In this chapter, we examine the effects of stress on task performance, and attempt to integrate research findings via a heuristic model of stress and performance. We review three approaches by which the behavioral scientist has attempted to reduce the performance decrements imposed by high stress conditions: (a) human factors, (b) training, and (c) selection. Finally, we summarize future trends and military needs for stress research.

THE MILITARY REQUIREMENT

The problem of maintaining effective task and mission performance under stress has been consistently identified as a priority area for military research (see Driskell & Olmstead, 1989). The topic of stress was identified as a primary focus for military research as early as 1917 (Yerkes, 1918); and as recently as 1988, a chapter in the National Research Council report *Enhancing Human Performance* was devoted to the management of stress (Druckman & Swets, 1988). Regardless of the extent of technological advancements made to enhance the performance of military personnel, the problem of maintaining effective task performance in a stressor environment will remain.

The concern with effects of stress on task performance is of central interest to the military for several reasons. First, the military operational environment is by definition an extreme stress environment. Both personnel and equipment must be prepared to operate efficiently in this combat environment, which is the true test of military preparedness. The extent and magnitude of this problem has been recognized for some time, particularly in the area of combat performance (Marshall, 1947; Schwartz & Winograd, 1954). For example, stress effects during the Normandy campaign in World War II were such that,

> the soldier was slow-witted; he was slow to comprehend orders, directions, and techniques ... Memory defects became so extreme that he could not be counted upon to relay a verbal order. (See Siegel *et al.*, 1981, p. 13.)

A second reason for the historical emphasis of the military on stress research is that failure to consider and prepare for the effects of stress on soldier performance exacts such a high price. That is, stress-induced decrements in performance are most likely to occur when they can be least tolerated: *during critical combat situations*. It has been noted that while performance in a high stress environment may degrade even the best trained unit, it will *eliminate the untrained unit*.

The concern with overcoming stress decrements in military performance is shared by many countries, as evidenced by research carried out by American researchers (Burke, 1980; Driskell, 1984; Driskell, Moskal, & Carson, 1987) as well as Israeli (Friedland & Keinan, 1986), British (Labuc, 1984), and Soviet (Solov'yeva, 1981). In summarizing this threat, a recent report from the US Army School of Advanced Military Studies concluded that, 'Combat stress will be one of the most significant causes of loss of manpower' (Coomler, 1985, p. i). Other researchers have agreed that 'During critical periods of a mission, susceptibility to [psychological] threat may be the decisive factor between success or failure' (Wherry & Curran, 1966, p. 228). With increasingly complex tasks to be performed in the increasingly 'high tech' military environment of the future, the effects of stress on task performance will become even more significant.

HUMAN PERFORMANCE UNDER STRESS

In order to specify what we mean when we speak of stress or stress conditions, we borrow the definition used by Folkman (1984) and her colleagues of stress as a relation between a person and the environment that (a) taxes or exceeds the person's resources and (b) threatens his or her well-being. For our purposes, we restrict our analysis to acute stress—stress that is sudden, novel, or unexpected, and of relatively short duration. This differentiates the present perspective from work dealing with chronic, cumulative, or life stress conditions. Further, we restrict our attention to overload conditions, where demand is greater than ability. Thus, this definition of acute stress excludes the effects of stressors such as boredom or sleep loss (although both overload and underload conditions may oper-

ate through a similar process; see Harris & Berger, 1983). Our focus, then, is on task performance under *acute* stress, and on the development of strategies to overcome the detrimental effects of stress on performance. Although we emphasize military performance, research findings in this arena are applicable to many applied settings that share the commonalities of novel, extreme stress performance conditions, such as flight operations, nuclear power plants and other industrial settings, and police work.

Various stressors have been shown to affect task performance. These include crowding (Hayduk, 1983; Schmidt & Keating, 1979), noise (Broadbent, 1978), performance pressure (Baumeister, 1984), workload (Wickens, 1979), anticipatory threat of shock (Wachtel, 1968) or of dangerous conditions such as parachuting (Burke, 1980; Hammerton & Tickner, 1969) or bomb disposal (Rachman, 1982), heat stress (Williams, 1984), and emergency conditions, such as nuclear power plant incidents or flight emergencies (Foushee, 1984; Krahenbuhl, Marett, & Reid, 1978). Research has been conducted to examine diving emergencies (Radloff & Helmreich, 1968), flight emergency training (Dougherty, Houston, & Nicklaus, 1957; Smode, Hall, & Meyer, 1966), performance decrements (Berkun, 1964; Kerr, 1966), and combat (Kubala & Warnick, 1979).

In these and other studies, we find a number of measurable effects of stressors, including physiological arousal such as increased heartbeat, labored breathing, and trembling (Rachman, 1982), motivational losses (Innes & Allnutt, 1967), increased self-monitoring (Carver, Blaney, & Scheier, 1979), stressor after effects (Cohen, 1980), cue restriction and narrowing of the perceptive field (Combs & Taylor, 1952; Easterbrook, 1959), decreased search behavior (Streufert & Streufert, 1981), longer reaction time to peripheral cues and decreased vigilance (Wachtel, 1968), degraded problem-solving (Yamamoto, 1984), performance rigidity (Staw, Sandelands, & Dutton, 1981), and even lowered immunity to disease (Jemmott & Locke, 1984). Data show that performance stress alone may increase errors on operational procedures threefold (Villoldo & Tarno, 1984). Similarly, Idzikowski & Baddeley (1983) found that the time taken to complete manual tasks doubled under stress conditions.

The point of this brief summary is that the effects of stress on task performance are well documented and have been examined over a considerable period of time. However, knowledge of these specific instances of stress effects may be of less importance than an understanding of the process through which they function. In the following section, we present a heuristic model of stress and human performance. The development of this model serves two primary purposes. First, it provides a theoretical basis for understanding the determinants and performance consequences of stress. That is, the model identifies some of the critical factors that determine stress effects, and the process through which they operate. Second, the model provides an orienting strategy—a way of integrating findings as well as providing guidance for the direction of research.

AN INTEGRATIVE MODEL

Figure 10.1 illustrates a simple four-stage model of stress and human performance. An environmental stimulus becomes salient, and acquires a positive or negative valence through the appraisal process. This leads to the formation of performance expectations, which in turn determine differentials in performance.

The process illustrated in Figure 10.1 involves four stages: (1) the presence of specific environmental stimuli, (2) the operation of the appraisal process, (3) the development of performance expectations, and (4) the resulting psychological, behavioral, and physiological effects. The process is initiated by the introduction of specific environmental stimuli such as noise, an alarm, or other potential stressors. The next stage is the activation and operation of the appraisal process. Appraisal is the process of evaluation of a potential stressor situation. A distinction may be drawn between two types of appraisal; primary and secondary appraisal (Folkman, 1984). Primary appraisal involves evaluation of the threat, or of environmental demand. That is, does this situation pose a threat?

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