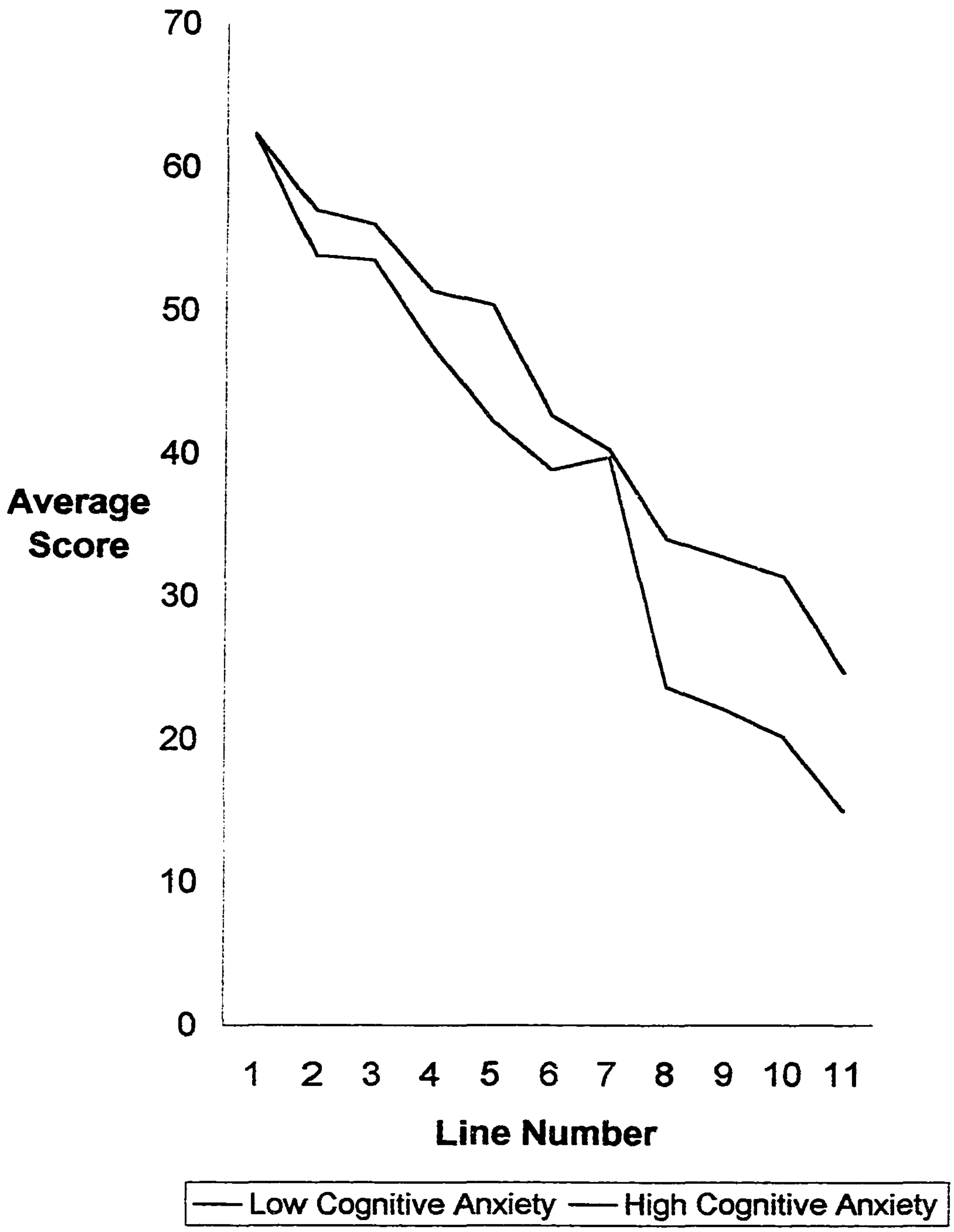
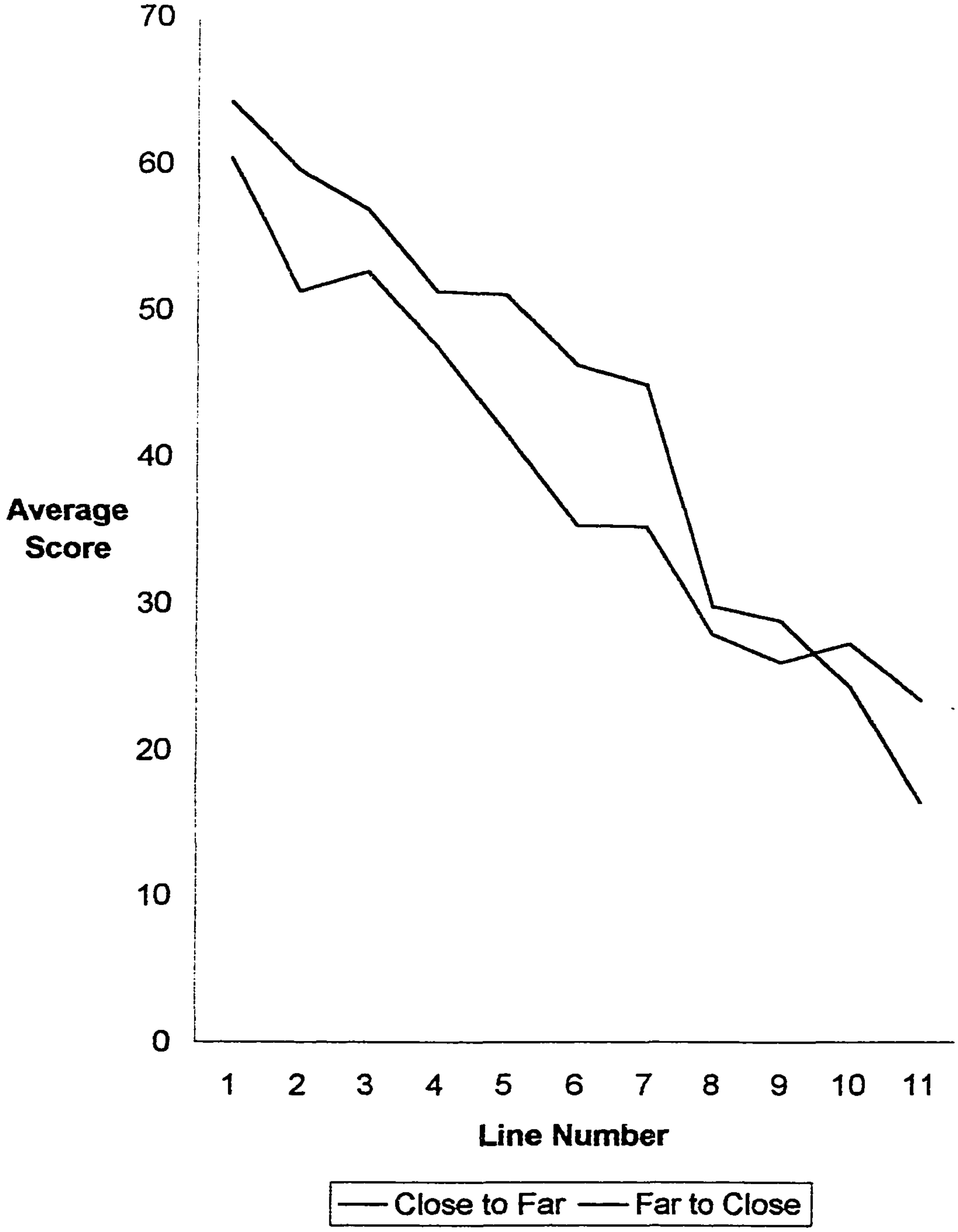

70
60
50
40
30
20
10
0
Average Score
1 2 3 4 5 6 7 8 9 10 11
Line Number
Low Cognitive Anxiety
High Cognitive Anxiety

Figure 9. The significant interaction between Score and the Order factor; Participants who went from Far to Close (15 feet to 5 feet) scored significantly more points at the closer distances, while those participants who went from Close to Far scored significantly more points at the farther distances.

Figure 9


70
60
50
40
30
20
10
0
Average Score
1
2
3
4
5
6
7
8
9
10
11
Line Number
Close to Far
Far to Close

Appendix A

The Competitive State Anxiety Inventory -2; Cognitive Subscale.

Self-Evaluation Questionnaire

ID#____________________ Sex: M F Date:________

Directions: A number of statements that athletes have used to describe their feelings before competition are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate *how you feel right now*--at this moment. There are no right or wrong answers. Do *not* spend too much time on any one statement, but choose the answer which describes your feelings *right now.*

	Not at All	Somewhat	Moderately So	Very Much So
1. I am concerned about this competition	1	2	3	4
2. I have self-doubts	1	2	3	4
3. I am concerned that I may not do as well in this competition as I could	1	2	3	4
4. I am concerned about losing	1	2	3	4
5. I am concerned about choking under pressure	1	2	3	4
6. I'm concerned about performing poorly	1	2	3	4
7. I'm concerned about reaching my goal	1	2	3	4
8. I'm concerned that others will be disappointed with my performance	1	2	3	4
9. I'm concerned I won't be able to concentrate	1	2	3	4

Appendix B

The Post-Experiment Questionnaire

---

1. At what number line did you feel most challenged? ____________________

2. At what number line did you feel least challenged? ____________________

3. At what number line did you feel that your performance decreased? _________

4. At what number line did you feel that your performance increased?_________

5. At what number line did you feel most comfortable? That is, at what number line would you prefer to throw from?______________________________

6. At what number line did you feel least comfortable? That is, at what number line would you least prefer to throw from? ______________________________

7. Did you care about this task? That is, did you try to score points from all distances? ____

Appendix C

The Activity Questionnaire

NAME ____

ID# ________________________ PHONE# _________________

Please indicate a response for the following by **CIRCLING** the appropriate answer.

HAVE YOU EVER:

1. PLAYED FRISBEE?	YES	NO
2. PLAYED FRISBEE GOLF?	YES	NO
3. PLAYED PLASTIC-TIPPED DARTS?	YES	NO
4. GONE BOWLING?	YES	NO
5. PLAYED POOL?	YES	NO
6. PLAYED MINIATURE GOLF?	YES	NO

IMAGE EVALUATION TEST TARGET (QA-3)

150mm

6″

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