Performance and Arousal

Until recently, the traditional Inverted-U hypothesis had been the primary model used by sport psychologists to describe the arousal-performance relationship. This hypothesis is based on work by Yerkes and Dodson (1908), which focused on the decision-making abilities of mice when presented with varying intensities of a stressor. According to the basic tenets derived from this research, optimum performance should be seen at levels of moderate arousal. As arousal approaches extremes (a comatose state on one end and panic attack on the other), performance will decline accordingly. The end result is a curvilinear relationship between arousal and performance that resembles an inverted-U.

Modification of this hypothesis for application to sport has also suggested that this relationship is dynamic (Landers & Arent, 2001; Mahoney, 1979). That is, the curvilinear function can shift to the left or right depending on individual characteristics (i.e. high skilled or low skilled, extroverted or introverted) and the type of task (i.e. simple or complex). This inverted-U relationship has been demonstrated across numerous studies in the psychological and motor performance literature (e.g. Anderson, 1990; Babin, 1966; Levitt & Guthin, 1971; Martens & Landers, 1970; Wood & Hokanson, 1965). Other investigators however have questioned the lack of clear support for the inverted-U relationship (Hockey', Coles, & Gaillard, 1986; Jones, 1995; Neiss, 1988). Despite of a number of criticisms, even the most ardent critics have, at times, used the inverted-U hypothesis to support their findings (Hockey et al., 1986) or have stated, "... as a correlational rather than causal hypothesis, it can be said to be supported by the totality of evidence ..." (Neiss, 1988, p. 355).

The criticisms of the inverted-U hypothesis have been conceptual and methodological. Investigators (Anderson, 1990; Neiss, 1988) have noted tile mistake of using the terms "arousal" and "anxiety" interchangeably. In the psychology literature, the tern1 arousal is often used synonymously with the term "activation" and refers to a nondirective generalized bodily activation. Arousal is thus, considered an energizing function responsible for harnessing the body's resources for intense and vigorous activity (Sage, 1984). Anxiety, on the other hand, is an emotional state or reaction often characterized by unpleasant feelings of intensity, preoccupation, disturbance, and apprehension (Spielberger, 1975). Some investigators (Anderson, 1990) have proposed a broader view of arousal that goes beyond a unitary physiological (i.e. electro-cortical, autonomic) dimension, to include a behavioral dimension as well. What is clear however is that although the constructs of arousal and anxiety may at times be highly related, arousal is conceptually and operationally not the same as anxiety and therefore, theories based on the construct of arousal should not be replaced by anxiety-based theories (Anderson, 1990; Neiss, 1988).

Critics of the inverted-U hypothesis have focused on the apparent lack of clear support for the hypothesis (Hockey et al., 1986; Neiss, 1988). However this criticism is based solely on studies that have manipulated incentive or threat to produce changes in arousal (Neiss, 1988). Therefore, the available research evidence is limited, because in most studies arousal has been examined as a dependent rather than independent variable. Anderson (1990) and Neiss (1988) both argued that, if one wished to examine the effects of arousal on performance, data cannot be derived from anxiety or incentive manipulations. To adequately examine this criticism, it is important that the arousal-performance relationship be examined by actually manipulating arousal levels. Furthermore, these arousal manipulations should be relative to arousal levels of" each participant. In other words, arousal should be standardized as a percentage of a person's maximal arousal to control for baseline differences due to such factors as fitness, experience, and genetics.

Some investigators (Hardy & Fazey, 1987; Jones, 1995) have also questioned the predicted shape of the arousal-performance curve. They have argued that once optimal performance has been achieved, further increases in arousal will produce a sharp drop in performance rather than a more gradual performance decline. Landers and Arent (2001) suggested that to observe a smoother inverted-U shaped function several levels of arousal must be manipulated.

The **Yerkes-Dodson Law** dictates that performance increases with physiological or mental arousal, but only up to a point. When levels of arousal become too high, performance decreases. The process is often illustrated graphically as a curvilinear, inverted U-shaped curve which increases and then decreases with higher levels of arousal. Research has found that different tasks require different levels of arousal for optimal performance. For example, difficult or intellectually demanding tasks may require a lower level of arousal (to facilitate concentration), whereas tasks demanding stamina or persistence may be performed better with higher levels of arousal (to increase motivation).

Because of task differences, the shape of the curve can be highly variable. For simple or well learned tasks, the relationship can be considered linear with improvements in performance as arousal increases. For complex, unfamiliar, or difficult tasks, the relationship between arousal and performance becomes inverse, with declines in performance as arousal increases. The effect of task difficulty led to the hypothesis that the Yerkes-Dodson Law can be decomposed into two distinct factors. The upward part of the converted U can be thought of as the energizing effect of arousal. The downward part is caused by negative effects of arousal (or stress) on cognitive processes like attention, menory and problem solving.