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We review and summarize the literature on work stress with particular emphasis on those studies that examined the effects of work characteristics on employee health. Although there is not convincing evidence that job stressors cause health effects, the indirect evidence is strongly suggestive of a work stress effect. This evidence comes from occupational studies that show differences in health and mortality that are not easily explained by other factors and within-subject studies that demonstrate a causal effect of work experiences on physiological and emotional responses. We argue that studies relying on self-reports of working conditions and outcomes, whether cross-sectional or longitudinal, are unlikely to add significantly to the accumulated evidence. Finally, we make recommendations for how organizational researchers are most likely to contribute to this knowledge.

The belief that stress, and in particular, work stress, is a causal agent in physical and mental disorders as well as organizational outcomes such as absenteeism and reduced productivity has gained widespread acceptance. Ivancevich and Matteson (1980) proferred the conservative estimate that stress costs the U.S. economy $50-90 billion annually, a figure that at the time they wrote it approached 10% of the GNP. Estimates about how much of this total cost of stress emanates from the occupational sphere vary widely. One often cited source (Lublin, 1980) discusses the rapid growth of "psychiatric injury claims" in the state of California. In particular, claims for "gradual mental stress," a worker compensation term that refers to the cumulative emotional effects of exposure to primarily psychosocial demands at work, accounted for 11% of all occupational disease claims in the period 1981-1982 (National Council on Compensation Insurance, 1985).

The general notion that prolonged exposure to stressful job demands can lead to a variety of pathological outcomes receives tantalizing support from a broad literature in behavioral medicine and epidemiology. However, close inspection of the research investigating specific work-related factors fails to produce a satisfying picture of how, or even whether, certain work experiences lead to physical or

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mental disorders. Kasl (1978, 1986) has been an eloquent critic of this literature. Writing from an occupational epidemiology perspective, Kasl has articulated better than anyone the methodological criteria that must be satisfied in order to reach conclusions about whether objective occupational exposures (e.g., to high levels of workload) are causally involved in the etiology of disease (e.g., coronary heart disease). In his view, existing research designs do not approximate closely enough this set of criteria to allow us to make causal inferences. Although Kasl's emphasis has been mostly on *how* we study work stress, Brief and Atieh (1987) have questioned *what* we study. Brief and Atieh conclude that the correlational evidence does not convincingly demonstrate that commonly measured work stresses (e.g., role conflict and ambiguity) are even strongly related to measures of subjective well-being outside of the work sphere, much less causally implicated. Their recommendation is that we shift our attention to particular types of stresses, specifically those related to economic issues, rather than the role stresses that have been so ubiquitous in this literature.

Whether work stress really costs the economy billions of dollars is debatable. Less debatable is the significant investment that the academic community continues to make in studying the issue. Our perusal of this literature uncovered more than 300 published articles dealing specifically with work and stress in just the last 10 years. Such writings appear in the academic journals of a diverse array of fields including psychology, sociology, engineering, public health, epidemiology, management, criminal justice, and law. Articles in the popular press and the trade journals contribute hundreds more to this figure. In addition, there are a number of review articles and books that cover various aspects of this literature. Broad overviews of the work stress literature are provided in books by Beehr and Bhagat (1985), Brief, Schuler, and Van Sell (1981), Cooper and Payne (1978), Hurrell, Murphy, Sauter, and Cooper (1988), Ivancevich and Matteson (1980), Ivancevich and Ganster (1987), and Quick and Quick (1984). Other books cover narrower slices of the work stress field, such as stresses relevant to blue-collar workers (Cooper & Smith, 1985; Salvendy & Smith, 1981), health professionals (Payne & Firth-Cozens, 1987), and worker control (Sauter, Hurrell, & Cooper, 1989). In addition to these books, there are a number of review articles that provide overviews and critiques of the job stress literature (e.g. Beehr & Newman, 1978; Cooper & Marshall, 1976; House, 1974; Kasl, 1978, 1986; McGrath, 1976; Sharit & Salvendy, 1982), as well as reviews of stress management research (e.g., Murphy, 1984; Newman & Beehr, 1979). Given this extensive literature and the existence of prior reviews, we decided to limit the scope of the present article in order to achieve several specific aims.

First, we want to provide the *JM* reader, who is not necessarily familiar with the work stress literature, a general overview of the major trends in the field. In so doing, we will provide a very brief history of the field and a general accounting of the areas that are currently receiving emphasis. Second, we will make a critical appraisal of the current literature according to how well it addresses the following question: "What causal inferences can we make about the effects of working experiences on the mental and physical health of workers?" Most of the evidence relating to this question appears in outlets that would not be classified as manage-

ment or organizational science journals. Organizational researchers publishing in organizational journals (e.g., the 10 listed by Blackburn, 1990) tend to cite work from other disciplines much more than they are cited by researchers in the other fields. Given the need for applied fields to draw on more basic disciplines, this direction of flow is expected. Nevertheless, we believe that organizational scientists have things to say to those in other fields, and this belief leads to our third objective. We would like to make some suggestions about where organizational researchers can best "fit in" amidst this varied company of interdisciplinary investigators. Thus we will conclude with a discussion of the research questions that might best be attacked by organizational scientists as well as the methodological strategies that would likely be most productive.

We begin with brief historical overviews of research programs that provided an impetus for organizational researchers' current involvement in work stress research. Research on role stress and burnout continue to receive attention. The work of Scandinavian researchers and sociologists predate current study of serious health risks posed by job and occupation exposures, respectively. This review is followed by a brief overview of theoretical models that we believe are the most influential among the morass of formulations put forward during the past three decades.

We then critically examine the success of various work stress investigative methodologies for determining the extent of association between stress exposures at work and serious health outcomes. The occupational evidence, percept-percept, and percept-nonpercept research define the parameters of this methodological retrospective. In addition, we examine the evidence concerning major personality variables that have been theorized, and in some cases identified, to bear on the relationship between work stress exposures and stress outcomes. Throughout this review we attempt to maintain operational distinctions between the exposures that occur at work (i.e., factors that can be labelled as "stressors" and that are most frequently manifested as demands or constraints on an individual) and the posited reaction of the individual to such exposures (i.e., stress outcomes such as somatic disturbances, morbidity, disease-related mortality, and mental disturbances that may or may not have physiological bases, such as depression). More ambiguous terminology such as "work stress" should refer to the patterns of association between these two domains. As will be noted further on, however, in both theory and methodology, the literature is frequently unclear regarding such distinctions.

The History and Scope of Job Stress Research

A classic study by Friedman, Rosenman, and Carroll (1958) revealed that accountants' levels of serum cholesterol rose as the tax deadline approached and returned to normal after this busy period. As one of the early job stress studies, this investigation embodied many of the design characteristics that critics of the present-day literature describe as necessary: there was an objective assessment of a suspected job stressor, physiological outcomes that are implicated in the development of coronary heart disease were measured, and the study was at least somewhat longitudinal. It is with some irony that we observe that a minority of subse-

quent studies are able to match this degree of methodological sophistication even as the field has become more developed conceptually and theoretically.

Role Stress

Interest in work stress picked up speed in the 1960's and became heavily influenced by the work at the University of Michigan's Institute for Social Research. The publication of the role stress study by Kahn, Wolfe, Quinn, Snoek, and Rosenthal (1964) inspired two decades of research on role conflict, role ambiguity, and role overload as the major independent variables of interest. Lazarus' (1966) transactional model of stress, with its focus on the subjective appraisal of events, was also becoming an influential general theory of stress. It is perhaps more than coincidental, then, that the methodological paradigm for studying job stress also made a noticeable shift around this time away from objective environmental factors toward subjective appraisals of the working environment. At least 200 studies have been reported that assess the correlations between role conflict and ambiguity perceptions and affective outcomes. Jackson and Schuler's (1985) meta-analysis of this literature indicates that self-reports of these role stresses generally correlate about .30 with job-related affective measures of worker distress. The relationships of role stress variables with other assessments of mental and physical health have yet to be convincingly established.

Scandinavian Research

Another major stream of job stress research comes from the Scandinavians, particularly the Swedes, and began to become well known in the U.S. in the 1970's. Combining both laboratory and field studies, these researchers applied activation theory principles to the study of work conditions and worker well-being (Frankenhaeuser, 1979; Frankenhaeuser & Gardell, 1976; Levi, 1972). Based on the activation theory proposition that performance, mental efficiency, and well-being are maximized at some intermediate level of physiological activation, their studies focused on working conditions that were likely to produce either underload or overload. The Swedish sawmill study reported by Johansson, Aronsson, and Lindstrom (1978) is one of the better known studies in this tradition and illustrates the focus and methods characteristic of this line of research. Subjects were classified by job type into high versus low risk categories, and expert ratings of job content were obtained from observers as well as from the subjective reports of the workers. Outcome variables consisted of affective responses, psychosomatic symptoms, and neuroendocrine activation measures (adrenaline and noradrenaline). The primary independent variables of interest in both the field and laboratory studies (e.g., Johansson, 1981) have consisted of factors such as work pace, attentional demands, control over pacing and other working conditions, and underutilization of skills. This program of research has, to a much greater extent than in the U.S., been directed toward the formulation of public policy regarding both the design of work (i.e., that it be meaningful, etc.) and the role of workers in determing their fate (i.e., that they have voice and control). The Scandinavian work has also spawned what is now referred to as the job demands-job decision latitude model (Karasek, 1979). This model drives much of the current research

on occupational stress and we will devote more space to its coverage in this review.

Burnout

Several other trends might be identified in the wider stress literature. One of these trends is reflected in the large body of research on job "burnout." Burnout was conceived as a chronic affective response to stressful work conditions that featured high levels of interpersonal contact (Freudenberger, 1974; Maslach, 1982; Shinn, 1982). Shirom (1989) argues that the "unique content of burnout has to do with the depletion of an individual's energetic resources" (33). Interest in burnout grew during the 1970's, at which time the initial focus was on the so-called helping professions such as nursing, social work, and teaching. From this rather narrow range of occupational categories, however, the construct has metastasized to a wide range of occupations that involve any degree of interaction with other people, including military and police officers (Burke & Deszca, 1986; Jones, 1985), managers (Cahoon & Rowney, 1984; Glogow, 1986), librarians (Birch, Marchant, & Smith, 1986), and even blue-collar workers (Ursprung, 1986). Shirom (1989) has recently reviewed this literature and notes that more than 300 articles have been published just between 1980 and 1985. Our intention here is only to note that there is a large burnout literature that represents a significant fraction of the published literature on job stress. Shirom (1989) provides an excellent summary of this research that includes a critical appraisal of burnout's construct validity.

Occupation-specific Studies

We would note one other general trend in the job stress literature: there is a proliferation of idiographic studies whose aim is to discover and analyze the specific sources of stress in particular occupations. In recent years studies have reported such descriptions for nurses (e.g. McGrath, Reid, & Boore, 1989), teachers (e.g. Blase, 1986; Brenner & Bartell, 1984; Friesen & Sarros, 1989; Mykletun, 1984), caregivers (e.g., Chiriboga, Weiler, & Neilsen, 1989), occupational therapists (e.g., Rogers & Dodson, 1988), paramedics (e.g., Grigsby & McKnew, 1988), firefighters (e.g., Lim, Ong, & Phoon, 1987), hospice staff (e.g., Yancik, 1984), correctional workers (Brodsky, 1982), and South African educational psychologists (Basson, 1988), among others.

The approach generally consists of asking job incumbents to describe the aspects of their job that make them feel stressed. Although investigators do uncover unique attributes of different occupational groups that are reported to be causes of stress, there is also a striking degree of similarity in the nature of the stressors from one occupation to the next. In large part this apparent similarity of occupations reflects nothing more than the propensity of stress researchers to use similar questionnaires that tap the same set of theoretical constructs (e.g., work overload, role conflict and ambiguity, lack of support, lack of control, and low opportunities for career advancement). However, even in studies that use a more inductive qualitative methodology, one is often struck by the predictability of the sources of stress discovered in a given occupation. On the one hand, this might reflect some

underlying mechanisms that are universally involved in the stress process, as would be argued from certain theoretical perspectives such as the job demands-job decision latitude model. On the other hand, we might be observing the effects of a widely held implicit theory about work stress acquired from years of exposure to descriptions in the popular press. Inductive studies attempting to describe the sources of stress in particular occupations are, in principle, very much like job analysis studies. Thus, it is interesting to note that in their review of the job analysis literature, Spector, Brannick, and Coovert (1989) were somewhat disturbed to find that students given job titles produce ratings that converge fairly well with those of experienced job analysts who have much information about the jobs. They wondered to what extent this reflects veridical job knowledge (because educated people have some knowledge about many jobs) or whether it reflects the existence of widely held, and perhaps innaccurate, job stereotypes. In general, studies that have examined particular occupations in depth have not produced data that contribute new insights about the more general process of job stress. Even less have they contributed to the question of whether specific objective environmental exposures in the workplace cause mental and physical health problems. An exception to this conclusion can be found in the study of air traffic controllers (Rose, 1987), which we discuss below.

Theoretical Models of Job Stress

Selye's General Adaptation Syndrome (Selye, 1976), Cannon's work that underlies Selye's propositions (e.g., Cannon, 1929), and Lazarus' transactional model of stress (Lazarus, 1966) have exerted an influence on the general direction that job stress researchers have taken. Each of these models provides a different paradigm for approaching the problem of work-related stress. Selye's model directs the investigator to focus more on the objective features of the environment, whereas Lazarus' model steers one to focus on the individual's subjective appraisal of environmental demands. But although these models affect how researchers conceptualize the general problem of work stress, they do not provide specific guidance as to what particular features of work are apt to be most important. For work stress in particular, two theoretical approaches have dominated the literature: the Person-environment fit model (French, Caplan, & Harrison, 1982) and the job demands-job decision latitude model (Karasek, 1979).

P-E Fit Theory

P-E fit theory has roots in the descriptions of motivational processes of Lewin (1951) and Murray (1938), and is embodied in many models of organizational behavior (e.g. Hackman & Oldham, 1980; Lofquist & Dawis, 1969). Its prominence in the sphere of work stress can be traced to French and his colleagues, who have elaborated the model over the years and have been connected to much of the empirical work assessing its validity (Caplan et al., 1975; French et al., 1982; French & Kahn, 1962). The basic tenet of the theory is that the degree of fit between the individual and the job environment determines the stressfulness (or "strain") that is experienced. Two types of fit are generally specified: (a) that between outcomes provided by the job and the needs, motives, or preferences of the individ-

ual, and (b) that between the demands and requirements of the job and the skills and abilities of the worker. Although French and his colleagues have distinguished these two versions of fit at a conceptual level, subsequent empirical work with P-E fit has not operationally discriminated between the types. Tests of the model in the work stress literature have related measures of misfit (both types), usually consisting of deviation scores, to various measures of physiological and psychological strain. The most extensive examination of the model was made in the University of Michigan study of 23 occupations (Caplan et al., 1975), where fit scores were often found to be better predictors of strain outcomes than the P or E components. Harrison's (1985) summary of P-E fit research reaches an overall positive assessment of the model.

The heuristic value of the model has been somewhat limited, however. The utility of the theory lies in its specification of the process whereby occupational experiences become stressful and not in delineating the specific work characteristics that are expected to be important. Consequently, researchers using this approach have generally referred to the same small set of dimensions on which to assess fit. The largest study (Caplan et al., 1975) measured eight. In addition, tests of the theory have been beset by a number of difficult methodological problems, not the least of which has been the almost total reliance on subjective report as the basis for measuring the fit components. Edwards and Cooper (1990), though not rejecting the potential utility of P-E fit theories, provide a probing examination of the methodological and conceptual shortcomings that have plagued this literature. In essence, they demonstrate that (a) theorists have not properly specified their models in terms of relating the two types of fit to the appropriate outcomes, (b) investigators have not adequately distinguished between the various mathematical forms of fit (discrepancy, interactive, and proportional), (c) inappropriate measures have been used for the P and E components (in addition to the general limitations imposed by a self-report approach), and (d) researchers often employed inappropriate statistical models to assess the relationship between P-E fit and stress outcomes. Perhaps for these reasons, P-E fit theory, which was so prominent in the 1970's, was no longer the dominant influence in the work stress literature of the 1980's.

The Job Demands-Job Decision Latitude Model.

As interest in the process model of P-E fit seemed to wane in the late 1970's, a content model began to capture the attention of job stress theorists. Known variously as the job demands-job decision latitude model, the decision latitude model, or the demands-control model (Karasek, 1979), it has provided the underlying theoretical basis for most large-scale studies of job stress conducted in the last 10 years. In its basic form, the model specifies two broad constructs that can vary independently in the work environment. Job *demands* are defined as psychological stressors, such as requirements for working fast and hard, having a great deal to do, not having enough time, and having conflicting demands. It must be stressed that these are psychological demands and not physical ones. Thus a fast and hectic workpace may impose physical requirements that lead to fatigue, but the stress-related outcomes predicted by the model are related to the psychological

effects of this workload (e.g., the anxiety associated with the need to maintain the workpace and the associated consequences of failing to complete the work). Job *decision latitude* comprises two components: the worker's authority to make decisions on the job (decision authority), and the variety of skills used by the worker on the job (skill discretion). Operationally these two components are combined into one measure of decision latitude, or control.

The first major hypothesis of the model is that strain, which is a stressful condition that leads to mental and physical health problems, occurs when jobs are simultaneously high in demands and low in control. This hypothesis rests on the reasoning that high demands produce a state of arousal in the worker that would normally be reflected in such responses as heart rate or adrenaline excretion. When there is a constraint on the responses of the worker, as would occur under conditions of low control, the arousal cannot be appropriately channelled into a coping response and thus produces an even larger physiological reaction that persists for a longer time. The second hypothesis is that positive outcomes (motivation, learning and healthful regeneration) occur when an individual occupies an "active" job: that is, one that has both a high level of psychological demands and a high level of control. Karasek (1989) alludes to new theoretical developments in the model that involve the reciprocal effects of learning and stress and that serve to make the model a more dynamic description of the process of the person-environment interaction. However, these developments are not yet widely disseminated, and the empirical focus has been on the investigation of the joint effects of demands and control on health outcomes. The demands-control model almost completely dominates the occupational epidemiology literature concerned with work stress (Kristensen, 1989), but stress researchers in the organizational sciences have only recently begun to be influenced by it.

Although there seems to be a growing consensus that worker control is important for health and well-being (Sauter et al., 1989) and that the demands-control model provides a useful vehicle for studying control, two broad criticisms of the model remain. First, job decision latitude (control) combines a number of theoretically distinct constructs and these are apparent in the operationalizations of researchers. For example, control measures have included such diverse indicators as dealing with customers and the public (Haynes, LaCroix, & Lippin, 1987), repetitious/monotonous work (Haynes et al., 1987; Karasek, 1979), educational requirements of the job (Karasek, 1979), skill utilization (Sauter, 1989), and possibilities for ongoing education as part of the job (Johnson & Hall, 1988). Such a broad inclusion threatens to make the control construct virtually indistinguishable from the more traditional conceptualization of stress as the imbalance between individual capabilities and environmental demands. Kasl (1989) and Sauter and Hurrell (1989) question what has been learned theoretically or practically by the model if control remains such a broadly conceived construct.

Second, it is not always clear what is meant by the "joint effects" of demands and control. Karasek's (1979; 1989) discussion of the construct clearly reflects an interactive meaning, but how this translates into a statistical modelling of the interaction has been debated (Ganster & Fusilier, 1989; Kasl, 1989). These critics have concluded that the epidemiological evidence seems to support mostly an ad-

ditive model of demands and control rather than an interactive one. Karasek (1989) has countered that the interaction formulation endorsed by the critics is too restrictive, and that, indeed, job demands will have a different impact depending on the decision latitude of the worker. Researchers have yet to explore other statistical models, such as those suggested by Bobko (1986) that use *a priori* contrasts to capture interaction effects.

Tests of the model have been of two types. The most extensive efforts and generally the ones most supportive of the model have been large-scale epidemiological analyses that rely on occupational-level assessments of the independent variables (demands and control). These have been both cross-sectional and longitudinal studies. The other methodology consists of cross-sectional studies that relate, at the individual level of analysis, self-reports of demands and control to various stress-related outcomes. The epidemiological studies focus on coronary heart disease and associated risk factors (e.g. blood pressure), whereas the self-report studies generally focus on self-reported disorders (usually of an affective nature). Lately, a few of the individual-level studies have used either physiological outcomes such as catecholamine excretion (Ganster & Mayes, 1988) or behaviorally based outcomes such as sick days (Dwyer & Ganster, in press).

Overall, support for an interactive demands-control model is mixed. The early studies (Alfredsson, 1985; Alfredsson, Karasek, & Theorell, 1982; Karasek, 1979; Karasek, Baker, Marxer, Ahlbom, & Theorell, 1981; Theorell, Alfredsson, Knox, Perski, Svensson, & Waller, 1984) were generally reported to be supportive of the model, but, on closer examination, this evidence is difficult to interpret. First, there is little evidence of a statistical interaction between demands and control variables that fits the predictions of the model. Second, a variety of other confounding factors, including both individual risk factors and other job characteristics such as physical exertion, potentially come into play in explaining the results of any given study. In addition, some of the later studies have failed to find any supportive results (Pieper, LaCroix, & Karasek, 1989; Reed, LaCroix, Karasek, Miller, & MacLean, 1989) As a whole, then, the large-scale occupation-based studies using diagnosis of coronary disease or associated risk factors as criteria fail to provide convincing support for the model.

The evidence from the individual-level studies is also mixed. Landsbergis (1988) found support for the interactive model for a sample of 289 health care workers for predicting self-reported affective outcomes. Using a 1-year longitudinal design, Bromet, Dew, Parkinson, and Schulberg (1988) reported limited support for an interaction between demands and control in predicting a self-report measure of alcohol problems. Other investigators using self-report measures of affective outcomes (e.g., job satisfaction, depression, anxiety, somatic complaints) have failed to support the interactive model (Ganster & Mayes, 1988; Hurrell & McLaney, 1989; Payne & Fletcher, 1983; Spector, 1987; Tetrick & LaRocco, 1987). A laboratory experiment reported by Perrewe and Ganster (1989) found no interactions between manipulated demands and control in a simulated letter-sorting task on physiological outcomes, and only partial support for affective outcomes. However, Ganster and Mayes (1988) found that the model predicted intentions to quit and adrenaline excretion on the job for a sample of

306 white and blue collar workers. Dwyer and Ganster (in press) report the only study to investigate the interaction between objective demands (as assessed by job analysis) and perceived control on an objective outcome (sick days) and found that demands were associated with sick days only under conditions of low perceived control, thus supporting the model. Finally, Schnall, Pieper, Schwartz, Karasek, Schlussel, Devereux, Ganau, Alderman, Warren, and Pickering (1990) showed that individual reports of job demands and decision latitude were predictive of diastolic blood pressure and structural changes in the heart in a case-control analysis. The investigators controlled for an extensive list of confounding factors, but their statistical analyses were not done in a way to demonstrate that the effects of demands and control were interactive rather than additive.

The job demands-job decision latitude model, despite its lack of clear empirical support, will likely continue to exert a major influence on the field of occupational stress. A variety of methodological limitations have been discussed by reviewers of the model (Ganster, 1989; Kasl, 1989) as potential alternative explanations for supportive findings. However, many of these methodological issues might have also conspired against the theory. For example, just as ecological correlations (from the occupation-level studies) can lead to spurious inferences about the effects of individual-level variables, so can they also mask true effects. Aggregating individual responses to the occupation level is a very crude procedure that eliminates a great deal of true variability that exists within occupations, thus making it very difficult to detect effects. Similarly, imprecision in the operationalization of the job decision latitude construct can mask real effects by incorporating non-relevant dimensions and neglecting relevant ones. Several authors have also suggested typologies that might lend more precision to the measurement of the control construct (Fisher, 1985; Ganster, 1988; McLaney & Hurrell, 1988).

The demands-control model of job stress should provide an appealing theoretical basis for organizational stress researchers. First, it has a natural kinship with other organizational theories, particularly in the area of task design, with its concern for worker autonomy and use of skills. Second, the central proposition of the theory draws support from much basic experimental evidence in psychology that demonstrates the importance of personal control in explaining reactions to stress (Averill, 1973; Miller, 1979; Seligman, 1975). Third, the theoretical mediation process involving chronic neuroendocrine and cardiovascular over-arousal is a plausible explanation for the development of morbidity. Finally, the theory suggests a practical approach toward alleviating the detrimental effects of job demands that is not predicted to reduce productivity. In fact, the theory predicts that interventions increasing worker decision latitude can increase productivity through the enhanced learning and motivation that is expected to follow. Thus, despite the lack of uniform empirical support for the model, we recommend that organizational researchers continue to devise better tests of it.

Does Job Stress Cause Mental and Physical Ill Health?

In attempting to summarize and evaluate the available evidence pertaining to this question, we are forced to be highly selective in choosing the studies to review. There are several ways that this question can be approached, depending on

the definitional perspective one adopts concerning the stress concept. Two of the ways that stress has been treated are (a) an environmental stimulus that initiates a chain of responses that ultimately leads to pathological ends, or (b) an organismic response to real or imagined environmental events. Few would dismiss the important role that cognitive appraisals play in determining affective and physiological responses, and few would deny that there are important individual variations in the way that people respond to the same event. It is important to understand the cognitive processes that intervene between exposure to environmental conditions and eventual health outcomes to arrive at an understanding of the phenomenology of the stress experience. However, we would argue that as organizational scientists we should focus our attention on the objective working conditions that trigger this process. Linking health outcomes, or at least their plausible short-term precursors, to objective characteristics of the environment allows us to determine whether it is the job exposures themselves that are important for well-being or whether it is the predispositions that people bring with them to the workplace, including prior health status, that account for health. In addition, if we attempt to make work environments more healthful, we ultimately must intervene at the objective level. For these reasons we will concentrate our review on those studies that have some objective indicator of the work environment and a relatively objective indicator of worker well-being. For the majority of studies that consist of subjective reports for both stressors and outcomes, we will provide only a broad summary.

Studies at the Occupational-level of Analysis

We will limit our review of occupational-level studies to those examining variation in occupations or jobs and its relation to mortality rates, morbidity, and other health-related outcomes. We will not review occupational comparisons examining variation in physical hazards (e.g., carcinogens, noise) even though such physical hazards may be potential interpretations of occupational differences in certain health outcomes. Our purpose is to examine the evidence most suggestive of pathogenic characteristics attributed to the task environment, most notably psychologic factors and behavioral task demands (or psychosocial stressors).

Occupational variation tends to be measured in either of two ways. One approach uses fairly objective occupational classifications (e.g., retail salesperson) and relates these to aggregate health data. Normally these data have been compiled by responsible government agencies into registries. Variations in this approach include the imputation of finer-grained job classifications to job titles within occupational categories and the use of occupational coding schemes (e.g., the stress temperament code from the Dictionary of Occupational Titles, U.S. Department of Labor, 1977; Adelman, 1987). These various codes or classifications may be related to health outcomes as independent variables in statistical analyses or else the occupational differences are inspected casually. This approach obviously lacks subtlety because reliable within-job or within-occupational variation in relevant environmental characteristics is ignored and, consequently, meaningful human processes that may explain links between putative causal characteristics cannot be examined. A second major approach is to collect measures of work

perceptions on standardized self-report instruments and then either aggregate these to occupational status (as in much of the work of Karasek and his colleagues) or else examine the individual-level variation in conjunction with objective occupational classifications (e.g., House, Strecher, Metzner, & Robbins, 1986). Although aggregation also removes conceivably important individual-level variation, it may add richness insofar as the data are measured, as perceived by the incumbents themselves, as contrasted with imputations provided by external observers who may not fully understand the work process.

Most of the occupational research is conducted by epidemiologists having an interest in identifying population risk factors or populations that are most under risk. Although acknowledging some of its limitations, these researchers take the Durkheimian perspective that the broader social system is an appropriate level for some areas of epidemiological inference. Indeed, this perspective would be suitable if occupational groups were homogeneous in pathogenic work characteristics.

Kasl (1984) has noted that occupations roughly equivalent in terms of physical environment and social status often have widely divergent morbidity and mortality rates. For example, professors and others in the teaching fields have mortality rates for arteriosclerotic heart disease that are about one-half the rates of physicians, lawyers, pharmacists, and insurance agents. General practitioners also have much higher disease-related mortality than specialty fields within the medical profession. Kasl (1978) noted that suicide rates for refracting opthamologists are roughly 10 times the rates found among optometrists. The work in these two professions is very similar; the only obvious difference is the higher level of education among the opthamologists. Although little is known about different indicators of social class and how these explain occupational health differences, the healthier physical status found among those high on certain social class indicators, presumed to be caused by healthier lifestyles and better access to health care, is the general justification for using social class as a control variable. Hence in this case, using education as a social class variable per se does not explain the relative *unhealthfulness* of the opthamologists and may demand a closer look at task differences and how these are perceived.

Similar counter-intuitive occupational differences have been reported more recently. Examining 180,000 California deaths, Beaumont and Singleton (1990) reported that female secretaries and typists had a very high risk of breast cancer relative to the risks expected for their demographic distribution, whereas women involved in retail sales and bookkeeping were at very low risk. Melius, Sestito, and Seligman (1989) also observed a proportional mortality rate for colon cancer that was five times the expected value among New York mathematical and computer scientists, and bone and skin cancer risk was four times the expected value among secondary school teachers. Generally, however, psychosocial factors receive the attention of oncologists only in the case of breast cancer. By way of explanation, Brownson, Reif, Chang, and Da (1990), in finding very high relative risk of brain cancer among white collar professionals, interpreted the evidence as a higher propensity of persons in particular professions, particularly professions requiring more education, to seek diagnostic treatment and become classified as

cancer cases. In the case of liver cirrhosis caused by alcoholism, for example, Slattery, Alderson, and Bryant (1986) observed several lower class occupations in which unexpectedly high cirrhosis death rates were associated with very low rates of admission for psychiatric treatment relative to other occupations. However, though the Brownsen et al. interpretation seems plausible in explaining broad occupational differences (e.g., white collar versus blue collar), it is difficult to imagine cultures within several of the higher risk occupations, especially those requiring graduate education, as being more averse to seeking health care.

Less confounding of lifestyle and social status may be found in studies comparing occupations within fairly homogeneous economic sectors. Hoiberg (1982) examined the health status of over 184,000 male employees of the U.S. Navy across a period of three decades. Major occupational differences in alcoholism, mental disorders, hypertension, heart disease, ulcers, and diabetes were observed overall, and casual inspection of the morbidity rates across intuitively similar status occupations revealed some major disparities.

A few studies testing specific hypotheses regarding occupational differences have lead to interesting and possibly more definitive conclusions than the exploratory surveys described above. In examining the mortality rates of 324,822 British men in 556 occupations, Fletcher (1988) observed sizable differences in mortality rates across occupations within five levels of social status (social status was not defined). Wives' mortality correlated with the occupational risk of the husbands, even after controlling for reported morbidity. Moreover, single women in the same occupations did not share the occupational risks of the married men. Fletcher speculated that some work-leisure spillover effect was occurring in the marital relationships. The social class control provides some basis to rule out the alternative interpretation that spouses shared similar health habits and access to medical care, and the major mortality differences between similar occupations within social class categories contradicts a self-selection by social class interpretation.

Alston (1986) studied 623 adult female suicides in four U.S. states. Contrary to Durkheim's theory that women in occupations that are not traditional for their gender would be at higher risk for suicide, women in more traditional occupations (excluding homemaking) were found to have significantly higher rates. Hence as some of the occupational evidence merely contradicts implicit theories of the relative stressfulness of particular occupations, confirmatory investigations have also debunked long standing sociological theories. Occupational comparisons also show promise in confirmatory investigations of characteristics that can reasonably be regarded as homogeneous attributes of particular occupations. In a study of 1206 pregnant Connecticut women, Teitelman, Welch, Hellenbrand, and Bracken (1990) confirmed that the proportional hazard rate for pre-term birth was significantly higher for workers classified in occupations requiring prolonged standing in place (e.g., sales clerk) than among "sedentary" (e.g., typist) or "active" (e.g., registered nurse) occupations. Such explicit hypotheses regarding plausible occupational differences are, unfortunately, exceptions in the occupational stress literature, however.

Although the occupational literature provides some suggestive data and occa-

sionally identifies targets for increased epidemiological scrutiny, inferences regarding work characteristics nearly always rest on potential ecological fallacies, particularly given the very limited number of alternative interpretations that can be ruled out using the data contained in the registries. Moreover, the overall evidence for a relationship between work characteristics provided by this literature is not encouraging. Reed, LaCroix, Karasek, Miller, and MacLean (1989) found no relationship between job characteristics imputed to occupational classifications and coronary heart disease incidence among 8000 male Hawaiian workers in an 18-year prospective study. A unique characteristic of this study was that the men selected for the analyses had remained in the same occupation for the entire duration of the study. Morbidity and mortality rates are usually analyzed in relation to "last" occupations, which often compose a very short portion of the worklife of the individual. Their last occupation might also reflect a selection process that is precipitated by a medical disorder. For example, it may be more sedentary in nature than prior occupations in order to accomodate a disability (Hernberg, 1986). Moreover, government registries frequently misclassify occupations, morbidity classifications, and causes of death (Melius, Sestito, & Seligman, 1989). The Reed et al. (1989) investigation did not appear to suffer these limitations.

House (1980) reported no effects of objective job characteristics imputed to the Caplan et al. (1975) physiological sample of factory workers on psychological strain or cardiovascular or respiratory morbidity outcomes. Only two perceived demands, both relating to responsibility, were correlated significantly with the physiological outcomes, but on average they accounted for less than one percent of the variance. It should be noted, however, that Position Analysis Questionnaire (PAQ) characteristics imputed to jobs within a subsample of these data by Shaw and Riskind (1983) were quite sizably correlated with a range of morbidity outcomes. Pieper, LaCroix, and Karasek (1989) imputed job characteristics to occupations listed in four major national studies of heart disease. There was no reliable evidence of risks posed by psychologic demands. The sheer breadth of these investigations and the quality of their imputation strategies and statistical analyses set them apart from many of the more suggestive studies discussed above.

There are also frequent failures to replicate occupational disparities across time and geographic locations in the better prospective studies. For example, though female clerical workers were shown to be at an unexpectedly high risk for cardiovascular disease in the Framingham study (Haynes & Feinleib, 1980), a probability sample of nearly 2000 female residents of a single county in California found no unexpectedly high mortality rates among female clerical workers followed over an extended period of time (Kotler & Wingard, 1989). Two major differences between these studies were the greater geographic heterogeneity of the Framingham study and its earlier historical period of data collection. Although such threats to external validity also exist for other kinds of work stress studies, they would seem to be more pertinent as the level of analysis increases.

Several large-scale prospective studies have found morbidity or mortality rates at the level of individual perceptions without any corresponding effects at the occupation level. A major example is the Tecumseh Community Health Study in which House et al. (1986) observed sizable relationships between conventional

job stressor instruments in morbidity-related death rates, but occupational classifications were unrevealing. This is not to suggest that occupation level variables are always inferior to perceived job characteristics as predictors. For example, in a multivariate study of all Finnish prison employees that controlled for social status, Kalimo (1986) observed no relationship between conventional perceived demands and cardiovascular risks posed by serum cholesterol and blood pressure levels, whereas occupational differences were strongly predictive. Those positions in close contact with prisoners were more at risk. In a study of Australian government employees reported by Frommer, Edye, Mandryck, Grammeno, Berry, and Ferguson (1986), age-adjusted occupational differences were sizably related to systolic blood pressure (SBP), as were a number of perceived job demands. The perceived job demands could not explain the occupational differences in SBP, however. In these studies there may have been pathogenic characteristics of the work environment that were not identifiable in advance as potential job stressors. Nevertheless, these latter studies are more indicative of the very limited conceptual schemas used to represent stressors at the individual level than they are encouraging of the use of occupation-level inference.

On the whole, weak results are so common and alternative interpretations of significant findings so pervasive that it is not possible to glean conclusions concerning the etiological role of work stressors from the occupational literature. Social status alone may explain away several of the more encouraging findings. In a cross-sectional study of British male civil servants, Marmot, Shipley, and Rose (1984) observed a linear negative relationship between occupation level within the civil service and mortality rates associated with all 10 disease factors they evaluated. These gradients were consistent across smokers and non-smokers and levels of obesity, blood pressure, and blood sugar. Type A personality, a characteristic implicated in cardiovascular disorders, was positively related to occupation level, as is commonly found in other studies. Moreover, the social class differences were observed even among men working in the same offices. Because social class is a multidimensional construct and little is known regarding the dimensions of it that are most relevant to occupational stress differences, it is likely that several of the social class proxies obtained from registeries and used as controls in comparing occupations are deficient.

As noted by Kasl (1978, 1984), fine-grained occupational distinctions may also mask subtle selection effects. For example, he speculated that a health-related personality difference may have caused some highly educated opthamologists to choose refracting opthamology, a profession very similar to the apparently "healthier" field of optometry, because it was less demanding than other fields of opthamology. In addition, different occupational selection requirements regarding the health of applicants, occupation-specific personal norms for health cognizance, or undiscovered physical hazards provide viable alternative interpretations in most studies. Notwithstanding the validity of these inferential threats, the simple fact is that we cannot rule them out using the occupational data. Provided one could establish internal validity of causal inference, the occupational constructs are not revealing of the pathogenic character of work. Several suggestions have been put forward toward improved conceptualization of occupational char-

acteristics (see House, 1987). Nevertheless, the evidence accumulated since Kasl's (1978) review should do nothing to dampen his discouragement toward this approach to work stress research.

Studies Using Self-reports for Stressors and Outcomes

There are hundreds of studies that obtain measures of perceived workplace stressors such as role conflict and ambiguity, overload, lack of control, boredom, repetitiveness, and so forth, and that evaluate their correlation with self-reported outcomes such as job satisfaction, depression, and somatic complaints (headaches, sleep problems, stomach upset, etc.). To meta-analyze this whole literature would be a daunting task and one probably not worth the effort. However, at least two meta-analyses have examined subsets of the literature. Jackson and Schuler's (1985) meta-analysis of the role conflcit and ambiguity literature assessed the degree of relationship between these constructs and a wide range of attitudinal and behavioral outcomes. One class of outcome measures, "tension/anxiety," comes closest to representing indicators of a stress response. For this class of outcomes the average correlation across 43 studies with a cumulative sample size of 7570 was .30. When corrected for the low reliability of measures and range restriction, the "true" correlation between role ambiguity and tension/anxiety was estimated at .47. For role conflict, the average correlation across 23 studies and 4035 subjects was .28 (.43 when corrected). Brief and Atieh (1987), however, noted that the outcome measure here refers mostly to job-related tension and anxiety and that "it is not safe to assume that these job-related measures adequately capture how workers assess their well-being *in life*." (116). Spector's (1986) meta-analysis evaluated the relationships between several control-related variables and physical and emotional distress. Employee reports of "control" (using either autonomy or participation measures) produced corrected correlations of -.34 with self-reported physical symptoms and -.32 with emotional distress. Reviewers (e.g., Kasl, 1986) have enumerated several reasons (e.g., methods variance and a frequently large conceptual overlap between independent and dependent variable measures) why such correlations probably overstate the true effects of the alleged stressors. Overall, these studies, as a group, fail to provide convincing evidence that role stresses cause mental and physical health problems.

There are compelling reasons why stress researchers cannot continue to rely on subjective reports of the work environment as their sole indication of exposure to workplace stressors. The worst cases fall into what Kasl (1978) termed "a self-serving methodological trap that has tended to trivialize a good deal of the research on work stress" (13). In these instances, measures of the workplace stressors (e.g., "To what extent do conflicting demands from different people at work cause stress on your job?") contain so much conceptual overlap with the outcome measures (e.g., "How much stress-related tension do you experience on your job?") that their correlation reveals little of theoretical or practical significance. Correlations between subjective reports of stressors and self-reported health outcomes might also reflect nothing more than the influence of some third variable. One dispositional variable, Negative Affectivity, has been receiving attention in this regard, and we discuss it later in this review. Common method variance and

consistency effects are also frequently cited as sources of spurious correlations between self-reported variables. Finally, the existence of a mental or physical disorder can influence the perception or reporting of the work environment, either as a direct effect of the disorder or indirectly through a process of attribution (Kasl, 1986:60).

Spector, Dwyer, and Jex (1988) recently assessed the convergent and discriminant validity of eight self-reported job stressors by comparing ratings of job incumbents and their supervisors. They found reasonable convergence for reports of autonomy, workload, job satisfaction, reports of number of hours worked, and number of people worked for, but low validities for role ambiguity, constraints on performance or goal attainment, and interpersonal conflict. Even for measures with good convergence, however, smaller correlations were found between supervisor reports of the stressors and self-reported symptoms than between subordinate reports and symptoms. Although these data might provide some encouragement that different observers can rate some job stressors similarly, they cannot discount consistency effects in observed correlations or causal effects of outcomes on stressor perceptions.

The debate about the appropriateness of subjective assessments of self-reported job stressors is sometimes cast as a theoretical issue concerning the nature of stress itself (Dohrenwend & Shrout, 1985; Lazarus, DeLongis, Folkman, & Gruen, 1985). The cognitive appraisal model of stress (Lazarus & Folkman, 1984) emphasizes the important role of perception as the critical mediating process between environmental demands and outcomes. This view asserts that psychosocial demands do not act as stressors (in terms of their effects on health) unless they are appraised as such. Even to the extent that this position is valid, we still need to focus on the objective conditions that give rise to the appraisals and learn what accounts for the linkage or lack of linkage between these factors. This objective-perceived stressor linkage remains a much neglected issue, but a recent study by Kirmeyer (1988) provides a good example of how this issue might be attacked. Kirmeyer devised an observational recording system whereby she could obtain objective assessments of the workload of police dispatchers. Observers recorded the activities of 72 officers for one or more shifts and produced quantitative measures of the volume of objective workload as well as interruptions and competing demands. Workload scores derived by the observers explained 38% of the variance in officers' subjective reports of work overload. A measure of the Type A behavior pattern explained an additional 5% of the variance in subjective reports. Unfortunately, because there were no measures of stress-related outcomes, except for a coping measure, the link between objective exposures and health outcomes could not be estimated.

Studies Using Self-reported Stressors and Objective Outcomes

A methodological improvement over total dependence on self-report data is to at least obtain outcome measures of a more objective nature. Increasingly, this is being accomplished by taking physiological measurements that are interpreted either as indicators of stress-based arousal or as precursors to disease. Some recent examples of this approach come from the organizational literature.

Frew and Bruning (1987) obtained questionnaire assessments of perceived work factors (role conflict and role clarity, and job design characteristics) from 62 managerial and supervisory personnel as well as casual measures of blood pressure, heart rate, and galvanic skin response. The self-reported job factors generally failed to correlate with the physiological outcomes (but did correlate with an anxiety measure). Steffy and Jones (1988) surveyed 65 clerical workers about sources of work stress (essentially role conflict and ambiguity), job dissatisfaction, and stressful life events. Their set of physiological measures included blood pressure, serum cholesterol, triglyceride serum level, and uric acid level, and these failed to correlate with the perceived stressors. These cross-sectional studies from the organizational literature tend to confirm the general pattern of findings reported elsewhere (e.g., Caplan, Cobb, French, Harrison, & Pinneau, 1975; Chesney et al., 1981; Haynes et al., 1978; Shirom et al., 1973). A recent exception to this trend, however, was reported by Matthews, Cottington, Talbott, Kuller, and Siegel (1987). They found that self-reports of job dissatisfaction, lack of participation, uncertain job future, unsupportive supervisor, unsupportive coworkers, and difficulty of communication correlated significantly with diastolic blood pressure for 241 blue-collar factory workers.

Overall, studies in this category have not reported a consistent pattern of relationships among self-reports of stressors and physiological indicators of stress. The few positive findings (e.g., Matthews et al., 1987) seem to come from the studies that have more elaborate controls on potential confounding variables and more standardized physiological assessment protocols. For example, Matthews et al. obtained six measures of diastolic blood pressure measured by two different nurses for each subject. Care was taken to provide an adequate rest period before assessment and the procedure was highly standardized. Moreover, statistical analyses controlled for age, alcohol consumption, smoking, body mass index, family history of hypertension, and severe noise-induced hearing loss. Finally, individuals were screened who had received medication for diagnosed hypertension. All of these procedures serve to enhance the reliability of the physiological assessments and increase the likelihood of revealing significant associations when they exist in the population.

Studies Using Objective Assessments of Job Stressors

A number of investigators have attempted to link objective operationalizations of work demands to either subjective or objective indicators of a stress response, health outcomes, or behavioral responses. These studies fall into several categories based on their research strategy, and we will describe selected examples to illustrate the various approaches.

One design strategy that has been used with some success can be described as a within-subject naturally occurring quasi-experiment. The procedure here is to pick up a cohort of individuals before they encounter some particular work stressor and assess them repeatedly before, during, and after the exposure. The study of tax accountants by Friedman, Rosenman, and Carroll (1958) is a classic example of this approach. There are numerous other examples of this general method. For example, paramedics have been observed to excrete higher levels of

adrenaline on days that they work compared to off-work days (Dutton, Smokensky, Leach, Lorimor, & Hsi, 1978). Similarly, Frankenhaeuser (1979) found that men showed increases in adrenaline levels (in the evening) as the number of overtime days they worked increased.

A variant of this within-subject design is the naturally occurring experiment where the investigator can capitalize on the occurrence of some major event in the subjects' worklives. The advantage of these studies is that they can focus on specific events that are perceived as major disruptions or challenges and thus are expected to be stressful. Caplan and Jones (1975) measured both subjective perceptions of stressors (workload and ambiguity) as well as subjective (anxiety and depression) and objective (heart rate) indicators of strain for a sample of 73 computer users at two times: in anticipation of a major shutdown of the campus computer and 5 months afterward. They found that strain responses declined from the presumably stressful pre-shutdown period to the later period. However, corresponding changes in the subjective reports of workload and ambiguity did not appear, thus obfuscating the interpretation of the outcome data. The fact that the two measurement periods corresponded to seasonal (spring and fall) and semester changes made "history" threats to internal validity more plausible (Cook & Campbell, 1979). Eden (1982) improved on this design by observing student nurses as they progressed through two "critical job events" (CJEs): their first comprehensive patient care and their final exam in nursing. He found a consistent pattern of rising and falling indicators of strain (including anxiety, blood pressure, heart rate, and serum uric acid) that corresponded as predicted to the high and low stress periods. Eden (1990) extended his prior study by observing the responses of 29 university computer users at four times: (a) just prior to a computer shutdown that would cause a marked increase in workload, (b) during the subsequent vacation period, (c) at the reopening of the computer when subjects faced an acute backlog of work, and (d) about a month later during a more routine period of their job. Planned comparisons between the two CJEs and the routine work period showed significant differences for subjective ratings of work overload, self-reported psychological strain, and blood pressure and heart rate. Work versus vacation contrasts were significant for subjective workload but generally not for psychological or physiological strain.

Parkes (1982) also examined relatively short-term effects of work demands on the affective (depression, anxiety, social dysfunction, work satisfaction) and sickness absence responses of a group of student nurses. Parkes randomly assigned the nurses to either surgical or medical wards and to wards with mostly male or female patients. The nurses rotated through the different wards, so Parkes could assess within-subject differences across the wards. She found that changes in objective demands (measured by number of admissions) correlated with perceived demand, but were *negatively* correlated with social dsyfunction and sickness. There was a significant ward effect on the affective measures that appeared to be mediated by perceived levels of personal discretion. There was no ward effect on sickness-related absence.

As a group these studies provide a fairly believable picture that individuals respond affectively and physiologically to periods of acute high workload or events

in which performance is critical. It is not entirely clear, however, what the implications are of these short-term responses for the etiology of disease. One of the most comprehensive studies in this within-subject framework is the 5-year study of air traffic controllers (ATCs) (Rose, Jenkins, Hurst, Herd, & Hall, 1982; Rose, Jenkins, Hurst, Kreger, & Hall, 1982; Rose, Jenkins, Hurst, Livingston, Barrett, & Hall, 1982). This study is particularly important because of its comprehensiveness in operationalizing objective work demands, subjective appraisals of demands and job attitudes, physiological indicators of strain, and changes in physical and mental health. Over 200 male ATCs had blood samples drawn every 20 minutes for 5 hours on 3 or more days over a 3-year period, and these could be compared to objective and subjective assessments of workload. Rose (1987) recently summarized this work and noted the following results. First, there was only a slight increase in neuroendocrine response (cortisol) corresponding to increases in objectively and subjectively measured workload. Second, those men who were high cortisol responders were subsequently *less* ill, were *more* satisfied with their jobs, and were described by their peers as *more* competent. Rose concluded that the high cortisol responders were more engaged and challenged by their work. Rather than reflecting a state of distress, this might more accurately reflect a healthy functional state of physiological arousal, or *eustress*.

Also fitting in this category of studies that evaluate objective job stressors are those that experimentally manipulate work characteristics. As might be expected, most of this research has been completed in the laboratory, but there are examples of field experiments as well. Examples of the former type include short-term manipulations of work overload and underload (e.g., Frankenhaeuser & Gardell, 1976; Perrewe & Ganster, 1988; Sales, 1969) and machine-pacing versus self-pacing of work (Johansson, 1981). From such studies it seems reasonable to conclude that laboratory-induced psychological demands can produce physiological as well as affective responses. The major limitation with this strategy is that we cannot estimate what the long-term effects of such exposures are. It is tempting to assume that chronic exposures to conditions such as high workload or forced-pacing would produce a cumulative effect over time that would lead to deterioration in health or performance. But there is little evidence that demonstrates that such generalization over time is warranted. In many cases situations initially characterized by novelty and threat evoke a strong neuroendocrine response at first, but responsivity diminishes over repeated exposures (Rose, 1987).

Field experiments have the advantage of testing the effects of exposure to demands that are much more potent than those that can be manipulated in the laboratory, and they often have a longer duration. An excellent example of a field experiment that focused on one specific stressor and carefully controlled other confounds is the study by Timio and Gentili (1976). They manipulated the payment methods for 16 confectioners in a repeated measures design. Half the workers started on a piece rate payment schedule, then cycled to a daily pay schedule, and then cycled back to a piece rate schedule, with each cycle lasting for 4 days. The other half of the sample performed under a daily pay/piece rate/daily pay sequence. Cumulative daily measures of adrenaline, noradrenaline, and 11-hydroxycorticosteroids showed a very large effect for the piece rate payment method,

with levels of adrenaline, for example, being two to three times higher when working on piece rate. Timio and Gentili (1976) noted that the exertion levels of the workers were identical during each phase of the study, leading them to conclude that the effects reflected a "corresponding augmentation in stress and distress" (264). An experiment by Timio, Gentili, and Pede (1979) also showed that neuroendocrine responses are affected by working on an assembly line. But assembly line work entails a number of characteristics (e.g., forced pacing, repetitiveness, monotony, lack of social interaction), making it harder to pinpoint the exact nature of the stressor than in the Timio and Gentili (1976) experiment. Jackson (1983) tested the effects of participation in decision making by assigning employees of a hospital outpatient facility either to a participation or no-intervention control group. Self-report measures confirmed that employees in the participation condition experienced a greater amount of control over work-related matters. The intervention produced lower levels of self-reported emotional strain at a 6-month posttest and a 9-month follow-up.

Field experimental studies are still uncommon but the few that have been reported indicate that certain work characteristics (especially piece rate pay) can produce significant changes in physiological measures of stress. Whether such effects as increased excretion rate of catecholamines (e.g, Timio & Gentili, 1976) have a significant long-term effect on health is less established.

Individual Differences and Other Potential Moderators of Job Stress

Job stress researchers have studied individual differences in the belief that they influence reactions to objectively stressful events or appraisals of events as being stressful, or they simply add to the variance explained in the stress outcome. The earlier job stress reviews examined few studies demonstrating meaningful relationships between personality variables and stress symptoms on the job. However, the introduction of new constructs (e.g., hardiness) and the proliferation of research on old ones (e.g., Type A) suggests that this aspect of the literature merits critical attention.

As in other areas of organizational research (see Weiss & Adler, 1984), personality variables have been specified to affect stress outcomes in a variety of ways. First, the indirect effects of personality through stressors have been examined. This may represent an appraisal effect wherein persons with different personalities appraise the same objective event differently, or it can represent personality differences in the enactment of stressful environments. For example, in a laboratory experiment conducted by Froggatt and Cotton (1987), Type A's were found to create significantly more objective stress than Type B's by increasing the volume of workload imposed on themselves to complete a fairly simple task.

Second, personality has been studied from the perspective of "fit" with the work environment. In "discrepancy" models of fit (Edwards & Cooper, 1990), the effect size is a function of the personality variable's deviation from some ideal characteristic. Other fit investigations have examined the effects of work stress as a function of the level of the personality variable. Personality has frequently been specified as a "need" for the characteristic in this P-E fit research. Results are often disappointing despite concerted attempts to operationalize the personality

factor to suit the environmental stressor of interest. For example, Benson, Kemery, Sauser, and Tankesley (1985) failed to replicate previous research that had found role clarity (the opposite of role ambiguity) to have a stronger relationship with job satisfaction among workers high in need for clarity.

Finally, other research has examined the effect of personality in individuals' self-selection into stressful environments and direct relationships between personality and stress outcomes unique to organizational life. Our review focuses on major personality constructs that have been studied in the job stress context or that seem to have potential for contributing to this area.

Type A behavior pattern. The Type A behavior pattern (TABP) has been studied extensively by work stress researchers since it was originally implicated as a possible coronary risk factor in the Western Collaborative Group Studies (WCGS; Rosenman et al., 1964). The conceptualization of the Type A as hard driving, competitive, job involved, and hostile has led to much research examining how stressful work demands may contribute to developing Type A characteristics or else exacerbate the effects of Type A. The basic mechanism links Type A to elevated cardiovascular endpoints (e.g., blood pressure), which in turn increase the risk of cardiovascular disease. The relationship between Type A and work has been posited to take on a variety of different forms. One perspective (Zyzanski & Jenkins, 1970) suggests that Type A's select themselves into more stressful work environments. Type A workers are known to work longer hours and work more overtime, and they report higher workload, supervisory responsibilities, and role conflict (see the review by Ganster, Sime, & Mayes, 1989). However, this could also be interpreted as an A-B difference in cognitive appraisal of events as suggested by several laboratory experiments (e.g., Gastorf, 1981). In addition, as found in the Froggatt and Cotton (1987) experiment, Type A's are adept at increasing the demands required of them. The evidence from occupational comparisons also contradicts the self-selection hypothesis. In the Caplan et al. (1975) study, some of the occupations with higher proportions of Type A's had on average longer reported hours and higher reported workloads, but in contrast, several of the "Type B" occupations were evidently highly stressful (e.g., machine-paced assemblers) and showed higher average scores on somatic complaints. In view of the available evidence from occupational comparisons, the Caplan et al. (1975) findings being most informative, Kasl (1978) concluded, "as yet the available evidence for Type A does not in any clear way implicate the work environment" (21-22).

Most of the limited support for the influence of work stress on Type A comes from studies comparing female homemakers with women working outside the home (e.g., Lawler, Rixse, & Allen, 1983). In these studies, women working outside the home are much more likely to be classified as Type A's. This research rests on the assumption that homemaking is less stressful than industrial work in general, however. No study has been sufficiently designed to examine the effects of the work environment on Type A. Prospective studies that follow individuals between different job environments would be required to address the issue definitively. Nevertheless, we suspect that such a difficult investigation would not be practical given that it is also implausible in light of the occupational evidence.

The evidence does not contradict the interpretation that Type A's appraise events as being more stressful, however. If Type A's are biased toward appraising innocuous events as arousing demands, then Kasl's (1978) stance requires reconsideration. Indeed, much Type A research was conducted in the 1980's, and it indicated that appraisals of work stress have significantly higher implications for stress symptoms among Type A workers than among Type B workers (the "hyperreactivity" hypothesis). Most of this research has employed subjective role stress and control measures. Several of these studies have employed physiological measures of stress effects, and among these more critical studies there is an evident preference toward managerial samples (Chesney, Black, Chadwick, & Rosenman, 1981; Howard, Cunningham, & Rechnitzer, 1986a; Ivancevich, Matteson, & Preston, 1982).

The only major test of the hyperreactivity hypothesis using a strong objective comparison on a job stressor did not support the reactivity hypothesis. Hurrell (1985) compared postal workers on machine-paced jobs ($n = 2803$) with their coworkers on self-paced jobs ($n = 2715$) and observed no A-B differences on anxiety or depression. Ganster et al. (1989) observed interactions between occupational stressfulness as measured by the DOT stress temperament code and Type A. Type A was significantly associated with epinephrine and diastolic blood pressure in high stress occupations, whereas Type B's were inclined to higher levels of these stress indicators in low stress occupations.

Objective measures of stressors are clearly necessary to disentangle Type As' cognitive appraisal of stress from their reactions to stress. Knowledge gained from such programs could aid in the focusing of intervention programs designed to alleviate the job stress experienced by Type A's. Profitable research will probably require use of the Structured Interview (SI) method of TABP measurement because recent research attests to its superior construct validity (see the review by Ganster, Schaubroeck, Sime, & Mayes, 1991).

Work stress research may also profit from an interactionist perspective on Type A. Ganster, Schaubroeck, Sime, and Mayes (1990) found that supervisors' Type A status was positively related to the physical health symptomatology reported by subordinates who expressed a feeling of chronic irritation. The results indicated that various leader behaviors perceived by the subordinates were associated with the SI-measured TABP of supervisors, and this helped to explain the outcomes. To our knowledge, this is the only research implicating a personality variable in the ill health of other persons. Future research could be more fully interactionist and determine if Type A in general, or hostility in particular, influences the provision of social support to co-workers and the seeking or receipt of social support from them.

Hardiness and locus of control. Based on the work of Kobasa and her colleagues (e.g., Kobasa, Maddi, & Zola, 1983), a personality construct labelled "hardiness" has emerged as a factor in buffering individuals from the debilitating effects of stressful events. Hardiness is defined by the conjunction of high internal commitment, perceived personal control, and challenge seeking in daily life. Most of the studies have reported interactions between perceived job stressors and hardiness in predicting strain outcomes. For example, Kobasa et al. (1983)

observed that stressful life events were positively related to illness among less hardy male executives, but not among their hardy counterparts. Only one study has demonstrated fairly convincing job stress interactions in predicting physiological indicators, however. In a longitudinal investigation, Howard et al. (1986b) observed that hardy workers suffered smaller increases in systolic blood pressure, diastolic blood pressure, and serum triglycerides in response to increasing role ambiguity than did less hardy workers. Interestingly, both of these studies found that introducing Type A as a third term in the interaction increased the variance explained. Non-hardy Type A's experienced the most stress symptoms in these studies. Manning, Williams, and Wolfe (1988) conducted a longitudinal analysis of hardiness and its relationship to physiological outcomes, but hardiness exhibited only main effects.

Although an internal locus of control is seen as an integral aspect of the hardy personality, it has been examined in isolation from the other hardiness components in some studies of job-related stress. Much of this research has focused on the construct's conceptual link with the Karasek formulation. Despite field evidence that internals prefer work situations high in control, however, LOC does not appear to influence the stress effects of lack of control. For example, internals studied by Marino and White (1985) reported fewer psychological strains resulting from job specificity, but other control dimensions did not turn up interactions.

Fusilier, Ganster, and Mayes (1987) reasoned that internals' tendency to perceive situations as controllable would lead them to be more active in coping with role conflict. In support of their hypothesis, role conflict was found to be more strongly related to somatic complaints among externals. However, perhaps the most critical role played by LOC is in the individual's response to dissatisfying or frustrating conditions. In such studies, internals are expected to exhibit fewer maladaptive responses because of their stronger attempts to exert control. For example, Storms and Spector (1987) found that external blue collar workers were significantly more likely to respond to normal organizational frustrations with aggression, sabotage, or withdrawal.

Self-esteem. Self-esteem has frequently been viewed as an indicator of psychological health. In the organizational stress literature, for example, Adelman (1987) related a measure of occupational complexity from the DOT to reported "self-confidence," which was operationalized akin to self-esteem. As noted by Kasl (1984), this frequent inability to distinguish independent from dependent variables impedes the use of trait measures in stress research.

Other research has examined self-esteem as an independent variable having positive main effects on psychological strain. Its role in the organizational literature is formed primarily by the "plasticity hypothesis." The plasticity hypothesis posits that persons having low self-esteem (low SE's) are in general psychologically more susceptible to risks imposed by organizational events (Brockner, 1988).

Although the plasticity hypothesis has been supported in the study of feedback effects, peer group interaction, and the socialization of role taking, factors that can be seen to influence stress responses, very little research has examined plausible extensions into the effects of job and organizational stressors. Mossholder, Be-

deian, and Armenakis (1981) reported that role ambiguity was negatively related to job satisfaction among low SE nurses but not among high SE nurses. The same pattern of self-esteem's interaction with job stress in predicting satisfaction was found across a variety of perceived job stressors in a study conducted by Sekaran (1986). Ganster and Schaubroeck (in press) observed a similar pattern for the effects of role conflict on somatic complaints among firefighters. Hall's (1972) model of coping with role conflict would suggest that low SE's may respond to role conflicts with passive coping behaviors, and this passive response should make them more susceptible to stress outcomes. However, inasmuch as role stress has not been implicated in the etiology of major health symptoms (e.g., blood pressure), the suggestion that self-esteem is critical to the job stress process awaits future research using such outcome measures.

Negative affectivity. Recently, Brief and his colleagues (e.g., Brief, Burke, George, Robinson, & Webster, 1988) have proposed that trait negative affectivity (NA) is a nuisance factor that explains away the relationships between self-reported stressors and stress outcomes. NA is defined to subsume "a broad range of aversive mood states, including anger, disgust, scorn, guilt, fearfulness, and depression" (Watson & Pennebaker, 1989: 234-5). The personality constructs of trait anxiety and neuroticism are frequently used to represent NA due to their very high convergence with each other as well as with other presumed NA exemplars. Brief et al. (1988) found that significant zero-order relationships between life stress and strain were eliminated after partialling NA. Ganster, Fox, and Schaubroeck (1990) replicated this effect using a variety of conventional job stressors and a confirmatory factor analytic framework. If indeed NA explains the effects of perceived stressors on subjective strain outcomes, then this casts further doubt on the value of percept-percept stress research.

The jury is still out on this issue. At the very least, however, the charge should encourage researchers conducting such research to include an NA measure in their data collection protocols. Confirmatory factor analysis can aid in determining whether the NA variables correspond to the same measurement domains as the stressors or stress symptoms. In addition, the effects of NA may be considered in selecting instrumentation. Descriptive, positive or neutrally framed job stress items may be less susceptible to NA contamination than evaluative, negatively framed items.

In general, personality variables may be more strongly related to stress symptoms than they are to other outcomes commonly studied in organizational research (e.g., job performance, leader effectiveness). This relationship should be expected because stress disorders will be influenced by cross-situational consistency in maladaptive behavior and cognitive appraisals, notwithstanding the potency of any particular situational contingencies. Nevertheless, our review suggests that, as in other research areas (Weiss & Adler, 1984), correlations between personality measures and strain outcomes provide a very limited portrait of the role of personality in job-related stress. First, the personality measures are very imperfect and therefore the true construct effects may be obscured. Second, and more importantly, however, it is clear that personality plays a number of different roles in the etiology of job stress, particularly in relation to job stressors. Perhaps

the knowledge gained by studying personality can best be applied to indentifying the subgroups for which particular environmental demands are likely to be more stressful. Provided a clearer understanding of individual risk factors, we can evaluate the impact of interventions with more precision, and we can direct changes in the work environment that are designed to lessen stress to those who most require the changes.

Summary

Looking at the evidence as a whole, what can we conclude about the effects of workplace stress on mental and physical health? At this point we should probably rephrase the question to make it more consistent with the way we have examined the literature: To what extent do psychosocial characteristics of the workplace cause mental and physical ill-health? From a conservative perspective the following statements seem warranted:

1. There are occupational differences in mortality and morbidity that are not easily explained by the confounding effects of other risk factors. However, it is impossible to assert that there is a causal effect of occupational experiences, per se, as opposed to related effects (such as membership in a social class) and the health-related behaviors that accompany them. In addition, the occupational comparisons cannot isolate specific job characteristics that might be implicated in health.
2. Exposure to acute events that involve responsibility for others or in which successful performance has significant personal consequences can produce elevated levels of physiological responding and emotional distress. Evidence for this conclusion comes from both naturalistic studies involving repeated within-subject comparisons and field experiments. The big question here involves the long-term consequences of these acute exposures. Do people in general successfully adapt (or habituate physiologically) or do chronic exposures accumulate for increased risk of morbidity?
3. The better designed studies show a significant relationship between self-reported stressors (lack of participation, lack of social support, hectic job demands, and low decision latitude) and epidemiologically meaningful outcomes such as diastolic blood pressure. These findings suggest a chronic exposure effect. However, in addition to being cross-sectional, interpretation of these results is severely constrained by the self-report nature of the independent variables.

At this point the reader might be disappointed in the meagerness of these conclusions because they seem to suggest that this large literature has revealed little of consequence. We would attempt to temper this reaction by stating two things. First, we have applied strict standards to the evidence with the aim of reaching causal inferences. Our list of conclusions would be longer if we provided a list of "relationships" that have been reported between work characteristics and stress-related outcomes. But prior reviews have been generous in supplying such lists and the reader may consult them. Second, our list of conclusions is revealing in what is *not* there. For example, high workload does not come out as a significant stressor, in contrast to many popular conceptions. The evidence from studies

making objective assessments of workload as well as several large sample correlational studies simply do not reveal that high workload is a significant source of mental or physical health problems. Even the expanded construct of "job demands," which includes things such as "hectic pace" and "conflicting demands," does not consistently produce cross-sectional correlations with objective outcomes and sometimes does not even correlate with self-reported outcomes.

Despite the limitations of the existing data, however, the evidence as a whole is highly suggestive that work experiences play a significant role in mental and physical health. The evidence is good that certain job events and characteristics produce elevated neuroendocrine and cardiovascular responses, and there are plausible models for theorizing that over time such elevations might lead to disease. We just have not been able to make the link between exposure to the job characteristics and the development of the diseases.

A Research Agenda for the Organizational Scientist

What can the organizational researcher contribute to the job stress literature? Kasl (1986) has provided a set of methodological criteria and design guidelines for the epidemiological researcher who wants to demonstrate the effects of job stress on health. These were recently reiterated by Mackay and Cooper (1987) as guidelines for occupational stress researchers. Without stating them yet again, we can summarize these by noting that the researcher must begin studying a healthy cohort before they are exposed to the stressor and follow them for a long enough period for disease processes to develop and become manifest, all the while making objective assessments of stressors, measuring mediating processes, and assessing vulnerability factors that might interact with the stressor. Of course, this is an idealized set of guidelines, but it is probably unrealistic for the organizational researcher to even attempt to approximate them. We would suggest two reasons for this pessimism. First, even if one could locate a cohort of subjects and control their selection into jobs that varied systematically on some hypothesized stressor, the development of disease is apt to take a very long time. Maintaining a measurement protocol for mediating processes (e.g., physiological responses) and objective assessments of the stressor for years would be very difficult and costly. Second, it would be unlikely for the objective characteristics of the job to remain steady enough over the years to make the link between them and the disease. That is, people move into and out of different jobs over time, and increasingly, task characteristics for a given job are apt to change to reflect the implementation of new technologies.

If we are not likely to meet the stringent criteria of occupational epidemiology, what types of research strategies might be recommended for the organizational researcher? There are undoubtably many approaches that could yield useful insights, and our recommendations are not meant to represent an exhaustive list of the research designs that are applicable in this area. Nevertheless, we feel there are a few issues that deserve particular emphasis. Thus, we propose the following set of recommendations as a tentative set of "requirements for a useful study of job stress":

1. *Focus on one or a few objective stressors.* We do not discount the impor-

tance of subjective appraisals in mediating one's response to the work environment, but these ultimately must be anchored in objective assessments. Making objective measurements of the work environment allows us to study the relationship between objective characteristics and subjective appraisals, and it focuses us on concrete ways to change the work setting. There are numerous examples of potential work stressors that have appeared in the literature (e.g., vigilance requirements, workpace and degree of control over pacing, responsibility for people or equipment, conflicting demands, overload). We are not advocating the abandonment of subjective reports. The challenge here is to develop a method for objectively assessing the stressor of interest, preferably at the individual level of analysis. Direct observation is sometimes practical, as was demonstrated by Kirmeyer (1988) in her study of police dispatchers. She was able to develop reliable observational assessments of workload, competing demands, and interruptions, as well as different patterns of coping. Sometimes assessments can be made of stressors at the level of the job. Dwyer and Ganster (in press), for example, assessed demands by performing job analyses for workers in a manfuacturing plant that focused on requirements for working fast and to close tolerances.

Experimental manipulation is certainly another way to obtain an objective operationalization of job stressors. There is no need for us to reiterate the advantages of experimental designs for making causal inferences, but this strategy remains under-represented. It is here that organizational researchers can probably make the greatest contribution to the stress literature. Jackson's (1983) field experiment is an example of capitalizing on an opportunity to assess the effects of a change that was anticipated to lessen stress (increased participation and control). Martin and Wall (1989) effectively focused on the joint effects of high attentional demands and high cost responsibility in a qausi-experimental design that measured worker reactions as they rotated through jobs that varied on these factors. An example of larger-scale quasi-experiments is provided by Wall, Kemp, Jackson, and Clegg (1986), who followed the course of an autonomous work groups intervention. Laboratory experiments are limited by the intensity of the stressor that can be reasonably manipulated and their usually short time frame. However, Manning, Ismail, and Sherwood (1981) created conditions of role conflict for student nurses in a simulation that generated high levels of both "experimental" and "mundane realism" (Fromkin & Streufert, 1976), and produced both affective and physiological changes.

Finally, technological changes, especially those involving computerization, provide much potential for the stress researcher. Computerization of work can lead to positive changes, but can also bring about greater mental demands, opportunities for closer supervision and monitoring, and losses in control (Johansson & Aronsson, 1984). Hockey, Briner, Tattersall, and Wiethoff (1989), for example, describe a methodology for the analysis of computer stress that allows the investigator to focus on the relationship between workload and controllability. This approach has the advantage of providing an objective way to measure control variables relevant to hypotheses from the demands-control model, whereas previous studies have relied on subjective measures.

One clear advantage of using more objective operationalizations of stressors is

that they are more likely to be stressors to which the job incumbent is continuously or more frequently exposed. Much research has shown that continuous or frequent exposures that provide little opportunity for physiological recovery are taxing on the anabolic and immunological systems on which the body relies for regeneration from stress (Karasek et al., 1982; Sklar & Anisman, 1981). Indeed, frequency and duration are important dimensions (in addition to intensity) of stress exposures identified within the General Adaptation Syndrome. Hence organizational stress researchers should strive to measure more continuous exposures such as those that appear to be inherent characteristics of the work environment.

2. *Employ longitudinal designs that bracket significant changes in objective stressors.* A design is not useful just because it has a longitudinal component. For example, measuring workers at one time and then a year later when nothing has changed about their jobs does not really tell us much that a cross-sectional design could not have. Such panel designs do not rule out third variable causes, attributional effects, or even consistency effects. The ideal longitudinal design, of course, involves the experimental manipulation of stressors and random assignment. However, even naturally occurring changes in the work can afford opportunities for making reasonable causal inferences, especially if there are not strong selection confounds. An excellent example of a longitudinal design that spanned important changes in the work and was able to follow health change effects is the study of Belgian bank clerks by Kittel, Kornitzer, and Dramaix (1980).

In the conduct of longitudinal designs, it is necessary not only to obtain pre-exposure baseline measures of the dependent variables of interest, but also to obtain measures of prior health status. In addition to generally being the most powerful predictor of later health status, prior health status can itself affect degree of exposure to work stressors through selection effects. Bergner and Rothman (1987) provide a practical guide for the selection of health status measures that the organizational researcher can consult.

3. *Obtain "hard" outcome measures.* Most of the dependent variables used in this literature are self-reports of affect or somatic health complaints. We do not dismiss the construct validity of all such reports. However, such measures are often treated as if they have some predictive validity for such outcomes as actual morbidity, lost time, or even mortality. There is little empirical basis on which to stake such claims. If we truly want to estimate the "costs" of stress to individuals as well as organizations, we should obtain as many measures as possible that more directly reflect such costs. This does not mean that we should focus only on diagnosed medical conditions such as myocardial infarction or admission to psychiatric institutions. In fact, such measures are usually of little value in experimental studies because they have low base rates in working populations (necessitating huge samples) and they take a long time to develop (making it hard to link them to job exposures). Examples of more useful outcomes include variables such as sick days, voluntary absences, health claims, and accidents. Even medical malpractice claims have been linked to conditions of work stress (Jones, Barge, Steffy, Fay, Kunz, & Wuebker, 1988). Such outcomes have direct cost implications and can plausibly be linked to stress processes. We would note that job per-

formance has not been linked consistently to job stress, nor is there sufficient theoretical justification for hypothesizing a general relationship.

Physiological indicators of stress are becoming more evident in the studies of organizational researchers, and it is worth noting their problems and prospects. Most such measures can be classified either as indicants of a non-specific stress response (or arousal) or as precursors of subsequent disease states. Physiological measurement presents a number of difficulties, not the least of which is choosing ones that suit the aims of the research. It is uncertain what the usefulness of some measures such as heart rate (Caplan & Jones, 1975) are, because they do not seem to have any epidemiological significance and they are not even good measures of activation. Other measures, such as blood pressure (especially diastolic), are more closely linked to health outcomes, but there are large inter-individual differences in responsivity that might make blood pressure a less sensitive indicator than the investigator needs. Similarly, other cardiac risk indicators, such as serum cholesterol, show large inter-individual differences in reactivity, and within-subject designs might generally be necessary to obtain adequate precision to evaluate the effects of work stressors.

Neuroendocrine responses still show promise in this literature, and have been most successfully employed by Frankenhaeuser and her colleagues in Sweden. It is important for the researcher to bear in mind the differences between the adrenocortical (cortisol) and the adrenomedullary components (adrenaline and noradrenaline) in terms of what they indicate in the stress response. Adrenomedullary reactivity often suggests a high level of active coping with a stressful demand, and it is not clear that it presages later health problems or even subjective distress. Elevations in cortisol, however, are often associated with passive coping or situations in which the subject is having difficulty mastering the work demand. Antoni (1987) suggests that chronic cortisol elevation is likely implicated in suppression of immunological functioning and in mental health problems such as depression. Finally, there are numerous confounding factors that make the use of physiological measurements expensive and difficult. Fried, Rowland, and Ferris (1984) provide a good discussion of these issues. If one is to incorporate physiological assessments in stress studies, collaboration across disciplines is probably necessary to make the effort worthwhile.

Conclusions

We have attempted to provide a broad overview of the work stress literature that took a critical perspective toward what the evidence could tell us about the health effects of job and occupational characteristics. In order to be more expansive in some areas, we have neglected other issues relevant to this topic. For example, investigators frequently cite the need to attend to non-work sources of stress in conjunction with work stressors. We have taken the perspective of one who desires to identify risk factors in the job environment so that these can be managed; thus we have not examined the contributions of off-work demands. A case can be made, however, that people are not randomly placed in different jobs, that different people have varying non-work demands, and that these demands can thus be confounded with work stressors being investigated. However, there is

little evidence that non-work demands interact with work demands in any powerful way. Klitzman, House, Israel, and Mero (1990), for example, found that non-work stressors and work stressors were each *independently* associated with physical and mental health problems. Although measuring non-work stressors might add to the total explained variance in health outcomes, it does not appear that such assessments will generally change the significance of the work stressors themselves. But investigators need to be sensitive to the potential for confounding. There is a growing awareness that women may be more vulnerable to the demands of work to the extent that they often have more non-work demands than men. Whereas such off-work demands might have health implications for women, there is not much evidence that they are thus more reactive to demands at work. In fact, a "role expansion model" perspective argues that work can often provide "increased opportunities for self-esteem, social resources, and satisfaction" (Sorensen & Verbrugge, 1987: 237). Our advice, then, is to be sensitive to differential vulnerability factors, whether those be personality or demographic characteristics or non-work demands.

Finally, we have not reviewed research on stress management interventions, though some have employed field experimental designs as well as physiological outcome variables (e.g. Bruning & Frew, 1987; Ganster, Mayes, Sime, & Tharp, 1982). Mostly, we have neglected these because they are not informative about our central question. Stress interventions reported in the literature have focused on individual coping skills, but not on the changing of work stressors themselves. Our recommendations for the researcher in this article are consistent with those of others (Murphy, 1984): that we focus on characteristics of the work environment itself. Of course, an ideal way to study the causal impact of objective stressors on health and organizational outcomes is through intervention experiments. Ideally, managers will begin to better recognize the potential benefits of such intervention experiments both for their organizations and for their employees.

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