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IN THE CONTEXT OF TERRORISTIC ACTS

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PSYCHOMATIC IMPLICATIONS OF CONFINEMENT BY TERRORISTS

by

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After a terrorist attack or siege has ended, the authorities and survivors survey what damage has been done. Physicians describe the physical damage done to the victims' bodies in terms of the body tissue damage caused by guns and other instruments of violence. Psychiatrists try to assess the damage done to the victims' psyche by the terrifying events that have taken place. It is possible that something will be missed, however, in the ordinary physical and psychological evaluation. The victim has been exposed to a situation in which many subtle physical changes take place in the body as a response to the stressor in that situation. These changes may be only temporary, but as I shall argue, such changes may leave a permanent mark on the body that affects future health. Furthermore, the stress response of the body is not limited in time to reactions during attack or captivity. Changes in one's life produced by either pleasant or unpleasant events can have implications for future health. The extremely unpleasant situation of being the victim of terrorism has an impact that reaches far beyond the time of capture, an impact that may result in further stress reactions.

The Physiology of Stress

Bodily response to threatening situations occurs in three basic response systems: the skeletal muscular system, the autonomic nervous system and the endocrine system. We are all familiar with the fight or flight responses that are enabled by the postural and locomotive functions of the skeletal muscular system. Somewhat less obvious are the numerous adjustments of the autonomic nervous system that also support the fight or flight response. The autonomic nervous system regulates physiological systems that are usually beyond voluntary control such as the constriction and dilation of blood vessels. Recent research has

shown that some voluntary control of such functions can be learned by biofeedback, but at best, the control is far less than that over skeletal muscles. Autonomic regulation is accomplished by adjustments in the balance of the two principal divisions of the autonomic nervous system: the sympathetic and the parasympathetic. The two branches are distinct anatomically and when they are stimulated they usually have opposing effects on the end organs they control. The sympathetic nervous system is, at least initially, activated during stress. Some of the effects of such activation are listed in Table I. The heart beats faster and more strongly, blood is diverted from the skin to the muscles, the airways to the lungs open more widely, and digestive activities are suspended. The evolutionary significance of such changes is clear: they prepare the organism for immediate physical effort to meet the challenge of the stressor. The parasympathetic nervous system on the other hand may be either inhibited or activated during stress. However, it is sometimes difficult to know if an observed change is produced principally be sympathetic or parasympathetic effects. For example, the pupil of the eye dilates under stress, a change that could be obtained by stimulating the sympathetic system or by inhibiting the parasympathetic system. Both of these systems have a baseline rate of activation and it is essentially a change in the balance between these rates that produces effects on many of the end organs. Although this balance usually shifts to the sympathetic side under stress, there are some exceptions. The syndrome of vaso-vagal fainting represents an increase in parasympathetic activation in which heart rate slows and blood pressure falls, producing syncope. Another example of parasympathetic activation under stress is seen when subjects react with an increase in motility and tone of the gastrointestinal tract, resulting in diarrhea.

Many autonomic nervous system changes can be perceived directly by the person undergoing stress and may increase his feeling of being afraid. Endocrine responses to stress are even more widespread than autonomic responses but cannot be perceived by the subject in the same way. Table 2 lists some of the hormones and other chemical substances that have been assayed by stress researchers and found to change during or after stress. These chemical changes are interrelated in very complex ways. The anterior pituitary secretes stimulating hormones that affect other organs such as the adrenal cortex and thyroid. The hormones released by the adrenal cortex have effects on most body systems that result in wide-spread changes in body chemistry. Feedback systems exist that counteract the swings in hormone levels produced by stress. As in the case of the autonomic nervous system, stress affects an endocrinal system which is already operating at some baseline level.

The overall integration of the muscular, autonomic, and endocrine response systems is accomplished by the brain. The hypothalamus and limbic systems of the brain control the specific patterns of autonomic

and endocrine response. The cortex, though more remote from the neural pathways that control the stress response, often initiates the entire sequence by perceiving the threatening situation. The cortex is unnecessary if the stressor is pain or some other physical stimulus such as heat or cold. However, immediate physical discomfort does not always constitute the prime source of stress for people involved in terrorist action.

Selye in his description of the General Activation Syndrome emphasizes that there is a temporal sequence of events that occurs in prolonged and severe stress. His description of stress stages is based on the response of the adrenal cortex of rats exposed to severe stressors. Stage I is divided into the shock phase in which the adrenal cortex is normal in size but is being stimulated by ACTH from the pituitary and the counter-shock phase in which the adrenal cortex has enlarged. In Stage II, the stage of resistance, the adrenal cortex has returned to normal size but is still secreting more steroids than before. In a sense this is an adjustment to chronic stress. Stage III, or the stage of exhaustion, only comes about when the stressor is intense and prolonged. During this stage the adrenal cortex enlarges again but is unable to provide sufficient steroid hormones and becomes depleted. At this point the organism becomes very vulnerable to infection and other diseases. It is unlikely that an exhaustion of corticosteroids would occur in a human in a captivity situation lasting a few days or even a few weeks, but Selye's scheme does serve to emphasize that the immediate stress reaction may be quite different from the prolonged stress reaction. Furthermore, substances that were repressed during stress may rebound to higher than normal values when the stressor is removed. As is noted in Table 2, that is the case for serum pepsinogen.

Activation and Performance

The ability of the person to think and to act is modified during stress. Psychophysiologists studying the effect of stressful situations on performance have conceptualized the complex of physiological changes we have outlined as being indices of psychological activation or arousal. Psychological activation is low when a subject is relaxed and drowsy and high in states of emotional excitement. One generalization that has emerged from experiments relating activation level and performance is that the relationship between these two variables has the shape of an inverted U. Performance is optimal on a wide variety of tasks at intermediate levels of activation. Too much or too little activation produces a decrement in performance. Furthermore, the optimum arousal

level for simple tasks is higher than for complex tasks. To perform a simple and possibly boring task requires a degree of alertness that would interfere with the performance of difficult tasks for which a more relaxed mental state is necessary. Examples of the kinds of tasks that show this effect are tasks of motor coordination, of perceptual discrimination, and vigilance. Ways in which activation level has been manipulated experimentally include administration or threat of electric shocks, presentation of continuous loud noise, and sleep deprivation.

One of the ways in which activation affects performance is to change one's state of attention. At high levels of attention, attention can be too sharply focussed on a few relevant parts of the stimulus field and other relevant stimuli can be missed. For example, stimuli presented near the center of the visual field could be detected whereas other signal stimuli in the periphery may be missed. For some tasks this narrow selectivity of attention is an advantage. In the Stroop test, subjects must report the color of words printed on cards as quickly as possible after presentation of each successive card. The difficulty of the task stems from the fact that the words are color names and when a subject sees the word "red" printed in blue ink, he may say "red" instead of "blue" or may take longer to respond with the correct answer. There is evidence that under conditions of high activation, subjects do better at this task because their attention is riveted to the color of the word and there is less tendency to read the word. In general, however, such abnormal focussing of attention is detrimental to performance.

Different types of personalities react differently to stress. Some people are more prone to high activation in emotional situations or are slower to return to a relaxed state after becoming excited. These people perform complex tasks poorly under stress. According to the findings of Eysenck and his coworkers people with introverted personalities are chronically more highly activated than people with extroverted personalities. As a result introverts may perform better on simple boring tasks than extroverts because the activation level of the extroverts is suboptimal. Under stress however, the extrovert may do better than the introvert, because the activation of the introvert is too high while the activation of the extrovert moves into the optimal range.

One is faced with a number of problems when one tries to apply these insights to the problems of terrorism. For example, is it best to exert emotional pressure on the terrorist or deprive him of sleep before negotiating with him or before trying to capture him by force? A laboratory vigilance task which requires a subject to wait for a long time for a visual display to change is very similar to the continuous vigilance required of the terrorist who is watching for

threatening moves from his captives or from the outside authorities. However, its applicability to the terrorist-hostage situation is limited by the fact that attention can be allotted in various ways according to the plans of the subject. One interpretation of the narrowing of attention in high activation is that the subject attempts to resist the distraction of arousing stimuli. Noise, shocks, and other emotionally arousing events not only increase physiological activation but also distract attention and this may explain some of the performance deficit at high arousal levels. However, to a certain extent the allotment of attention (a concept very closely related to the allotment of effort) is dependent on plans and needs of the organism. The sleep-deprived subject can succeed in restoring normal performance and adequate activation by exerting compensatory effort. However, motivation to perform well and feedback about performance are crucial to sustaining and modulating the compensatory effort required. Most studies of the relation of arousal to automobile accidents are unable to show that fatigue, boredom, and other activation-lowering factors increase the probability of accidents, as long as the driver is still awake. The driver may exert less effort and drive less carefully, but seldom so carelessly as to cause an accident. It is only when the driver actually falls asleep at the wheel, that fatigue and boredom take their toll.

Stress, Disease and Death

There is evidence of varying quality that stressors and the emotions resulting from them can result in disease and death. The effects of the stressor may be immediate or delayed. At one end of the time scale are reports of death occurring within minutes or hours of experiencing an emotion-arousing situation. Usually the victim has a history of cardiovascular disease or is of an age where cardiovascular disease is likely. However, Herbert and Mead have collected accounts of deaths following closely after stress situations in young and presumedly healthy people. Some of these accounts come from anthropologists and missionaries, who tell about members of primitive tribes dying of unexplained causes within a few days of eating a tabu food by mistake or after learning that witchcraft was being practiced against them. For example, in Australia a man's enemy would point a bone at him, and if the effects of this pointing were not counteracted by appropriate magic, the victim would fall sick and die within a few days. In these situations the beliefs of the society reinforce the beliefs of the individual that he will die, and in the case of breaking tabus, that he should die. The behavior of the dying person in these societies is not one of fear and agitation but more of hopeless acceptance of death.

There are also anecdotal reports about people in Western societies who have died because they were firmly convinced that death would come. For example:

"An assistant was hated by the students of a college. They condemned him in a joking manner to death, carrying out the ceremony in a serious manner. The assistant was held with his head on the chopping block, eyes bandaged, while one student made the noise of a swinging axe, another dropped a warm, wet cloth on his neck. The assistant died instantly."

The same authors cited other examples of the lethal effects of panic. In a bomb shelter in London in 1943 a bomb went off nearby and the electric power failed leaving 600 people underground in the dark. Supposedly 200 of these people died of panic before an exit route was reestablished. A lethal anxiety state was described in the Spanish Civil War of 1936-1939 where people under the stress of circumstances developed a state of anxiety, perplexity, and helplessness. A week later a fever supervened and over 95% of the 100 died within a few days. Although a physician reported normal cerebrospinal fluid findings in these patients, one might wonder if the victims were suffering from some sort of undiagnosed encephalitis.

Studies that look at the effect of stressors on health over a time span of a few months emphasize that stressors eliciting fear and anxiety are not the only type of stressors that affect health. Rahe in a series of studies employed a questionnaire that is designed to measure life change. Items include both unpleasant changes such as the death of a family member or being fired from work and pleasant changes such as a vacation or a job promotion. Both types of changes result in more sickness in the near future. In one study American seamen filled out the questionnaire before going on a cruise. They were divided into high-and low-risk groups on the basis of total life change registered on the questionnaire. In the first month at sea the high-risk group had 90% more sickness than the low-risk group. This difference declined over the ensuing 6 months, but even after six months the high-risk group had more illness than the low-risk group.

Some authors have felt that certain psychological responses to stress predispose to sickness or death on this time span of a few months. Engle found that often a person died when he was in a situation characterized by intense emotion, a fear of loss of control over the precipitating situation, and feelings of hopelessness. The person had often given up psychologically shortly before his death. Greene and his coworkers studied sudden death in patients, 77% of whom had a history of coronary heart disease. Typically the patients had

been depressed from one to three months, had become involved in an arousing situation at home or work, and had been returning to their baseline state of depression when death occurred.

Anticipating a significant event in one's life may decrease the probability of death. Phillips and Feldman discovered that the death rate decreased in the 6 months before birthdays, especially one month before birthdays, and is increased after birthdays, reaching a peak in the first three months following the birthdays. This variation is greatest for those who are distinguished, for whom the ceremonial occasion of a birthday would elicit the greatest social response.

Long-term follow-ups of people exposed to stressful situations such as prison camp incarceration often suggest that such situations have far-reaching consequences for the survivor's state of health. Survivors of prison camp incarceration have higher mortality and morbidity rates than age and sex-matched comparison groups for many years after liberation. Eitinger and Strom found that the excess in mortality was greatest among the prisoners who had been exposed to the worst conditions, and that the higher mortality persisted at least 15 years after release. More than the expected number died of tuberculosis and other infectious diseases and by accidents, lung cancer, and coronary artery disease. In some samples liver disease secondary to alcoholism is very much increased in ex-prisoners. The increase in accident rate was especially striking among Korean War prisoners during their first year of release. Eitinger and Strom also investigated the incident of disease based on registered diagnoses when survivors came into contact with the national health system. Ex-prisoners had much higher incidences of tuberculosis, neurosis and nervousness, alcohol and drug abuse, gastric and duodenal ulcers, and complaints of back pain. The incidence of cardiovascular disease was not significantly higher.

Among survivors of prison camps it is difficult to separate the effects of stress from other more specific disease factors such as starvation, infection, and physical trauma from hard labor and torture. Of course separation is only partially possible even in theory, since stress probably decreases the resistance to infectious disease. In any case the situation of these prisoners differed considerably from the situation of the prisoners of terrorists, who are seldom held as long or under such severe conditions. It is possible that the starvation in the prison camps actually reduced the subsequent incidence of coronary heart disease in some groups. Also the figures about mortality and morbidity of prison camp survivors could be misleading because the captives may have been healthier than average at the time of capture (such would be expected for soldiers) and the ones that survived may have been the healthiest members of this group.

Stress Responses and Disease Mechanisms

Although the examples named in the last section are evidence that stress influences health, they fail to tie together the physiological stress response and disease in any specific way. The physiological stress reactions are examples of what Cannon has called "the wisdom of the body" since they have the purpose of preparing the organism for increased muscular effort. Through the process of evolution, those physiological changes that enhanced an animal's ability to fight or flee were favored. For this reason, the stress response involves similar changes to those that actually take place during physical activity. This complicates the use of physiological indicators to measure emotion in real situations. I can illustrate this point from one of our own experiments. We were interested in verifying the relationship between increased heart rate and emotional stress during every-day activities. Subjects in our experiment wore a light tape-recorder that recorded their electrocardiograms during a 24-hour period. During this period subjects kept a diary of activities and rated the emotional arousal associated with each activity. Figure 1 shows physical responses of a subject recorded in this way. The figure shows the mean heart rate per minute (bpm) at certain periods during the day, and the output of an activity sensor for the same periods. Note the tremendous variation in heart rate that is associated with different activity levels. When the subject was sitting his heart rate was between 80 and 90 bpm and while he was hurrying from place to place it was from 100 to 120 bpm. During sleep the heart rate reached a low of 50 bpm. Such variations are typical. Note that at 3:50 pm there is an increase of heart rate to 105 bpm without any accompanying increase in activity. At that point in time, the subject, who was a psychiatrist-in-training was conducting a group therapy session in which he began to get angry at what one of the patients was doing. This anger, which from an evolutionary standpoint began to prepare the psychiatrist to punch the patient in the nose, illustrates two points. First, the amount of increase in a physiological variable due to emotion may be very small compared to the variations that take place during mild physical effort. Second, it illustrates how in modern civilization a physiologically adaptive response is no longer useful. Nowadays emotional arousal rarely is followed by immediate fighting or fleeing.

A central paradox in psychosomatic theory is that the psychological stress response is an adaptive mechanism that helps the body avoid breakdowns in function, while at the same time it is postulated that the stress response itself can lead to breakdowns and disease. How can mechanisms that have evolved to protect the body become mechanisms of destruction? One possibility is that extreme emotions can elicit extreme physiological responses that are no longer adaptive and are

even incompatible with life. This might apply to the cases of death occurring within minutes or hours of the stressful event.

Cannon thought that in cases of voodoo death, extreme activation of the sympathetic nervous system could be the cause of death. The symptoms of such an activation might be elevated heart rate, sweating, enlarged pupils, and fever. On the other hand the experiments of Richter point towards parasympathetic activation. Wild Norway rats that are forced to swim in a tank die quickly, especially if their whiskers are clipped off before putting them in the tank. Whiskers provide useful orienting information to these rats. The rats did not die from drowning but from heart rate slowing and cardiac arrest, which points to massive vagal stimulation. A milder form of this phenomenon is seen in vasovagal fainting attacks in humans exposed to a stress such as blood drawing. Heart rate and blood pressure drop. The relationship of the autonomic nervous system to different kinds of emotion is complex in that emotional arousal stimulates both sympathetic and parasympathetic pathways. However, anxiety is usually more associated with sympathetic discharge, and depression and giving-up with parasympathetic discharge. Thus, in autonomic terms, extremes of either emotion might have cardiovascular effects that could prove lethal. Usually they would not be so because of the numerous regulatory mechanisms the body has to prevent excessive swings in physiological functions; but people with pre-existing heart disease might be unable to accomplish this regulation. This heart disease need not be known to the patient or his physician. Certainly the presence of pathological changes in cardiac and vascular function in older men in Western societies is the rule rather than the exception.

Another possibility is that continued activation of a physiological mechanism useful in acute stress situations leads to pathological changes. For example, the increase in blood pressure that occurs in acute stress is too small to be harmful and has the evolutionary purpose of preparing the person for physical action, but if the stress continues at a low level for a longer period of time, the mechanism that regulates blood pressure can be altered so that blood pressure is maintained at a higher level even when the stressor is removed. It is as if the setting of a thermostat has been turned up. The net result is a decreased life expectancy due to the complications of hypertension. Early man who relied on hunting for his existence was better served by these mechanisms. In the first place, early man was more likely to benefit from reacting to stress with physical activity: fight or flight. In the second place he seldom lived to an age where the complications of elevated blood pressure would be noticed.

There are other components of the stress response which, if prolonged, lead to other diseases of end organs. Alexander emphasized

certain diseases as being stress related: bronchial asthma, essential hypertension, ulcerative colitis, certain types of dermatitis, rheumatoid arthritis, thyrotoxicosis, and peptic ulcer disease. Certain general symptoms such as headaches, menstrual disturbances, eating disorders, and sleeping disorders are also often affected by stress. For the so-called psychosomatic diseases the quantitative relationship between psychological factors is much less clear-cut than, say, the relationship between infecting agent and infectious disease. Stress can have either an etiological or a modulating influence on psychosomatic diseases, depending on the individual and the intensity of the stress response.

Variations in Stress Responses

Not everyone reacts the same way to a stressful situation. What is stressful to one person may not be stressful to another. The stress response itself does not have an identical physiological form in everyone. These types of variability may explain why some people develop stress-related diseases and others do not. At this point it will be useful to consider some of the sources of variability in more detail.

First some kinds of stressors produce specific kinds of physiological response. Some of this differentiation is simply due to the fact that the autonomic nervous system has specific regulatory tasks that are not related to stress in itself. For example extreme cold and extreme heat may both be stressful, but the autonomic changes that cause conservation of heat such as peripheral vasoconstriction, shivering, and suppression of sweating, are the opposite of those that produce dissipation of heat. Another type of differentiation lies more on a psychological plane. This type of stimulus-response specificity is based on experiments pioneered by Lacey which indicate that if the stressor is the type that requires attention to the external environment the heart rate decreases, while if the stressor requires attention to internal processes, the heart rate increases. An example of a situation requiring attention to the environment is a vigilance task and an example of a situation in which attention is directed inwards is doing mental arithmetic in the presence of outside distraction. What is interesting about these two types of situation is that, although heart rate behaves differently in the two cases, skin conductance rises in both. In other words, increased heart rate does not always accompany increased skin conductance and psychological stress.

Second, there is a great deal of difference between people in their particular patterns of response to stress. However, the same person will often react consistently to different stressors or show response specificity or stereotypy. Some people are heart rate reactors, while others are blood pressure or muscle reactors. This labelling refers to the variable that shows the most change, and does not mean that most people react exclusively in one way. Instead, quantitative differences in reactivity in various systemsresults. It is generally assumed that these idiosyncratic differences in patterns of reactivity are based on genetic anatomical differences, though it is possible that some types of physiological patterning might be the results of learned patterns.

Third, there may be some emotional specificity in the reactions to stressors in that reactions may be different if fear or anger or other emotions are experienced. Under some circumstances anger may produce a rise in diastolic blood pressure while anxiety or fear produces a fall. In general, the cardiovascular response to anger-provoking stimuli is similar to the effects of nor-epinephrine while the response to anxiety-provoking stimuli is similar to epinephrine effects. The emotion associated with depression and giving-up may lead to more parasympathetic arousal than anxiety. It is likely that the effects of the specific emotion are much smaller than the effects of emotional arousal in general. In fact, emotional arousal and physiological changes occur to pleasant events as well as to unpleasant ones. Also some psychological states that are not usually thought of as emotional states are associated with physiological activation. When subjects are actively involved in social interaction, activation is higher than when they are not so involved. The subject might describe himself as "involved" or "participating" rather than using a word such as "anxious" or "excited". The same kind of activation may accompany the feeling of being hurried.

A fourth type of specificity is personality specificity. Dunbar found in the late 1930's that people with different diseases had different personalities. For example, men with coronary heart disease seemed to be hard-driving achievement-oriented people. Her work was criticized later for its shortcomings such as difficulties in getting a random sample of patients, but in recent years some of her ideas have been vindicated in better designed studies. Friedman and Rosenman have described a coronary-prone behavior pattern they call the type A personality. People with this pattern are competitive, very aware of the pressure of time, very deeply involved in their work, and have difficulty relaxing. They do not complain of anxiety and cannot be labelled neurotic. They are active doers and not people who brood over problems. In a prospective study of 3,400 men free of coronary heart disease, the presence of the type A pattern led to a much greater risk of heart attack or other symptoms of coronary heart disease in the 39 to 49 year old group. From the standpoint of physiology we might expect these

people to be constantly manifesting stress-related changes even though they are generally happy with their lives and find the stress exciting and pleasing, if they notice it at all. Rosenman and Friedman have shown that this personality pattern goes together with elevated cholesterol, triglycerides, and decreased blood clotting time during work activities, all pnysiological changes that can plausibly lead to coronary heart disease.

A fifth type of specificity of physiological stress reaction that had preoccupied psychiatrists in the 50's and 60's was conflict specificity, an idea developed by the psychoanalyst Franz Alexander. He associated different psychosomatic disease with different intrapsychic conflicts that might be manifested in different personalities. For example, his investigations of patients with peptic ulcer disease convinced him that these patients had dependency conflicts that could either lead to a dependent personality or a very independent personality whose independence is a denial of dependence. Such a personality develops in people who have had dependent relationships on their mothers. This often took the form, when the person was an infant or child, of being fed to alleviate frustration. Alexander pictured peptic ulcer disease as a kind of physiological regression. The frustrated adult acts as a child waiting to be fed by secreting acid and digestive enzymes that can eat holes in the stomach if no food is actually present. For non-psychoanalysts it is easier to see the mechanism as a Pavlovian conditioned reflex, in which stress situations serve as a conditioned stimulus for gastric secretion.

A good example of the interaction of various kinds of specificity to produce actual disease is the experiment of Weiner and his coworkers. These investigators screened 2,073 inductees into the American army to find those with serum pepsinogen levels in the upper 15% and the lower 9%. These 120 people were given a battery of psychological tests and an upper GI series. These subjects received a second GI series between the 8th and 16th week of basic training. It turned out that 3 men had healed ulcers and one man an active ulcer on the first examination, and 5 more developed active ulcers by the time of the second examination. It was found that both the level of serum pepsinogen and psychological test results predicted who would get ulcers but that these two predictors were not independent. All of the 9 people who got ulcers were in the high serum pepsinogen group. Also 7 of the 9 were among 10 men selected by the experimentors on the basis of psychological testing to be those most likely to develop peptic ulcer because of psychological conflicts. These men were selected before either the men or the experimentors knew they had ulcers. These results show that physiological differences and psychological differences are both important in determining the development of peptic ulcer disease and that physical and psychological predisposing factors may be correlated. In terms of

the previous discussion this is an example of response specificity and conflict specificity interacting to produce ulcers.

Psychological Defenses and Physiological Response

Although we have categorized some of the sources of variability in physiological response to stressors, the psychological aspects of this categorization are a bit superficial. Personality and conflicts cannot be easily put into distinct compartments. Personality tests can be misleading. For example, numerous studies have shown that a person's self rating of anxiety in a personality test bears little relationship to the physiological reactivity shown in an anxiety-provoking situation in the laboratory. One of the many reasons for this is that physiological changes are more closely related to the emotional state during physiological recording than to a general personality trait of anxiety-proneness. Specific aspects of a situation may be more important in determining the emotional reaction than the fact that such situations are stressful to a hypothetic average person.

For a situation to be stressful, the individual must evaluate it as threatening; and that evaluation depends on the subject's past experiences, attitudes and psychological defenses. The function of defenses is to make a situation that is perceived as threatening at some level, more benign through intra-psychic mechanisms. The physiological impact of psychological defense is illustrated in some of the studies of Lazarus. He presented subjects with films of aboriginal puberty rites involving mutilation of the penis. The films had various sound tracks. If the sound track promoted denial that there was any pain or discomfort involved, or intellectualization by presenting a theoretical sociological explanation of what was going on, a viewer's heart rate and skin conductance response was less than when no sound track was used.

One of the persistent ideas in psychosomatic medicine is that defenses that lead to repression of emotion result in greater physiological expression. This is tied together with some of the early ideas of Freud that postulated that emotional stimuli produced an increase in psychic energy that had to be discharged by emotional expression or it would become dammed up and find outlets in somatic symptoms. Originally the somatic symptoms were considered to be symbolic expressions of the conflict that were functional rather than organic: that is, there was no organic physical pathology underlying the disability or

complaint. Later there was a tendency to believe that dammed up emotional energy could also be discharged in activity of the autonomic nervous system or other physiological systems. These ideas are not confined to psychoanalytically-oriented psychiatrists. In California at least, there is a fairly wide-spread belief among the lay public that failure to express feelings can lead to psychosomatic illness. In some ways the research findings of Lazarus and others contradict this belief in that defenses that prevent emotional expression also result in less somatic disturbance, at least in the physiological systems tested. Other experiments suggest that emotionally-expressive people show more autonomic lability than less expressive people.

Epstein and Fenz have done an interesting series of experiments that show the relationship of performance, defense and physiological response in a stressful situation that is less artificial and more intense than many laboratory stress situations. These investigators have studied sport parachute jumpers, making measurements of psychological and physiological response before going up in the airplane, during the flight up to the moment of jumping, and after landing. Experienced parachutists are different from novices in the timing of their physiological and psychological fear responses. Earlier in the jump sequence, for example immediately after getting in the airplane, experts and novices were equally fearful and equally physiologically activated. However, as the moment of the jump approached, experts showed a decrease of physiological and psychological fear response, while novices showed an increase right up to the last moment. In some way, experienced parachutists can turn off their fear response as the moment of the jump approaches. If each of the two groups is further divided into two on the basis of performance ratings, the good performers at each level of experience have a decrease in physiological activation in the last parts of the jump sequence. Among experts, the mean heart rate at the time of jump for the poor performers was 120 and for the good performers was 85. These findings confirm the inverted U relationship between arousal and performance by showing that very high arousal levels are associated with disruption of performance.

In these studies the defense of denial was found more frequently in the novice group. For example one novice jumper said, "I was not afraid at all until I looked down and saw my knees trembling. Then I realized how scared I really was." Thematic apperception test cards of parachuting scenes were presented to novice and expert jumpers in order to learn more about their mechanisms of defense. In the stories of novices the hero was usually either completely calm or intensely fearful. The heroes in the stories told by experienced jumpers concentrated their thoughts on the task of jumping and seemed to be oriented towards taking in sensory information relevant to the task. Although they did not insert denials of fear in their stories, they generally

avoided expression of emotion. We can infer from these results that the novice group was unsuccessfully attempting to control their fear by denial, while the experienced group, who had less fear to control because they were more familiar with the task, could control what fear remained by avoiding thinking about their feelings. Both physiological and psychological reactions depend on the efficiency of the defense and the strength of the emotion being defended against.

Under periods of intense emotion another defense mechanism comes into play in certain individuals. It is the experience of depersonalization or derealization. Depersonalization is the feeling that the self or mind is outside the body, and derealization the feeling that although the mind is within the body, the outside world is unreal or remote. These two experiences are not completely distinct and represent only some of the possible experiences of splitting between parts of the mind, body, and external world. Arthur Koestler describes one of these experiences in his book The Invisible Writing. He had been captured and imprisoned during the Spanish Civil war. He writes:

> "On the day when Sir Peter and I were arrested, there had been three occasions when I believed my execution was imminent...On all three occasions I had benefited from the well-known phenomenon of split consciousness, a dreamlike, dazed self-estrangement, which separated the conscious self from the acting self--the former becoming a detached observer, the latter an automaton, while the air hums in one's ears as in the hollow of a seashell."

This experience does not always lead to an alleviation of anxiety but can be accompanied by continued psychic distress as in the anxiety-depersonalization syndrome described by Martin Roth. What is especially interesting about this experience is that physiologically there seems to be a kind of truth in the feeling that the relationship between mind and body has changed. Lader has reported a case of an anxious woman who intermittently experienced intense panic and depersonalization. When the patient experienced depersonalization the skin conductance indicators of anxiety indicated decreased activation. This mechanism was a kind of safety-valve that prevents the organisms from being overwhelmed by panic and prevents physiologic systems to go too far from equilibrium.

Conclusions

The description of the experience of being captured by terrorists can leave no doubt that for most people it is the kind of situation that will elicit a physiological stress response. The evidence we have presented suggests that if such response is intense enough or prolonged enough it will have important consequences. Although the length of the stress situation of captivity by terroristsmay only last a few hours or days, the threat of this situation is much greater than most events in ordinary life and is certainly much greater than any threat that has been administered in the laboratory in research studies. Being captured by terrorists is not on the Rahe list of "significant life events" because of the low frequency of this event in the population, but it certainly represents a very significant event.

Changes in one's pattern of life have been reported following captivity: the stress of the event reaches far beyond the actual period of captivity. Such changes are known to have health implications either through the mechanisms of the primary physiological stress response or through secondary mechanisms, such as increased use of alcohol and other drugs, accident-proneness, and other covert or overt suicidal behaviors.

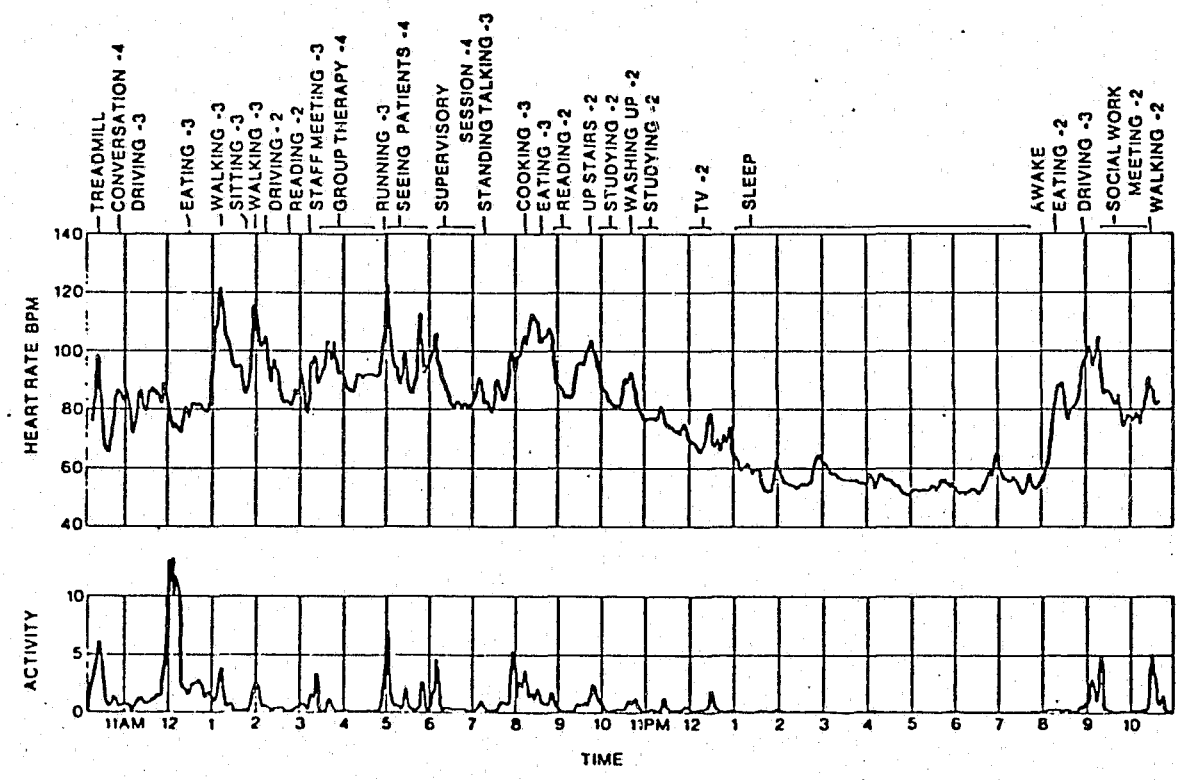
The extent of the health disability of the victims of terrorism needs to be specifically investigated. It is impossible to draw quantitative conclusions on the basis of research done on stressors of different magnitude or duration. Two features that future research on psychosomatic implications of captivity must have are implied by our discussion. First, because there is so much variability between individuals in their response to stress it will be necessary to examine a fairly large number of cases to draw any definite conclusions. These cases should be examined for a variety of physical illness and not be limited to the few traditionally psychosomatic ones. Thorough physical examinations will be necessary to distinguish between complaints of sickness and actual demonstrable physical sickness. Second, a control group is essential to provide a baseline rate for illness so that valid inferences can be made. This control group should be as similar in age, sex distribution, and social background to the group exposed to the terrorists as feasible.

The nature of modern terrorist tactics, particularly hijacking, meet many of the requirements of empirical research. Many of the complicating factors that have plagued psychosomatic investigations

of prisoner of war survivors are absent. First, comparable control groups are readily available. Since the victims have only a symbolic significance it makes little difference to the terrorists which airplane is hijacked. A second airplane that was not hijacked can be our comparison group. Second, air travellers tend to be more representative of the general population then prisoners of war for example who come from a population of physically healthy young men. Thus, the results of investigation of victims of hijacking may be more generalizable to the general population. Third, the stressors in captivity situations are largely psychological. Physical hardship or torture are the exception. It has been difficult to separate the long-term effects of psychological and physiological trauma in the case of prisoners of war and concentration camp victims, who have been malnourished, mishandled, and exposed to infections. Fourth, the psychological stress is well-defined in nature and in timing. Prisoners of war and concentration camp victims underwent profoundly stressful situations even before capture. Soldiers had been in combat and the Jews had seen the gradual destruction of their world. The victim of terrorism is caught by surprise and the onset of the stressor can be timed to the minute. Although reactions to the event of being captured will vary from person to person, the stressor at least is externally similar for everyone, so that investigations of different coping mechanisms are simplified.

Research on the issue of psychosomatic implications of terrorism is essential to resolve the extent of damage to the victim. We cannot be satisfied with mere speculation, however plausible it may be. As far as I know, there is no hard evidence that short-term stressors have the consequences I have argued that they could. The body has remarkable homeostatic mechanisms and recuperative powers, and there is no reason to add unfounded hypochondriacal worries to the others the victim has. In order to satisfy you, me, and policy-makers involved in this issue a well-controlled medical and psychological investigation of these victims needs to be undertaken.

Figure 1. Heart rate in beats per minute (bpm) and physical activity level (arbitrary units) for a male psychiatric resident over a 24-hour period. The graphs connect data points representing 6-minute running averages. The kinds of activity and subjective anxiety-tension levels on a 0 to 10 scale are indicated on the top of the figure. Record ends at 10.40 a.m.



SUBJECT TH

TABLE I

AUTONOMIC NERVOUS SYSTEM RESPONSES TO STRESSORS

Organ	Response
Eye	Dilation of pupil
Heart	Increase in pacemaker rate Increase in conducting velocity of excitation Increase in strength of contraction
Arterioles	Dilation of coronary arterioles Constriction of peripheral arterioles
Lungs	Relaxation of bronchiolar muscles
Stomach and intestines	Decrease in motility Decrease in tone
Skin	Sweat secretion Piloerection
Adrenal medulla	Secretion of epinephrine Secretion of norepinephrine
Genitalia, male	Inhibition of erection Facilitation of ejaculation

TABLE II

ENDOCRINE AND OTHER CHEMICAL RESPONSES TO STRESSORS

Substance	Source	Change of serum level	
		Immediate	Post-stress
ACTH	Anterior pituitary	Up	-
TSH	Anterior pituitary	Up	-
GH	Anterior pituitary	Up	Up
ADH	Posterior pituitary	Up	-
Glucocorticoids	Adrenal cortex	Up	-
Mineralocorticoids	Adrenal cortex	Up	-
Epinephrine	Adrenal medulla	Up	-
Norepinephrine	Adrenal medulla	Up	Up
Thyroid hormones	Thyroid	Up	Up
Insulin	Pancreas	-	Up
Androgens	Testicles	Down	-
Estrogens	Ovaries	Down	-
Pepsinogen	Stomach	Down	Up
Free fatty acids	Adipose tissue	Up	-
Lipoproteins	Liver	Up	-
Coagulation factors V & VIII	Liver	Down	Up
Fibrinogen	Liver	Down	Up
Uric acid		Up	-
Iron		Down	-

END