Emotional Arousal and Motor Performance

By JOSEPH B. OXENDINE

One of the most widely accepted principles of human behavior is that people perform best when "motivated." This principle is validated when keenly interested children exhibit greater enthusiasm and performance on school tasks than less interested children. Highly excited individuals performing unexpected feats or attaining unusual levels of performance is further evidence. However, empirical evidence seems to indicate that high levels of excitement interfere with efficiency in certain activities. In one situation, therefore, a high level of motivation may place the individual at a distinct advantage, whereas, at another time a person so stimulated would be hindered. The relationship between arousal and performance is a complex one and does not appear to follow a straight line. This paper will investigate several aspects of this phenomenon.

WHAT IS EMOTION?

One difficult problem in analyzing the arousal-performance question is that of defining and categorizing human emotion. The terms "motivation," "excitement," or "arousal," though often used interchangeably may imply different things to different individuals. When one speaks of emotional arousal he may be referring to one or a combination of the following "negative" conditions: fear, anger, anxiety, jealousy, embarrassment, disgust, boredom, or rage. "Positive" states may include: joy, elation, ecstasy, interest, happiness, and love. The list is limited only by one's vocabulary and point of view. Although the emotional states result from different situations, the physiological response of the individual is often similar. Certainly, there is a high degree of overlap in both physical and psychological reactions to many of the indicated conditions.

Since it is not yet possible to establish distinct lines of demarcation between the various terms describing emotion, perhaps the most useful approach is to describe emotion on the basis of level of arousal or activation. In this way the emotional state may be placed on a continuum from high to low activation as follows: excited, alert and attentive, relaxed, drowsy, light sleep, deep sleep, coma, and death. Different levels are reflected in physiological changes which are controlled by the autonomic nervous system. Extensive investigation of the physiological response was carried out by Can-
non in 1929, and more recently by Hanson (1967), Husman et al. (1968), Johnson (1949), and Scubic (1955). Woodworth and Schlosberg (1963) present a thorough description of the known responses. Heart rate, blood pressure, muscle tension, respiration, galvanic skin response, and many other bodily functions have been identified as being sensitive to changes in emotional arousal.

In this discussion, emotional arousal will refer to those conditions in which one's "normal" physiological functions have been intensified.

AROUSAL AND MOTOR PERFORMANCE

Any effort to develop generalizations regarding the role of emotional arousal and motor performance must consider several factors. According to Cratty (1968), Husman (1969), and Oxendine (1968) the optimum level of arousal varies with the particular motor task, i.e., different tasks require different levels of arousal for most effective performance. In addition, the optimum arousal state varies from person to person. For example, high anxiety versus low anxiety, extraversion versus introversion, and experience versus nonexperience are some of the individual variables making it difficult to establish definitive guidelines for all persons. Furthermore, even for the same person the optimum level would be expected to vary somewhat from day to day. This principle is supported by Lewin's "Life-Space" concept which indicates that individuals respond to situations according to both internal and external stimuli.

Despite the limitations presented by the task and the individual variables, an effort will be made to generalize on the basis of research and literature available. The Yerkes-Dodson Law, now more than a half century old, can be used as a point of reference. According to this Law, complex tasks are performed better when one's drive is low while simple tasks are performed better when drive is high. Therefore, drive which is either too great or too low for a particular task may result in impaired performance. It is assumed here that "drive" is somewhat related to motivation or arousal. There is abundant empirical research evidence to support this widely accepted generalization, and, in addition, several plausible explanations have been offered. Nevertheless, the Law fails to answer many questions for the teacher or athletic coach interested in gaining more specific guidelines for the conduct of his activities. For example, when the Yerkes-Dodson Law is used, there is a question of which tasks are "complex" and which are "simple." Furthermore, what is "high drive" and "low drive"? With the uncertainty and latitude inherent in the Law, the researcher or the practitioner can explain any results on the basis of the task being either complex or simple or the level of drive being either high or low, whichever seems to support the results in a given situation. Such reflective explanations, however, are of little value in predicting performance. Though offering a rough guide as an explanation.
of emotional arousal and performance, the Yerkes-Dodson Law is inadequate in terms of today's needs.

On the basis of research evidence, scientific literature, and empirical observation the following generalizations are offered on the arousal-performance topic:

1. A high level of arousal is essential for optimal performance in gross motor activities involving strength, endurance, and speed.
2. A high level of arousal interferes with performances involving complex skills, fine muscle movements, coordination, steadiness, and general concentration.
3. A slightly-above-average level of arousal is preferable to a normal or sub-normal arousal state for all motor tasks.

Arousal effects on strength, endurance and speed. As an example of the positive relationship between arousal and physical strength, the following incident is cited by Oxendine (1968):

The following case was described in a newspaper a few years ago. A man, after having jacked up his station wagon to change a tire in his driveway, was called into his house. Moments later, one of his children, who had been observing the proceedings ran into the house to tell his father and mother that the car had fallen off the jack and on another child. Both parents ran outside, and the quick-thinking father immediately began resetting the jack in order to lift the car off the child. The mother, seeking more immediate results, took hold of the car and manually lifted it so that the child could crawl out from under! So great was the strain that, in the process, a bone was broken in her back. Certainly, this feat was outside the expected performance possibilities of the woman, who was described as average in size. (p. 173)

Most persons can recall unusual feats of strength when persons have been confronted with emergency situations. These incidents run the gamut from "superhuman" actions by men during war to little old ladies carrying refrigerators downstairs and outside a burning house.

D. L. Johnson (1965) reported that subjects with induced motivational techniques made significant gains in strength, whereas, a nonmotivated group did not. One technique which simulated the competitive aspects of an athletic contest increased strength scores to a greater degree than other motivational techniques. Johnson further reported that subjects with below average strength and subjects with above average strength made similar improvements under conditions of motivation. Gerdes (1958) found that motivated subjects increased performance in pull-ups and push-ups.

On the basis of research and observation, there is every reason to believe that a very high arousal state will result in most extraordinary strength performances. Therefore, the gymnast performing an "iron cross," the weight lifter pressing a heavy weight, or the student doing a leg lift with a dynamometer—each would do his best if greatly aroused.

As an example of the relationship
between arousal and endurance, I am reminded of the following personal incident which occurred approximately three years ago. I was nearing the completion of a three mile run which ended with a long uphill climb through a wooded area and the customary painful level of fatigue had become very evident. Suddenly, out of the brush sprang two large Weimaraner dogs, noticeably unhappy, and, in fact, exhibiting a high level of unwarranted hostility. After about 15 seconds of stressful uncertainty, I was rescued by the owner. As I resumed jogging I realized that not only had my pace increased but there was a total absence of any sensation of fatigue. I could not attribute the sudden burst of energy to the 15 second “rest.”

Cannon (1929) cites the case of John Colter who along with a companion was seized by a group of Indians in Montana in 1808:

Colter was stripped naked; his companion, who resisted, was killed and hacked in pieces. The Chief then made signs to Colter to go away across the prairie. When he had gone a short distance he saw the younger men casting aside everything but their weapons and making ready for a chase. Now he knew their object. He was to run a race, of which the prize was to be his own life and scalp. Off he started with the speed of the wind. The war hoop immediately arose; and looking back, he saw a large company of young warriors, with spears, in rapid pursuit. He ran with all the speed that nature, excited to the utmost, could give; fear and hope lent a supernatural vigor to his limbs, and the rapidity of his flight astonished him-self. After nearly three miles his strength began to wane. He stopped and looked back. Only one of his pursuers was near. The Indian rushed towards him, attempting to cast his spear and fell headlong. Colter seized the spear, killed his enemy and again set out, with renewed strength, feeling, as he said to me, as if he had not run a mile. (p. 226)

Fatigue results in an increase in the threshold of a muscle and, thus, motor responses become slower. During fatigue, muscle thresholds increase from 100 percent to 200 percent and occasionally much higher in situations involving extreme amounts of work. Muscles usually return to their normal condition in 15 minutes to two hours of rest. Cannon (1929) reported research in which fatigued animals were injected with adrenalin immediately after the cessation of long work periods. He reported that animals with threshold increases of 150 percent had this decrement cut in half within five minutes as a result of the adrenalin. Rested animals did not increase their muscle response time with the injection of adrenalin. He concluded, therefore, that the injection of adrenalin had a counter action on the effects of fatigue.

While it is unlikely that Indians, Weimaraners, or injections of adrenalin will be used as a regular means of increasing endurance in sports participants, it does seem clear that situations eliciting strong emotional arousal will result in significant endurance gains. Incidents seeming to show a positive relationship between fright, anger, or
other forms of arousal and speed are within the experiences of most persons. Unfortunately, in these situations accurate measures of speed are not usually made. Whereas, feats of strength are usually verifiable, it is rare that anyone is available to clock frightened people over a measured course. Nevertheless, the belief remains that a child being chased by either a bully or a ghost will run faster than when told by the teacher to “run as fast as you can.” In experimental situations, a relationship between movement speed and motivation has been shown by Gerdes (1958), Miller (1960), Henry (1961), and Strong (1963). Thus, there is ample reason to assume that sprinters will run faster and swimmers will swim faster if highly aroused.

AROUSAL EFFECTS ON COMPLEX AND FINE CONTROLLED MOVEMENTS

Numerous situations can be cited from sports in which highly motivated or aroused individuals performed less well on complex tasks. The typical young baseball pitcher who becomes highly excited in a tense game situation is less likely to throw strikes than in practice or a routine game situation. Similarly, erratic or subpar performance in a high pressure situation may be expected from the basketball player shooting a free throw, a gymnast in a balancing routine, or a diver attempting a fancy dive. Frequent interference in activities requiring complex and controlled movements appear to support the Yerkes-Dodson Law.

The interference effects of high emotional arousal appear to have greater detrimental effects on tense or highly anxious persons than on those less anxious. Carron (1965) reported that a shock stresser (electric shock from a constant current electronic simulator) had a detrimental effect on high anxious male college students in a balancing task, whereas low anxious subjects were unaffected. Late in the learning period, however, the detrimental effect of the stresser on high anxious subjects was lessened. In reviewing several research studies in this area, Carron concluded that in tasks of low difficulty, high anxious subjects were found to be superior to low anxious subjects. However, in tasks of high difficulty, low anxious subjects proved superior. Stress seemed to be particularly detrimental when persons were largely unacquainted with a particular activity. However, experience in the activity tended to reduce the adverse effects of stress. Bergstrom (1967) reported that experienced airplane pilots performed less well on a complex motor task during stressful conditions. The stressful situation used was distracting flashing lights and the performance of a secondary task along with the main task. Bergstrom reported that the human pilot can perform extremely difficult and complex tasks in a calm laboratory situation or a simulated cockpit. When the system is airborne, however, the pilot's performance seriously deteriorates as a result of the stress. Pinneo (1961) reported that as tension increased so did the errors in a complex tracking task.
In a study of steadiness, Eysenck and Gillen (1965) reported that high drive subjects performed at an inferior level to low drive subjects in a hand steadiness test. Basomity, et al. (1955) found a decrement in performance in hand steadiness following the administration of adrenalin, and Haugy (1954) reported an increase in fine tremor after the administration of a stimulant drug. Several authors report that muscle tension and tremor is a normal characteristic of increased tension. Such tension may easily result in the inability of the pass receiver in football to catch the ball. The same may be true for the basketball player attempting to catch the ball or retrieve a rebound, or the field hockey player unable to exercise the typical “give” with the stick when receiving the ball.

Hussman (1969) states that as emotion goes up, functioning intelligence goes down. Of course, effective intelligence is an important factor in athletic contests, not to mention I.Q. tests and performance in general daily routine. However, rising emotion and declining intellectual functioning is probably not a straight line relationship. That is, there is no evidence to indicate that an emotional state slightly above normal is less effective than a “normal” or even below average level. Nevertheless, there is little question about the distracting effects of extreme levels of emotion on any type of performance involving reasoning powers. Such interference may be particularly harmful when the performer is in an activity requiring quick thinking or fast decision making. Extreme examples of this interference occur when the individual “freezes” or “goes blank.”

EMOTIONAL AROUSAL AND PERFORMANCE IN SPORTS

Research dealing with the role of emotional arousal in ordinary sports activities is sparse. Some studies have attempted to determine the level of arousal associated with participants in different sports without determining the relationship between that level and subsequent performance. Other studies specifically designed to relate arousal to performance level usually consider the team as a whole to make a generalization about a particular sport. One of the few studies in this specific area was conducted by Harmon and Johnson (1952) who found that a major college football team played its best game of the season when aroused to the highest level. On the other hand, the team performed poorest when the arousal level was at the lowest state. However, to generalize that a football player performs best when he is most highly motivated is a rather crude generalization. The game of football is so varied and complex that optimum emotional arousal for the different skills may vary from near the norm line to extreme high levels. For example, the offensive guard or tackle required to block the individual straight across the line will probably exhibit speed and power most effectively if he is motivated to the highest possible degree. On the other hand, the open field runner is required to exhibit agility, balance, and judgment in direction as well
as good running speed. Therefore, a moderate level of arousal may be most helpful. Finally, the quarterback when throwing a pass, and the field goal kicker would probably perform best at a low level of arousal so that they relax and focus their attention on the task at hand and, thus, make the accurate and rather delicate responses necessary for success. For the performance of individual tasks in football, therefore, it appears that different levels of arousal would be ideal for players at different positions.

Without adequate research relating emotional arousal to specific sports skills, suggestions as to the most appropriate level for different sports activities are speculative. Nevertheless, Table I includes a summary of suggestions regarding the optimal arousal level for the typical participant in a variety of sports activities. These are based on some reflections on the re-

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<th>Level of Arousal</th>
<th>Sports Skills</th>
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<tr>
<td>#5 (extremely excited)</td>
<td>football blocking and tackling performance on the Rogers' PFI test running (220 yards to 440 yards) sit up, push up, or bent arm hang test weight lifting</td>
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<tr>
<td>#4</td>
<td>running long jump running very short and long races shot put swimming races wrestling and judo</td>
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<tr>
<td>#3</td>
<td>basketball skills boxing high jumping most gymnastic skills soccer skills</td>
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<tr>
<td>#2</td>
<td>baseball pitchers and batters fancy dives fencing football quarterback tennis</td>
</tr>
<tr>
<td>#1 (slight arousal)</td>
<td>archery and bowling basketball free throw field goal kicking golf putting and short irons skating figure 8's</td>
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<tr>
<td>0 (normal state)</td>
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search and opinions which relate to the components necessary for performance in the activities listed.

In Table I, the #5 level refers to extremely high levels of excitement approaching “blind rage” while the #1 level suggests a condition only slightly more intense than a normal relaxed state. Skills are placed on the scale at a point seeming to reflect the needed ingredients for excellent performance. That is, those activities high on speed, strength, or endurance needs but low on complexity, fine muscle control, and judgment are placed nearer to #5. Those activities placing high priority on fine muscle control and coordinated movements but low on strength and speed are placed nearer to #1. Of course, many skills require a combination of these several factors and, thus, fall somewhere in between #1 and #5. For example, the boxer, though needing the strength, speed, and endurance afforded by high emotion must devote attention to analyzing his opponent’s moves and figuring out a way of maximizing his own strengths while exploiting his opponent’s weaknesses. In addition, he must protect himself. Consequently, the boxer who becomes unduly angry or “loses his head” is an easier target for the more composed boxer. Similarly, the sprinter in a short race is likely to lose some efficiency at the start of the race and during the first few steps if a state of extreme tension exists at the starting blocks. However, in a slightly longer race, i.e., 200 yards, the negative effects of extreme tension would be minimized while the benefits (speed and endurance) would be maximized. For longer races such as a mile or greater, there is a tendency for the highly aroused runner to throw caution to the winds, fail to pace himself, and tire badly near the end of the race.

For an activity such as golf putting, an extreme level of arousal is often devastating. The golfer is likely to putt the ball much too strongly because of his general muscular tension or, on the other hand, much too easily, because of his fear of overputting. The same holds true for other skills emphasizing accuracy and precision. I have never known a basketball coach to say to a young player who has just missed an important free throw, “You did not try hard enough.” Rather, most problems arise when individuals try too hard.

ESTABLISHING THE DESIRED AROUSAL LEVEL

Understanding the optimal level of arousal for each activity is only part of the information needed to make effective use of emotions in motor skills. Also needed is a means of determining the arousal level of an individual or group at a particular time, and further, the ability to alter it. Each of these topics is appropriate for a major investigation. Only a brief overview will be presented here.

Since emotional arousal as considered in this discussion is reflected in physiological responses, the only accurate means of determining one’s condition is by the measurement of these responses. Usually this requires the use of some equipment of varying de-
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grees of sophistication. Several experimental psychology books including the one by Woodworth and Schlosberg, Experimental Psychology (1963), describe procedures used in the measurement of most responses related to emotional arousal. However, experienced athletic coaches and physical education teachers have developed ways of making empirical judgments as to whether an individual is "up" for an impending event. In 1929, Cannon described a highly aroused football player as "sitting grimly on a bench, his fists clenched, his jaws tight, and his face the grayish color of clay." Today's football coaches recognize these and other behaviors as being characteristic of the highly aroused player.

Changing arousal state in the desired direction requires an understanding of some basic principles of psychology and skill in using certain techniques. Most texts relating to the psychology of behavior or teaching devote large portions to these processes. The following techniques have been used in practical and experimental situations to raise the level of arousal for participation in motor activities: competition (challenges), praise and reproof, rewards and punishment, "pep" talks, music, and hypnosis. Ironically, most of these have been used both to heighten and to lower the level of arousal. For example, in one situation music with a stirring, rhythmic beat and with increasing intensity may be used to raise one's general level of excitement. In another situation, soft or soothing music may be used to calm overly excited participants prior to competition. A great deal of research is essential before refinement can be made in the use of these or other techniques for promoting the desired arousal level of athletic participants.

REFERENCES

13. Hussman, B. F.; Hanson, D.; and Walker, R. "The Effect of Coaching Basketball


