

Measuring Stress in Humans

A Practical Guide for the Field

Edited by

Gillian H. Ice and Gary D. James



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Measuring Stress in Humans

The purpose of this book is to present state-of-the-art non-invasive methods of measuring the biological responses to psychosocial stress in non-laboratory (field) settings. Following the pathways of Seyle's General Adaptation Syndrome, the text first describes how to assess the psychosocial stressors of everyday life and then outline how to measure the psychological, behavioral, neurohumeral, physiological and immunological responses to them. The book concludes with practical information on assessing special populations, analyzing the often complicated data that are collected in field stress studies and the ethical treatment of human subjects in stress studies. It is intended to be a practical guide for developing and conducting psychophysiological stress research in human biology. This book will assist students and professionals in designing field studies of stress.

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Contents

<i>Contributors</i>	<i>page</i> ix
<i>Foreword by Geoffrey A. Harrison</i>	xi
Part I: General principles	1
1 Conducting a field study of stress: general principles	3
GILLIAN H. ICE and GARY D. JAMES	
Part II: Measuring stress responses	25
2 Cultural dimensions of the stress process: measurement issues in fieldwork	27
WILLIAM W. DRESSLER	
3 Measuring emotional and behavioral response	60
GILLIAN H. ICE	
4 Measuring hormonal variation in the sympathetic nervous system: catecholamines	94
DANIEL E. BROWN	
5 Measuring hormonal variation in the hypothalamic pituitary adrenal (HPA) axis: cortisol	122
TESSA M. POLLARD and GILLIAN H. ICE	
6 Measuring physiological changes in the cardiovascular system: ambulatory blood pressure	158
GARY D. JAMES	
7 Measuring immune function: markers of cell-mediated immunity and inflammation in dried blood spots	181
THOMAS W. McDADE	
Part III: Practical issues in studying stress	209
8 Measuring stress in special populations	211
SHARON R. WILLIAMS	
9 Study design and data analysis	226
GARY D. JAMES and GILLIAN H. ICE	

10	Protection of human subjects in stress research: an investigator's guide to the process	246
	GARY D. JAMES and GILLIAN H. ICE	
11	Epilog: summary and future directions	266
	GARY D. JAMES and GILLIAN H. ICE	
	<i>Index</i>	269

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Foreword

Stress has been recognized as an important psycho-physiological state since the pioneering work of Hans Selye. But until quite recently it has mainly been perceived in humans as a condition generated by extreme and hostile environments such as going into battle, hospital or academic examinations. Increasingly, however, it has been identified as being a consequence of many aspects of lifestyle and the events of everyday living and that, to varying degrees, large numbers of people experience it. Indeed, from the point of view of long-term health, low-level frequent chronic stress is likely to be much more important than occasional acute episodes.

Chronic stress can hardly be studied by experimental procedures in the laboratory. It clearly needs a population approach with investigators monitoring people in the “field” as they go about their daily business. Psychologists have gained important insights by the design of questionnaires which can be applied not only to particular groups undertaking activities which are deemed to be stressful, such as air traffic controllers, but also to whole populations, experiencing a diversity of lifestyles. They have identified various elements, particularly in occupational situations, which aggravate stress, as for example absence of job control, but questionnaires are of little use outside one’s own language, or at least culture. They also have questionable validity in the study of children.

For these wider studies it is necessary, or at least desirable, to have some physiological measures of the stressed state, either of the homeostatic mechanisms which are elicited to control stress or of the morbid consequences of being stressed. In principle, such measures are not only objective but also appropriate for any population or population group situation in any culture. They also avoid the dangerous pre-judgment of whether or not some environment is stressful, for what can generate great stress in one individual may cause none in another. Environments may certainly contain stressors, but stress itself is a phenomenon of the organism not of the environment. Having said that, there are many problems both theoretical and practical in both obtaining the desired

physiological information and interpreting it. Some, such as blood pressure, can usually be obtained fairly easily, though readings can be very labile. However, others, such as hormone levels in urine or saliva, can be immensely difficult. For many purposes, especially cross-cultural comparisons, one would like 24-hour urine samples, but even with the most willing and co-operative of subjects, one or more urinations are likely to be missed, unless the subject is confined to a hospital bed!

Then there are the complex problems of interpretation. Epinephrine, for example, is often referred to as a stress hormone. The excretion is certainly greatly raised when people go into battle, examinations or competitive sport, but it is also raised in those playing in a pop band and lowered in those who report being endlessly bored. It would seem to reflect levels of psychological arousal and while many unpleasant experiences cause arousal, so can those we enjoy. Few would call a good party stressful.

Matters such as these are discussed at great length and with great authority in this book. It covers all the physiological approaches to measuring stress, considering both broad theoretical issues and the practical methods that have been used. It sets these discussions within the wider framework of study design, varying culture and research ethics with populations. It is surely indispensable for any anthropologist studying stress, but with its emphasis on practical matters it should also be of great value to clinicians, psychologists and physiologists. It has no competitors; there is no other book like it.

Geoffrey A. Harrison

Part I

General principles

1 *Conducting a field study of stress: general principles*

GILLIAN H. ICE AND GARY D. JAMES

Introduction

In recent years, interest in the study of stress has expanded, particularly in the disciplines of anthropology and human biology where the focus of research has drifted toward evaluating the adaptive biological, cultural and psychological responses to stressors inherent in everyday living. Field studies of stress in these disciplines have been conducted across a wide continuum of contexts. These range from an assessment of the stress of “modernization” where biological and cultural responses of populations undergoing rapid industrialization/Westernization are examined, e.g. James *et al.* (1985), to the responses of people facing novel, new environments in modern, Western societies, such as occur in nursing homes (Ice *et al.*, 2002).

Biologically, in studying the stress response, measurements can be made at any of several junctures in the psychophysiological pathways between stressful stimuli and adaptive or pathological outcomes. Measures include emotional/behavioral responses, hormonal variation in the sympathetic adrenal medullary system (SAMS), hormonal variation in the hypothalamic pituitary adrenal axis (HPA), physiological changes in the cardiovascular system and enhanced immune responses. The choice of the most appropriate measure will be determined by a combination of the goals of research, the population of interest and practical concerns. In addition to the particular stress marker(s) chosen for a study, the appropriate sampling strategy and design must be determined. These range from group comparisons of a one-time measure, to ecological momentary assessments, to multiple measures evaluated in a longitudinal design. Some study designs used in stress research require special analytic strategies and sophisticated statistical approaches.

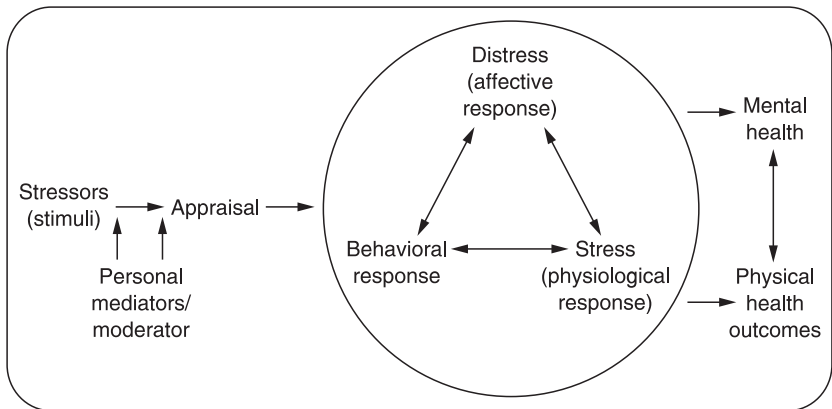


Figure 1.1. The stress process.

While stress markers themselves are common outcome measures, the ultimate goal in stress research is to determine the relationships between stress and health or stress and adaptation. To this end, several conceptual models have been proposed across a variety of disciplines. It is the intent of this chapter to first provide an overview of these models as well as the tools and instruments used to evaluate the stress experience by researchers in the various disciplines, and then to introduce an integrated model in which stress is considered a *process by which a stimulus elicits an emotional, behavioral and/or physiological response, which is conditioned by an individual's personal, biological and cultural context* (Figure 1.1).

Definitions of stress and their origins

Stress research can be confusing as there are a multitude of definitions which are often not equivalent. The term “stress” has been used to refer to at least three different components of the stress process: 1) the input or stimuli, 2) processing systems, including both physiological and psychological and 3) the output or stress response, e.g. rise in blood pressure (Mason, 1975; Levine and Ursin, 1991). Different disciplines have focused on different aspects of the stress process. Table 1.1 provides a general guide of different approaches by discipline.

Early research on the physiological processes related to stress has been described by Walter Cannon (Cannon, 1914), the author of the “flight or fight syndrome.” He also coined the term “homeostasis” to describe the process of maintaining internal stability in the face of environmental

change (Cannon, 1932). This term does not mean something fixed and unchanging, but a relatively constant, complex, well coordinated and usually stable condition. Cannon was also interested in determining the specific mechanisms of response to changes in the external environment, which allowed for optimal bodily function. He showed that there are specialized sensory nerves to communicate the state of the rest of the body to the brain, that the brain is able to detect non-optimal internal states, and that the brain can call a variety of mechanisms into play to compensate correctly. Finally, he noted that failure to maintain homeostasis could result in tissue damage or death, and he was among the first to examine the challenges of psychologically meaningful stimuli and the impact of moods (Cannon, 1929, 1932).

Hans Selye popularized the concept of “stress” and many researchers trace the origin of its study and definition to Hans Selye and his 1936 paper, “A syndrome produced by diverse nocuous agents” (Selye, 1936). In this paper, he described stress as a non-specific response of the body to “noxious stimuli.” Selye’s concept described a physiological response to physical and physiological stimuli, described as stressors (Selye, 1946). Selye later named and elaborated on the process as the general adaptation syndrome (Selye, 1946). This syndrome has three stages: 1) alarm reaction, 2) stage of resistance and 3) stage of exhaustion. In the alarm stage, the body reacts to a stimulus by activating the hypothalamic pituitary adrenal (HPA) axis. The resistance stage signals successful adaptation to the stimulus. Exhaustion occurs when exposure to stimuli is prolonged. Selye believed that the body’s stores of glucocorticoids (the output of the HPA axis) were depleted. Most researchers now believe that the body does not deplete stores of glucocorticoids but that prolonged exposure to a stressor results in suppression of the immune system and wear and tear of several body systems, which then places individuals at risk of a variety of disease outcomes.

While Selye and biomedical researchers conducted their research on physical and physiological stressors in animal models, several investigators starting looking at the impact of psychosocial stressors in humans. The initial focus of these investigations was traumatic or major life events. Many credit Adolf Meyer and Harold Wolff in the 1930s and 1940s for early development of research examining stressful life events and illness (Rahe, 1989; Cohen *et al.*, 1997). Meyer suggested that physicians should record life events as part of their medical examination while Wolff went on to describe the association between life events and illness (Cohen *et al.*, 1997). One of the first published scales created to measure life events, “The Social Readjustment Rating Scale” (Holmes

Table 1.1. *Variables used by different disciplines*

Discipline	Definition of stress	Stressors	Processing/ appraisal	Interacting variables	Response	Outcomes
Biomedical animal research, including physiology, biological psychology & neurology	Non-specific response to stimulus	Cardiac catheterization; cold or heat exposure; competitive social interaction; food, sleeping or sensory deprivation; handling; isolation or crowding; immobilization	Rarely measured	Rarely measured	Hormonal and physiological	Organ damage
Social psychology	Transaction between the person and the environment	Daily hassles, life events	Focus of research	Demographics, personality factors, social resources	Perceived stress, physiological response	Mental health and physical health outcomes
Sociology	Psychosocial stress:	Chronic stressors (strains), role strain	Variably measured	Social values, social context,	Perceived stress, emotional,	Mental health outcomes,

Cultural anthropology	socially derived stressors which lead to negative affect or distress	Variable	Incongruity, cultural stressors	Frequently measured	Cultural context, resistance resources, social resources	social support, self-concept, life course	behavioral response	social relationship disruption
					Mental and physical health outcomes, cultural syndromes, local idioms of distress			
Human biology/ biological anthropology	Disruption in homeostasis or allostasis		Variable, including cultural, environmental and physical stressors	Rarely measured	Cultural context, life cycle		Physiological response	Physical health outcomes
Physiology, biomedical sciences, with a human focus	Allostasis		Variable, many human equivalents to animal stressors	Rarely measured	Demographic factors		Physiological response	Allostatic load, physical health outcomes

and Rahe, 1967) has become the foundation upon which most current life events scales are based. While these researchers were looking at humans, they were still working from a Selyen model of a non-specific response to stressors.

Stress research focused on major life events through the 1960s with researchers further expanding the kinds of events that might be considered stressful. As it started to become clear that there were individual differences in the response to such events, Lazarus and colleagues developed a theory of stress which emphasized appraisal and coping in the late 1960s and 1970s. Lazarus has argued in multiple publications that the “stimulus-centered perspective” of life events approach and the physiological approaches of Selye and Cannon were too simplistic (Lazarus, 1984; Lazarus and Folkman, 1984; Lazarus, 1999). Lazarus and colleagues suggested that the best way to view the stress process is as a transaction between the person and environment (Lazarus, 1984; Lazarus and Folkman, 1984; Lazarus, 1999). The impact of any potential stimulus is determined by an individual’s appraisal and coping. Within this transaction, an individual goes through a cognitive assessment to determine if a particular circumstance is a threat and if s/he has the resources or coping skills to meet the demand placed upon him/her by the threat (Lazarus and Folkman, 1984). Lazarus and Folkman define coping as, “constantly changing cognitive and behavioral efforts to manage specific external and/or internal resources of the person” (Lazarus and Folkman, 1984, p. 141). In addition to emphasizing the importance of appraisal and coping Lazarus has suggested that we shift our focus from major life events to daily hassles (Lazarus, 1984, 1999). From this cognitive theoretical approach, there may be limitless types of transactions between the person and environment depending on the context and the person’s age, culture and experience. While psychologists were expanding the model of stress, the Selyen model still had a great impact on future biomedical and neurological research (Elliot and Eisdorfer, 1982). As Selye maintained that the stress response was non-specific (i.e. did not vary by stressor), the stressors chosen by biomedical researchers using animal models were often based on convenience rather than research question (Elliot and Eisdorfer, 1982). The concept of a non-specific response has since been questioned as a number of researchers have demonstrated variation in response to different stressors (Mason, 1975). Mason (1975) cited several studies which demonstrate that the HPA axis response to stressors varies with the type of stressor and the experimental conditions. He further pointed out that many of the “physical stressors” used in animal experiments have a psychological

component. For example, in his own research on starvation in monkeys, the HPA response was significantly diminished when monkeys were fed non-nutrient placebo food (Mason, 1974). The placebo acted to minimize the psychological effect of sudden deprivation. Mason was one of the first to cross the disciplinary boundaries by incorporating psychological models of stress in his biological models. Cassel (1976) further pointed out that the Selye concept of a non-specific response led many to suggest that there is such a thing as a “stress state” or “stress disease.” He suggested, as many have now come to believe, that stress does not produce a specific disease but rather places people in a state that makes them more susceptible to a range of diseases. He suggested that “psycho-social processes acting as ‘conditional stressors’ will, by altering the endocrine balance of the body, increase susceptibility of the organism to direct noxious stimuli, i.e. disease agents” (Cassel, 1976, p. 109). Both Mason and Cassel were influential in getting future researchers to think of stress as a process rather than a simple stimulus-response relationship suggested by biomedical researchers and those in the life-event arena.

Pearlin and colleagues (Dohrenwend and Pearlin, 1982; Pearlin, 1989) further criticized the life events and “stimulus–response” approaches on a number of accounts. First, they questioned the theory that all change is harmful and suggested that only change that is undesirable, unscheduled, non-normative and uncontrollable is harmful. Second, they suggested that the life-events approach treats events as if they occur in a vacuum without consideration of the socioeconomic context in which they occur. Further, they critiqued the instruments for measuring exposure to life events as a conflation of acute events with ongoing stressors. Pearlin suggested that health may be impacted not by the individual “major” event but by the “continuing circumstances in which the event is embedded” (Pearlin, 1989, p. 244). For example, if an individual forecloses on his/her house, s/he was likely to have experienced problems of continuous poverty and debt prior to the actual foreclosure. Pearlin did not suggest that life events are unimportant to the stress process, merely, that “some events under some conditions are powerful stressors that affect people’s lives directly and indirectly” (Pearlin, 1989, p. 245). Pearlin emphasized the importance of looking at chronic stressors which he called strains. These were defined as “relatively enduring problems, conflicts and threats that many people face in their daily lives” (Pearlin, 1989, p. 245). His research particularly emphasized the importance of role strains which are problems connected to the social roles which people fill. Most importantly, Pearlin suggested that we should not look at chronic stressors or major life events in

a vacuum as they may come together to produce stress in a number of ways (Pearlin, 1983). Life events may lead to chronic stressors or result from chronic stressors and they can interact and provide meaning for one another. While Lazarus focused on cognitive appraisal as a mediator of the stress process, Pearlin discussed the importance of social values in mediating the impact of a stressor. These social values “regulate the effects of experience by regulating the meaning and importance of the experience” (Pearlin, 1989, p. 249).

Lazarus, who emphasizes the individualistic aspect of the stress process, cautions against the socio-cultural approach to the stress process in which the impact of social structure or culture results in or mediates stress (Lazarus, 1999). By examining the stress process in this manner, Lazarus and Folkman argue that generalizations based on such analyses simplify our understanding of the process and distill a dynamic process into a static one in which people are treated as “carbon copies” as opposed to individual cognitive and emotional beings (Lazarus and Folkman, 1984). However, by examining social forces or social context, Pearlin is not really suggesting that individuals are carbon copies but that they do exist in a social context which should be considered when examining the stress process.

Dressler has been very influential in bringing cultural context into stress research (Dressler, 1991, 1995; Dressler and Bindon, 1997; Dressler and Bindon, 2000). In fact, he argues that culture has influence on multiple components of the stress process. Cultural context influences meaning of stressors, patterns of stressors and coping resources. Further, culture can be a stressor or it can be a mediator. His work on lifestyle incongruity and cultural consonance (further explained in Chapter 2) has had a tremendous impact on stress research within anthropology and human biology. These elegant models connect the individual process of stress with the social and cultural context, in a sense fusing the models of Lazarus and Pearlin.

Human Biologists (or Biological Anthropologists) have a history of looking at environmental stressors as a source of human variation. They often take the wider perspective that stressors are anything that take the body away from homeostasis and thus, by default, stress becomes a disruption in homeostasis. However, historically human biologists have approached stress in a very Selye way. The traditional focus on adaptation to environmental stressors has carried over into the way that social stressors are often examined. Thus, human biologists have often started with a potential stressor and compared individuals exposed to those who are not. Often a “stress hormone” or health

outcome is used to determine if the two groups differ in their level of stress. If there is a difference, this confirms that the potential stressor is indeed a stressor. Unfortunately, this research often left out notions of appraisal or socio-cultural context. With the maturing of stress research in human biology, models have become more complex and involve more of the stress process.

In 1988, Peter Sterling and Joseph Eyre introduced the concept of *allostasis*, literally “achieving stability through change” in order to provide a logical structure for understanding the ever-shifting integrated biobehavioral, endocrinological and physiological systems of the body that promote adaptation and drive natural selection (Sterling and Eyre, 1988). For example, were blood pressure to remain constant throughout the day, individuals would have difficulty responding to their own changing activities and other environmental variations. However, because it is part of an allostatic system, blood pressure will vary continuously to adapt the individual to the changing circumstances. Because it continuously changes, the individual does not have a single “homeostatic” blood pressure state per se, but rather has many stable states, which are directly related to the many and ever-changing internal and external environmental conditions to which the individual must adapt. The multiple stable states of blood pressure differentiate this physiological system from other bodily homeostatic systems such as those that maintain tissue pH. The HPA and SAMS axes also act as allostatic systems (McEwen and Stellar, 1993; McEwen, 1998a,b). Some have suggested that because the concept allostasis unifies the physiology of acute and long-term adaptations and stress responses as well as their outcomes into a single process, it should replace the stress concept (McEwen, 2002). As part of this argument, McEwen (McEwen and Stellar, 1993; McEwen, 1998a,b) has introduced the concept of allostatic load. While allostasis is critical to adaptation and survival, “allostatic load” is defined as “the price the body pays over long periods of time for adapting to challenges” (McEwen, 2001, p. 44). McEwen and colleagues have created an index of allostatic load and applied it to the health outcomes of participants in the MacArthur Aging Studies. To measure allostatic load, indicators of “system failure” (e.g. high blood pressure, large waist to hip ratios, elevated urinary epinephrine and cortisol, etc.) were tallied. The index was calculated from the number of indicators in which a participant’s measurements fell in the uppermost (4th) quartile of the population distribution (Seeman *et al.*, 1997a). This index of allostatic load predicted declines in cognitive and physical functioning,

cardiovascular disease and mortality (Seeman *et al.*, 1997a,b; Karlamangla *et al.*, 2002).

In many ways, the concept of allostasis can be seen as a new spin on the old Selye concept of stress. However, recently Schulkin (2004) edited a volume entitled *Allostasis, Homeostasis, and the Costs of Physiological Adaptation* in which a spectrum of physiological and biobehavioral processes were recast and evaluated from the perspective of allostasis. Based on the discussions in this volume, it is quite possible that the concept of allostasis may join homeostasis as the foundation for future understanding of the relationship between stress and adaptation.

Putting the models together: the stress process

While the stress field has matured, it is still marked with disciplinary differences in theoretical and measurement approaches. Many of these theoretical approaches have been debated in the literature. Pearlin (1989) went as far as suggesting that disciplines should maintain their distinctive approaches to the stress process. Specifically, he argued that sociologists should avoid using medical and epidemiological models in their examination of stress. "These differences are reasonable and legitimate and they should be maintained. Sociologists should avoid immersion in the medical and epidemiological models that emphasize diagnosis and case finding. Such immersion not only fails to serve the goals of social research; it may even hinder the achievement of those goals by diverting time and resources to issues that are extraneous to social inquiry" (Pearlin, 1989, p. 253). We fundamentally disagree with this point of view and suggest that integrating such disciplinary approaches will lead to greater understanding of the stress process as similar disciplinary integration has furthered other research within human biology and other fields (Little and Haas, 1989; Rosenfield, 1992; King *et al.*, 2002; Abrams *et al.*, 2003). It can be argued that different disciplines are really just focusing on the portion of the process which best fits with their general disciplinary interests. Merging sociocultural, psychological, biomedical and evolutionary models of stress leads to a greater understanding of social, biological and cognitive components of the stress process.

"Stress etches itself into our biology and behavior, usually initiates a series of biobehavioral countering responses, and ultimately bears consequences for our social relations, ideological constructs, and evolutionary trajectories" (Goodman *et al.*, 1988, p. 170). Thus, we propose that stress be defined as a *process by which a stimulus elicits an emotional,*

behavioral and/or physiological response, which is conditioned by an individual's personal, biological and cultural context (Figure 1.1). Further, the field of stress research would benefit from multiple measures across the entire process. Thus, this text guides the reader across the stress process and discusses measurement issues for the different components of the model presented in Figure 1.1. This text is intended to assist researchers in designing field-based research on stress. While these will be discussed in greater detail within each chapter, below we define and discuss in general terms the different components of the process.

Stressors

Like the rest of the stress process, stressors or stressful stimuli have been defined and categorized in several different ways. Generally speaking, they are the things that set the whole stress process in motion. Stressors are often defined as a stimulus which elicits a response; for example stressors can be defined as “external events or conditions that affect the organism” (Breznitz and Goldberger, 1982, p. 3). Wheaton notes, as others have, that the definition of a stressor is often linked to a physiological response (Wheaton, 1999). Not only is this a tautology but it is also possible that a stressor initiates a behavioral or emotional response in absence of a physiological one. He suggests that we return to an engineering concept of stress to define stressors as, “an external force acting against a resisting body” (Wheaton, 1999, p. 280). This force does not necessitate a response if an individual's resistance resources are adequate or if the force does not overload the individual's “elastic limit” (Wheaton, 1999). Stressors can be categorized along several lines, most commonly based on the temporal course or origin. For example, stressors can be categorized as acute or chronic. They may also be divided into physical, environmental or psychosocial stressors. The problem with any categorization is that it is artificial. When does a stressor become chronic for example? If the stressor occurs daily but is short-lasting each day, is that acute, chronic or somewhere in between? Equally artificial is the division based on origin. Although some physical stressors will initiate the stress process without cognitive appraisal (e.g. altitude, temperature, infection), cognitive appraisal can act to moderate the effect of the physical stressor (Mason, 1975). For example, if someone panics as they begin to have breathing difficulties at a high altitude this may exacerbate the physiological stress response. Is this then a physical or psychological stressor or both? Lazarus also divided

stressors based on intensity, i.e. life events vs. daily hassles (Lazarus, 1984, 1999). In his description of stressor taxonomy of stressors, Pearlin noted,

it should be recognized that the distinction is a construct of the researchers and does not necessarily parallel the awareness people have of their hardships and problems. People do not ordinarily sort out the various stressors that impinge on them nor do they cognitively separate eventful stressors from enduring strains [chronic stressors]. For many, the boundaries between different types of stressors become blurred as they face a mix of these stressors in the flow of their daily activities. Indeed, these boundaries can also become blurred in the eyes of the stress researcher. This is because events frequently merge into chronic strains, the strains frequently heighten the risk of stressful event. It is this tendency of events and strains to merge and blend with each other that supports the construct of stress proliferation.

(Pearlin, 1999, p. 403)

Pearlin also distinguishes between primary and secondary stressors. Primary stressors are the original stressor and secondary stressors are those stressors that result from the original stressor (Pearlin, 1999). There have been numerous classifications of stressors over time; Chapter 2 discusses stressors in more detail.

Mediators and moderators

There are a variety of personal and cultural mediators and moderators that may positively or negatively affect the stress process. As with all other aspects of the stress process, different disciplines have focused on different factors. What is the difference between a mediator and a moderator? A mediator refers to a factor through which a stressor impacts the individual. A moderator somehow changes the relationship between a potential stressor and the response on an individual, “Moderating resources to control the emergence of secondary stressors, thus blocking stress proliferation” (Pearlin, 1999, p. 404). Mediators and moderators affect one’s appraisal of stressors and influence the emotional, behavioral and physiological responses of individuals. A whole range of factors have been variably labeled as mediators or moderators including appraisal, personality, coping, social networks and self-concept. While these terms are often used interchangeably, the distinction is determined in analysis. If there is an independent

association between a factor and the outcome, then the factor is a mediator. If there is a statistical interaction, then it is a moderator.

The personality factors that have been most systematically examined as mediators or moderators of stress are type A & B, locus of control, John Henryism and optimism/pessimism. These personality types are largely rooted in specific cultural contexts and may not be applicable to all cultures. Personality factors are assumed to change the way that one appraises a stressor or can alter the emotional or behavioral response to stressors.

Social functioning includes social networks and social roles. There has been a great deal of work looking at the relationship between social networks and health but much of this work has been done without direct measure of physiological or emotional response. Social networks are almost always viewed as positive mediators, however, they may produce stressors in some contexts. For example, for older adults we often assume that large social networks are essential; however, older adults may find relying on others as stressful if they cannot reciprocate. We need to go beyond simply looking at the size of social networks in stress research. Dressler discusses social networks and social resources in greater detail in Chapter 2.

Historical experience of a stressor is likely to influence the appraisal of a stressor. This is rarely taken into account in stress research; however, there is evidence that repeated exposure to a particular stressor attenuates the physiological stress response. Whether this is due to physiological adaptation, a learned behavioral response or recruitment of coping mechanisms is unclear.

Mediators and moderators are also influenced by other components of the stress process including behavioral responses and an individual's health status. An individual who strengthens social networks in response to stressors has strengthened his/her adaptive capacity. On the other hand, individuals with mental or physical health problems may find themselves with a reduced social network and a loss of meaningful social roles, leaving them more vulnerable to stressors.

Coping behaviors are seen as moderators or mediating resources, "where the effects of the other components of the stress process on outcomes are channeled through the resources. Their treatment as mediators assumes that resources are not immutable but can be diminished (or replenished) by the social and economic statuses surrounding the stress process and by the ensuing stressors" (Pearlin, 1999, pp. 405–6). However, as these behaviors are often employed after a stressor is appraised as threatening, we consider them as part of the stress response.