

STRESS and Performance in Diving

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Best Publishing Company

**STRESS AND PERFORMANCE
IN
DIVING**

Arthur J. Bachrach and Glen H. Egstrom

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PREFACE (PRELIMINARY)

In recent years, skin and scuba diving have become increasingly popular sports throughout the world. There are many reasons for this increase. Among the major factors have been the surge in interest in physical fitness and exercise, the growing ability to visit attractive dive sites because of improved travel opportunities, the growing awareness of the pleasures of the underwater world created by media attention, and the expanding availability of training programs.

Revealing the many pleasures of diving has created some problems as well. Divers have become aware of the potential difficulties that may be encountered in diving and appear to be aware of the risks as well as the joys attendant upon diving. It has been our experience over the years, in our interactions with other divers in club meetings, national and international conferences, and diving courses, that divers today are infinitely more sophisticated in their knowledge and in their interests.

A scant decade ago, when some of the early workshops in underwater medicine were presented at conferences (such as Our World Underwater in Chicago), there were some divers who questioned whether such technical topics were appropriate to the average sports diver. Today, workshops and seminars are a standard part of most diving meetings, reflecting strong interest in gaining more information, in order to dive safely. *Skin Diver Magazine* demonstrates a similar trend; a survey of its readership indicated a growing demand for more knowledge of the technical side of diving.

This book is designed to meet, as best we can, the need for accurate and comprehensive information about diving. It is aimed at the serious diver who wants to know more in order to enhance the enjoyment and safety of diving. Because we sincerely believe that the modern diver *is* sophisticated and serious about learning, we have gone into detail about those areas of diving we deem important. Moreover, we have taken a scholarly tack in providing citations and references related to the material so that the interested divers may further study topics of importance and relevance in their own sports diving activities.

We have had the privilege of participating in many dive conferences and have gained immeasurably from the exchange of ideas, as well as having fine times! As individuals, and frequently together, we have worked with such outstanding sports diving shows as Underwater Canada, Our World Underwater, Boston Sea Rovers, Sea Space, and the diving medical seminars sponsored by Medical Seminars, Inc., Human Underwater Biology, The International Society for Aquatic Medicine, DAN, the University of California, Temple University, and The National Oceanic and Atmospheric Administration (NOAA). Our participation in many workshops sponsored by the Undersea Medical

Society has provided an opportunity to meet with colleagues and keep current with advances in research and practice in diving medicine. Meetings with the International Conferences on Underwater Education (IQ) and the British Sub Aqua Club have also proved enormously enjoyable and informative. It has been a most rewarding experience for both of us to enjoy personal communication with these groups of active divers; we have learned a great deal from them. The data in this book are a product of our own experience in diving and in diving research, and from our interactions with these other divers and diving groups. To all these groups we offer our most sincere thanks.

Additionally, we have had fine encouragement and support from a number of individuals in the development of this book. Among these friends and associates have been Donna Egstrom, Mary Margaret Matzen, Regina Hunt, Paula Bell and Sharee Pepper. The help and encouragement of Best Publishing, in particular Jim and Susie Joiner, is gratefully acknowledged.

We hope this book will be of interest to our diving associates and will provide both information and amusement. It will please us if it also serves as a stimulus for further communication and interaction.

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CHAPTER 1

THE NATURE OF STRESS

THE IMPORTANCE OF STRESS

Stress in diving is probably the central problem in the accidents and resulting injuries and fatalities that occur to divers, particularly sport divers. Most researchers in diving accidents implicate panic, as a response to stress, as the major cause of diving fatalities. The skills learned in training, such as the careful use of equipment and the techniques of coping with accidents, appear to be lost in a panic situation. Therefore, it is important to understand stress and the way people learn to handle stress.

WHAT IS STRESS?

Stress is both a concept and a term that is most complex. In everyday usage, stress has acquired an almost universally negative connotation: "stress management" courses and concepts usually are aimed at reducing stress, without ever adequately defining it. The definitions of stress themselves are unclear. For example, is stress the situation that evokes a response in the individual, *or*, is stress the response itself? Some have suggested that the term *stress* describes the environmental stimulus (internal or external) which creates an imbalance of some sort, and that the term *strain* describes the response to the stressor.

HOW IS STRESS MEASURED?

Opinion has also been divided regarding approaches to measuring stress and the responses to stress. One approach is biological, in which stress responses have been measured as physiological events (endocrinological changes, sweating, tremor, etc.); the other approach is behavioral or psychological, in which measures of the stress response have been directed toward changes in performance or cognition. To resolve differences in the two approaches discussed above, one can view stress as an agent, internal (e.g. hunger) or external (e.g. fear stimulus), and the response to stress as a behavior of the individual that has both physiological and psychological components.

STRESS DEFINED

A simple but useful functional definition of stress is offered by McGrath (121)*, who views stress as the result of an imbalance between

*The numbers in parentheses are references for citation and for further information.

the demands placed upon an individual and the capacity of the individual to respond to the demands. Welford (172) observed that stress will vary not only with the environmental and social conditions which affect demand, but, also, with the individual characteristics of training, bodily condition, and other variables which affect capacity.

Sells (149) believes that for a situation to be stressful the individual must perceive the consequences of his or her failure as important. For example, the person must perceive potential capability of handling the demand by virtue of level of capability. Thus, if you were placed in a situation where auditions to perform in an opera were being held, and you recognized that your vocal capacity was not at a professional level, you would probably not try out for a role. There would probably be little, if any, stress involved. If, on the other hand, you believed you were capable of meeting the demand, and decided to try out, then there could be stress resulting from your fear of failing, or of being *unsuccessful*.

Welford (172) states that stress is related to effort and an awareness of benefit and cost ratios on the part of the individual. He further suggests that "stress will arise not only when demand exceeds capacity of the toleration of unpleasantness beyond what he is willing to bear." This element adds to definitions of stress by illustrating the developmental aspects: "stress will not arise suddenly at the point where coping becomes impossible, but is a continuous variable, increasing gradually as demand approaches a person's capacity or willingness." Stress, no matter how defined, appears always to have an element of induced imbalance.

CURRENT STRESS THEORIES

Current thinking about stress derives from biologists such as Bernard (29), whose theory homeostasis suggested that central to physiological function was "the constancy of the internal milieu," that is, the body kept in balance. Homeostasis represents the restoration of balance following the imbalance induced by stress. It is crucial, not only to Bernard's theory, but also to those of Cannon (41) and Selye (150), whose General Adaptation Syndrome has stimulated interest in recent years.

STAGES OF STRESS

Selye's approach to stress has been a popular one. Simply stated, the General Adaptation Syndrome (GAS) holds that stress can be perceived in defined stages:

- a) The first appearance of the stressor (whatever the stimulus) evokes an *alarm* reaction that produces an initial *shock* reaction.
- b) This is followed by the start of recovery in *counter shock*, during which the body's responses are mobilized to handle the shock.

- c) Next comes the *stage of resistance*, a compensatory response in which the organism copes and adapts. Frequently, the response is one of overcompensation, above the normal level of resistance.
- d) The stage of resistance is successful or when coping reserves are depleted, by a movement toward a *stage of exhaustion*.

In this stage, resistance to stress drops below normal, as it does in the initial alarm reaction (shock). This state of shock leads to a drop in body resistance, a physiological breakdown, and perhaps death. Diagrammatically this may be represented:

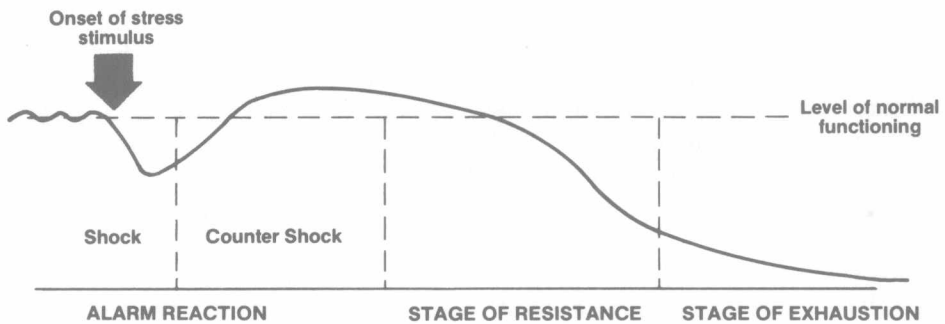


Diagram 1. Selye's General Adaptation Syndrome

CHARACTERISTICS OF STRESS

It is obvious that stress is not a single event; the capability of the individual to respond to stress varies and can change according to the situation. Adapting to stress is costly. A person may have normal recovery from a stressful event, but continued stress may deplete adaptive reservoirs and render the individual less able to cope with subsequent stress. This explains why an older person may respond adequately to surgery, mobilize resistance to stress, and then die from pneumonia, a stress event for which additional adaptive energy is insufficient.

The nature of stress may be summed up as follows: (Bachrach, 13). Stress is *complex*. Stress and the responses to stress involve marked physiological changes, as well as alterations in performance and behavior.

STRESS IS INDIVIDUAL IN NATURE

Stress is always an *arousal stimulus* in which excitation occurs, but the perception of the stress by the person is individual in nature. For example, is the stressor perceived as a threat with potential harm, or as a challenge which mobilizes for a response?

Arousal may be considered a general, nonspecific state of excitation. The interpretation of the arousal by the individual determines the direction in which energy will be expended to respond to the stress; this response is known as the "fight or flight" reaction. The interpretation involves an assessment of the nature, severity, and potential consequences of the stressor.

People can respond to stress with a positive response in which performance is improved, or with a negative response in which performance is degraded, or with an "immune" response in which no detectable physiological or behavioral alterations appear. Furthermore, an individual's response to stress is not always the same under different circumstances. Although we may speak of a general response characteristic for a particular person, the respective response may depend on the type of behavior. For example, a person may respond with degraded performance on tasks that require concentration, but with no perceptible effect on performance of tasks that are more routine.

Whether a situation is stressful, and therefore potentially disruptive to the person is *state dependent*, i.e. the perceptions and goals of the individual define it as a stressor. If the goal of a dive is to film sharks, the non-appearance of sharks would be stressful. If, however, the goal was to fish, the presence of sharks could be a stressor.

To illustrate just how individual a response to stress can be, consider Figure 1, which depicts a person doing a job few of us could handle.

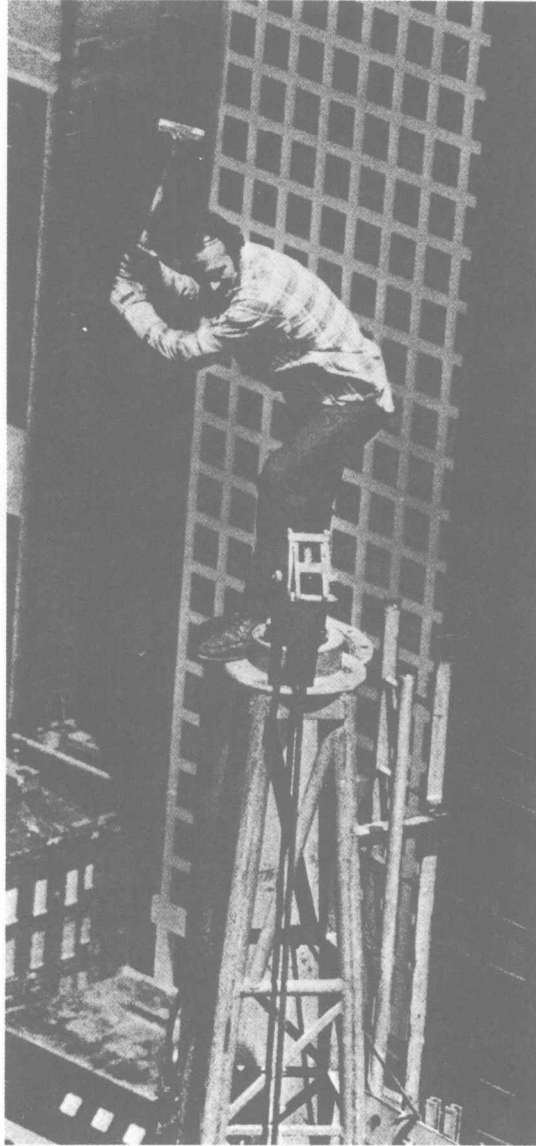


Figure 1. Standing on a tiny tower platform 500 feet above Chicago and swinging a hammer is a stress response that is individual and unusual. (Courtesy Chicago Tribune)

Another individual response that we find of particular fascination is represented by Figure 2. These sketches, made by John B. Thayer, Jr., were drawn under conditions most people would consider highly stressful.

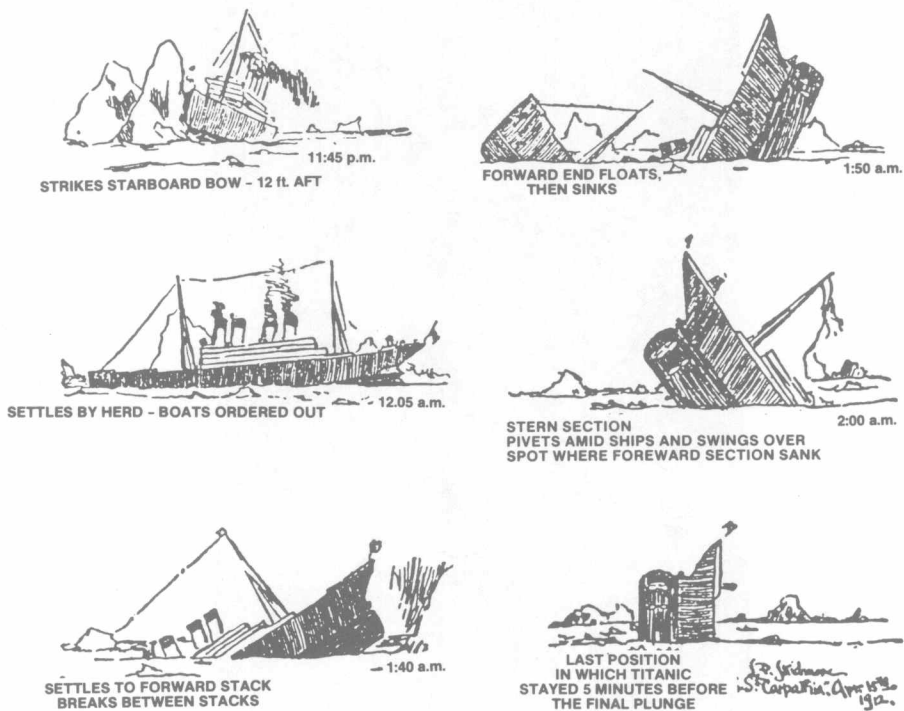


Figure 2. Sketches of the *Titanic* by "Jack" Thayer. These sketches were outlined by John B. Thayer, Jr., on the day of the disaster, and afterwards filled in by L.D. Skidmon, of Brooklyn.

After being rescued from the wreck of the *Titanic*, (which claimed his father's life) Thayer sat in the lifeboat and sketched the *Titanic* as it was sinking. (April, 1912) His outlined sketches were later filled in by another artist, L. Skidmon (Myer, 134).

STRESS IS BASICALLY LEARNED

The perception of an event as being stressful, or not stressful, is largely learned by an individual and depends on experience and conditioning. Direct experience of threat from a specific stress stimulus need not occur for a person to be stressed. Many individuals in our society would consider snakes to be a stress stimulus, but the actual incidence of being threatened by a snake is extremely low. One might say the same for the diver's response to sharks as a stressor - the incidence of attack in proportion to the perceived threat is low.

Learning to perceive a certain stimulus as stressful in this context largely results from *modeling*; a means by which some individual(s) condition other individual(s) (who do not experience the actual threat) to fear objects and events. Parents and peers provide important models for such fear behavior.

No one is neutral in stress and stress response. An individual's level of vulnerability to stress is formed by learned coding of stimuli as being aversive or dangerous. The vulnerability level interacts with the normal stress response that occurs in everyone; it is related to the homeostatic restoration of balance from imbalance, a continuing process. Zubin refers to the individual as normally being in an "idling" state ready for mobilization against stress; this concept is similar to that of Selye's level of normal resistance. The vulnerable person appears to have a lowered threshold of sensitivity; whereby a stressor which might not markedly affect one individual may have strong effects on a vulnerable person.

Information processing and skill in using information may be illustrated by two different games: chess and poker. In chess, all the information upon which to base a decision for action is available: it lies before the player on the board. The skill of the player is of paramount importance as one uses the data. Contrast this with poker: depending upon the game, minimal information is available with some cards displayed as data and others are hidden behind the hand. Skill in decision-making is also crucial in poker, but a bit of luck is involved - it's easier to bluff in poker than in chess. In life, events are more like poker than chess - adequate information is not available and must be guessed or deduced. A major way to reduce stress is to reduce uncertainty.

VULNERABILITY TO STRESS

Ambiguity to the environment means the events facing the individual lack clear and precise meaning. A lower tolerance to ambiguity is typical of a person vulnerable to stress. Arousal increases because the individual is uncertain about what is likely to happen, what consequences can occur if it happens, and what action can be taken to cope with the event. These concerns produce a sense of lack of control, which further increases arousal.

All of us make decisions with less than complete information, but a good decision maker has acquired the ability to process the available

information and choose a course of action that seems best tailored to the available data. These skills reflect a flexible approach to problem-solving, and are difficult to find in a stress-vulnerable person. Consequently, one of the most important aspects of training is to teach the skills required to process information in order to cope with changing and stressful stimulus events.

Heightened susceptibility, or vulnerability, to stress also results from the individual's expectations of dangers or threats - even in a condition where there is no immediate threat. Much of this anticipation of danger stems from estimates of the possible consequences of a potential threat, and/or the uncertainty involved. Stress, and all the psychological and physiological signs associated with it, may occur in anticipation of events that never occur. Or, as has been discussed, "Psychological stressors may precede the physical event, last longer and continue to evoke stress after the physical event is past." (Baum, et al., 27)

It is also true that the anticipated stress threat may be, in actuality, less severe than the individual expected. This fact often leads to a sense of relief and, indeed, even exhilaration after the incident is over. We have all seen a novice diver, on a check-out dive, go through an almost hilarious euphoria upon completing the dive. This behavior probably reflects relief from having successfully handled an event that had taken on strong threat qualities.

STRESS IS CULTURALLY DETERMINED

Stress modeling can be as much a function of a society as that of an individual, such as a parent, and standards of behavior, such as value systems, can become models and determine individual response. While responding to stress by contrast is largely individual and learned, such reactions are strongly culturally determined.

In our society, for example, two central concerns appear to be conditioned in most people to some extent. Murray (133) describes these concerns as: the fear of being harmed, and the fear of being shamed or "looking foolish." Thus, avoiding harm and avoiding being a subject of ridicule are important culturally conditioned behaviors. It is, perhaps, ironic that the fear of looking foolish may cause divers to attempt diving activities beyond their capabilities; thus they place themselves (and others) at risk rather than chance peer ridicule. This fact illustrates an important point about risk-taking, an important concern in diving.

In essence, an individual in our society takes two types of risks: physical risk and social risk. In physical risk, the person engages in behavior that may lead to bodily harm. Sports activity, such as football, involves some element of physical risk in the possibility of injury, but proper preparation and protection minimize such risks. The same is true in diving. In social risks, however, the person fears looking foolish in front of friends or business associates. In many ways the risk of social

censure, or disapproval, overrides an individual's concern about physical risk, and thus leads to taking chances.

Another characteristic of our society is that the lack of stimulation, boredom, or ennui is considered stressful, and leisure is almost inevitably equated with activity and not with relaxation. The term "killing time" is unique to Western society. (Bachrach, 17)

STRESS: CAN BE NEGATIVE OR POSITIVE

Stress is not necessarily negative. Stress stimulation, as we have noted, may be preferable to the boredom of low stimulation. In fact, the human being, in certain circumstances, takes risk for the "thrill" of it. Humans seek imbalance under certain conditions for the pleasure of restoring balance; consequently, we see individuals riding on roller coasters or engaging in greater risk activities.

A recent survey of trends relevant to consumer marketing strongly suggested that recreational activities will increasingly be thrill-seeking and high risk. This survey Yankelovich (180) foresaw an exponential increase in high-risk activities, referred to as "flirtation with danger," in which greater numbers of individuals will indulge in such sports as sky-diving, hang-gliding, high-speed auto racing, and scuba diving.

In this study, one motive identified for entering into high-risk activities was excitement, another was a testing of self-worth - based on the concept that mastering dangerous activities can make one a better person, and another was that "driving oneself to the brink is a path to better self-understanding." (Yankelovich, 180)

A most important aspect of this risk-taking behavior is that the participant believes that there is still adequate control over the situation. The person who climbs on a roller coaster has faith in the engineering, and believes that safety measures have been followed so that the thrills of the ride will not be a dangerous enterprise. In a similar fashion, the person who goes down the ski slope believes that safety considerations have been met by the resort, and there is sufficient control over personal performance so that the excitement of the skiing will not result in serious injury or death.

Control over the equipment is a crucial aspect of any training, as is an understanding of the conditions in which the sport is performed. Thus, although there is always an element of physical risk in sky-diving, hang-gliding, auto-racing, and scuba diving, individuals who engage in these activities must believe in their own competence, and in the competence of those associated with the activities - partners and operators alike. In stress, and in coping with stress, the individual's sense of control and competence is crucial.