Chapter 19

The nature and measurement of work-related stress: theory and practice

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Introduction

In a civilised society people should have the right to work in order to earn an adequate living to support themselves and their families. It is the duty of their society to provide appropriate opportunities for them to do so, to ensure that such work is without detriment to health or risk to safety, and to support those, who through no fault of their own, cannot work. The fact that these things are not always possible presents a challenge to society. Work-related stress is part of that challenge. Surveys of working people in Europe, North America and elsewhere have identified work-related stress as a major cause of ill-health, sickness absence, early retirement, and as a threat to safety.

In England and Wales, data from the Labour Force Surveys of 1990 and 1995 showed that stress and stress-related illness were second only to musculo-skeletal disorders as the major cause of ill-health for working people (Hodgson *et al.*, 1993; Jones *et al.*, 1998). At that time, it was estimated that this resulted in about 6.5 million working days lost to industry and commerce each year. In terms of annual costs, estimated within the 1995–96 economic framework, the financial burden to British society, its organisations and people, was at least £3.7–3.8 billion. Data from the subsequent survey carried out in 2001/2002 revealed that the estimated prevalence of stress and stress-related conditions had increased twofold from 1990 levels (Health and Safety Executive, 2003). Although musculo-skeletal disorders were more prevalent than stress and stress-related conditions in England and Wales, the latter were responsible for more lost working days (13.4 million as compared to 12.3 million). The average number of days lost per case for stress, depression or anxiety (just over 29 days per case) was significantly higher than for any other work-related illnesses.

Such figures are typical across many countries. It is not surprising therefore that there is a legal imperative in many countries for employers to address the challenge of work-related stress. In Britain and the European Union, this is now relatively long established as part of the general provision in law for health and safety.

In 1989, the European Commission published its Framework Directive on the Introduction of Measures to Encourage Improvements in the Safety and Health of Workers at Work (EC, 1989). All Member States of the European Union were required then to transpose these measures into their respective national legislation. The Directive required employers to avoid risks to workers' safety and health, to evaluate those risks that could not be avoided, to combat such risks at source (Article 6: 2) and to 'consult workers and/or their representatives and allow them to take part in discussions on all questions

relating to safety and health at work' (Article 11: 1). Employers were charged with developing a 'coherent overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors related to the working environment' (Article 6: 2). They had to 'make an assessment of the risks to safety and health at work' and to 'decide on the protective measures to be taken' (Article 9: 1). It was stated that risk assessment should involve 'a systematic examination of all aspects of the work undertaken to consider what could cause injury or harm, whether the hazards could be eliminated, and if not what preventive or protective measures are, or should be, in place to control the risks' (European Commission, 1996). In other words, employers in the European Union have a responsibility to take reasonable steps to protect their employees from all aspects of work or the working environment that could be detrimental to their safety and health. These include those related to the experience of stress.

In addition, in England and Wales in the 1990s, precedents were established in common law for employees allegedly damaged by employers' failure to fulfil their duty of care, in relation to the design and management of work, to sue for reparation. In a landmark case in 1994, John Walker, a social services manager, obtained a judgment against his former employers for failing to protect him from a health-endangering workload (Industrial Relations Law Reports, 1995). The judgement made it clear that there was no reason why psychological damage should be excluded from the scope of an employer's duty of care while issues of work design and management have always been within the scope of the law. Previously, 'damage' was largely understood in terms of physical harm. Since the Walker case, there have been other cases in Britain where employees have been awarded financial settlements for claims that can be said to be stress-related.

This chapter provides an introduction to nature and measurement of work-related stress. Both are central to its study and management. The issues involved here are not straightforward given both the nature of the phenomenon (Cox, 1993) and the complexity inherent in undertaking scientifically 'acceptable' research in the context of real working life (Griffiths, 1999). Partly as a result, measurement issues have given rise to much debate between academics (Cox *et al.*, 2003).

Nature and definition of stress

There is now broad agreement on the nature of 'work-related stress' and on the psychological processes involved. This consensus is reflected in European legislation and related guidance. For example, in 1995 the British Health & Safety Executive (Health & Safety Executive, 1995) described work stress in its guidance for employers as:

> . . . the reaction people may have to excessive pressures or other types of demand placed upon them.

Two years later, the European Commission's Working Group on Stress (European Commission, 1997) concluded that:

> Work-related stress is the emotional and psycho-physiological reaction to aversive and noxious aspects of work, work environments and work organisations. It is a state characterised by high levels of arousal and distress and often by feelings of 'not coping.'

Both statements were consistent with a more detailed and theoretically based position set out by the authors in Cox (1993, p. 17):

> Stress arises when the person perceives that he or she cannot adequately cope with the demands being made on them or with threats to their well being, when coping is of importance to them, and when they become anxious or depressed as a result. The experience of stress is therefore defined by, first, the person's realisation that they are having difficulty coping with demands and threats to their well-being, and, second, that coping is important and that the difficulty in coping worries or depresses them.
>
> This approach allows a clear distinction between, say, the effects of lack of ability on performance and those of stress. If a person does not have the necessary knowledge or level of skill to complete a task then their performance will be poor. They may not realise this or if they do it might not be felt to be of importance or give rise to concern. These are not 'stress' scenarios. However, if the person (a) does realise that they are failing to cope with the demands of a task, and (b) experiences concern about that failure because it is important, then this is a 'stress' scenario.

Contemporary definitions of work stress have their roots in the different approaches to its study that developed during the latter half of the 20th century. These are discussed below. The current consensus represents a move away from early engineering and physiological approaches, towards a more psychological approach that involves an understanding of the importance of people's interactions with their environment, and of their perceptions and their emotional reactions to work.

Theoretical approaches and models

In 1978, Cox described three different theoretical approaches to the study of work stress: (i) the engineering or stimulus-based approach, (ii) the physiological or response-based approach, and (iii) a psychological approach. This particular architecture of theory has been taken up and used by many subsequent authors including Cooper *et al.* (2001).

The engineering approach conceptualises work stress as a stimulus, an aversive or noxious characteristic of the work environment and as a cause of strain. In contrast, the physiological approach defines stress in terms of the common physiological effects of a wide range of aversive or noxious stimuli and as a response to a threatening environment. Both approaches were conceptually rooted in the stimulus–response (S–R) psychology of the immediate pre- and post-war years (1940s to early 1970s). The psychological approach is more contemporary and conceptualises work stress in terms of the dynamic interaction between individuals and their work environment. When studied, stress is either inferred from the existence of problematic person–environment interactions or measured in terms of the cognitive processes and emotional reactions that underpin those interactions. This is the approach to measurement that is expounded here. Cox (1978, 1993) suggested that the main psychological approaches and models could be divided into (i) the interactional theories which describe the architecture of person–environment interactions (French *et al.*, 1982) person-environment-fit model, Seigrist's effort–reward imbalance model (1996), and Karasek's job-demands/job control model (Karasek *et al.*, 1981; Karasek and Theorell, 1990), and (ii) the transactional

theories, that describe the processes involved in such interactions, and include appraisal theories of stress and coping (Lazarus, 1966; Cox, 1978; Lazarus and Folkman, 1984).

Engineering approach

The engineering approach treated stress as a stimulus characteristic of the person's environment and as an independent variable. It was usually conceived in terms of excessive load placed on the individual, or some other aversive or noxious element of that environment (Cox, 1978; Cox and Mackay, 1981; Fletcher, 1988). Occupational stress was thus treated as a property of the work environment, and usually as an objectively measurable aspect of that environment. In 1947, Symonds wrote, in relation to psychological disorders in RAF flying personnel, that '... stress is that which happens to the man, not that which happens in him; it is a set of causes not a set of symptoms'. Thirty years later, Spielberger (1976) argued, in the same vein, that the term stress should refer to the objective characteristics of situations. According to this approach, stress was said to produce a strain reaction which, although often reversible, could prove to be irreversible and damaging. The concept of a stress 'threshold' grew out of this approach and became part of the description of individual differences in 'resistance to stress' or vulnerability.

Physiological approach

The physiological approach to the definition and study of stress received its initial impetus from the work of Selye (1950, 1956). He defined stress as 'a state manifested by a specific syndrome which consists of all the non-specific changes within the biologic system' that occur when it is challenged by aversive or noxious stimuli. Stress was treated as a generalised and non-specific physiological response and as a dependent variable. Selye argued that the physiological response was tri-phasic in nature involving an initial alarm stage (sympathetic-adrenal medullary activation) followed by a stage of resistance (adrenal cortical activation) giving way, under some circumstances, to a final stage of exhaustion (terminal reactivation of the sympathetic-adrenal medullary system and death). Repeated, intense or prolonged elicitation of this physiological response, it was suggested, increased the wear and tear on the body, and contributed to what Selye (1950, 1956) described as the 'diseases of adaptation'. This apparently paradoxical term arises from the contrast between the immediate and short-term advantages bestowed by physiological responses to stress (energy mobilisation for an active behavioural response) and their long-term disadvantages (increased risk of certain 'stress-related' diseases).

Criticisms of engineering and physiological approaches

Three types of criticism of these early approaches have been offered: (i) they no longer account for enough of the available empirical data, (ii) they are dated and conceptually limited, and (iii) they represent an over-medicalisation of the subject. The latter is particular to the physiological approach. These criticisms are outlined in more detail below.

The first criticism is that the engineering and physiological models no longer adequately account for the existing data. Consider, for example, the effects of noise on performance and comfort. The engineering model would seem to suggest that exposure to loud noise (as 'stress') would cause, in a direct and simple manner, impairment of performance, discomfort and possibly ill-health. However, the effects of noise on task performance, for example, are not a simple function of its loudness nor of its frequency but are subject to its nature (type of noise) and to both individual differences and situational effects (Cox, 1978; Melamed *et al.*, 1993). Further, noise levels that might normally be disruptive may help maintain task

performance when subjects are tired or fatigued (Broadbent, 1971), while even higher levels of music may be freely chosen in social or leisure situations. The simple equating of demands (such as loud noise) with stress has been associated with the erroneous belief that a certain amount of 'stress' is associated with maximal performance (Welford, 1973) and possibly good health.

Scott and Howard (1970) wrote 'certain stimuli, by virtue of their unique meaning to particular individuals, may prove problems only to them; other stimuli, by virtue of their commonly shared meaning, are likely to prove problems to a larger number of persons'. This statement implies the mediation of strong cognitive as well as situational (context) factors in the overall stress process. Such a point also has been made by Douglas (1992) with respect to the perception of risk. Such perceptions and related behaviour, she argued, are not completely explained by the natural science of objective risk but are strongly determined by group and cultural biases.

The physiological model is equally open to criticism. Both the non-specificity and the time course of the physiological response to aversive and noxious stimuli have been shown to be different from those described by Selye (1950, 1956) and required by this model. This was obvious by the early 1970s. Mason (1968, 1971), for example, showed that some noxious physical stimuli do not produce the stress response in its entirety. In particular, he has cited the effects of heat. About the same time, Lacey (1967) argued that the low correlations observed among different physiological components of the stress response are not consistent with the notion of an identifiable response syndrome. There is also a difficulty in distinguishing between those physiological changes that represent stress and those that do not, particularly as the former may be dissociated in time from the stressor. By the 1980s, there was much research suggesting that if the stress response syndrome did exist, it was not non-specific. Subtle but important differences in the overall pattern of response have been demonstrated (e.g., Dimsdale and Moss, 1980; Cox and Cox, 1985; Cox *et al.*, 1985).

The second criticism of the engineering and physiological models of stress is that they are dated and conceptually limited, being set within the relatively simple stimulus-response paradigm of the immediate pre- and post-war years. They largely ignore individual differences of a psychological nature, together with the perceptual, cognitive and emotional processes that might underpin them (Sutherland and Cooper, 1990). They treat the person as a passive vehicle for translating the stimulus characteristics of the environment into psychological and physiological responses. In large part, they ignore the interaction between the individual and their environment that is an essential part of systems-based approaches to biology, behaviour and psychology. They ignore the psychological, social and organisational contexts to work stress.

The third criticism is particularly focused on the physiological model. The ideas promoted by Selye (1950, 1956) and his advocates dictated a 'medicalisation' of the subject area. This was associated with an attendant narrowing of focus within the definition and practice of stress management. This approach has encouraged strategies that concentrate on individuals and their responses to 'stress', independent of the context within which the problem occurs. Partly as a result of this, we have witnessed the development of band-aid 'solutions' (relaxation or aromatherapy, for example) to stress problems in the workplace. Such views also tended to encourage the attribution of responsibility for any weakness or problems to the individual. Attempts to re-work the physiological approach have not resulted in a more coherent or clearer account of stress research or stress management. The development of notions of 'good' stress (eustress) and 'bad' stress (distress) have not resolved any of the existing problems, but have simply added to the semantic confusion. They have further encouraged the misguided view that 'some stress is good for you'. This erroneous belief in optimal levels of stress has been used on occasions to justify or excuse poor work design and management practice.

Psychological approaches

The third approach to the question of definition is a psychological one, and offers what is essentially a cognitive–emotional model of stress. In doing so, it attempts to overcome some of the criticisms that the other two types of model have attracted.

Variants of this psychological approach dominate contemporary stress theory, and among them two distinct types can be identified: the interactional and the transactional (Cox, 1978, 1993). The former focuses on the architecture or structure of individuals' interactions with their work environment, while the latter is more concerned with the psychological processes underpinning those interactions. Transactional models are primarily concerned with cognitive appraisal, emotion and coping. In a sense they represent a development of the interactional models, and are largely consistent with them. This chapter adopts a transactional approach based on Cox (1978, 1985, 1993). It proposes the unifying concept of a stress process, beginning with (i) its antecedent factors (in relation to work) and (ii) the cognitive perceptual processes involved and the emotional experience of stress; it then considers (iii) the health correlates of that experience. This approach provides a framework for measurement.

Stress as a psychological phenomenon

Stress has been defined as a cognitive state (Cox, 1985a, 1993) which is part of a wider process reflecting the person's perception of and adaptation to the demands of the (work) environment. Arguably, its defining aspect for the individual is essentially emotional. This approach emphasises the person's cognitive appraisal (Lazarus, 1966) of the situation, and their emotional reaction to it. It treats the whole process of perceiving and reacting to stressful situations within a problem solving context (Cox, 1987). Stress is not treated as a dimension of the physical or psychosocial environment: it cannot be defined solely in terms of workload (see Chapter 18) or the occurrence of events determined by consensus to be stressful. Equally, it cannot be adequately defined solely in terms of responses that are sometimes correlates of stress, such as physiological mobilisation or performance dysfunction. Framed in this way, the study of work stress is largely about normal people failing to cope with the problems that face them in their working lives and the experience and consequences of that failure.

A central feature of this approach to work stress is the process of cognitive appraisal (Lazarus, 1966), which Holroyd and Lazarus (1982) defined in terms of being 'the evaluative process that imbues a situational encounter with meaning'. Later refinements of this theory (Folkman *et al.*, 1980) suggest that there are primary and secondary components to the appraisal process. Primary appraisal involves a continual monitoring of the person's transactions with his or her environment, focusing on the question, 'Do I have a problem?' Secondary appraisal is contingent upon the recognition that a problem exists and involves a more detailed analysis and the generation of possible coping strategies (see below). It has been suggested by Cox (1978, 1987, 1993) that the overall process of appraisal involves a continual monitoring of at least four aspects of individuals' transactions with their environment, and a continual evaluation of the balance between them (Cox, 1987). Cognitive appraisal appears to take account of individuals' perceptions of:

1. The demands on them
2. Their ability to cope with those demands
3. The constraints under which they have to cope, and
4. The support they receive from others in coping.

Demands

Demands are requests for action or adjustment, whether cognitive, emotional, behavioural or physiological in nature. They require some degree of decision making and the exercise of skill. They may be imposed by the external environment, say as a function of work or the work-home interface, or may be internal, reflecting the person's needs: material, social or psychological. There may be several important dimensions describing external (job) demands, for example, 'pleasantness/unpleasantness' and 'ease/difficulty' (see Cox, 1985b). Demands usually have a time base, the effects of which may be amplified by an acute sense of time urgency (type A behaviour: Zyzanski and Jenkins, 1970).

Ability to Cope

The absolute level of demand would not appear to be the important factor in determining the experience of stress. More important is any discrepancy which exists between the perceived level of demand and individuals' perceptions of their ability to meet that demand. The size of this discrepancy appears to be an important determining factor in the stress process. However, the relationship between the discrepancy and the intensity of the stress experience may be curvilinear rather than linear (Cox, 1978). Within reasonable limits stress can arise through either overload (demand > abilities) or through underload (demand < abilities), or through some combination of the two. A person's ability to cope with such an imbalance may be constrained or supported in different ways and to different extents.

Constraints

Constraints operate as restrictions or limitations on free action or thought, often reflecting a loss or lack of discretion or control over actions. These may be imposed externally. For example, constraints may be imposed by the requirements of specific jobs or by the rules of the organisation. They may also be role related or reflect the beliefs and values of the individual.

There is some discussion in the literature as to whether the effects of job demands and constraints (job discretion) are additive or subject to a true interaction. Karasek (e.g., Karasek, 1979; Karasek *et al.*, 1981) has argued that a true interaction exists, while others, for example Warr (1990), have found evidence only for a simple additive effect. Despite this, the notion that high job demands and constraints create a disproportionately risky condition for worker health remains popular particularly among policy makers.

Support

Support can be made available in different ways, most essentially through 'social interaction': through advice and information, through practical assistance or by providing understanding and declaring empathy. It is possible that women need and are more sensitive to social support than men (Cox *et al.*, 1983, 1984).

Environmental antecedents of work stress

The concepts of demand and ability, constraint and support are high level ones and, in the reality of work, are combined and represented in a wide variety of different ways. The way they combine largely reflects the way work is designed and managed in its social and organisational contexts and the work characteristics that these processes determine (see Figure 1). Much of the current discussion of work stress is therefore focused on what are essentially failures of work design and management.

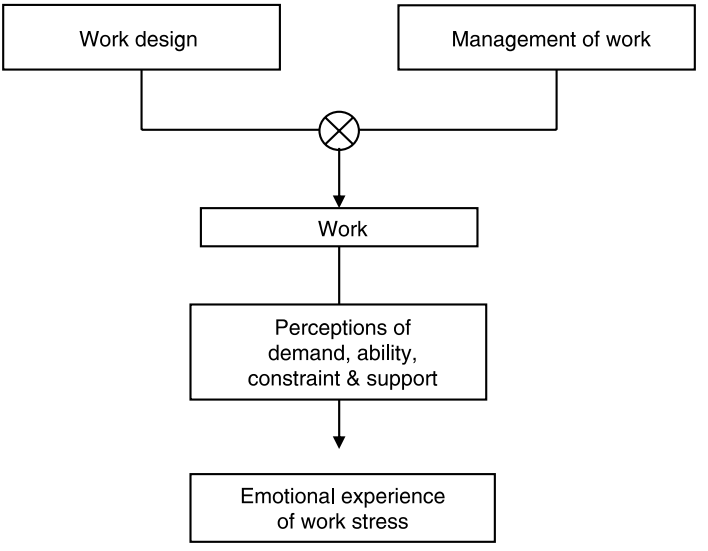

Figure 1 Antecedents of work stress.

Those work characteristics that have the potential for causing harm to the individual are 'hazards' and those that do so and are associated with the experience of stress are 'stress-related hazards' or 'stressors'. Sometimes, these stressors have been termed 'psychosocial and organisational' hazards. They are now well represented in the academic literature and in guidance published for employers by governments, unions, employers' bodies, insurers and the media. There has been much research into such sources of stress at work, and many taxonomies have been published (see, e.g., Cooper and Marshall, 1976). There appears to be broad agreement across these taxonomies. An example is provided in Table 1.

Individual differences and coping

A key component of psychological theories of stress is the concept of 'coping'. It concerns people's attempts to make a potentially stressful transaction less stressful (Lazarus and Folkman, 1984) and reduce the emotional experience of stress (Ferguson and Cox, 1997). These attempts are context-specific and are based on initial perceptions of the situation (primary appraisal) together with an evaluation of the possible ways of dealing with it (secondary appraisal). It is clear that people vary in their coping styles and preferences (Semner, 2003) as well as in their flexibility. Optimists, for example, have been shown to be more likely to use coping strategies that are appropriate for the situation than are pessimists (Carver and Scheier, 1999).

There are many different ways in which a person's coping resources might be conceptualised; however, it could be useful to think of them in terms of energy, knowledge, attitudes, skills and behavioural style. Here the idea of skill has to be extended beyond traditional conceptualisations in terms of psychomotor and technical skills, to include social and cognitive skills. The attitudes and behavioural style as well as personal knowledge and skills can be developed both through formal education and training and more informally through untutored experience. Furthermore, several elements of this 'package' of resources are subject to change, influenced by factors such as time of day, fatigue, and state of health. In addition to any consideration of its cognitive and perceptual elements, the state of stress is

Table 1 Psychosocial and Organisational Hazards (Adapted from Cox, 1993)

Content of work	
Job content	Lack of variety or short work cycles, fragmented or meaningless work, under use of skills, high uncertainty, continuous exposure to people through work
Workload and work pace	Work overload or under load, machine pacing, high levels of time pressure, continually subject to deadlines
Work schedule	Shift working, night shifts, inflexible work schedules, unpredictable hours, long or unsociable hours
Control	Low participation in decision making, lack of control over workload, pacing, shift working, etc.
Environment and equipment	Inadequate equipment availability, suitability or maintenance; poor environmental conditions such as lack of space, poor lighting, excessive noise
Context to work	
Organisational culture and function	Poor communication, low levels of support for problem solving and personal development, lack of definition of, or agreement on, organisational objectives
Interpersonal relationships at work	Social or physical isolation, poor relationships with superiors, interpersonal conflict, lack of social support
Role in organisation	Lack of participation; role ambiguity, role conflict, and responsibility for people
Career development	Career stagnation and uncertainty, under promotion or over promotion, poor pay, job insecurity, low social value to work
Home-work interface	Conflicting demands of work and home, low support at home, dual career problems

often defined by the person's experience of negative emotion, unpleasantness and general discomfort.

The effects of stress

Many of the effects of stress are short-lived and cause no lasting harm, but if intense or sustained can be more damaging. The experience of stress is usually accompanied by changes in the way people feel, think, behave, and in their physiological function. Anxiety and depression are common symptoms, as are irritability, impaired memory and attention span. Interpersonal relations may be damaged. Evidence suggests that stress is associated with cardiovascular disease, gastro-intestinal disorders, musculo-skeletal disorders and impaired immune function (Cox *et al.*, 2000). In addition, work-related stress is thought to account for a significant proportion of the variance in many maladaptive health behaviours such as smoking, substance abuse and sleep patterns (Shirom, 2003). Ultimately, work stress may affect the healthiness and productivity of the organisation (Cox and Thomson, 2000) through a variety of pathways: increased absence and intention to leave, poor morale and commitment, lack of trust; poor productivity and poor quality of work; and poor safety performance. It can therefore be costly to organisations beyond the cost to the individual.

Measuring work-related stress: a framework

This chapter takes the stress process and its key elements, as described above, as its framework for measurement. It incorporates aspects of risk assessment (see also Chapters 32 and 34).

Elsewhere, the authors have described and discussed a full risk assessment methodology for work-related stress (Cox *et al.*, 2002, 2003). This framework is applicable to group study and risk assessment purposes in the workplace rather than to the clinical assessment of individuals. It is a nomothetic method rather than an idiopathic one. It is not possible to offer a comprehensive review of the plethora of measures which might be used in such an approach. The discussion here is focused on the Nottingham methodology as presented in its Work Environment Survey, and two self-report instruments — the Stress Arousal Checklist (SACL) and the General Well-being Questionnaire (GWBQ).

Triangulation

Essentially the approach to measurement set out here is built on the inter-relatedness of data from three different sources: an assessment of the work environment (antecedent factors: stressors), the measurement of the emotional experience of stress, and the assessment of health and wellbeing. Relating data from three different sources has been referred to as triangulation (see below) and, for best practice, such data should be collected using different methods. However, in reality, both in research and practice, this is the exception rather than the rule and much depends on self report.

Ideally, the principle of triangulation should be applied both within and between domains. Across domains, data collection could take the form of continuous or repeat monitoring and thus be capable of mapping and cross referencing changes in all domains. This should help overcome the problem of missing data and help resolve inconsistencies in the data given that these are not extreme. Within domains, several different measures should be taken and preferably across different measurement modalities to avoid problems of common method variance. This may be most relevant and easiest to achieve in relation to the measurement of changes in the third domain: behaviour, physiology and health status. There is no available evidence to suggest that the various measures from the different domains can be statistically combined into a single and defensible 'stress index'.

Measurement of the stress process

What has to be measured is the stress process: 'antecedents in the work environment → the experience of stress → its psycho-physiological and health correlates'. This might be simplified conceptually to the basic health and safety equation of: 'work hazards–stress–harm'. In this context, the overall measurement process can be said to resemble a risk assessment. This approach underlines both the complexity of measurement and the inadequacy of asking for or using single one-off measures of stress (however defined).

Somewhat similar approaches can be found in the literature. For example, Bailey and Bhagat (1987) recommended a multi-method approach to the measurement of stress consistent with the concept of triangulation. They have argued in favour of balancing the evidence from self-report of work and experience, physiological and unobtrusive measures. Their unobtrusive measures relate to what Folger and Belew (1985) and Webb *et al.* (1966) called non-reactive measures, and include: physical traces (such as poor house-keeping), archival data (such as that on absenteeism), private records (such as diaries), and non-intrusive observation and recordings.

Assessing the work environment

The Work Environment Survey is a methodology for collecting data on the possible antecedents of the experience of stress in failures of work design and management. It uses situational reasoning and focuses on building a consensus model of the problems

inherent in the work environment. It operates first through a rolling series of interviews, with the work group of concern, to build a model of work and any failures of work design or management or problems in its social or organisational contexts.

From this model, a quantitative assessment instrument is developed and tailored to the situation of the work group being assessed. This is essentially a device for assessing the risk to health, broadly defined, of these different problems and the role of the experience of stress in mediating or moderating that relationship. In this way, the three key elements of the stress process (see above) are tied together in overall measurement process. The instrument is validated through discussions with the work group of concern. The instrument is then applied to the whole assessment group.

Measuring the experience of stress

Within the measurement framework described above, the experience of stress is defined as a psychological state which is part of and reflects a wider process of interaction between individuals and their (work) environment. That experience is essentially emotional in nature. Within the present framework, the measurement of stress should be based primarily on self-report measures which focus on the associated emotional experience (Cox, 1978, 1985a, 1993).

Stress arousal checklist (SACL)

The measurement of mood may offer one direct method of tapping the individual's experience of stress, and there was a surge of interest in this issue in the late 1970s and in the 1980s as witnessed by a series of articles in the *British Journal of Psychology* (Cox and Mackay, 1985; Cruickshank, 1984; King *et al.*, 1983) and elsewhere (Burrows *et al.*, 1977; Ray and Fitzgibbon, 1981; Russell, 1979, 1980; Watts *et al.*, 1983). Most of these studies have employed the 'Stress Arousal Checklist' (SACL) developed by Cox and Mackay and originally published in the *British Journal of Social and Clinical Psychology* (Mackay *et al.*, 1978).

The SACL is an adjective checklist and was developed using factor analytical techniques (Cox and Mackay, 1985; Gotts and Cox, 1990; Mackay *et al.*, 1978) for the measurement of self-reported mood. It presents the respondent with 30 relatively common mood describing adjectives, and asks to what extent they describe their current feelings. The model of mood which underpins the checklist is two dimensional. One dimension appears to relate to feelings of unpleasantness/pleasantness or hedonic tone (stress) and the other to wakefulness/drowsiness or vigour (arousal). Such a model is well represented in the relevant psychological and psychophysiological literature (see, e.g., Mackay, 1980; Russell, 1980). The split half reliability coefficients for the two scales which tap into these dimensions have always proved acceptable: for example, arousal 0.82 and stress 0.80 (Watts *et al.*, 1983; Gotts and Cox, 1990). Both were conceived of and developed as state measures, and are thus seen as transient in nature. The statistical device of test–retest coefficients is therefore not appropriate as a test of reliability.

Consistent with the transactional model (see above), it was suggested by Mackay *et al.* (1978) that the stress dimension may reflect the perceived favourability of the external environment, and thus have a strong cognitive component in its determination. Arousal, it was suggested, might relate to ongoing autonomic and somatic activity, and be essentially psychophysiological in nature. It became obvious that stress may partly reflect how appropriate the level of arousal is for a given situation, and the effort of compensating for inappropriate levels (Cox *et al.*, 1982).

Together the two dimensions can be used to describe a four quadrant model of mood within which characteristic emotions and related states may be identified: high arousal

and high stress (anxiety), high arousal and low stress (pleasant excitement), low arousal and high stress (boredom), and finally, low arousal and low stress (relaxed drowsiness). There are now many reported studies using the SACL, and reporting data from its two scales (Burrows *et al.*, 1977; Cox *et al.*, 1982; King *et al.*, 1983; Ray and Fitzgibbon, 1981; Watts *et al.*, 1983). There have also been a number of studies which have used modified versions of the checklist (Cruickshank, 1982, 1984), although locally inspired changes in the instrument cannot always be defended (Cox and Mackay, 1985).

A third scale has been suggested based on the use of a '?' category on the response scale associated with the different mood adjectives. This category signifies, in part, uncertainty about whether the adjective given currently describes the respondent's mood. A score based on the frequency of '?' responses might reflect an inability to report feelings, and this may be symptomatic of a disordered psycho-physiological state. Such a scale has an acceptable split half reliability coefficient: 0.89 (Cox and Mackay, 1985).

A compilation of the available British and Australian data has allowed the publication of mean levels for different groups, broken down by country of origin, age, sex and occupation (Gotts and Cox, 1990). Some of these 'normative' data are presented in Table 2.

Measuring health at work

Fortunately, it appears that the experience of work-related stress is more likely to be associated with changes in the level of general malaise than in the incidence of death, or of disease, disability or injury (see Cox *et al.*, 2000b). For most studies, general malaise has to be the focus of measurement. General malaise has also been referred to as sub-optimal health.

A theory of sub-optimal health

Health has been defined as a changeable state along a continuum from complete healthiness to death (World Health Organisation, 1946; Rogers, 1960). This broad definition implies that health cannot be equated with mere absence of obvious disease, injury or disability, and is not restricted to the sound physical condition of the body; it also has psychological and social aspects. In this context, well-being relates to individuals' experience of their health.

An important watershed in the health continuum is represented by the point where disease, disability or injury become obvious to the person, and are usually represented by objectively verifiable and clinically significant signs and symptoms. Some of these will be

Table 2 Some Normative Data for the SACL (derived from Gotts and Cox, 1990)

	Dichotomised scores						*Q*		
	Stress			Arousal					
Sample	*x*	SD	*n*	*x*	SD	*n*	*x*	SD	*n*
Mixed population	6·0	4·6	1027	6·4	3·2	1040	4·2	4·2	1079
Males: mixed sample	6·0	4·7	296	6·6	3·2	297	4·9	4·6	266
Females: mixed sample	6·0	4·6	731	6·3	3·3	743	3·9	4·1	584
Students	6·3	4·9	515	5·7	3·6	518	4·7	4·1	535
Ages 16 to 30	6·2	4·6	466	6·0	3·2	469	5·0	4·3	379
Ages 31 to 45	5·9	4·9	344	7·2	3·3	353	3·5	4·2	334
Age more than 45	5·1	4·2	122	6·4	3·3	123	3·7	4·1	1132

More complete normative data have been published as part of a manual for the SACL (Gotts and Cox, 1990). Further information can be obtained from the authors.

diagnostic of a particular condition; others will more generally reflect the impact of that condition. Some will inevitably represent the effects of stress experienced in relation to being ill.

The zone between complete physical, psychological, and social healthiness on the one hand, and obvious disease, disability or injury, on the other, has been termed sub-optimal health (Rogers, 1960). It has been suggested that sub-optimal health may be represented as an experiential pool of signs and symptoms of general malaise, each, on its own, of no particular clinical significance and certainly not diagnostic of any particular condition. Such signs and symptoms may or may not be precursors to disease, injury or disability depending on the operation of a wide range of health risk and salutogenic factors. At any time, different groups of signs and symptoms within the experiential pool will imperfectly predict particular ill-health outcomes. As a condition develops, the predictive group will refine itself, attract new signs and symptoms, and the prediction itself may strengthen. As a condition weakens, or the person recovers, then the reverse process will occur. It is 'sub-optimum health', as a concept and an experience, that equates most closely to the popular understanding of 'wellbeing' and the two terms are used more-or-less interchangeably here.

A person considered to be normally healthy, by themselves or others, or more particularly judged not to be ill, will still experience something by way of such signs and symptoms of general malaise, and the possible pool of such experiences will be formally present at the group level. At this level, structural modelling will reveal a pattern and clusters of signs and symptoms reflective of an underlying normal experience model. However, it has been suggested that the normal experience of well-being may both reflect the experience of stress as one mediator of the effects of life and working conditions, and also in turn affect other responses to stress, such as self-reported mood (see Mackay *et al.*, 1978; Cox and Mackay, 1985).

The General Wellbeing Questionnaire was developed within the framework of this theory of suboptimal health.

Development of the general well-being questionnaire (GWBQ)

It was in the mid 1980s that the Nottingham group began to build a measurement tool for well-being based on the self-report of signs and symptoms of general malaise (Cox and Brockley, 1984; Cox *et al.*, 1983, 1984). There were several different questionnaire instruments available at the time that by the nature of their scales and internal structure offered some description of that area of health (Crown and Crisp, 1966; Derogatis *et al.*, 1974; Goldberg, 1972; Gurin *et al.*, 1960). However, none of these were judged to be exactly what was required for use with a more-or-less healthy working population in Britain and for the purpose of assessing work-related stress.

Initially a compilation of non-specific symptoms of general malaise was produced from existing health questionnaires (see above) and from diagnostic texts. These symptoms included reportable aspects of cognitive, emotional, behavioural and physiological function, none of which were clinically significant in themselves. From this compilation, a prototype checklist was designed with each symptom being associated with a five point frequency scale ('never' through to 'always') which referred to a six month response window. In a series of classical factor analytical studies, on British subjects, variously reported (Cox *et al.*, 1983, 1984), two clusters of symptoms or factors were identified (see Table 3). These factors were derived as orthogonal. The first factor (GWF1) was defined by symptoms relating to tiredness, emotional lability, and cognitive confusion; it was colloquially termed 'worn out'. The more cognitive items would appear to imply difficulties in decision making (in the specific context of feeling 'worn out'): (a) Has your thinking got mixed up when you have had to do things quickly? (b) Has it been hard for you to make up your mind? and (c) Have you been forgetful?

Table 3 Items Defining the GWBQ Scales (International Version)

GWF1	
	Have your feelings been hurt easily?
	Have you got tired easily?
	Have you become annoyed and irritated easily?
	Have your thinking got mixed up when you have had to do things quickly?
	Have you done things on impulse?
	Have things tended to get on your nerves and wear you out?
	Has it been hard for you to make up your mind?
	Have you got bored easily?
	Have you been forgetful?
	Have you had to clear your throat?
	Has your face got flushed?
	Have you had difficulty in falling or staying asleep?
GWF2	
	Have you worn yourself out worrying about your health?
	Have you been tense and jittery?
	Have you been troubled by stammering?
	Have you had pains in the heart or chest?
	Have you unfamiliar people or places made you afraid?
	Have you been scared when alone?
	Have you been bothered by thumping of the heart?
	Have people considered you to be a nervous person?
	When you have been upset or excited has your skin broken out in a rash?
	Have you shaken or trembled?
	Have you experienced loss of sexual interest or pleasure?
	Have you had numbness or tingling in your arms or legs?

These may have implications for personal problem solving and coping (see Cox, 1987). The second factor (GWF2) was defined by symptoms relating to worry and fear, tension and physical signs of anxiety; it was colloquially termed 'up tight and tense'. This model of sub-optimum health appeared to have some face validity in that it was acceptable to a conference audience of British general practitioners and medical and psychological researchers (see Cox *et al.*, 1983).

It is therefore suggested by the authors that sub-optimum health, the 'grey area' between complete healthiness and obvious illness, is made up of two states, one related to being 'worn out' or exhausted, and the other related to being 'up tight and tense'. The former has an interesting cognitive component, possibly related to decision making and coping, while the latter is partly defined by physical symptoms of anxiety and tension. It has been shown that people vary in the extent to which they report these feelings, both between individuals and across time, and it has been suggested that this variation may not only (a) reflect the experience of stress, but also (b) affect other responses to stress, such as self-reported mood (see Mackay *et al.*, 1978; Cox and Mackay, 1985). There is evidence that in workplace studies the worn-out or exhaustion scale shows greater utility in workplace studies than does the tense and uptight scale; it demonstrates a more consistent relationship with other, non-health measures of interest within the workplace (Cox *et al.*, 2000).

This research culminated in the publication in English of the General Well-Being Questionnaire (Cox and Gotts, 1987).

Table 4 Some Normative Data for the GWBQ (Derived from Unpublished Data of Cox and Gotts) for Mixed Populations

INTERNATIONAL VERSION (1987)						
	'Worn out'(12 Items)			'Up tight' (12 Items)		
Sample	*X*	S.D.	*n*	*X*	S.D.	*n*
All	16·7	8·3	2300	10·7	7·4	2312
Males	15·9	7·8	1031	8·2	6·5	1042
Females	17·4	8·6	1262	12·8	7·4	1262
British sample by age (years)						
16–20	16·5	8·7	141	11·5	7·9	141
21–25	16·9	9·2	147	11·3	7·6	147
26–30	15·6	8·4	236	10·2	7·5	236
31–35	17·2	8·6	239	9·0	6·5	239
36–40	16·1	8·1	201	9·2	7·5	201
41–45	15·5	8·6	199	10·4	7·7	199
46–50	16·0	8·3	175	9·7	7·7	175
51–55	14·5	8·0	174	9·1	7·4	174
56–60	13·7	8·0	127	7·7	6·6	127
>60	13·5	6·4	26	4·8	5·8	26

Further information can be obtained from the authors.

In the late 1980s new data were collected through a series of linked studies in Britain and Australia. These data were re-analysed, and the model and its associated scales were amended to increase their robustness in relation to this international sample, and also to a diversity of homogeneous samples (see Table 4).

A number of symptoms (items) were deleted from the original scales, but no new symptoms were added. The two new international scales were each defined by twelve symptoms but retained their essential nature: worn out and tense and uptight. The deleted symptoms were among the weaker ones in terms of scale definition and item loadings. The early questionnaire was revised, new norms were computed and an international version was published and has been in use since then (e.g., Cox and Griffiths, 1995, Cox *et al.*, 2000).

Recent developments

The more recent development of the GWBQ has focused on two issues: the question of cultural-linguistic difference and the further development of the scales.

The possibility of cultural-linguistic differences in the experience and report of well-being has been explored in working populations in Taiwan (Ruey-Fa, 1993) and in Singapore (Ho, 1996). For example, bilingual Taiwanese school teachers (English and Mandarin) completed English and Mandarin versions of the GWBQ. The data clearly showed the emergence of identical two factor models from these data sets with teachers' scores on the two versions being very highly correlated. The Taiwanese (Mandarin) model was indistinguishable from the UK English language version. Despite this extreme test, the cultural-linguistic interchangeability of the GWBQ should not be taken for granted, and is a matter of empirical test between its English origins and other cultural-linguistic situations.

Recent research by the authors has suggested that feelings of being worn out or exhausted are commonly associated with exposure to poor work design or problems with the management of work and often moderate the relationship between such failures and their health effects. Qualitative data collected during these studies has allowed the authors to begin both extending and refining the measurement of being 'worn out' or exhausted with the possibility of developing new sub-scales within the existing measurement framework. This development should allow a greater sensitivity of measurement and, hopefully, a greater depth of understanding of the effects of work stress on well-being.

Organisational healthiness

In addition to measurements of individual health and stress, there are various measures of 'organisational' healthiness (Cox and Thomson, 2000) that may be used in studies of the correlates of stress at work. Their choice will depend on the case in question. In some organisations, for example, absence from work may be a key measure. In others, where there may be a tendency to work through illness, or to work at home, it will be meaningless.

Concluding comments

This chapter has attempted to describe the nature of the problem of work-related stress in a way that points up its relevance to both individual workers and to their organisations. It is an important contemporary issue in occupational health and safety. The current consensus defines stress as a psychological state with an important emotional component. Furthermore, there are now theories which can be used to relate the experience and effects of work stress to exposure to work hazards and to the harmful effects on health that such exposure might cause. These theories can be used to place the measurement of stress within a health and safety framework and link it to risk assessment. This approach facilitates both the measurement and the management of work-related stress.

The inadequacy of single one-off measures is widely recognised in the literature but despite this they continue to be used. This diversity may account for much of the disagreement within stress research on measurement. Part of the solution to this problem lies with agreeing the theoretical framework within which measurement is made, but part lies with the development of a more adequate technology of measurement based in 'good practice' in a number of areas including occupational health psychology, psychometrics, knowledge elicitation and knowledge modelling. A forced standardisation of measurement is not being argued for here and should be resisted for its effects on scientific progress. What is being argued for throughout is better measurement processes, conforming to recognised good practice in relevant areas, and applied within a declared theoretical context.

The approach offered here is based on the stress process and is consistent with risk assessment. It considers: the antecedents of stress in failures of work design and management, the experience of stress, and its effects of health or well-being. These three key elements in the stress process can be brought together in a particular way. First, the relationship between exposure to the failures of work design and management, on the one hand, and possible effects on health or well-being, on the other must be explored. Then the question of whether this relationship is mediated or moderated by the experience of stress is examined. Logically this establishes a description of the stress process that is secure using the principle of triangulation. This may well be sufficient for the Courts of Law as well as those of applied science.

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