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Occupational Stress and the Mental and Physical Health of Factory Workers

James S. House

Survey Research Center
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ABSTRACT

This study assessed the relation of potentially stressful objective job characteristics to perceived psychosocial job stress and the relation of both of these to a variety of indicators of physical and mental health. The study also determined whether any of these relationships were conditioned (i.e., moderated or specified) by a variety of individual (i.e., age, education, work motivations, and aspects of the Type A behavior-pattern) and situational characteristics (i.e., social support, exposure to physical-chemical hazards, and piecework). The strengths of the study in relation to the literature on occupational stress are: (a) it focused on objective job characteristics as well as perceived stress; (b) it examined the relationship of a wide range of job stresses to a wide range of health outcomes, thus assessing whether the effects of any or all job stresses are specific to one or two health outcomes or quite broad and general; (c) it assessed the effects of psychosocial job stress on health, both controlling for and in conjunction with the impact of physical-chemical hazards; (d) it considered a wide range of potential conditioning variables and (e) its focus on blue collar workers.

The major source of data was a self-administered mail questionnaire sent to all 2,856 workers in a tire, rubber, plastics, and chemicals plant in a small northeastern city. The response rate was 67.6 percent overall and 70 percent among white males who constituted over 95 percent of the work force of this plant and were the focus of our analyses. Objective ratings of potentially stressful job characteristics were made for all major job types in the plant, and limited medical examination data were obtained for a

nonrandom subset of 353 of the 1809 white male questionnaire respondents. The major findings were as follows:

1. A wide range of perceived occupational stress (e.g., excessive workload, role conflict, responsibility, lack of intrinsic rewards) were associated with both reported symptoms and medical signs of ill health. These results confirm and extended those of other studies and indicate that psychosocial job stress has pervasive adverse effects on mental and physical health.
2. Objective job characteristics were related to perceived stress in the predicted way, but the relationships were weaker than expected. Among the objective job characteristics considered, only piecework and shiftwork had clear adverse effects on health.
3. Two conditioning variables had strong and important effects
   A. Exposure to physical-chemical hazards conditioned the relationship of perceived job stress to self-reported respiratory and dermatological problems, but did not affect the relationship of stress to other health outcomes. The results indicate that psychosocial job stress may exacerbate the effects of physical-chemical hazards on dermatological and respiratory functioning. This is a novel and potentially very important finding, which should be explored in further research.
   B. Social support had three types of effects:
      i. Support tended to be inversely related to perceived stress.
      ii. Support buffered the impact of perceived job stress on self-reported symptoms of ill health, especially neurotic and ulcer symptoms. That is, among workers

with high levels of support, stress had little impact on these health outcomes, while among those with low support, stress had substantial adverse effects on health.

iii. Support also "dampened" the impact of job characteristics on perceived stress. That is, there was simply less relation between job characteristics and perceived stress among those with high support compared to those with low support. However, these effects did not necessarily result in a lower level of perceived stress among those with high support. These results suggest that interpersonal relations may be somewhat more important, and job characteristics somewhat less important than we expected in determining levels of perceived job stress. Overall, social support should be an important variable in future research and in any applied efforts to reduce job stress or its impact on health.

The major limitations of the study are: (a) its cross-sectional nature, (b) its primary reliance on self-report indicators of health, and (3) its exclusive focus on white males. Future research should increasingly be prospective or longitudinal in nature, include more independent and objective measures of health, and consider a wider variety of work populations (e.g., women, minorities).

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Preface and Acknowledgements

This report presents the major results of work which has been carried out over a five-year period at several institutions and in conjunction with many people. Thus, although this report has a single author, it embodies the contributions of many people and organizations.

This research never would or could have been carried out without the support and cooperation of the United Rubber Workers' Union, the major tire and rubber manufacturing companies, and especially the workers of Whitewall Plant, the participants in our research. The initial stages of the study (through the data collection) were carried out with the support and cooperation of the Occupational Health Studies Group of the University of North Carolina School of Public Health. Anthony J. McMichael and Berton H. Kaplan played major roles in the design of the study and the collection of the data, and have collaborated in later stages of the study as well. Wayne Gerber, Robert Spirtas, Frederic Romm, H. A. Tyroler, John Gamble and Mark Van Ert of OHSG assisted with various phases of the research. Robert Atwater facilitated a number of complex administrative matters. The late John Cassel provided major intellectual stimulus and support to this work.

The bulk of the analysis was done at Duke University under grant 1 R01 MH28902 from the National Institute of Mental Health (Center for the Study of Metropolitan Problems), which also supported the preparation of this report at the University of Michigan. A number of excellent research assistants contributed to this work, most notably James A. Wells and Lawrence R. Landerman who supervised most of the major data processing and made major intellectual contributions as well. Mark Jackman, William Price, and Maggie Rogers assisted extensively with various aspects of the analysis, while Darryl May, Nancy Lifson, and Kathy Kyker assisted in various portions of the work. Jean Brenner, Susan Thomas and Margaret Moore provided excellent clerical support.

The final analyses and report were completed at the Institute for Social Research of the University of Michigan. Lynn Levin provided very able research assistance that allowed the project to make the transition from Duke to Michigan as smoothly as possible, and Marie Klatt typed the final report with great skill, care, and good humor, under somewhat stressful conditions. Marge MacKenzie and Judy Wainscott also provided valuable secretarial assistance. My colleagues at Michigan, especially John R. P. French, Jr., James LaRocco, Theodore Newcomb, and William Mason discussed a number of difficult substantive and methodological issues with me.

A project and report of this scope generates its own occupational stresses. The various people named above have also been sources of social support which have "dampened" and "buffered" the effects of this stress on my physical and mental health. My wife, Wendy, has provided both spouse and coworker support while enduring the brunt of the job-nonjob conflicts generated by this work.

PART I

INTRODUCTION AND METHODS OF THE STUDY

Chapter 1

INTRODUCTION

The relationship between work and health is a problem of growing concern in our society. The spiraling costs of health care make increased attention to health maintenance and disease prevention imperative. Understanding the impact of work on health is one major route to promoting health and preventing disease, though by no means the only, or necessarily most important, route. Still, with most adults spending one-third to one-half of their waking life at work, what happens on the job must be a major factor in the etiology of health and disease. Beyond this, we also know that many jobs expose workers to particular health hazards. Thus "occupational safety and health" has been a legislated policy objective of the Federal government since 1970.

Promoting occupational safety and health traditionally has meant reducing or eliminating physical, chemical, or biological hazards in the work environment. Increasingly, psychosocial forms of occupational stress have been implicated in the etiology of poor mental health and psychosomatic disease (House, 1974a and b; Jenkins, 1971 and 1976; Kasl, 1974 and 1978). However, existing evidence relating occupational stress and health is quite fragmentary (House, 1974a; Kasl, 1978), and is viewed quite skeptically by some. Ashford (1976), for example, devotes only a few pages to psychosocial stress in an almost 600-page volume on occupational disease and injury. Discussions of stress in blue collar jobs are especially likely to be limited to physical-chemical hazards (e.g., Poulton, 1978). Thus, although there is growing evidence that psychosocial job stress may impair the health of blue collar as well as white collar workers (cf. Kasl, 1978), there is a clear need for more and better evidence on the relationship of psychosocial as well as physical-chemical stresses to the health of blue collar workers.

The present study provides further evidence of the association between occupational stress and mental and physical health among blue collar workers while addressing a number of issues which have received little or no prior empirical study. Although skeptical about the impact of psychosocial job stress on health, Ashford (1976:124-26) has emphasized the need for research which simultaneously considers the relationship to health of psychosocial job stress and physical-chemical hazards, both because apparent effects of occupational stress might really be due to physical-chemical hazards and because the effects of stress and physical-chemical hazards may be interactive. That is, psychosocial stress may make persons more susceptible to the effects of noxious physical, chemical or biological agents in the environment, thus playing a role in the etiology of many diseases, not just those traditionally considered psychosomatic.

The need to examine in a single study the additive and interactive effects of psychosocial job stress and physical-chemical hazards on health suggests a second neglected issue -- the need to consider the effects of occupational stress in relation to a wide range of physical and mental health outcomes. Although a variety of authors have argued that psychosocial stress of all types may be an etiological factor in almost all diseases (e.g., Cassel, 1970 and 1976; Syme, 1967 and 1974), most theory and research has focused on the relation of one or a few psychosocial stresses to one or a few diseases (e.g., job dissatisfaction or the "Type A" behavior pattern in relation to coronary heart disease). Existing evidence is insufficient to decide whether the effects of a given form of occupational stress are "specific" or "general". To decide this issue and hence to better understand the likely psychophysiological mechanisms through which such effects occur, it is essential to study the relation of multiple indicators of stress to multiple health outcomes in conjunction with other physical, chemical, and biological factors which might induce these health outcomes.

Finally, although most stress researchers have converged on a paradigm which delineates the major classes of variables and relationships involved in understanding the impact of stress on health, the implications of this paradigm are not well reflected in existing empirical research (cf. McGrath, 1970:15-17; Levine and Scotch, 1970:280-81; French et al, 1974). Figure 1 presents a version of this stress paradigm previously developed by the author to integrate what we know about occupational stress and health and to identify current gaps in our knowledge and priorities for further research (House, 1974a and b). In the past, "stress" has been conceived sometimes as a property of objective social environments (e.g., heavy workload demands), sometimes as a subjective psychological condition or emotion (e.g., fear) and still other times as a physiological reaction (e.g., high blood pressure). The paradigm of Figure 1 applies the term "stresses" to people's perceptions of situations, but more importantly suggests that an adequate understanding of any phenomenon usually considered under the rubric of stress requires consideration of (1) objective social conditions or situations conducive to stress, (2) psychological perceptions of these situations, and (3) physiological, as well as behavioral and psychological, responses. The important question is not what is stress, but rather why and when do given objective social conditions give rise to perceptions of stress (i.e., fear, threat, dissatisfaction, etc.), and why and when do such objective conditions and/or

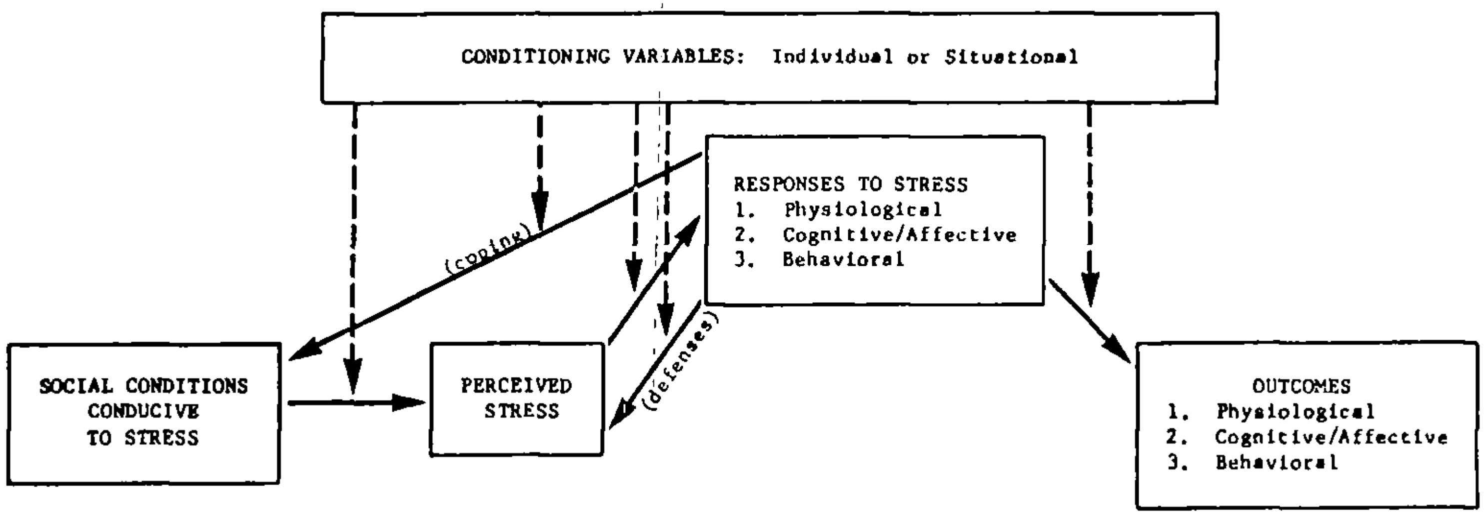


Figure 1. A Paradigm of Stress Research

NOTE: Solid arrows between boxes indicate presumed causal relationships among variables. Dotted arrows from the box labeled "conditioning variable" intersect solid arrows, indicating an interaction between the conditioning variables and the variables in the box at the beginning of the solid arrow in predicting variables in the box at the head of the solid arrow.

subjective perceptions produce given kinds of immediate responses and/or more enduring health outcomes?

Each arrow in Figure 1 embodies a set of hypotheses which should be tested as fully as possible in all stress research. The model suggests that potentially stressful objective social conditions (e.g., monotonous work, deadline pressures) produce enduring health outcomes (e.g., physical and mental illness) only if these conditions are perceived as stressful and responded to in a manner conducive to disease. Given two workers exposed to identical workload demands, for example, one may perceive the situation as quite stressful or threatening while the other views the pressure as a pleasant challenge. Which occurs will depend on other "conditioning variables" such as how competent and fast each worker is or whether he or she can count on help and support from others. Given several workers who all perceive the situation as threatening, one may alter the situation (or himself) to reduce the objective pressures and the perception thereof; another may alter his or her perception in the absence of a situational change; and a third may do nothing but become physiologically aroused, anxious, or behaviorally immobilized. Again, which response occurs depends on who is responding and in what situation, and the nature of the immediate response will determine the nature of the enduring outcomes.

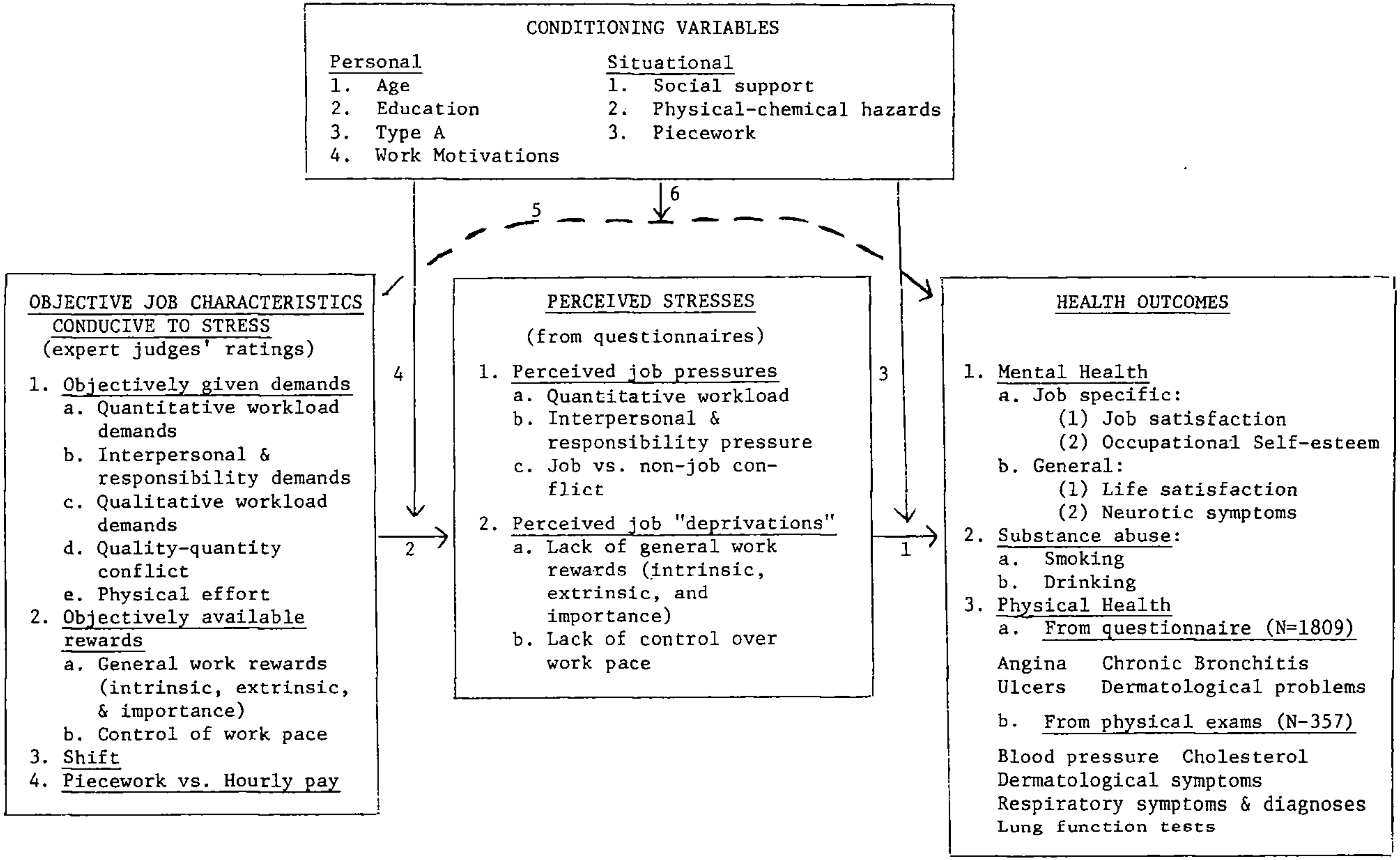
A fully adequate understanding of occupational stress phenomena in relation to health would simultaneously consider all five classes of variables in Figure 1. However, previous research has, not unexpectedly, largely dealt with only two classes of variables at once -- generally the relation of objective job conditions <u>or</u> perceived stress to health outcomes. Such research has indicated clear associations between such factors and health, but has not been able to consider many important relationships and contingencies in Figure 1. Although it is probably still not feasible or desirable to include all five classes of variables in a single study, the need to design studies including three or four of these classes has been previously noted (House, 1974a and b). We are theoretically and methodologically least prepared to consider immediate responses to perceived stress (i.e., processes of coping and defense) at this time. Thus, priority should go to understanding the interrelations among (1) objective social conditions, (2) perceived stress, and (3) conditioning variables in predicting (4) health outcomes.

The data collected for this study include multiple examples of all four of these classes of variables, as indicated in Figure 2 below. That is, we have data on (1) a variety of health outcomes from both questionnaires and physical examinations, (2) a range of perceived stresses as reported by workers, (3) expert observers' ratings of a variety of objective psychosocial pressures and rewards for all jobs in the plant, and (4) a few carefully selected conditioning variables. The nature of these data will be described more fully below; in all cases measures were chosen or designed to be as valid and reliable as possible.

In sum, this study has a number of unique concerns. First, it focuses on blue collar workers, a somewhat neglected group in the literature on psychosocial job stress and health. Second, it assesses the effects of psychosocial job stress on health both controlling for, and in conjunction with, the impact of physical-chemical hazards. Third, it examines the relationship of a wide range of stresses to a wide range of health outcomes, thus assessing whether the health effects of particular stresses (or all stresses) are specific to one or two health outcomes or quite broad and general. Fourth, it examines two neglected issues in much research on occupational stress and health: (a) the relation of objectively assessed job characteristics to both perceived stress and health, and

Figure 2

The Stress Paradigm as Applied in the Study, Including All Major Relevant Variables



(b) the conditioning effects of selected individual and situational variables on relationships of objective job characteristics to perceived stress and of both of these to health outcomes. The results will advance our scientific understanding of the impact of occupational stress on the health of factory workers, and workers more generally. Greater scientific understanding will hopefully increase the potential for, and effectiveness of applied efforts to improve health by reducing occupational stress and/or mitigating its effects.

The Research Setting

This study was able to address such a wide range of issues because of the unique context in which it was conducted. In 1970 the United Rubber Workers Union and the major tire and rubber manufacturers entered into a contractual agreement which specified that for every hour worked a fraction of a cent would be deposited in a special fund for research on the effects of working conditions on health in the tire and rubber industry. The research was overseen by a joint union-management committee, which contracted schools of public health to carry out the research and granted them full scientific autonomy. A major portion of the research was conducted by a multidisciplinary team of epidemiologists, biostatitians, industrial hygienists and social scientists comprising the Occupational Health Studies Group of the University of North Carolina School of Public Health. The present study was conducted by the author in collaboration with members of the OHSG staff and up through the data collection the work was supported entirely by OHSG.

In conjunction with OHSG a mail questionnaire survey was carried out in late 1974 on the entire nonsupervisory work force of a sizable (about 2,800 employees) tire, rubber, plastics and chemicals plant in the northeastern United States, hereafter known as Whitewall Plant. The mail questionnaire, which provides the major data source for this study, assessed workers' status on a wide range of health outcomes, their perceived exposure to physical-chemical hazards and their perceptions of psychosocial job stress and related variables. The nature of OHSG and its relationship with the company and union also allowed collection of a wide range of ratings of objective job characteristics conducive to psychosocial stress (described fully in Chapter III). It also permitted access to (a) physical examinations data collected from a non-random subset of the plant workforce as part of the study on the effects of vinyl chloride, and (b) to selected environmental assessments taken in the plant by industrial hygienists. Thus the study achieved an unusually full assessment of the working conditions, perceived stresses, and health status of the workers in Whitewall Plant and was thus able to address the key issues delineated above. The specific source and nature of the data will be described more fully in subsequent chapters. The remainder of this chapter will provide an overview of the major concepts and relationships examined in the study.

Basic Research Questions

Perceived Stress and Health

Arrows 1 - 6 of Figure 2 define the major research questions of this study. In line with a number of prior studies, we expect the perceived stresses to be inversely related to mental and physical health (Arrow 1). The perceived stress variables used here (shown in the middle panel of Figure 2) were those identified as related to health outcomes in prior work on occupational stress and/or as major sources of "stress," "alienation," or discontent in blue collar jobs generally. Following French, Rodgers and Cobb (1974), in Figure 2 we divide these stresses into two broad categories: (1) pressures, which are produced by the interpersonal or performance demands of the job being excessive relative to the worker's abilities and (2) deprivations, which are produced when the rewards and opportunities fail to satisfy the worker's needs or motives. French, Kahn, Cobb, Caplan and their coworkers have produced a sizable body of evidence linking variables like workload, interpersonal (e.g. role conflict), and responsibility pressure, and job vs. non-job conflict to a variety of physical and mental health outcomes (cf. Kahn, et al., 1964; Sales, 1969; Kahn and French, 1970; Caplan, 1971; House, 1972; French and Caplan, 1973; and Caplan, et al., 1975). Job dissatisfaction and low occupational self-esteem will be treated here both as mental health outcomes, and, in line with prior research (Kasl and French, 1962; Sales and House, 1971; House, 1972; Bradburn, 1969) as determinants of other health outcomes. Lack of intrinsic and extrinsic rewards and of power and control over work activities have been persistent sources of discontent and poor mental health in blue collar populations (e.g., Blauner, 1964; Kornhauser, 1965; Levitan, 1971). The data presented here largely replicate and extend prior work, but are being relatively unique in focusing on blue collar workers and including a very wide range of health outcomes.

Objective Job Characteristics, Perceived Stress and Health

Students of occupational stress and industrial social psychology more generally have long emphasized the importance of understanding how objective job characteristics (or the objective work environment) may produce subjective responses to work, including both perceived stresses and health outcomes (e.g., French, Kahn, and Mann, 1962; French, Rodgers and Cobb, 1974).* Both applied and theoretical considerations make it crucial to know the extent to which perceived stress and/or illness are produced by (1) the objective nature of jobs or (2) the nature of workers and how they approach their work or (3) some combination of (1) and (2). Theoretically, Figure 1 and similar models (e.g., Kahn, et al., 1964) clearly posit that perceived stress, and hence health, is produced by the joint effects of objective job characteristics and conditioning variables such as workers' personal characteristics which influence the perception of, and responses to, given objective conditions. Yet only rarely is the validity of such models fully tested. Efforts to improve health by reducing occupational stress could attempt to alter the objective nature of jobs and/or to modify workers' aptitudes and interests so they can cope better with objective job demands and deprivations and/or to improve the "fit" between workers' aptitudes and interests and the objective demands and opportunities of their jobs. At present, we generally lack adequate knowledge to decide which strategy (or strategies) to pursue.

Methodological difficulties in assessing the objective nature of job demands and opportunities have been the primary impediment to generating adequate data on the effects of objective job conditions on perceived stress and health. Standard occupational classifications developed for other purposes (e.g., Duncan, 1961; Edwards, 1933) have generally proved of limited value in predicting health outcomes and many perceived stresses (cf. Marks, 1967; Jenkins, 1971). Efforts at direct rating of objective job demands and

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*This discussion deals only with objective psychosocial conditions of work (e.g., amounts of workload, responsibility, variety and challenge, pay, etc.). This study will also consider objective physical-chemical working conditions (e.g., dust, fumes, chemicals, noise, heat) below under the heading of "conditioning variables."

opportunities have been rare and generally limited in scope because adequate ratings scales are unavailable and the costs and access problems are prohibitive, especially in professional and managerial jobs where there may be great differences even among jobs in the same category. Still, initial efforts to rate the objective stressfulness of jobs and relate it to health outcomes suggest the utility of, and need for, further work (cf. Kahn, 1964; Caplan, 1971; Friedman, Rosenman, and Carroll, 1957; Russek, 1965).

By focusing on the work force of a single factory and having exceptional access and cooperation from both company and union, the present study was able to make a substantial effort to assess objective job characteristics and to relate them, alone and in combination with conditioning variables, to both workers' perceptions of stress and relevant health outcomes. Since many workers in the factory performed identical, or highly similar, jobs, it was possible to group all workers into 21 groups which were quite homogeneous with respect to the actual nature of the work performed including psychosocial job demands and opportunities. That is, a new occupational classification was created which was more appropriate for this study than any existing classification. Using company job evaluation data and ratings by expert judges (described more fully below) we have developed quantitative ratings for each of the 21 occupational groups on all of the dimensions of job demands and rewards shown in the left-hand panel of Figure 2. These dimensions were designed to capture the objective conditions which are most likely to give rise to the perceived stresses in the middle panel of Figure 2.

Our analysis will seek to understand how these objective job conditions affect workers' perceptions of stress (Arrow 2, Figure 2) and health (Arrow 5), and to what extent the effects of the objective job environment are mediated through subjective perceptions of the environment as stressful or non-stressful (Arrows 2 and 1) as opposed to having a direct effect (Arrow 5). Arrow 5 is dotted because most, if not all, of the effect of the objective environment should be so mediated. The effects of these objective job characteristics on both perceived stress and health are expected, of course, to be importantly conditioned (or "moderated" or "specified") by relevant personal and situational characteristics (Arrows 3, 4 and 6). That is, statistical interactions are hypothesized between the conditioning variables and the objective job conditions in predicting perceived stresses and health outcomes. The nature of these interactions will be described for each conditioning variable below.

In sum, the assessment of objective psychosocial job conditions and the analysis of their interplay with conditioning variables in predicting perceived stress and health was one of the major and unique objectives of this study. The assessment procedures are of some methodological interest and the results of these analyses fill an important gap in existing knowledge and potentially have important applied, as well as theoretical, implications.

Conditioning Variables

Understanding the ways in which personal and situational characteristics condition the effects of objective job conditions on perceived stress (Arrow 4 in Figure 2) and of both of these on health outcomes (Arrows 3 and 6) also has major applied as well as theoretical importance. Such conditioning effects are an increasingly central tenet of stress researchers, especially Lazarus (1966) and his co-workers (Lazarus, et al., 1974). If the health effects of objective job conditions and/or perceived stress are exacerbated or ameliorated by certain conditioning variables, modifying these factors offers an alternative mechanism for improving health without directly modifying objective job conditions (or perhaps even subjective stress).

However, attempts to document such conditioning effects outside of the laboratory have been limited in number and scope. The present study extends this limited body of knowledge. The availability of extensive data on objective conditions of work offers special promise in this area as well, since prior theory and research suggests that conditioning effects of psychosocial variables are especially important and likely on relationships of objective job conditions to perceived stress and/or health outcomes (Lazarus, 1966; Lazarus, et al., 1974; Caplan, 1971). The number of possible conditioning variables is very large. The present study focuses on a limited number of personal and situational characteristics which seem especially promising in light of prior theory and research.

Age: House (1972) found that measures of perceived stress were much more positively correlated with heart disease risk factors among middle-aged and older men (over age 45) than among younger men. This finding had not been anticipated but seemed congruent with the idea that bodily resilience and resistance declines with age, thus increasing vulnerability to environmental stresses of either psychosocial or physical-chemical nature. The present study provides a good opportunity for replicating and extending these results. Age may also modify the impact of objective job characteristics on perceived stress. The tendency of job satisfaction to increase with age has been repeatedly noted, and one proposed exploration of the phenomenon is that workers come to perceive the same job conditions more favorably or they age, due perhaps to a tendency to temper aspirations and expectations over time.

Education: In the last decade, numerous authors have argued that levels of education importantly condition the reactions of blue collar workers to their jobs. Specifically, O'Toole (1974) and others (e.g., Shepherd and Herrick, 1972) have argued that better educated workers are more likely to feel deprived and dissatisfied with low skilled jobs, and hence that rising levels of education among workers will lead to increased disenchantment with traditional factory jobs. This view clearly suggests that objective job rewards should have more impact on perceived rewards (and job satisfaction and health) among more educated workers compared to less educated workers. However, education can also be viewed as an adaptive resource for coping with stress. In this view the impact of objective job demands on perceived job demands and health may be less among higher educated as opposed to lower educated workers. The present study provides what is often lacking in discussions of these issues -- substantial empirical data.

Type A "Personality:" Friedman and Rosenman (e.g., 1971) have described a hard-driving, aggressive, time urgent behavior pattern or personality which they term "Type A," and have shown it to be a risk factor in coronary heart disease (cf. Jenkins, 1975). But precisely how and why this association exists remains unclear. Type A persons may be more exposed to potentially stressful situations and/or they may react more intensely to such situations as Caplan (1971) suggests, or they may simply create perceived stress for themselves regardless of the objective situation. The present study tests not only whether the Type A syndrome is directly related to perceived stress and to a range of health outcomes, including but not confined to coronary disease, but also whether Type A interacts with objective job characteristics in predicting perceived stress or with either of these factors in predicting health.

Work Motivations: Theories of "person-environment fit" (French, et al., 1974) or "personality-social system congruence" (Inkeles and Levinson, 1968) predict that the effects of reward deprivation will be exacerbated among individuals who have a high level of need or motivation for the rewards in question. The present data include measures of work motivations which are fully parallel with the measures of perceived rewards of work noted in Figure 2. Thus, for example, it is possible to test the oft heard assertion that many blue collar workers don't mind boring jobs. Further, for example, do jobs which are subjectively perceived, or objectively rated as requiring little skill, initiative or ingenuity have deleterious effects on health only (or mainly) among those who are highly motivated for intrinsic rewards in work?

Social Support: Research reviewed by Cassel (1976) and Cobb (1976) suggests that supportive social realtionships with significant others can ameliorate or "buffer" the effects of potentially stressful objective conditions and/or perceived stress on health, though others have noted that the evidence for pure conditioning or "buffering" effects is not strong (cf. Pinneau, 1976). Social support may act directly to reduce stress or improve health, because supportive others make fewer stressful demands or meet important needs for positive relations with others. In a pure "buffering" effect, however, support conditions or modifies the relationship of objective conditions to perceived stress or the relationship of either of these to health. Cassel (1976) and Cobb (1976) present some general examples of such effects, while Gore (1973) and Caplan (1971) have provided limited evidence of such effects with respect to occupational stress. The present study has tested for both direct and conditioning effects of social support, and improves on much prior research by distinguishing between social support from four sources: (a) work supervisors, (b) coworkers, (c) spouses, and (d) friends and relatives. We expected that supervisors and coworkers would have greater effects on relationships involving only occupational variables, while spouses and friends and relatives would be more relevant to relationships involving more general health outcomes (and perhaps the most general job-related variables such as job satisfaction).

Physical-chemical Hazards: The present study is unique among studies of psychosocial job stress in including exposure to hazardous physical-chemical work environments as a major class of conditioning variables. Some theorists (e.g., Cassel, 1970 and 1976; Syme, 1967 and 1974) suggest that the most important effects of stress are not to induce disease directly, but rather to alter bodily resistance mechanisms in ways that exacerbate the effects of noxious biological, physical, or chemical agents. Yet this theoretically very important idea is seldom tested because phychosocial stress is rarely studied in conjunction with noxious biological, physical or chemical agents. Thus the present study offers a rare chance to test a major theoretical issue in the stress literature. Confirmation of this hypothesis would also have important practical implications in suggesting that coincidence of psychosocial job stress with physical-chemical hazards is especially dangerous.

Piecework: A final conditioning variable is whether workers are paid on a piecework basis, a relatively common arrangement in tire manufacturing. As indicated in Figure 2, piecework may itself induce perceived stress, especially quantitative workload. However, piecework may also modify the impact of objective characteristics on perceived stress or of the relationship of either of these to health. The potential importance of piecework was suggested more by our discovery of its prevalence and significance in

Whitewall Plant than by prior research. It appeared, for example, that at least some perceived stress among pieceworkers (e.g. workload pressure) might be largely self-induced, while in non-piecework jobs such pressure was produced more directly by job characteristics. Thus, some objective job characteristics might show less relationship to perceived stress among pieceworkers vs. other workers. The phenomenon of piecework can be discussed more fully and fruitfully in Part II.

As will be discussed more fully in Chapter 4, a cross-sectional study like this one is not the optimal one for assessing conditioning effects, and probably confounds some true conditioning affects (i.e. statistical interactions) with direct (i.e. additive) effects of the conditioning variables. Further, many of these variables have important direct effects on perceived stress and health in their own right, apart from their conditioning properties. Thus, the analysis and results in Parts II and III focus on the direct or additive, as well as the conditioning or interactive effects, of these variables.

Plan of the Report

The remainder of Part I will detail the data collection and index construction procedures with respect to the questionnaire data on perceived job stress (Chapter 2) and the ratings of objective job characteristics (Chapter 3) and provide an overview of the data analysis procedures used in Parts II and III. Parts II and III will present the analyses of the major relationships in Figure 2. Part II (Chapters 5 - 7) presents analyses of relationships of objective job characteristics to perceived stresses, including the impact of conditioning variables on these relationships. The conditioning variables will be presented as they enter the analysis.

Part III (Chapter 8 - 13) will analyze the impact of objective job characteristics and perceived stresses on (a) self-reported job evaluations or job-specific mental health (Chapter 8), (b) self-report indicators of general mental health (Chapter 9), (c) reported use and abuse of tobacco and alcohol (Chapter 10), (d) self-reported symptoms of a range of physical health outcomes (Chapter 11), and (e) medical examination assessments of selected physical health outcomes (Chapter 12). Conditioning effects will be considered in each of these chapters. Measures of health outcomes are generally presented as they enter the analysis. Chapter 13 will attempt to summarize the impact of job characteristics, perceived stress, and conditioning variables on the full range of health outcome. Finally, Part IV (Chapter 14) will review the findings of the study and their implications for research and practice.

Causal Inferences and Cross-Sectional Data

Despite the many strong features of this study, it has one major limitation -- its cross-sectional nature -- the ramifications of which have become more evident as the analysis has proceeded. The stress paradigm is clearly a causal framework, which implies a clear temporal and causal ordering of the major classes of variables in the study. Our analysis is conducted in accord with this causal framework, but the true causal priorities underlying many relationships in this study are open to some dispute. It is highly plausible that job characteristics affect perceived stress and health, rather than vice versa, though it is possible that workers who have or are prone to certain stress perceptions or health outcomes may somehow be selected into these occupations.

The causal priorities between perceived stress and health are more debatable. The cross-sectional nature of the data makes it impossible to firmly establish that the associations observed in Part III between perceived stress and health reflect a causal impact of stress on health rather than reverse or some pattern of reciprocal causation. Poor health could lead people to perceive more occupational stress under any job conditions and/or to self-select themselves into jobs with greater psychosocial stress if such jobs had lower levels of other health hazards (e.g., high demands for physical effort or high exposure to physical-chemical hazards). The plausibility of these alternatives can be partially tested by controlling for levels of job mobility since beginning work in the plant (more mobile persons are more likely to have self-selected themselves into jobs since the workers' latitude of choice increases with seniority), and for awareness of ill health (reflected in reporting physician's diagnosis of various illnesses). Analyses reported elsewhere (House et al., 1979; Wells, 1978) suggest that the relationships in this study are unaffected by such controls. Further, most analyses in this study control for a number of factors (e.g., age, smoking behavior) which might spuriously produce associations between perceived stress and health. Thus, the available evidence suggests that a substantial portion of the associations evident in this study reflect a causal impact of stress on health, though health very likely has some reciprocal effects on stress, especially self-reports thereof. As has been stressed by the author (House, 1974a and b) and others (Kasl, 1978), longitudinal and experimental studies of occupational stress and health are critically needed to clarify such causal priorities. Nevertheless, the current study can make a substantial contribution to existing knowledge of occupational stress and health, which must for the present be drawn largely from cross-sectional studies.

Chapter 2

DATA COLLECTION PROCEDURES AND MEASURES OF PERCEIVED JOB STRESS, MOTIVATION, AND SATISFACTION

The study population was the entire hourly (nonmanagerial) workforce of a large tire, rubber, plastics and chemicals manufacturing plant, here referred to as Whitewall Plant, in a small northeastern city. Although Whitewall Plant workers can in no way be considered a representative sample of any larger population of blue collar workers, the work force of the plant includes a full range of blue collar occupations from skilled craftsmen to operators of automated machines to machine tenders and assembly line workers to unskilled manual laborers. Chapter 3 will describe the work processes and job types of Whitewall Plant in some detail.

Overview of Data Collection

Questionnaire Data Collection

The major source of data for this study was a self-administered questionnaire (reproduced as Appendix A) which was mailed to all 2,856 hourly workers at Whitewall Plant in April, 1974.* The questionnaire assessed workers' job histories and their current levels of health status, exposure to physical-chemical hazards, and perceived occupational stress. Repeated followups by union and company representatives and by the research staff through the mail and through contact at the plant resulted in

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*The number 2,856 is the best estimate which could be made of the actual workforce at the plant at the time of the initial mailing, after adjustments for recent hirings, terminations, and workers' on long-term illness or disability leaves.

1,930 valid returned questionnaires or an overall response rate of 67.6 percent. House, et al., (1977) present details of the data collection procedures in the context of reporting an experimental test of three methods of final followup.

Data from company records revealed that response rates were significantly below 67.6 percent among women (51.2%), blacks (36.9%), workers aged 18-29 (54.4%), the unmarried (38.0%) and night shift (11 p.m. - 7 a.m.) workers (58.8%). Since these groups overlap, controlling for nonresponse biases on several of these factors served to minimize the biases from the others. The small number of women (82) and black (103) workers in Whitewall Plant and their poor response rates precluded using these groups in most analyses. Thus, the present report include data for white male respondents only (N = 1809), for whom the response rate was 70 percent. Within the white male group, extensive analyses comparing respondents and nonrespondents and early versus late responders on all variables suggest that age is the remaining source of major non-response bias. (cf. Jackman, 1977 for a full report of these analyses). Once age is controlled there are few substantial significant differences between response groups. Thus age is controlled in all major analyses in this report.

Medical Data Collection

A nonrandom subset of 447 Whitewall Plant workers received medical examinations and tests in October, 1974, of whom 353 were white males who also returned questionnaires. These examinations were done by the National Institute of Occupational Safety and Health and OHSG to assess effects of long-term exposure to vinyl chloride, the major ingredient used by the chemicals division to make polyvinyl chloride which in turn was processed by the plants division. Thus, the medical examination group included all chemical and plastic workers and a small control group of rubber workers. Whereas plastics and chemical workers constituted only 13 percent of all workers in the plant, they comprised 67.5 percent of the medical examination subgroup. The unusual and special focus of the medical examination sample limited the range of analyses relevant to the present study which could be performed with these data. The results are presented in Chapter 13 and further considerations regarding the validity and generalizability of data from the medical subgroup are discussed more fully there.

Environmental Data

The major measure of exposure to physical-chemical hazards used in this study is based on items from the self-report questionnaire. The nature and validity of these items is explored in Appendix D. Some limited objective data on environmental exposures collected by industrial hygienists were also available. Appendix D compares the self-report and objective data and suggests the self-report data are satisfactory for most purposes. Generally, substituting the objective environmental data for the self-reports greatly attenuates, but does not invalidate the findings using the self-report data.

Development of Measures of Perceived Job Stress, Motivation and Satisfaction

In many ways the central construct of the theoretical paradigm depicted in Figure 1 is perceived job stress. Objective conditions of work give rise to perceptions of stress which in turn produce both transient responses and more enduring health outcomes. Indeed, the model implies that objective psychosocial conditions of work will affect health _only if_ they are perceived as stressful. Thus, the first major goal of this project was to measure levels of perceived job stress among the hourly workers in the Whitewall Plant. This chapter describes the questions and indices developed for this purpose and indicates the levels of such stress workers of Whitewall Plant reported on these measures and the interrelations among the different types of stress. As suggested in Chapter 1, two broad classes of job stress were assessed. Workers reported about both _job pressures_, which arise when job demands exceed worker's abilities to cope with them, and _job deprivations_ (or the lack of perceived job rewards). This chapter also describes measures of two general job evaluations or affects -- dissatisfaction with the job and/or with oneself as a worker. These are treated in this study as both job-specific mental health outcomes and as determinants of other health outcomes.

Besides its primary methodological purpose of introducing the measures of perceived job stress used throughout subsequent chapters, this chapter also serves the substantive purpose of describing the nature and levels of perceived job stress at Whitewall Plant. Such a description provides a context for later results on the relation of perceived job stress both to objective conditions of work and to indicators of mental and physical health. It may also contribute a broader understanding of the nature and extent of psychosocial job stress among blue collar workers. Discussions of job stress among blue collar workers, sometimes ignore psychosocial stress in favor of physical-chemical stressors (e.g., Poulton, 1978). Those who do consider psychosocial job stress among blue collar workers disagree as to how extensive and consequential it is. Some see most blue collar workers as relatively uninvolved in their jobs, hence not greatly bothered or affected by the pressures and deprivations they experience there. Others, however, see the pressure, lack of fulfillment and dissatisfaction of blue collar work as both substantial and consequential (cf. Kornhauser, 1965; Strauss, 1974 for discussions of these issues). The limited data of this chapter will hardly resolve this dispute but will give us a better feel for the nature and extent of psychosocial job stress in the Whitewall Plant.

Perceived Job Pressures

Perceived job pressures such as qualitative and quantitative workload, role conflict, and responsibility have been a major focus of research on occupational stress, especially in the program of research by French, Kahn, Cobb, Caplan and associates at the University of Michigan Institute for Social Research (e.g., French et al., 1965; Kahn et al., 1964; Caplan et al., 1975). Drawing heavily on the work of these investigators and my own earlier work (House, 1972) a pool of 20 items was developed to measure a range of types of job pressures. These items were evaluated via a mail questionnaire pretest and in discussions with groups of workers and union officials at Whitewall Plant who filled out the pretest questionnaire in the presence of the investigator and made suggestions for additions, deletions, and changes. On the basis of these results a final set of 15 items (shown in Tables 2.1 and 2.2) were included in the final mail questionnaire distributed to all hourly workers in the plant.

Intercorrelations (shown in Table B.1 of Appendix B) and principal component factor analysis of these 15 items, in conjunction with consideration of item content, suggested an initial clustering of these items into five indices -- job-nonjob conflict, role conflict, quality concern, responsibility, and workload. Table 2.1 shows the distribution

Table 2.1

Workers' Reports of Job Pressures (except workload)

All of us are occasionally bothered by certain pressures or stresses in our work. Here is a list of things that sometimes bother people. Please indicate how often you are bothered by each of them in your work.

Index / Item	(0) Not at all	(1) Rarely	(2) Sometimes	(3) Rather Often	(4) Nearly all the time	Mean	(N)
Job vs. Nonjob Conflict							
P 1. Feeling that your job tends to interfere with your family life	48%	22%	18%	7%	5%	1.00	(1785)
P 2. Being asked to work overtime when you don't want to	44%	23%	19%	9%	6%	1.10	(1777)
P 3. Feeling trapped in a job you don't like but can't change and can't get out of	49%	17%	21%	6%	7%	1.06	(1786)
Role Conflict							
P 4. Thinking you'll not be able to meet the conflicting demands of various people you work with	41%	32%	21%	4%	2%	0.95	(1782)
P 5. Not knowing just what the people you work with expect of you	37%	32%	22%	6%	4%	1.09	(1779)
P 6. Having to deal with or satisfy too many different people	25%	30%	26%	11%	8%	1.49	(1783)
Quality Concern							
P 7. Thinking that the amount of work you have to do may interfere with how well it gets done	23%	23%	33%	12%	9%	1.61	(1783)
P 8. Feeling that you have to do things on the job that are against your better judgment	19%	24%	39%	13%	4%	1.59	(1789)
P 9. Feeling unable to influence your immediate supervisor's decisions and his actions that affect you	28%	30%	28%	8%	6%	1.34	(1783)
Responsibility							
P 10. Not having enough help and equipment to get the job done well	13%	23%	40%	17%	7%	1.83	(1790)
P 11. Feeling you have too much responsibility for the work of others	36%	31%	23%	7%	4%	1.13	(1786)
P 12. Having to do or decide things where mistakes could be quite costly	26%	31%	27%	10%	5%	1.38	(1785)

Note: Percentages sum to 100% across rows except for rounding error. N varies slightly from question to question due to missing data.

of responses to each item in the first four indices while Table 2.2 gives similar data for the items in the workload index. The workload index is presented separately in Table 2.2 not only because it deals with a different type of stress than the other four indices, but because the form of the workload items was different. Each of the twelve items in Table 2.1 were introduced as "pressures" or "stresses" and respondents were asked to indicate how often they were "bothered" by them. The work-load items merely ask how often workers have to work very fast or hard, without explicitly asking whether they are bothered by their perceived workload (though the modifier "very" and "little" in these three items may implicitly suggest the pace is excessive and bothersome).

The data in Table 2.1 reveal that a majority of workers report being bothered "rarely" or "not at all" by most of these job pressures, while no more than 24 percent of workers report feeling bothered by any item "rather often" or "nearly all the time." Thus, the distribution of responses to these items is clearly skewed in the direction of lower pressure -- the means shown in the second column from the right all lie between 0.95 - 1.61 or between "rarely" and "sometimes" on the response scale. Thus, the "average" worker in the plant is reporting low to moderate levels of perceived stress, but a significant minority (between 6 percent and 24 percent or 100 - 400 men in absolute terms) report being bothered "rather often" or more by each stress item. The items in the responsibility and quality concern indices are most often perceived as bothersome, while those in the job-nonjob conflict and role conflict indices (except the last item in the role conflict index) were least often bothersome.

Although on the average the items in any cluster correlate equally or more highly with each other than with items in other indices (see Table B.1 of Appendix B) their manifest content is not always very homogeneous.

The role conflict and responsibility indices are the most homogeneous and face valid in terms of item content. The first two items in job-nonjob conflict index clearly focus on interference of the job with nonjob activities -- the first item doing so explicitly, the second item, implicitly.* The "feeling trapped" item is in this cluster because of its correlations with the other items, which suggest that one of the things workers who feel trapped dislike about their jobs is the way it interferes with their nonwork life. "Quality concern" is the most heterogeneous index cluster in Table 2.1 -- the items are quite highly intercorrelated but quite diverse in content. The name of the index reflects what appears to be the common thread among the items -- workers not being able to do their work as well as they would like due to the quantity of work, the supervision, or other factors.

Workers' responses to the workload questions, shown in Table 2.2, indicate that the vast bulk of men have to work very fast and very hard at least sometimes and often more. It might be noted that many of the items with the highest means in Table 2.1 also connote having too much to do (e.g., items numbers P 6, P 7, and P 10). Thus, in contrast to the other job pressures, high levels of workload seem to be quite common in this plant. Whether this workload has deleterious consequences remains to be seen.

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*The problem of unwanted overtime was added at the suggestion of pretest respondents. Overtime, especially on weekends, was not uncommon during peak production periods. The union-management contract stipulated that opportunities for overtime work were to be first allocated to volunteers on the basis of seniority. If there were not enough volunteers, supervisors could assign overtime to lower seniority workers. The problem with overtime is that it interferes with nonwork activities.

Table 2.2

Workers' Reports of Workload

Jobs vary in how much they require people to work fast and hard. Please indicate how often each of the following statements is true of your job.

Item	(0) Never	(1) Rarely	(2) Sometimes	(3) Fairly Often	(4) Very Often	Mean	(N)
P 13. How often does your job require you to work very fast?	4%	10%	41%	25%	21%	2.48	(1789)
P 14. How often does your job require you to work very hard (physically or mentally)?	4%	13%	42%	24%	17%	2.37	(1791)
P 15. How often does your job leave you with little time to get everything done?	8%	32%	38%	13%	9%	1.83	(1779)

Note: Percentages sum to 100% across rows except for rounding error. N varies slightly from question to question due to missing data.

The three items in each cluster of Tables 2.1 and 2.2 were combined into an index by simply summing the item scores. Table 2.3 shows the internal consistency estimates of reliability (coefficient alpha) and intercorrelations of these five indices (variables 2-6 in Table 2.3). These data indicate that all indices have satisfactory to good internal consistency and convergent validity. The major problem is in the area of discriminant validity (Campbell and Fiske, 1959) -- some indices have correlations with other indices which are almost as high as their reliabilities (also see Table B.1 of Appendix B). Thus it is uncertain that there are five clearly distinct measures of perceived job pressures. The discriminant validity problem is most serious with respect to role conflict, quality concern and responsibility. At least in Whitewall Plant, perceptions of these three types of pressure intercorrelate quite highly (r's = .51, .58, and .64). Detailed analyses reported elsewhere (House _et al._, 1979) only occasionally revealed meaningful differences in the associations of these three indices with other variables. These three indices also had some common content -- dealing with problems in work performance other than sheer quantity of work, especially problems of responsibility and interpersonal relations. Thus, the three indices were summed into a more general index of "interpersonal and responsibility pressure" which along with the workload and job-nonjob conflict indices will constitute the major indicators of perceived stress throughout the remainder of this report. Its reliability and intercorrelations are shown in Table 2.3.

Job Rewards and Deprivations

The second major domain of psychosocial job stress in this study involves deprivations or lack of rewards in work. From Marx's (1848) seminal discussion of alienated labor through recent discussions of

Table 2.3

Intercorrelations and Reliabilities (in diagonal) of Job Pressure Indices

Variable	1	2	3	4	5	6
1. Interpersonal & Responsibility Pressure	(.84)					
2. Role Conflict	.87	(.70)				
3. Quality Concern	.86	.64	(.72)			
4. Responsibility	.81	.58	.51	(.59)		
5. Quantitative Workload Pressure	.37	.26	.37	.31	(.73)	
6. Job-Nonjob Conflict	.47	.39	.48	.33	.23	(.56)

Note: All correlations are highly significant ($p < .001$). Missing data deleted pairwise resulting in an N between 1779 and 1791 depending on pair of variables involved.

Work in America (DHEW, 1973; O'Toole, 1974), lack of rewards, especially those derived from the intrinsic process of work itself, has been considered as a critical discontent of blue collar work. Others have argued, however, that blue collar workers may not greatly value such rewards or their jobs in general, and hence may not perceive a great lack of such rewards or may not be much affected by them. In this view many blue collar workers worry primarily about extrinsic rewards (e.g., pay, fringe benefits) and seek their major gratifications outside of work (cf. Dubin, 1976; Strauss, 1974).

Drawing heavily on the work of Quinn and Shepherd (1974), my own previous work (House, 1972), and the pretesting procedures noted above, 24 items were developed to assess the degree to which workers perceived various kinds of rewards in their jobs. This inventory covered the major domains of intrinsic (e.g., challenge, self-utilization, autonomy) and extrinsic (e.g., pay, working conditions) rewards which run through all major discussions of the nature and meaning of work (Herzberg, 1966; Gurin et al., 1960; Kahn, 1972). In addition, a number of items were included regarding the worker's control or influence over his pace of work, the way he does his work, and company policy as a whole. The issue of control is central to Marx's early discussion of alienation. More recently, Blauner (1964) has argued that contemporary blue collar workers desire control over their pace of work but, contrary to Marx's hypotheses, not over the means of production.

The meaning of levels of perceived rewards must be understood relative to what rewards the worker would desire. The 24-item inventory of work rewards was presented twice -- with workers asked to indicate how true each statement was first of their "present job" and later of the "kind of job you would like to have." The latter items are referred to here as questions on work motivations. The 24 items in each of these sets were intercorrelated (see Tables B.2 and B.3 in Appendix B) and factor analyzed. Based on considerations of item content and the results of these analyses for <u>both</u> sets of items (in order to assure that indices of perceived rewards and motivations were comparable), 20 of the 24 items were clustered into four indices of work rewards and work motivations. Table 2.4 shows the distribution of responses to both the rewards and motivation versions of these 20 items, grouped into their four clusters.

The first set of items in Table 2.4 are termed intrinsic rewards (and motivations) and describe opportunities for self-development, self-utilization, value-expression, autonomy and just doing interesting work. In contrast to the workers' reports of pressures which were generally skewed in the direction of low perceived stress, workers' descriptions of the kind of job they have (the left-hand panel of Table 2.4) reveal substantial perceived deprivation of intrinsic rewards. A majority of workers respond either "not too true" or "not at all true" on half of the items (R1, R4, R5 and R10), and 39 percent or more respond similarly on three of the other items (R2, R3, R7). Responses to all items are well-distributed over the four response categories but the mean response is generally below the midpoint (1.5) of the potential range (0-3) of responses. Particular deprivation is evident in the items dealing with the acquisition and use of skills and abilities (R1, R4, R5, and R6).

The data on motivations on the right side of Table 2.1 clearly show that workers have not devalued intrinsic rewards and adapted to their level of desired intrinsic rewards to the level they perceive in their current jobs. Between 53 percent and 75 percent of the workers at Whitewall

Table 2.4

Workers' Reports of the Kind of Job They Have (Work Rewards) and the Kind of Job They Would Like to Have (Work Motivations)

Index Item	Now we'd like to find out what your present job is like. Please indicate how true you think each of the following statements is of your present job.						In sections A-D you have described your present job. Now we would like you to "shift gears" and describe the kind of job you would like to have. Imagine you were applying for a new job, and say how well each of the following statements describe the kind of job you would like to get.					
	(0) Not at all true	(1) Not too true	(2) Somewhat true	(3) Very true	Mean	(N)	(0) Not at all true	(1) Not too true	(2) Somewhat true	(3) Very true	Mean	(N)
Intrinsic Rewards												
R 1. I have an opportunity to develop my own special skills and abilities	38%	18%	24%	19%	1.24	(1775)	6%	8%	32%	54%	2.35	(1735)
R 2. The work is interesting	26%	22%	31%	21%	1.47	(1784)	2%	2%	22%	73%	2.66	(1725)
R 3. I am given a lot of freedom to decide how to do my job	22%	17%	34%	26%	1.65	(1786)	3%	7%	36%	53%	2.39	(1736)
R 4. I am given a chance to do the things I do best	42%	21%	24%	12%	1.07	(1782)	3%	4%	30%	63%	2.54	(1740)
R 5. I can learn new things	41%	24%	22%	13%	1.08	(1787)	2%	2%	24%	71%	2.64	(1741)
R 6. I can use my skills, knowledge and abilities	34%	20%	29%	18%	1.30	(1786)	3%	3%	31%	63%	2.54	(1736)
R 7. I can really believe in the value of what I am doing	21%	20%	37%	22%	1.60	(1790)	2%	2%	26%	70%	2.64	(1739)
R 8. I can see the results of my own work	8%	8%	36%	48%	2.24	(1779)	1%	1%	22%	75%	2.71	(1740)
Extrinsic Rewards												
R 9. The pay is high	29%	30%	34%	7%	1.19	(1782)	3%	5%	31%	62%	2.51	(1734)
R 10. My job is secure	17%	19%	41%	23%	1.68	(1785)	2%	4%	22%	72%	2.63	(1731)
R 11. The physical surroundings are pleasant	42%	28%	24%	6%	0.95	(1785)	2%	3%	24%	71%	2.63	(1736)
R 12. The fringe benefits are generous	14%	18%	46%	22%	1.74	(1782)	2%	4%	29%	65%	2.56	(1739)

Table 2.4--continued

Index Item	Now we'd like to find out what your present job is like. Please indicate how true you think each of the following statements is of your present job.						In sections A-D you have described your present job. Now we would like you to "shift gears" and describe the kind of job you would like to have. Imagine you were applying for a new job, and say how well each of the following statements describe the kind of job you would like to get.					
	(0) Not at all true	(1) Not too true	(2) Somewhat true	(3) Very true	Mean	(N)	(0) Not at all true	(1) Not too true	(2) Somewhat true	(3) Very true	Mean	(N)
Importance Rewards												
R 13. The job has status and prestige, that is, people look up to it and think it is important	46%	23%	22%	9%	0.95	(1788)	8%	18%	39%	35%	2.00	(1732)
R 14. My job is clearly important to the success of the company	6%	10%	33%	51%	2.29	(1789)	2%	5%	30%	63%	2.54	(1735)
R 15. It takes real skill and experience to do my job well	23%	21%	33%	24%	1.57	(1786)	3%	9%	41%	47%	2.33	(1738)
R 16. I have a good deal of influence over things that affect me or my job	30%	28%	30%	12%	1.22	(1786)	4%	8%	44%	44%	2.28	(1736)
R 17 I have some influence over plant or company policy	63%	21%	12%	3%	0.55	(1787)	13%	22%	41%	24%	1.76	(1736)
Control Rewards												
R 18. I can do the work and keep my mind on other things most of the time	20%	22%	36%	23%	1.62	(1792)	22%	33%	29%	16%	1.38	(1724)
R 19. I can talk to other people whenever I want to	7%	14%	40%	39%	2.13	(1787)	6%	17%	43%	34%	2.04	(1725)
R 20. I can usually decide when to work fast and when to take it easy	15%	12%	39%	35%	1.92	(1791)	3%	7%	44%	46%	2.33	(1740)

Note: Percentages sum to 100% across rows except for rounding error. N varies slightly from question to question due to missing data.

Plant report each of the intrinsic rewards to be "very true" of the kind of job they would like to have, and the means for the motivation questions are all in the range of 2.35 to 2.71, near the maximum of 3.0. Thus, Whitewall Plant workers perceive they are receiving substantially fewer intrinsic rewards than they would like to have.

A similar picture emerges with respect to the next two clusters of reward items -- extrinsic rewards and "importance" rewards. Extrinsic rewards include perceptions of pay, fringe benefits, job security, and physical working conditions. Again the level of perceived rewards is low to moderate (cf. left-hand portion of Table 2.4), while these extrinsic rewards are about as universally desired as the intrinsic rewards (left-hand portion of Table 2.4). The index of importance rewards includes five somewhat varied items which were not expected a priori to cluster. These items refer to the prestige, importance, skill level, and influence that the worker perceives his job has -- the common denominator appearing to be a sense of importance in the eyes of self and others. The variation across items in perceived levels of importance rewards is the greatest for any cluster in Table 2.4 -- 84 percent felt it was "somewhat true" or "very true" that their jobs were "important to the success of the company," while 57 percent felt it was "somewhat or very true" that their jobs required "real skill and experience" and 42 percent responded similarly regarding their influence over things affecting their job, but only 15 percent felt it was "somewhat or very true" they they had "some influence over plant or company policy." The parallel responses on the right side of Table 2.4 show that importance rewards are somewhat less desired than intrinsic and extrinsic rewards, but much more desired than discourses regarding the uninvolved and unmotivated blue collar worker imply. Contrary to what

Blauner and others suggest, for example, over half of the workers feel that having "some influence over plant and company policy" should be "somewhat true or very true" of the kind of job they would like to have. In sum, workers report feeling substantially deprived of extrinsic and importance rewards, as well as intrinsic rewards.

The picture is quite different for the last cluster, termed "control" rewards because all refer to having control over the pace of work and the degree to which a worker must generally devote full attention to his work. Relative to the other clusters, workers are more likely to say these items are true of their job and less likely to wish these characteristics to be true of their desired job. Thus, the means on the motivation versions of two of these items are actually slightly lower than the means of the corresponding rewards versions -- indicating that, on the average, workers are getting about as much of these rewards as they desire.

Both absolutely and relative to the kind of job they would desire, workers in Whitewall Plant report substantial deprivation of intrinsic, extrinsic and importance rewards. Subsequent analyses will determine whether these deprivations produce deleterious effects on health and well-being. For later analyses, indices of intrinsic, extrinsic, importance and control rewards, and parallel indices of motivation were constructed by summing the scale scores (0, 1, 2 or 3) of the responses to the items in each cluster in Table 2.4. Table 2.5 (variables 2-5, and 7-10) shows the reliabilities and intercorrelations of these measures.

The most striking features of Table 2.5 are the quite high correlations which obtain among intrinsic, extrinsic and importance rewards (r's = .56, .68 and .43) and among the same motivations (r's = .69, .67 and .52), and the quite low correlations between motivations and rewards. The high

Table 2.5

Intercorrelations and Reliabilities (in diagonal)
of Work Rewards and Motivation Indices

Variable	1	2	3	4	5	6	7	8	9	10
1. Perceived "Work" Rewards	(.90)									
2. Intrinsic Rewards	.94	(.87)								
3. Extrinsic Rewards	.71	.56	(.62)							
4. Importance Rewards	.83	.60	.43	(.76)						
5. Perceived Control Rewards	.28	.27	.27	.16	(.54)					
6. "Work" Motivation	-.01	-.03	-.04	.05	.01	(.92)				
7. Intrinsic Motivation	-.05	-.06	-.06	.00	.02	.94	(.89)			
8. Extrinsic Motivation	-.08	-.08	-.04	-.06	.02	.81	.69	(.83)		
9. Importance Motivation	.08	.04	.02	.18	-.00	.85	.67	.52	(.79)	
10. Control Motivation	.06	.05	.01	.08	.30	.41	.36	.35	.35	(.65)

Note: Correlations are significant as follows: $r \geq .05$ ($p < .05$, two-tailed), $r \geq .07$ ($p < .01$, two-tailed), $r \geq .08$ ($p < .002$, two-tailed). Missing data deleted pairwise resulting in an N between 1716 and 1788 depending on the pair of variables involved.

correlation among these seemingly different types of rewards and motivations is somewhat peculiar to blue collar occupations, which seem to be either good or bad with respect to most types of rewards and which hence induce workers to be motivated to attain jobs which are good or bad in all respects (cf. House, 1972). The modest exception to this clustering of all rewards into "good" jobs (or the lack of them in "bad" jobs) are control rewards which correlate only modestly (r's = .16 - .28) with other rewards (and similarly for control motivation). Thus control over work pace tends to vary somewhat independently of the level of intrinsic, extrinsic and importance rewards, but the latter three are fairly closely intertwined. This situation is somewhat in contrast to the situation in white collar occupations where jobs are more often high on one type of rewards and low to moderate on others. In particular some white collar jobs (e.g., minister, teacher) provide substantial intrinsic rewards but relatively modest extrinsic and perhaps importance rewards (cf. House, 1972). Thus, in the blue collar population one can more correctly speak of a general level of job rewards and/or motivation. For this reason and because previous analyses of the separate indices of intrinsic, extrinsic, and importance rewards and motivation revealed few distinctive causes or consequences of these three separate types, we have combined them into indices of general "work" rewards and "work" motivations (variables 1 and 6 in Table 2.5).*

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*The general "work" rewards and motivation measures were created by summing the scores of the relevant intrinsic, extrinsic, and importance indices. This method intentionally weights the contribution of the component indices to the variance total index in proportion to the number of items in each.

Overall Job Evaluations

Based on their perceived rewards, pressures and a variety of other factors workers arrive at some summary evaluation of their jobs and themselves as workers, generally termed job satisfaction and occupational self-esteem, respectively. Our interview scale included a five-item measure of occupational self-esteem taken from House (1972) and four items measuring general job satisfaction from Quinn and Shepherd (1974). The self-esteem items did not, however, intercorrelate with each other and with the job satisfaction items quite as they had in previous studies (these item intercorrelations are presented in Table 4 of Appendix B). One self-esteem item was virtually uncorrelated with the other self-esteem and satisfaction items and was deleted from analysis and index construction. The remaining self-esteem and satisfaction items and workers' responses to them are presented in Table 2.6.

The self-esteem items were actually presented with one of the pairs of descriptive adjectives on the left, then the seven rating scale numbers and then the other adjective on the far right. In Table 2.6 both members of the adjective pair are presented on the left side of the table, with the left-hand adjective corresponding to 6 on the rating scale and the right-hand adjective phrase corresponding to 0 on the scale. The distribution of responses to all items is highly skewed toward the positive end of the scale -- the proportion of workers responding at or below the midpoint of the scale (i.e., 0-3) ranges from only 10 percent up to 41 percent. Thus most of these workers report moderate to high occupational self-esteem.

Levels of job satisfaction are more moderate with 50 - 56 percent of the respondents choosing the intermediate response (coded 1) on each question. Of the remaining respondents on each question, more choose the

Table 2.6

Workers' Reports of Overall Job Evaluation:
Job Satisfaction and Occupational Self-Esteem

A Priori Self-Esteem Items

Below are pairs of words or phrases which describe how a person might see himself in his work. For each of the pairs, circle the number which best describes how you see yourself in your work.

Descriptions	Rating Scale (6)	(5)	(4)	(3)	(2)	(1)	(0)	(N)
G 1. Successful - Not successful	49%	19%	12%	12%	4%	2%	2%	(1731)
G 2. Important - Not important	35%	11%	13%	20%	6%	5%	10%	(1706)
G 3. Do my best - Not doing my best	71%	15%	5%	4%	2%	2%	2%	(1747)
G 4. Happy - Sad	25%	18%	18%	25%	6%	3%	4%	(1700)

A Priori Job Satisfaction Items

Item	Response (& code)	%	(Total N)
G 5. All in all, how satisfied would you say you are with your job?	0. Not at all or	5%	
	0. Not too satisfied	19%	
	1. Somewhat satisfied	56%	
	2. Very satisfied	20%	(1788)
G 6. Knowing what you know now, if you had to decide all over again whether to take the job you now have, what would you decide?	0. Decide definitely not to take the job	8%	
	1. Have some second thoughts	50%	
	2. Decide without hesitation to take same job	42%	(1783)
G 7. In general, how well would you say that your job measures up to the sort of job you wanted when you took it?	2. Very much like	23%	
	1. Somewhat like	56%	
	0. Not very much like	21%	(1784)
G 8. If a good friend of yours told you he (or she) was interested in working in a job like yours for your employer, what would you tell him (or her)?	0. Advise him (or her) against it	14%	
	1. Have doubts about recommending it	52%	
	2. Strongly recommend it	35%	(1764)

Note: Percentages sum to 100% for each item except for rounding error. Based on its inter-item correlations the fourth self-esteem item was included in the final job satisfaction index after being recoded to the same range as other job satisfaction items (i.e., 0, 1, 2 = 0; 3, 4, 5 = 1; 6 = 2).

positive alternative (coded 2) than the negative one (coded 0). The variation in the percentage of positive responses across questions suggests that most workers are, at best, moderately satisfied with their jobs but see few viable alternatives. Thus, more respondents (24%) report themselves "not too satisfied" or "not at all satisfied" than say they are "very satisfied" (20%), and 21 percent feel their job is "not very much like" the kind of job they originally wanted. Yet 35 percent would "strongly recommend" their job to a friend and 42 percent would "decide without hesitation to take the job if they had it to do over. In sum, most Whitewall Plant workers appear moderately satisfied with, and resigned to, their jobs, but only a distinct minority are highly enthusiastic about their work.

The items in Table 2.6 were combined into three indices as indicated in the note to the table. Based on the pattern of inter-item correlations (cf. Table B.4 of Appendix B), the "happy-sad" item, originally intended to tap self-esteem was incorporated with the four a priori job satisfaction items into the final index of job satisfaction. The remaining three self-esteem items in Table 2.6 comprised the final index of occupational self-esteem.

Pressures, Rewards, Motivation and Job Evaluations

In sum, most Whitewall plant workers experience their jobs as unrewarding in most ways, both absolutely and relative to their motivations, but report only low to moderate levels of most job pressures except work-load which they report to be quite high. These perceptions presumably cumulate to produce moderate levels of job satisfaction and relatively high levels of occupational self-esteem. However, the extent and nature of the effects of pressures, motivations and rewards on levels of satisfaction and self-esteem remain to be seen.

Table 2.7 presents the intercorrelations and reliabilities of the major measures of job pressures, rewards, and motivations. Job pressures (variables 1-3 in Table 2.7) manifest low to moderate negative correlations with work rewards (-.09 to -.28) while correlating slightly positively, if at all, with work motivations. Motivations and rewards are essentially uncorrelated except for the .30 correlation between control motivation and control rewards. Thus, pressures, rewards, and motivations constitute fairly independent factors which may affect satisfaction and self-esteem. The bottom rows of Table 2.7 show the correlations of these measures with occupational self-esteem and job satisfaction. These correlations suggest that job satisfaction is much more strongly affected by perceived pressures, rewards and motivations than is occupational self-esteem, though the relative strength of these effects is similar in both cases (e.g., the strongest correlate of both satisfaction and self-esteem is "work" rewards).

Summary and Conclusions

This chapter has described the nature and development of the measures of perceived job stress to be used throughout the remainder of this study. From a pool of 15 items three major indices of perceived job pressures have been constructed: (1) interpersonal and responsibility pressure (9 items dealing with role conflict, responsibility, and concerns over the quality of work), (2) workload (3 items on perceived quantity of work and time pressure) and (3) job-nonjob conflict (3 items mainly concerned with conflicts between job demands and nonjob activities such as family life). From a pool of 24 items, two major indices of job rewards (lack of which is considered stressful) have been constructed: (1) general "work" rewards (17 items dealing with intrinsic, extrinsic, and importance rewards)

Table 2.7

Intercorrelation and Reliabilities (in diagonal) of Major Indices of Job Pressures, Rewards, Motivations, and Overall Evaluations

Variable	1	2	3	4	5	6	7	8	9
1. Interpersonal & Responsibility Pressure	(.84)								
2. Quantitative Workload Pressure	.37	(.73)							
3. Job-Nonjob Conflict	.47	.73	(.56)						
4. Perceived "Work" Rewards	-.10	-.09	-.28	(.90)					
5. Perceived Control Rewards	-.22	-.21	-.14	.28	(.54)				
6. "Work" Motivation	.11	.14	.12	-.01	.01	(.92)			
7. Control Motivation	-.01	.03	.02	.06	.30	.41	(.65)		
8. Occupational Self-Esteem	-.13	-.03	-.26	.42	.04	.04	.04	(.64)	
9. Job Satisfaction	-.27	-.24	-.44	-.61	.20	-.13	.02	.41	(.83)

Note: Correlations are significant as follows: $r \geq .05$ ($p < .05$, two-tailed), $r \geq .07$ ($p \leq .01$, two-tailed), $r \geq .08$ ($p < .002$, two-tailed). Missing data deleted pairwise resulting in an N between 1690 and 1780 depending on the pair of variables involved.

and (2) control rewards (3 items dealing with control over work pace). Parallel indices of job motivations were also developed. Finally, indices of two more general job evaluations (affected by both pressures and lack of rewards) have also been constructed: (1) job satisfaction (4 items) and (2) occupational self-esteem (3 items).

Two kinds of evidence suggest that these measures capture significant forms of work pressure, deprivation, and discontent among Whitewall Plant workers. Deprivation of general work rewards appears to be a particularly acute source of stress. On the average workers report having a rather low level of rewards both absolutely and relative to their motivation for such rewards. Consistent with this high level of deprivation, work rewards is by far the strongest correlate of both job satisfaction and occupational self-esteem. In contrast, there is little perceived deprivation of control rewards, and this variable has relatively weak effects on satisfaction and self-esteem.

Whitewall workers report a high level of workload and relatively modest level both of job-nonjob conflict and of interpersonal and responsibility pressure. All of these variables have moderate to substantial, statistically significant negative associations with job satisfaction, and all but one (workload) have a similar effect on esteem. Thus, although their mean levels and associations with satisfaction and esteem are more modest, job pressures also appear to be a source of significant and consequential job stress for Whitewall Plant workers.

Indicators of perceived job stress have limited meaning and utility, however, unless we understand their causes and consequences. Chapter 3 will describe the development of a set of measures of objective conditions of work conducive to perceived job stress and Part II (Chapters 5 - 7) will consider how well they can account for variance in job pressures in Whitewall Plant. Part III (Chapters 8 - 13) will then consider how both objective and perceived stress affect a variety of indicators of health. Our initial explorations suggest that perceived job stress is a more prevalent and consequential problem for blue collar workers than is often believed. Let us now consider the sources of such stress, and later turn to its impact on mental and physical health.

Chapter 3

THE ASSESSMENT OF OBJECTIVE JOB CHARACTERISTICS

Studies of stress, including occupational stress, have tended to define and generally to measure "stress" as either an individual perception or an objective social event or condition. Such an either/or approach misses one of the most important issues in the paradigm of stress research presented in Chapter 1 (Figure 1) -- how and why any given social event or condition comes to be perceived as stressful by some persons but not by others. It also makes it impossible to determine the extent to which the perception of stress and health consequences thereof are a function of the nature of persons, the nature of their social environment, or of the fit between them. Such a determination must be made if research is to provide the evidence necessary to formulate intervention programs for reducing stress.

The major impediment to research on the interplay between objective conditions of work and subjective perceptions thereof has been the lack of systematic methods for measuring a full-range of potentially stressful occupational conditions. Although the importance of assessing both the objective work environment and subjective perceptions of it has been repeatedly emphasized (cf. French _et al._, 1974; Kasl, 1978), most tests of this and similar theories have utilized measures of the perceived or subjective environment derived from interviews or questionnaires (cf. Harrison, 1978). Yet workers' self-reported perceptions of their environments may already be contaminated by characteristics they bring to the job or by their subjective reactions to the work environment. Thus, the need for objective measures of the work environment is clear; the means for obtaining such measures is not.

Despite the centrality of work and occupations in the social sciences, the measurement of the objective nature of work and occupations is not well developed, with the possible exception of measures of occupational status (e.g., Duncan, 1961; Treiman, 1976). With respect to potentially stressful conditions of work, previous work has either focused intensively on a few individuals and dimensions of work (e.g., Kahn, *et al*., 1964) or developed a broader assessment of conditions of work without linking it clearly to issues of perceived stress and health (e.g., Turner and Lawrence, 1965). Perhaps the most ambitious effort to measure of a wide range of objective working conditions (Jenkins, *et al*., 1975; Survey Research Center, 1977) went on contemporaneously with the present study and utilized data collection procedures beyond the means of our project, though with generally similar results as noted below. Thus, special procedures were developed to assess potentially stressful objective conditions of work in Whitewall Plant, drawing on the limited prior efforts in the area and adapting them to the constraints of time, money, and manpower. This chapter describes the measures developed, while Chapters 5 - 7 will explore their impact on perceived stress and health.

A Brief Overview of Plant Processes and Jobs

Starting from basic raw material (natural and synthetic rubber, chemicals such as sulfur and carbon black, steel wire and steel and synthetic tire cords) the rubber division of Whitewall Plant manufactured a full range of automobile, truck and special purpose (aircraft and industrial machinery) tires. The chemical division processed vinyl chloride monomer gas into polyvinyl chloride powder which the plastics division converted into vinyl plastic sheeting. These processes involve a wide range of types of jobs from simple manual labor to skilled crafts and the operation of complex automated equipment. A brief description of the major processes and jobs may help the reader to better understand the job classification and rating procedures presented below.

Tire production begins with bales of raw and synthetic rubber being split into small pieces and then mixed with carbon black, pigments, and oil in Banbury machines, which are like giant dough mixers. These "batch processing" machines are semi-automatic, with an operator loading the appropriate chemicals and rubber into the machine, setting a timer and a few other controls to achieve the proper mix for a particular batch, and watching for malfunctions. The necessary chemicals and oils are mixed and weighed out into batch-sized quantities by other workers called compounders and mixers. This first rubber mixture (or "master batch") is then cut by another large machine into small marble-like pellets to facilitate further handling and stored in large bins until needed.

The master batch is later combined in a Banbury mixer with sulfur and other chemicals to make specific grades of rubber for specific types of tires. This final batch then passes through a mill -- a machine with two rotating drums (like a large washer wringer) which rolls the rubber into a continuous slab, sections of which are cut off and stocked to await further processing. The mill operator, or millman, watches over the machine and cuts off and stacks rubber slabs (sometimes completely by hand, generally with the help of a machine called a wig-wag loader). Other millmen later feed these slabs into warming mills which knead and heat the rubber to make it workable. The millmen then feed the heated rubber off onto continuous conveyor belts leading to either calenders or tubers.

Calenders are large, highly automated machines, somewhat like rotary printing presses, which combine rubber with steel or synthetic fiber cords into rolls of cord-reinforced rubber sheet (plystock) which will constitute the plies of the tire. Each calendering machine is operated by a highly skilled operator who programs the machine for its runs and 4-6 helpers who assist in making sure cord and rubber are fed properly into the machine and unload the finished rolls of plystock. Tubers are also large, fairly automated machines which extrude either inner tube or tread stock and cut these to appropriate lengths. The tuber operator sets up and adjusts the machine to produce a certain type and grade of tube or tread and coordinates a crew of helpers who remove finished tubes or treads from the continuous conveyor on which they come from the tuber and transfer them to other conveyors or large movable metal racks called skids. Other simple, repetitive operations such as inserting valves in tubes and splicing the ends are also performed at this point.

Forklift trucks transport the plystock rolls to bias-cutting machines which cut the plystock into appropriate length strips for a single tire ply. Depending on the type of tire to be produced (i.e., radial vs. bias ply) these cuts are made at various angles (or biases) so that the cords of the tire will be positioned at the appropriate angles to each other. After the bias cut is made the plystock is spliced back together and placed on another roller. A bias cutter operator sets up and adjusts the bias cutter for each roll, and coordinates several helpers who assist in loading and unloading rolls of plystock and in splicing the bias-cut plystock. The feeding, cutting, and rewinding of the plystock is performed by the machine in a generally continuous sequence for each roll.

These rolls of bias-cut plystock are then moved to and loaded on tire-building machines. Skids of the appropriate, pre-cut tread stock are also delivered to the tire building machine along with wire hoops coated with rubber and fabric (called "beads") which will form the inside rims of the finished tire. Beads are produced in several steps. Strands of wire are twisted into a thin cable and coated with rubber on wire insulator machines. An operator sets up the machine, with the assistance of a helper, and then monitors the automatic production of rolls of rubber coated cable. A second machine, with a single operator, cuts the cable and splices it into hoops and a third machine with a single operator wraps the beads with fabric to further reinforce them. The beads are then loaded on skids and transferred to the tire building machines.

At least in Whitewall Plant, which was converted to tire production just after World War II and is not as mechanized and automated as some newer plants might be, tire-building remains a machine-assisted "semi-craft." Each tire builder operates a tire building machine, consisting of a mechanically controlled metal drum on which the tire is built and rollers which hold the rolls of plystock and feed them to the drum. The tire builder first positions a section of plystock on the drum and then presses a pedal which rotates the drum tearing one ply of pre-cut plystock from its roll. The ends of the plystock are then manually spliced together with a roller. This process is repeated for as many plies as will constitute the tire sidewalls. Then the tread is applied and pressure spliced by hand to the center of the sidewall plies. Finally, two beads are placed over the ends of the drum and the sidewall plies are automatically folded up over the beads. The end result is a rubber barrel which is referred to as a "green" tire. The tire builder is the crucial link in the production process and is expected to maintain high levels of quality control in the positioning and splicing of the various parts of the tire.

Green tires are inspected and then stacked on skids until ready for curing and final finishing. They are transferred by forklift trucks or conveyors to the curing presses which resemble large waffle irons. After the green tire is inserted, the press closes, subjecting the tire to intense heat and pressure. This simultaneously gives the tire its final shape, imprints its tread and labelling, and sets off the chemical vulcanizing reaction which hardens the previously soft and sticky rubber. Tires are removed from the curing press (automatically or by hand) and move by conveyor to the finishing department where they are balanced, trimmed and buffed to remove blemishes, and finally inspected. Each of the finishing operations is a simple mechanical operation performed by a single worker operating a single machine. In some areas, tires are moved between finishing operations by conveyor, producing a fast moving assembly line, in other areas large pallets of tires are brought by forklift truck to a finishing machine, and the operator processes them at his own pace. Tires passing final inspection are stacked on large pallets and moved by forklift truck to the warehouse for final distribution. Rejected tires are either sent back for refinishing or routed to special tire repairmen. These workers either diagnose and correct the defects and return the tire for reinspection or decide the tire is irreparably flawed and hence must be scrapped. Similar, but fewer, operations are performed in finishing, inspecting, and repairing tubes.

All production departments are serviced by utility workers who substitute for absent workers and perform miscellaneous duties, by skilled craftsmen who install and repair equipment, and by a routine maintenance and service (e.g., cleaning and oiling) staff as well as by forklift truckers. Thus, the tire and tube production includes a full range of types of factory work -- from skilled crafts and automated machine operation through machine assisted operations of varying complexity (some on continuous "assembly" lines) to simple manual labor.

The plastics division produces rolls of plastic sheets by a process very similar to the chemical compounding and mixing, Banbury mixing, and calendering operations in the tire and rubber division. Operations and jobs in the chemical plant are slightly different. The largest and most important group of workers operate the chemical reactors in which vinyl chloride monomer gas is transformed by catalytic reactions into a liquified powder. This mixture is then passed through a series of larger rotating dryer drums which convert it to a powder which is then put in bags for shipment or use by the plastics division. Most workers in the chemical plant operate the reactors or dryers, which involves mainly monitoring a control panel to prevent malfunctions (monitoring is more complex and the consequences of a malfunction more serious in the case of the reactors). Bagging of the polyvinyl chloride powder is a simple, machine-assisted operation. The same supportive functions (craftsmen, janitors, truckers, etc.) are present in the plastics and chemicals division as in the tire division.

Assessment of Objective Job Characteristics

If we are to assess the objective psychosocial nature of different jobs, we obviously must know what we mean by a job. But many answers are possible to the question: "what is your job?" At the most specific level each of us has a unique job, such as "operator of Banbury machine number 5" on the first shift at Whitewall Plant. The term "job" also refers to the activities required of and performed by persons doing essentially the same tasks, for example "operator of Banbury machine number 5 at Whitewall Plant" (of which there are three, -- one on each shift). "Job titles and descriptions" are written at this level at Whitewall Plant. At a slightly higher level of aggregation is the "job" of "Banbury operator" without distinguishing between the specific numbers or types of Banbury machines. There were 49 such Banbury operators at Whitewall Plant at the time of this study. At a still higher level of aggregation we can speak of "batch processing machine operator," a job which includes Banbury operators and operators of similar types of machines (e.g., the large drying machines in the chemical plant), of which there are some 85 in Whitewall Plant. Finally, the term "job" is sometimes used synonomously with the term "occupation" to refer to a group of similar jobs which have been accorded some public, often official (as by the Census or Labor Department) recognition, such as lawyer, bookkeeper, plumber, or "operative (not elsewhere classified) in rubber products manufacturing" (a category which might include half or more of the workers in Whitewall Plant).

One could rate the characteristics of jobs defined at any of these levels of aggregation. The Survey Research Center (1977) study cited above used the most specific definition of job, with a trained observer rating the characteristics of a single person's job on the basis of about one hour of observation. This approach has the advantage of describing each person's unique job and of being applicable to any job, while ratings based on any of the larger "job" aggregations run the risk of assigning a single rating to jobs which are significantly different. "Occupation" is the highest level of aggregation of "jobs," but is generally the most detailed way of classifying types of work and workers in social research. But most occupations include a diverse range of jobs (e.g., most jobs in Whitewall plant would fall into a single occupation in the Bureau of Census detailed classification of occupations). Thus, occupation, as it is conventionally defined, is not a suitable rating object for our purposes. On the other hand, in observing and rating the job of an individual worker, what is rated is an unknown mixture of the externally given characteristics of the job (i.e., the demands, expectations, opportunities, etc. which would confront any holder of that "job") and the particular pattern of work which a given individual has established for that job. Problems of time sampling also confront such methods -- how many observations at what times provide a reasonable picture of the job.

Thus, conceptual and practical consideration led to the rating in this study of jobs which were broader than the position occupied by a single person yet much narrower than conventional occupations. Members of the company, local union, and research staff familiar with jobs in the plant were used as "expert" raters of objective job conditions. Assuming reasonable agreement existed among these raters, the average of their ratings would be used as the ratings of each objective job characteristic. Because raters had limited time yet we wished to keep the "jobs" being rated as distinct and homogeneous as possible with respect to the type of work performed and the demands, opportunities, etc. involved, it was decided to try to classify all jobs in the plant into 20-30 job groups. Such ratings should reflect the raters perception of the common characteristics, demands, etc. of the work performed by all workers and jobs in the job group. Thus, the ratings are unlikely to be greatly affected by how individual workers define and perform their jobs, but the ratings for a job group may not apply equally well to all jobs in that group. The level of aggregation of our groups is equivalent to that of "batch processing operators" in the example above. The strengths and weaknesses of this particular strategy for rating "jobs" will be discussed at various points below.

Categorization of Jobs into Job Groups

The company personnel department classified the plant's hourly workforce into about 300 job classifications, each of which could have a separate job description, evaluation, and pay rate. In fact, many of these job classifications had identical descriptions and evaluations, though there were still over 200 distinct job descriptions for the plant. This list of 200-300 job classifications was collapsed into a set of 21 job groups, each group containing workers doing quite similar types of work. This final set of 21 job groups was developed by the principal investigator of this project over a one-year period based on a series of observations in the plant, reading of company job descriptions, and discussions with management and union officials with broad knowledge of the nature of jobs in the plant. Table 3.1 briefly describes each of these groups and shows the total number of workers in that group in the plant, and the number of respondents in this study from that group. Each job group included between 6 and 44 of the separate company job classifications and between 41 and 454 workers in the plant (between 25 and 288 of our respondents).

Available evidence (e.g., data on company ratings in Table C.1 of Appendix C) suggests that each of the 21 groups is reasonably homogeneous within itself and quite distinct from the other groups in terms of the nature of the work involved. Several groups are somewhat heterogeneous

TABLE 3.1

SUMMARY DESCRIPTION OF JOB GROUPS AND NATURE OF THEIR WORK

Group Number, Name and Description	Number in Plant	Number in Study
1. Batch processing machine operators Operate large machines, using a few relatively simple controls and monitoring a few gauges to ensure proper operation. Must follow basic specifications, maintain basic records, and coordinate activities with others (though not responsible for their work).	85	68
2. Compounders and mixers Measure, weigh, and mix dry and/or wet ingredients by hand or with simple mixing machinery. Move ingredients and mixtures about as necessary.	57	36
3. Millmen Operate milling machines, including loading stock into mill by hand, overseeing operation, and cutting or slabbing off at appropriate time. Fairly heavy and repetitive manual work.	97	71
4. Calender and Tuber Operators Directs and coordinates crew of 4 - 6 persons operating quite large, complex, automated, continuous process machinery. Adjusts and monitors a rather numerous and complex set of controls. Coordinates work with other departments, and follows fairly exacting specifications.	44	30
5. Calender helpers Assist in operation of calendaring machines, performing a standard, but somewhat varied, set of manual and monitory or record-keeping operation under direction of calendar operators.	62	57
6. Tube Machine Helpers (and related continuous, repetitive machine-paced operations) Product is delivered by continuous conveyor to worker who performs a simple, repetitive, manual operation (e.g., apply cement, remove from conveyor, position in machine that presses tread splices). Proto-typical "assembly-line" work.	130	98
7. Tire Builders Build passenger, truck, or industrial tires on tire building machines. Repetitive, but rather complex and self-paced, work.	454	288
8. Bias Cutter and Wire Insulator Operators Directs and coordinates crew of 3 - 4 persons operating fairly large and complex machine (not as large or complex as calendars or tubers). Sets up runs, adjusts machine and monitors production. Schedules work and maintains records.	41	25

TABLE 3.1--Continued

Group number, name and description	Number in Plant	Number in Study
9. Bias Cutter and Wire Insulator Helpers Assist in bias cutting or wire insulating operations under direction of operator. Perform a limited number of fairly simple operations, some (e.g., splicing) quite repetitive and machine paced.	71	44
10. Cure Tires and Tubes Operate tire and tube curing machines, involving a fairly simple repetitive cycle of activities, i.e. load, start, unload, perhaps spray, load again, etc. or prepare, bag, de-bag tires and tubes before or after curing - again fairly simple repetitive work.	149	120
11. Inspectors Inspect a generally continuous flow of products for defects. Repetitive work, but requiring considerable concentration, alertness, and knowledge of defects.	83	69
12. Materials classification and testing Test or check product for defects and/or sort and classify products with possible defects. Work involves a fairly high degree of variety and personal initiative in recognizing nature of defects and/or deciding on disposition of materials.	64	37
13. Tire and Tube Finishing: Low Skill/Assembly Line Perform brief and repetitive finishing operation on tires or tubes supplied continuously by conveyor.	88	55
14. Tire and Tube Finishing: Low Skill/Batch Perform brief and repetitive finishing operation on palletized batches on tire and tubes. In contrast to group 13, work is self-paced and involves more loading and/or unloading of tires from pallets.	43	32
15. Tire and Tube Repair Repair and re-inspect tires and tubes with defects. Repetitive work, but requiring considerable concentration, alertness and knowledge of defects.	57	37
16. Cleaning and routine service jobs Perform routine cleaning, oiling, or replacement tasks.	122	98
17. Skilled Crafts Perform maintenance, installation of new machinery, or construction work requiring trade knowledge and skill.	322	225
18. Power Truckers and Related Drive power trucks or tractors inside or outside of plant.	274	147

TABLE 3.1--Continued

Group Number, Name and Description	Number in Plant	Number in Study
19. Utility and Service and Related Perform tasks as directed by supervisors, usually involving moving products and materials within departments and otherwise assisting, supporting or relieving other production workers.	423	248
20. Chemical and related operators Operate very complex continuous process production equipment, involving adjusting and monitoring a complex set of controls.	68	64
21. Low Skill Machine Tending Jobs All jobs involve repetitive performance of a routine task, generally involving loading and/or unloading a production machine. Other operations, if any, are performed by the machine.	81	66
TOTAL	2815[a]	1915[b]

[a] This figure is slightly lower than the estimated total hourly work force (N=2856) at the time of our study because the figures in this table were compiled prior to our survey and because some workers were not permanently classified by the company.

[b] Occupational information was not obtained for 15 of the 1930 workers who returned questionnaires.

in that they combine a number of somewhat different (though related) types of jobs (i.e., group numbers 12 and 21) or are comprised of jobs which, although classified similarly, are inherently heterogeneous even within a single area of the factory (i.e., group 19). A number of other groups (1,8,9,14,15, and 16) are, as indicated by some of their titles (e.g., "Bias cutter and wire insulator operators"), slightly heterogeneous because they incorporate two quite similar, but still distinct jobs. The remainder are quite homogeneous with respect to the type of work involved, particularly along the dimensions of interest in this study.

The set of 21 job groups constitutes a nominal occupational classification which has proved useful in its own right. More importantly, this categorization provided a manageable set of job groups for which objective ratings could be made of specific dimensions of the job which might be causes of perceived stress.

Development of Job Ratings

The next goal was to identify objective job conditions which might be causes of the major perceived stresses in this study. In reviewing the company job descriptions it was discovered that for purposes of setting wage rates the company made ratings of the jobs on a variety of dimensions relevant to the purposes of the research. These ratings were done by a member of the company's department in charge of setting piece and wage rates and checked by another member of the same department. These raters were well-trained and knowledgeable (and this was confirmed by the quality of the additional ratings they made specifically for this research). The company ratings for several jobs were replicated independently by the principal investigator during one visit to the plant, and he agreed quite closely with them. Consequently, the company job ratings were sufficiently valid and reliable to be utilized as one source of objective job ratings. For those potential stressors not covered by the company job ratings, an additional nine rating scales were developed. A set of "expert" judges from the university research group, company, and union rated each of the 21 job groups on each of these nine scales. These rating scales and their properties are discussed in more detail below.

Company Job Ratings

The 10 company job rating scales used in the research are defined briefly in Table 3.2. These ratings dealt with job conditions relevant to workers' reports of perceived intrinsic rewards (cf. company ratings of "education or trade knowledge," "experience," "skill," "initiative and ingenuity" required by the job), responsibility pressure (cf. company rating of responsibility for: "material or product," "equipment or process," "safety of others," and "work of others"), and quality concern or qualitative workload (cf. company rating of "mental effort.) These ratings were available for the vast majority, but not all, of the jobs in the plant. For each of the 21 job groups in Table 3.1, the mean of each company rating for jobs in that group (weighted by the number of workers in each job) was computed across all jobs for which ratings were available (at least 80 percent of the jobs in every group). This mean score was assigned as the objective rating of that working condition for all workers in that job group. These means and standard deviations of the company ratings for each job group appear in Table C.1 of Appendix C and show very little variance in the company ratings across jobs <u>within</u> each of the 21 job groups (most standard deviations were $\leq .5$ on a five point scale), although there is substantial

TABLE 3.2

DESCRIPTIONS OF COMPANY JOB RATINGS

Ratings for each dimension are made by company personnel on a scale from 1 (low) to 5 (high), except responsibility for material or product and responsibility for equipment or process which are rated on a scale from 1 (low) to 10 (high). Definitions of rating scales are as follows:

<u>Education or trade knowledge</u>: Measures the requirements for mental training received in school, or by any other means of education, to develop characteristics not readily acquired by actual work or experience on the job.

<u>Experience</u>: Measures the length of time usually or typically required by an individual under usual conditions, with the specified education or trade knowledge, to learn to perform the work effectively.

<u>Skill</u>: Measures the amount of physical skill, dexterity, precision and/or acuity of the senses, or the degree to which it is necessary to control any of the physical senses in performing the operation.

<u>Initiative and Ingenuity</u>: Measures the independent action, exercise of judgement, the number of decisions and the amount of planning the job requires. Also measures the degree of complexity of the work.

<u>Mental Effort</u>: Measures the degree and continuity of direct thought, mental alertness, or concentration which the job requires.

<u>Physical Effort</u>: Measures the amount of physical effort exerted and with what degree of continuity, or the degree of muscular fatigue caused.

<u>Responsibility for Material or Product</u>: Measures the responsibility for preventing damage to new materials and partially finished or finished product.

<u>Responsibility for Equipment or Process</u>: Measures the responsibility for preventing damage to machinery or equipment, or for preventing loss of productivity to subsequent operations.

<u>Responsibility for the Safety of Others</u>: Measures the care which must be exercised to prevent injury to others, and the probable extent of such injury.

<u>Responsibility for the Work of Others</u>: Measures the requirement of the job for assisting, guiding, or planning the activities of a number of other workers.

variance between groups. These data suggest that the 21 job groups are indeed internally homogeneous in terms of the nature of the work involved. Since the groups are so homogeneous, assignment of the group mean to all jobs in the group seemed justified, and in some ways preferable, as a means of averaging out potentially arbitrary rating differences across very similar jobs. This procedure also provided estimated ratings for workers in particular jobs for which company job ratings were not actually available, estimates based on the average ratings of very similar jobs.

"Experts'" Job Ratings

Additional ratings were needed of working conditions likely to affect workers' reports of the following perceived stresses: quantitative workload, role conflict, quality concern or qualitative workload, prestige or importance rewards, and control rewards. In addition the technology involved in each job was rated to allow study of the effects of technology on both other objective conditions of work and workers' perceptions of their jobs. The rating scales shown in Table 3.3 were developed for these purposes and were expected to be linked with perceived stress as follows: workload ratings with perceived (quantitative) workload, interpersonal demands ratings with perceived role conflict, the quality vs. quantity ratings with perceived quality concern or qualitative workload, the importance and prestige rating with perceived importance rewards, and the control over work pace rating with perceived control rewards.

The rating scales were developed by the principal investigator utilizing a variety of sources. Several rating scales (i.e., the two "workload" ratings and that for "quality vs. quantity") were adapted from the parallel perceived stress measures; that is, the "expert" judges were

TABLE 3.3

RATING SCALES USED BY "EXPERT" RATERS

	Rating Points				
	1	2	3	4	5
Workload					
1. How often does the job require the worker to work very fast	Never (0% of time)	Rarely (1-15% of time)	Some-times (16-40% of time)	Fairly Often (41-70% of time)	Very Often (71-100% of time)
2. How often does the job leave the worker with little time to get everything done	Never (0% of time)	Rarely (1-15% of time)	Some-times (16-40% of time)	Fairly Often (41-70% of time)	Very Often (71-100% of time)
Interpersonal demands					
3. Number of persons with whom worker is required to interact at least every 2 hours to do his job (incl. foreman)	0	1-2	3-4	5-7	8 or more
4. Proportion of working time spent in required interaction with others	0%-10%	11%-25%	26%-40%	41%-60%	61%-100%
5. To what extent is what the worker does each day determined by requests and directions from other people which may vary from day to day (vs. the worker's activities being determined by machine demands, established procedures or individual initiative)	Not at all	Slightly	Moderately	Greatly	Almost Totally
Quality vs. Quantity					
6. To what extent does the amount of work to be done make it difficult to maintain quality (Note: consider both how exacting the work is and how much there is to do; rating should increase as jobs are either more exacting or more hurried, and should be highest for jobs which are both exacting and hurried)	Not at all	Slightly	Moderately	Greatly	Very Greatly
Importance and Prestige					
7. To what extent are these jobs important and prestigious (people who hold them are respected)	Not at all	Slightly	Moderately	Greatly	Very Greatly
Control over pace of work					
8. To what extent is worker free to control or vary his own pace of work, i.e., to stop or slow down, talk to others, etc. (Note: All workers are assumed to operate within confines of general supervision and production scheduling. This rating refers to control over pace of work within these bounds.)	No Control (can neither slow nor stop unless relieved)	A little Control (Can slow but not stop unless relieved)	Moderate Control (Can stop occasionally without relief slow often)	Great Control (Can stop or slow down almost at will)	Very Great Control (Worker completely sets own pace)

Technology of work

9. Which of following best describes the technology of the work process:

1) Skilled craft - Complex job planned, controlled and executed mainly by worker with high skill using many different hand tools. Nature of task highly variable.

2) Automated Machine Operation - Operates a complex and highly automated machine - main task is setting and monitoring a large number of controls and watching for malfunctions.

3) Craft-Machine Production - Complex job controlled and executed mainly by one worker using a large machine which helps to perform, structure and pace the work process. Nature of task fairly standard, but requiring considerable skill.

4) Machine Operation or Tending - Relatively routine and simple job performed by a single worker with a single machine which largely structures, performs and paces the work, or assisting in the operation of a more complex machine, under the guidance of an operator.

5) Assembly Line Production - Worker performs a few simple operations on product as it moves continuously by on conveyor system.

6) Material Handling - Worker is primarily engaged in moving (or expediting the moving of) batches of materials between stages of the production process.

7) Simple Manual Work - Simple, largely manual work, done mainly with hands or a few basic hand tools. (e.g., scoop, broom, shovel, baling hook, hand cart, etc.). No machines routinely used.

asked to make judgements similar to those made by the workers themselves. The first two "interpersonal demands" scales were adapted from Turner and Lawrence (1965), and the third "interpersonal demands" scale and the "control over work pace scale" were created for this study but modeled after related measures of Turner and Lawrence. The "technology" rating was also created for this study, but was strongly influenced by the previous work of Woodward (1965) and Blauner (1964). Finally the "importance and prestige" scale was developed for this study.

Four university researchers familar with the plant (the principal investigator, one other sociologist, and two industrial hygienists), three management officials experienced in job ratings, and four union officials who frequently observed throughout the plant (two time study engineers and two members of the local union safety committee) were recruited as "expert" judges to make the final job ratings. The raters were provided with a detailed list of all jobs comprising each of the 21 job groups ("Classification on Jobs at Whitewall in Terms of the Nature of the Work Involved"), the set of rating scales in Table 3.3, a sheet for recording their ratings, and the following written instructions:

Procedures for Rating Job Characteristics

1. If you are not familiar with the "Classification of Jobs at Whitewall in Terms of the Nature of the Work Involved," please review that document until you have a good conception of the type of jobs included in each of the 21 groups in that classification.

2. You are then to rate each of the 21 groups in that classification on the 9 rating scales shown on the next two pages. Place your ratings on the form attached as the last page of this packet. Note that the first eight rating scales have a range of 1 to 5, the ninth has a range of 1 - 7.

3. In making your ratings use the following procedures:

   a. Rate all job groups on the first scale (How often does the job require the worker to work very fast) before going on to the next scale. Then rate all job groups on the second, and so on through the last scale.

b. For each group, enter the number (usually 1,2,3,4, or 5) which best describes its position on the given scale. Do not worry about whether you use all the numbers on the scale -- in some cases you may feel that no group deserves a score of 5, or of 1 in other cases. Do try to make distinctions between groups whenever it is meaningful and concentrate on making sure that the job groups are as accurately ordered as possible in your ratings. That is, two job groups which "require the worker to work very fast" about the same percentage of time should receive the same rating on the first scale while other groups which more often require the worker to work very fast should receive higher ratings on that scale.

c. Even where you feel that different jobs within the same group deserve different ratings, you must make a single rating for the group. In such cases, choose the rating which would accurately describe the largest number of workers in that group (based on "N in plant" in the "Classification of jobs at Whitewall" which is the number of workers in each job code or group in the plant). That is, give a rating which would describe the predominant type of job(s) in that group.

The principal investigator met separately for about one hour with each of the three groups of raters (company, union, university) to go over the procedures and answer questions. Otherwise, the raters had no special training; and each rater then proceeded to make his ratings independently.

Overall Interrater Agreement: An analysis was made of the agreement among raters by computing for each rating scale Pearsonian correlations between each rater and each other rater across the 21 job groups.* Thus, there are 55 unique pairs of raters (i.e., $(11^2-11)/2$), and for each pair there are nine interrater correlations (one for each scale).

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*Pearsonian correlations were the most efficient method of computing interrater agreements. Pearson r's were compared with two other measures -- percentage agreements and Cohen's (1960) weighted kappa -- for a small portion of the present data. The Pearson r's were approximately equal to the percentage of groups on which two raters agreed exactly. Values of Cohen's weighted kappa -- a measure of the proportion of exact agreement between raters which is greater than expected by change given the marginal distribution of the ratings -- are generally about .20 less than the Pearson r's. These figures may give the Pearson r's greater intrinsic meaning to some readers.

TABLE 3.4

AVERAGE CORRELATION OF EACH RATER WITH OTHER RATERS[a]

	Raters								
	University			Company			Union		
	A	B	C	D	E	F	G	H	I
Average r with Company Raters	.59	.50	.43	.51	.54	.51	.47	.37	.51
Average r with Union Raters	.47	.41	.41	.45	.40	.47	.44	.38	.44
Average r with University Raters	.58	.50	.54	.44	.55	.52	.43	.31[+]	.56
Average r with All Raters	.54	.47	.45	.46	.49	.50	.45	.35[+]	.51

[a]Entries in the bottom row are the mean of 72 correlations (each rater having nine interrater correlations (one for each rating scale) with each of the other eight raters. The other row entries are means of 27 correlations, or 18 for the correlations of each rater with the other two raters from the same source (i.e., university, company or union).

[+]Average correlation below $p \leq .05$ (one-tailed) significance level (N=21)

Initial analyses assessed the quality of the raters by averaging the 90 correlations of each rater with all other raters across all nine rating scales.* This measure of average agreement of a rater with all others was used along with their average correlation with the principal investigator's ratings as an indicator of how well a rater understood the task and shared in the collective standards being used. Two raters (one from the research staff and one from the union) were markedly worse than the others on both empirical criteria and were discarded. This left nine raters, three each from the union, company and university research staff. Table 3.4 shows the average correlation of each rater with all other raters and with the other company, union, and research group raters taken separately. With two slight exceptions, all of the average correlations in Table 3.4 are significant ($p < .05$, one-tailed). Most notable in Table 3.4 is the fact that correlations across different groups of raters (e.g., union and company) are about as high on the average as correlations within each group. Thus, whatever is being agreed on here is most likely a function of the jobs being rated rather than the particular viewpoint of the raters (unless all raters share the same biases). This agreement across sets of raters whose perspectives differed and who had never discussed rating issues with each other is striking.

Scale-Specific Interrater Agreement: Levels of interrater agreement are a function not only of the raters but also of the rating scales -- some ratings are easier to make than others. Further, some raters who generally

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*The technology rating is really a nominal variable, however the rating numbers used for technology are ordered roughly in terms of skill, and Pearson correlations provided a good rough index of agreement, especially for decisions regarding the quality of the raters. Final technology ratings were made based on a percentage agreement criterion described below.

show satisfactory interrater agreement may manifest very low agreement with other raters on a specific scale because they failed to grasp or utilize the same connotations or frame of reference as other raters for that scale. Thus, a further analysis was made of the average intercorrelations between pairs of raters for each rating scale (and for summative indices of the two rating scales for workload and the three for interpersonal demands). The left-hand column of Table 3.5 shows these scale-specific average interrater correlations across all pairs of the nine raters shown in Table 3.4. The interrater correlation for all scales except the second workload scale and quality vs. quantity exceed the $p \leq .05$ (one-tailed) level of significance. However, the considerable variation in the magnitude of these correlations suggests that some ratings (e.g., workload) were much harder to make than others (e.g., technology). In some cases, especially workload, the level of agreement is distressingly low.

The average correlation of each rater with all others was then examined for each scale in an effort to identify raters who may have had notably lower agreement rates on a certain scale. Removal of such a rater from further computations involving that scale would result in higher scale-specific interrater agreement and hence, presumably, in more valid and accurate final assessments of each occupational group on that scale. A rater was excluded from further analyses involving a particular scale if his average correlation with other raters on that scale was less than .30 (or .20 in the case of the two workload and the quantity vs. quality scales which had proved the hardest on which to obtain interrater agreement). Excluding these discrepant raters, if any (as indicated in the last column of Table 3.5), yielded a new set of scale-specific interrater correlations shown in the middle column of Table 3.5 which are substantially improved in several cases (most notably the second workload and quantity vs. quality scales).

TABLE 3.5

AVERAGE CORRELATION BETWEEN ALL PAIRS OF RATERS FOR EACH RATING SCALE, BEFORE AND AFTER EXCLUDING DISCREPANT RATERS ON EACH SCALE

Rating Scale[b]	Before	After	Excluded Raters (cf. Table 3.4)
1. Workload	.34+	.42	B
a. Work very fast	.37	.37	None
b. Little time to get things done	.17+	.34+	B,D,I
2. Interpersonal Demands	.60	.60	None
a. Number of persons	.48	.60	H
b. Proportion of time	.44	.50	H
c. Requests and Directions	.40	.44	C
3. Quality vs. Quantity	.26+	.48	E,G,H
4. Importance/Prestige	.65	.65	None
5. Control of Workpace	.62	.62	None
6. Technology	.80	.80	None

[a] Each entry in the "before" column is the mean of 36 correlations (one between each of the 36 unique pairs of raters). Entries in the "after" column are based on proportionately fewer correlations whenever raters were excluded.

[b] See Table 3.3 for description of rating scales. Workload and interpersonal demands are summative indices of separate scales listed under each.

+ Average correlation below $p < .05$ (one-tailed) significance level (N=21)

<u>Computation of Experts' Job Group Ratings</u>: The average rating by all raters, excluding those noted in Table 3.5, was computed for each rating scale except technology. Table C.2 of Appendix C presents the mean and standard deviation of each of these ratings for each job group. As in the case of the company ratings, the variation in these ratings is generally substantially greater between groups than within. The means in Table C.2 were also incorporated into the individual-level data as objective conditions of work for each worker in each of the appropriate job groups. In the case of technology, mean values were not interpretable. Instead, each group was generally assigned the technology rating on which at least a majority of raters agreed. At least five of nine raters (and generally more) agreed on the technology designation for 16 groups. For the other five job groups (#1,8,12,14, and 15 in Table 3.1) raters tended to divide between two similar categories (i.e., craft-machine production vs. machine operation or tending in the case of groups 1,8, and 15; assembly-line production vs. material handling in the case of group 12; and assembly-line vs. machine operation or tending in the case of group 14). In these cases, the principal investigator made the final decision. The final technology ratings are also given in Table 2 of Appendix C.

<u>Indices of Objective Job Conditions</u>

Table 3.6 presents the intercorrelations of 18 company and experts' job ratings (all except technology) computed across the 21 job groups. For several reasons the separate ratings were intended to be combined into composite indices. First, compared to the individual scales, such indices constitute more reliable measures (cf. interrater correlations of indices of workload and interpersonal demands in Table 3.5 and internal consistency coefficients in Table 3.7 below). Second, they are better approximations

to the multi-item perceived stress measures which the objective ratings were intended to predict. Finally, the high intercorrelations among some rating scales could introduce serious multicollinearity problems in regression analyses involving a number of such scales. These problems can be lessened by combining highly intercorrelated ratings into composite indices.*

Thus, separate job ratings were combined into summative indices whenever rating scales were conceptually related and moderately to highly intercorrelated. The criterion of conceptual relatedness was primary so that the indices of objective job conditions would be conceptually meaningful; and the number of job groups was insufficient to justify clustering on largely or solely empirical grounds (i.e., factor analysis or related methods based on intercorrelations). The following set of indices were created:

Objective "work" rewards. This index combined the highly correlated (r's = .58 to .86) company ratings of the education, experience, skill, and initiative and ingenuity required by the job with the experts' rating of importance and prestige which correlated .72 to .91 with those from company ratings. The company ratings tap the degree to which the job is interesting, varied, challenging, etc. -- the potential for intrinsic rewards in the job. The high intercorrelations among these items were expected. That "importance and prestige" -- more extrinsic job rewards -- should correlate as highly with the four company ratings as they do with each other was somewhat surprising. Recall, however, that in Chapter 2 levels of perceived intrinsic,

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*Although the correlations in Tables 3.6 derive from analyses across the 21 job groups, similar intercorrelations emerge at the individual level since the individual-level data merely weight the group means by the N in each job group.

TABLE 3.6

INTERCORRELATION OF RATINGS OF OBJECTIVE CONDITIONS OF WORK ACROSS JOB GROUP (N=21)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Education	--																	
2. Experience	.77	--																
3. Skill	.58	.80	--															
4. Ingenuity	.70	.86	.65	--														
5. Importance and Prestige	.72	.91	.87	.87	--													
6. Mental Effort	.25$^+$	.30$^+$	.36	.30$^+$	.36	--												
7. Quality vs. Quantity	.29$^+$	.49	.50	.43	.55	.76	--											
8. Work Very Fast	-.38	-.20$^+$	-.01$^+$	-.17$^+$	.00$^+$	.44	.42	--										
9. Little Time	-.19$^+$	-.10$^+$	.11$^+$	-.04$^+$	.01$^+$	.49	.31$^+$	.73	--									
10. Control	.31$^+$	.35$^+$	.19$^+$	.15$^+$	.05$^+$	-.14$^+$	-.09$^+$	-.78	-.62	--								
11. Number of Persons	.39	.38	.26$^+$	.39	.48	-.14$^+$	-.06$^+$	.11$^+$	-.08$^+$	-.34$^+$	--							
12. % Time with Others	.46	.46	.26$^+$	.38	.43	-.13$^+$	-.04$^+$	.00$^+$	-.03$^+$	-.12$^+$	.84	--						
13. Requests and Directions	.44	.38	.06$^+$	.26$^+$	.14$^+$	-.42	-.34$^+$	-.51	-.30$^+$	.39	.45	.64	—					
<u>Responsibility for:</u>																		
14. Materials	.52	.50	.52	.67	.73	.11$^+$	.30$^+$	.12$^+$	-.07$^+$	-.26$^+$	.56	.35$^+$	-.03$^+$	--				
15. Equipment	.58	.36	.41	.41	.51	-.02$^+$	-.06$^+$	-.10$^+$	-.06$^+$	.21$^+$	.56	.29$^+$	.14$^+$	.60	--			
16. Safety of Others	.50	.39	.43	.29$^+$	.44	.05$^+$	-.01$^+$	-.12$^+$	-.08$^+$	-.02$^+$	.62	.64	.36	.28$^+$	.53	--		
17. Work of Others	.17$^+$	.36	.19$^+$	.49	.44	.07$^+$	.28$^+$	.18$^+$	-.09$^+$	-.30$^+$	.69	.60	.17$^+$	.44	.23$^+$	.44	--	
18. Physical Effort	-.31$^+$	-.18$^+$	-.09$^+$	-.27$^+$	-.35$^+$	.29$^+$	.24$^+$	-.10$^+$	.19$^+$	.28$^+$	-.66	-.57	-.18$^+$	-.53	-.42	-.43	-.38	—

$^+$Not significant ($p \leq .05$, one-tailed) extrinsic, and importance rewards were highly enough correlated (r's = .43 to .60) that they were combined into a single index of perceived work rewards for purposes of many analyses. These intercorrelations largely reflect the fact that intrinsic and extrinsic rewards are highly correlated within blue-collar occupations. That is, blue-collar jobs with high prestige, pay, etc. almost invariably involve greater demands for skill, ingenuity, variety, etc.; and vice versa (cf. House, 1972; Ch. 5).

To make it more comparable to the perceived work rewards index, the objective work rewards index was created by first summing the four company ratings of education, experience, skill and ingenuity (creating an index of objective intrinsic rewards) and then computing standard scores for each individual on this measure and adding it to their standard score on the (quite reliable) importance and prestige rating. Thus, the importance and prestige rating was weighted the same as the total of the four "intrinsic" ratings. The perceived work rewards index is similarly composed about equally of intrinsic rewards (eight items) and extrinsic and importance rewards (nine items).

Objective qualitative workload demands. The highly correlated (r = .76) company rating of mental effort and the experts' rating of quality versus quantity conflict were summed into an index of objective qualitative workload. Neither of these two ratings correlated higher than .55 with any other item, thus suggesting that they constitute a reasonably distinctive cluster. This index is analogous to the index of perceived quality concern described in Chapter 2.

Objective quantitative workload demands. This reasonably distinctive cluster involved experts' ratings of quantity of work ("work very fast" and "little time") and control over work pace. If the scoring of the control rating is reversed so that low control receives a high score, these ratings correlate .62 to .78 with each other, while they correlate only modestly (.09 to .44) with the two ratings comprising the qualitative workload index and less than .40 with all other ratings (Table 3.6). Thus, these ratings were combined with the more reliable control rating being given the same weight as the combination of the two workload items into an index of objective quantitative workload, very analogous to the index of perceived (quantitative) workload described in Chapter 2.

Objective interpersonal and responsibility pressures. The above three indices include 10 of the 17 ratings of social psychological aspects of the job in Table 3.6 (the 18th rating is physical effort). The remaining seven ratings are the four ratings of responsibility (for materials, equipment, safety and work of others) and the three ratings of interpersonal demands ("number of persons," "percent time with others," and "requests and directions"). Moderate to high intercorrelations are evident within each of these sets of items (.45 to .84) in the case of interpersonal demands; .23 to .60 in the case of responsibility) though individual ratings often are as highly correlated with ratings in some of the above indices (especially job rewards) than with other ratings in the same cluster. Two of the three interpersonal demands items ("number of persons" and "percent time with others") also correlate moderately to highly (.29 to .69) with the responsibility ratings. The correlations of the other interpersonal demands rating with the responsibility ratings are quite low (-.03 to + .36).

In sum, most correlations between the interpersonal demands ratings and the responsibility ratings are almost as high as the correlations within each cluster, and neither cluster is highly distinct from other ratings e.g., job rewards). These facts, coupled with the fact that perceived interpersonal and responsibility pressures were combined into a single index suggested that the seven items on interpersonal and responsibility measures be summed into an index of interpersonal and responsibility measures.*

The Quality and Relevance of the Ratings

How well have we succeeded in obtaining ratings of the objective characteristic of jobs which are relevant to, or commensurate with, the perceived stress variables in Chapter 2? This question raises two issues: (1) how well do the ratings correspond to the perceived stress dimensions, and (2) how valid and reliable are the present ratings compared to other similar efforts?

It appears that our ratings have captured job characteristics commensurate with the perceived stress measures discussed in Chapter 2, though the objective ratings estimate only the demands and opportunities presented by the job, while the perceived stresses include an evaluative assessment of whether such demands and opportunities are too little or too great. Our raters were able to make ratings of dimensions intended to be reasonably commensurate with the perceived stresses, and the pattern of intercorrelations among the ratings is strikingly similar, though not identical to that observed among the perceived stresses in Chapter 2. The analyses of Chapter 2 yielded five major indices: (1) perceived job rewards; (2) perceived control rewards; (3) perceived interpersonal and responsibility

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*The actual summation of these scores was made by first computing summative indices of responsibility for things (i.e., materials and equipment), responsibility for people (safety and work of others), and interpersonal demands. Standard scores for these three "subindices" were then added to create the final index of interpersonal and responsibility pressure. Other methods of summing and weighting these items might be equally or more justified but would produce similar results since different weightings of the same items in a summative index generally correlate .95 or better.

pressure; (4) perceived workload; and (5) perceived job-nonjob conflict. The objective ratings yield four major indices: (1) objective job rewards; (2) objective interpersonal and responsibility pressure; (3) objective workload (combining ratings of workload and control); and (4) qualitative workload. Chapters 5 and 6 consider how the objective and subjective measures relate.

The present ratings appear to be quite comparable in quality to others, particularly those developed by the University of Michigan Survey Research Center in the most extensive effort to date to measure job characteristics or environment. Jenkins _et al_ (1975) arbitrarily used a value of weighted kappa (Cohen, 1968) of .33 as indicating acceptable interrater reliability, and they achieved this level for about half to two-thirds of the ratings they made. (Recall that their ratings were made by trained observers after watching individual workers for about an hour.) As indicated above, we found that if Pearson r and weighted kappa (K_w) were computed for the same data, r exceeded K_w by about .20. The present study achieved interrater r's greater than .50 on five of nine scales (after excluding markedly discrepant raters, who were weeded out in the much more elaborate training procedure of Jenkins _et al_.). Jenkins _et al_. achieve markedly higher interrater agreement when ratings of a job are made by two raters at the same time than when ratings are made by two raters at different times. Our procedure probably lies somewhere between these two in terms of difficulty of achieving agreement.

Comparing specific rating dimensions, the two studies achieve very similar results, although precise comparisons are impossible. Table 3.7 provides some rough comparisons, obtained by averaging selected data in Table 1 of Jenkins _et al_. and comparing it with relevant data from this

TABLE 3.7

COMPARISON OF RESULTS OF JENKINS ET AL. (1975)
OBSERVATIONAL RATINGS OF JOB CHARACTERISTICS
AND RESULTS OF THE PRESENT STUDY

	Average Interrater Agreement			Coefficient α	
	Jenkins et al.		Present Study	Jenkins et al.	Present Study
Measure	$K_{\underline{w}(s)}$ (n=45)	$K_{\underline{w}(d)}$ (n=448)	r (n=36)		
1. Intrinsic Rewards	.53	.27	--	.96	.96
2. Importance/Prestige	--	--	.65		
3. Interpersonal Demands	.40	.15	.52	.88	.86
4. Control	.38	.23	.62	.95	--
5. Work Pressures/Workload	.17	.08	.40	.70	.88

Note: $K_{\underline{w}(s)}$ = average weighted kappa between pairs of raters rating at the same time

$K_{\underline{w}(d)}$ = average weighted kappa between pairs of raters rating at different times

r = average Pearson r between pairs of raters in this study

study. The results appear very similar if we remember that Pearson r's generally exceed weighted kappas for the same data by about .20, and if our rating procedure is viewed as lying somewhere between the two procedures used by Jenkins _et al_. (the $K_{w(s)}$ versus $K_{w(d)}$ columns of the table) in terms of difficulty of obtaining interrater agreement. In both studies interrater agreement and internal consistency between similar ratings are higher for ratings of job rewards than for ratings of pressures, with measures of workload type pressures yielding relatively low levels of interrater agreement in both studies. The Jenkins _et al_. study also found that ratings of different job characteristics were moderately to highly intercorrelated, and that these intercorrelations largely reflected the actual structure of jobs rather than any biases or expectations of the raters (Moch _et al_., 1977).

In sum, the reliability of, and intercorrelations among, our ratings appear similar to those of ratings in the few other studies of this type, most notably the more extensive and ambitious work of Jenkins _et al_. (1975). Their validity and utility depends, in part, on how they relate to commensurate perceived stresses -- the problem which will concern us in Chapters 5 - 7.

Chapter 4

ANALYSIS STRATEGY AND METHODS

The analyses in subsequent chapters will follow the causal flow of the orienting paradigm of the study (Figure 1). Part II (Chapters 5-7) examines the relationships of objective job characteristics (measures of which were described in Chapter 3) to subjective perceptions of stress (measures of which were described in Chapter 2), including how these relationships are conditioned by a variety of individual and situational factors. Part III (Chapters 8-13) then examines how objective job characteristics and perceived stresses relate to indicators of mental and physical health including general feelings about work (i.e., job satisfaction and occupational self-esteem) and life (i.e., life satisfaction and neurotic symptoms), indicators of substance abuse (i.e., cigarette smoking and excessive drinking), self-reported symptoms of a range of physical ailments (angina, ulcers, dermatological and respiratory problems), and signs of ill health derived from medical examinations and tests (i.e., signs of respiratory and dermatological problems or high heart disease risk). Analyses in Part III also consider the impact of conditioning variables. The measures of conditioning variables and health outcomes are generally described as they are introduced.

Analysis Procedures

Regression Analysis as the Basic Statistical Procedure

The basic method of statistical analysis used throughout this report is multiple regression and correlation using ordinary least squares (OLS) estimation procedures.

Regression analysis provided a flexible concise and cost-efficient method of executing and presenting a large number of multivariate analyses. Because it can estimate the effects of many independent variables simultaneously, regression analysis deals effectively with complex confounding and interdependency among these variables. It also can estimate interactive and nonlinear effects as well as linear and additive ones. Finally, it yields results which are both informative and readily interpretable.

In many cases, however, the data do not fully meet all of the assumptions of these procedures. Thus, we have at various points compared our OLS results with those from other procedures more perfectly suited to our data (e.g., logistic function analysis, log-linear models of cross-tabulations, and simple cross-tabular methods). Invariably, all procedures yielded essentially the same substantive results; that is, the relative magnitude and statistical significance of estimated relationships between variables varied only slightly across different procedures, and the minor differences would not substantially alter our substantive conclusions. A series of reports of one aspect of the results of the project (House et al., 1975, 1979; House and Jackman, 1979) illustrate how cross-tabular, logistic function, and regression analysis yield essentially the same conclusions with respect to the separate and joint effects on health of perceived stress and reported exposure to physical chemical agents.

Our data most seriously violate the assumptions of OLS regression analysis when we consider in Part III a series of dichotomous dependent variables (with means between .05 and .15) assessing whether or not workers report symptoms indicative of a given ailment. Comparison of results in two reports (House et al., 1979 and House and Jackman, 1979) using regression and logistic function analysis with these variables yielded very similar conclusions, though the regression results have some less desirable statistical properties (e.g., yielding occasional predicted values of the dependent variables which are below 0 and hence outside the possible range of these variables). However, regression procedures are invariably more cost-efficient and regression coefficients are also more readily interpretable. For these reasons and for the sake of simplicity and consistency in this report, only the results of regression procedures are presented here.

Pairwise Present Correlations

Because data are missing for a small to modest number of cases (minimum = 4, maximum = 253) on all variables in this study and numerous variables are included in most analyses, missing data were deleted "pairwise" rather than "listwise" in computing all correlations matrices. That is, each correlation is computed across all cases with valid data on both variables involved (regardless of whether information is missing on other variables involved in the same analysis). Listwise deletion would have resulted in large numbers of cases ($\geq$500) being lost in most analyses. In establishing degrees of freedom for tests of significance in multiple regression, the N was assumed equal to the lowest number of cases involved in any correlation in the matrix used for that analysis -- a conservative procedure. The N for any analysis varies mainly as a function of the dependent variable involved. Since the N's for most analyses vary slightly but all equal or exceed 1,550, the N's for individual analyses are not presented. Only zero-order correlations $\geq$.05 are considered statistically significant at the $p \leq .05$ level, two-tailed, which is equivalent to setting the N for all such analyses at 1,535 -- again a conservative procedure but justified with such a large number of cases.

The Metrics of Variables and Regression Coefficients

Only metric regression coefficients are presented in this report. The primary reason for this is that a major focus of this study is on conditioning effects, which involves comparing the slope of regressions estimated or computed for different subgroups of the total study populations. Such comparisons are valid only for metric regression coefficients, since comparisons of standardized coefficients computed on different groups confounds changes in the slope of the regression line with changes in the variance of the independent or dependent variables across these groups (cf. Duncan, 1976). A second reason, however, is that the metric regression coefficients are generally quite interpretable. Most importantly, many health outcome variables are dichotomous, and the metric regressions coefficient express the change in the proportion of people "ill" or with "marked symptoms of illness" for each unit change in the independent variable. Many other independent and dependent variables in the analyses have inherently meaningful metrics, e.g., age and education are coded in years, smoking in terms of number of cigarettes smoked per day.

However the major objective job characteristic and perceived stress variables developed in Chapters 2 and 3 do not have inherently meaningful or interpretable metrics. Hence all of these variables were converted to standard scores prior to all analyses in Parts II and III. Thus, the metric regression coefficients for these variables express changes in these variables in standard deviation units.

Estimation of curvilinear effects. A frequently heard objection to regression analysis is that it does not allow for curvilinear relationships. This is both true and not true. By definition regression analysis estimates the linear effects of independent variables on dependent variables.

But by appropriate choice and definition of independent variables, curvilinear relationships can be estimated and tested in a regression framework. One way of doing this is to represent a single analytic variable (e.g., age) as a set of dummy variables in the regression analysis as in equation (3) below. Many of the conditioning variables in this study will be treated in this way in order to allow for the possibility that their direct and/or conditioning effects on the dependent variable are not linear.

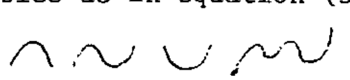
A second approach, polynomial regression, includes powers of each independent variable in the analysis. Thus, for example, equation (1) below allows for only a linear effect of X on Y, while equation (2) allows for a non-linear effect, as does equation (3):

$$\hat{Y} = a + b_1 X \qquad (1)$$

$$\hat{Y} = a + b_1 X + b_2 X^2 \qquad (2)$$

$$\hat{Y} = a + b_1 X_1 + b_2 X_2 + \ldots + b_y X_y + \ldots + b_y X_y \qquad (3)$$

where y = 1, ..., Y and X = 1 if a person is in the first category of the variable X, 0 otherwise, etc.

Whereas a set of dummy variables as in equation (3) allows for any possible curvilinear pattern (e.g., ), the X^2 or quadratic term in equation (2) estimates and tests for only a particular type of nonlinearity -- a relationship in which there is a single bend in the curve of the relationship between X and Y. Since only such quadratic curvilinearities are theoretically and substantively meaningful in this study, tests for nonlinearity were generally done by introducing quadratic terms in analyses of the impact of objective job conditions on perceived stress and of these variables on health.

If the quadratic (X^2) term was statistically significant, it was incorporated into all analyses, and together with the linear (X) term defines the nature of a curvilinear relationship. Depending on the coefficients of X and X^2, the nature of the relationship will vary roughly as follows (cf. Tukey, 1977):

If the regression coefficient for X^2 is:	and	The regression coefficient for X is:	then	The regression of Y on X is:
0 (or nonsignificant)		Positive (+)		Linear Positive:
0 (or nonsignificant)		Negative (-)		Linear Negative:
+		0		Parabolic:
+		+		Positively Skewed Parabolic
+		-		Negatively Skewed Parabolic
-		0		Inverted Parabolic
-		+		Positively Skewed Inverted Parabolic
-		-		Negatively Skewed Inverted Parabolic

The exact shape of the skewed parabolic curves will depend on the magnitude of the regression coefficient for X relative to the regression coefficient for X^2. Graphic presentation is used at several points to help the reader comprehend the quadratic effects.

The Analysis Strategy

Effects of Objective Conditions on Perceived Stress (Part III, Chapters 5-7)

The first major portion of the analysis will assess the impact of objective psychosocial job conditions (O_k's) on perceived stress (P_i's), net of (or controlling for) a set of control variables (X_i's) including age, education, physical effort demanded by the job and self-reported exposure to physical chemical agents. For each perceived stress, a series of stepwise regressions were run to select a set of linear and quadratic effects of objective job conditions such that each job condition added significantly to the variance explained by the others. A quadratic term for a variable was allowed to enter the equation only if it was significant net of the linear effect of that variable. The resulting final equations thus contained the set of control variables (X_i's) and linear (O_j's) and quadratic (O_j^2's) job condition terms, such that no other linear or quadratic effects of objective job condition could significantly improve the variance explained in perceived stress. These equations are of the general form:

$$\hat{P}_i = a + \Sigma b_j X_j + \Sigma b_k O_k + \Sigma b_1 O_k^2 \qquad (4)$$

The analysis then proceeded to test for the effects of a set of individual and situational conditioning variables (C_R's). Conceptually, a conditioning variable moderates or specifies the effect of one variable on another, in this case the effect of objective job characteristics on perceived stress. That is, for example, C conditions the effect of O on P if the slope of the regression of P on O varies significantly across levels of C. Statistically, this is evidenced by a significant interaction between the conditioning variable and the independent variable in predicting the dependent variable. Such interactions are tested by creating an interaction term or terms which represent the hypothesized interaction and then testing whether the interaction term or terms explain significant additional variance in the dependent variable, net of the additive or main effects of the independent and conditioning variable.

In the present study, conditioning variables have generally been coded as a set of three dummy variables representing high, medium, and low levels of each variable. Interaction terms were created by multiplying these dummies by the appropriate independent variables. To avoid linear dependencies, only two of the three dummy variables representing each conditioning variable and the corresponding two interaction terms were included in the actual analyses. If an independent variable was curvilinearly related to the dependent variable, interaction terms were formed and tested for both the linear (X) and quadratic (X^2) components of the relationship -- the quadratic interaction being tested net of the linear interaction.

Separate analyses were done for the effect of each conditioning variable on the relationship between each independent and each dependent variable. The baseline for the analysis is the appropriate version of equation (4) for each dependent perceived variable -- an equation containing the control variables and all significant linear and curvilinear effects of the objective job characteristics on that dependent variable. The first step in the analysis added the dummies for the conditioning variables to that equation:*

$$\hat{P}_i = a + \Sigma b_j X_j + \Sigma b_k O_k + \Sigma b_l O_k^{\,2} + b_m C_1 + b_n C_2 \qquad (5)$$

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*If the independent variable of interest was not in the baseline equation because it was not a significant predictor of P_i, it was added to the equation at this point. There are cases where a variable has no simple additive effect on a dependent variable, but does interact significantly with a conditioning variable in predicting that dependent variable. That is, the variable affects P only under certain levels of the conditioning variable.

As discussed further below, the additive or main effects of the conditioning variables, as estimated by b_m and b_n are of interest for several reasons.

Interaction terms involving the conditioning variable and a given objective job characteristic (e.g., O_5) were then added to equation (5), yielding:

$$\hat{P}_i = a + b_jX_j + \Sigma b_kO_k + \Sigma b_1O_k^2 + b_mC_1 + b_nC_2 + b_oC_1O_5 + b_pC_2O_5 \qquad (6)$$

If the C_1O_5 and C_2O_5 terms significantly increase the variance explained in P_i, then we have evidence that the relationship between O_5 and P_i varies across levels of C. The regression coefficients associated with O_5 (i.e., b_5), C_1O_5 (i.e., b_m), and C_2O_5 (i.e., b_n) indicate the nature of this variation. Substituting values of C_1 and C_2 in equation (6) yields the effects of O_5 on P_i at each level of C. If both C_1 and C_2 equal 0 (i.e., for persons in the omitted category of C, say C_0 or a "low" level of C), then equation (6) reduces to:

$$\hat{P}_i = a + b_jX_j + \Sigma b_kO_k + \Sigma b_1O_k^2 \qquad (6a)$$

If $C_1 = 1$ (or C is "medium") then equation (6) becomes:

$$\hat{P}_i = a + b_jX_j + \Sigma b_kO_k + \Sigma b_1O_k^2 + b_m + b_oO_5 \qquad (6b)$$

If $C_2 = 1$ (or C is "high") then equation (6) becomes:

$$\hat{P}_i = a + b_jX_j + \Sigma b_kO_k + \Sigma b_1O_k + b_n + b_pO_5 \qquad (6c)$$

That is, we can derive from equation (6) the effect of O_5 on P_i at each level of C. When C is "low" (i.e., $C_0 = 1$ and $C_1 = C_2 = 0$), this effect is given by the metric regression coefficient b_5. When C is "medium" (i.e., $C_1 = 1$ and $C_0 = C_2 = 0$), this effect is $b_5 + b_o$. When C is "high", this effect is $b_5 + b_p$.* These are the coefficients which are presented when a conditioning effect is significant. Thus b_5 in equation (6) is the effect of 0 on P_i when C is "low", b_o and b_n represent the <u>difference</u> between this effect and the effect when C is "medium" or "high", respectively. Hence, equation (6) provides a direct test and estimate of the conditioning effect of C on the relationship between 0 and P.

If the effect of 0_5 and P_i were curvilinear, a further equation is estimated adding appropriate interaction terms, i.e., $C_1 0_5{}^2$ and $C_2 0_5{}^2$. These coefficients estimate and test whether the quadratic component of the relationship varies across levels of C. Where the effect of 0_5 on P_i is entirely linear, the test of conditioning effects is a test for whether this relationship varies in strength across levels of C. If the effect of 0_5 on P_i is curvilinear, significant conditioning effects on C with respect to either 0_5 or $0_5{}^2$ indicate a change in the nature and extent of the nonlinear relationship across levels of P.

The analysis tested the effect of each conditioning variable in every relationship between each of six objective job characteristics and five perceived stresses -- a total of 30 relationships. With about 10 conditioning variables a certain number of significant effects would occur by chance alone. Thus, before attributing substantive significance to the results of these analyses, we have used two criteria to ensure that the pattern of results is not likely to reflect chance alone. Before concluding we have real evidence of conditioning effects, we have required that the

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*These estimates are identical to the metric regression coefficients which would be obtained if separate analysis to the effect of 0_5 on P_i were run for the three levels of C (the data having first been adjusted for the effects of all X_j and all other 0_k). It might also be noted that a, a + b_m and a + b_n are intercepts which would be obtained in these separate analyses.

number of such effects be greater than could occur by chance if the tests were independent of each other and that the pattern of these effects be substantively meaningful and interpretable. If the number of effects is not greater than might occur by chance, we conclude there is no evidence of conditioning effects.* Even if the number of significant effects equals or exceeds the level expected by chance, the pattern of such effects must be fairly consistent and substantively meaningful and interpretable before we conclude that there is clear evidence of a conditioning effect.

Effects of Job Characteristics and Perceived Stress on Health (Part III, Chapters 8-13)

After assessing the effects of job characteristics on perceived stress, the analysis turns to estimating the effects of both of these on a range of mental and physical health outcomes noted at the beginning of the chapter. The strategy here is analogous to that just described except that the dependent variables are now health outcomes with both job characteristics and perceived stress as independent variables
The analysis begins by estimating the linear and curvilinear effects of objective job characteristics on health, using procedures identical to those discussed above, except that the dependent variable is health instead of perceived stress. Conditioning effects were also tested in the same manner as above.

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*In fact, the tests are not independent of each other due to intercorrelation among the variables involved. Hence the precise number of significant conditioning effects which might occur by chance is not easily determined. Nevertheless, the number expected _if_ the tests were independent seems to be a reasonable heuristic criterion for making such a decision. Thus, by chance alone, we expect 10 percent of all tests of conditioning effects to be significant at the $p \leq .10$ level.

The analysis then turns to the impact of perceived stress on health. These effects are analyzed in conjunction with those of job characteristics. Thus, stepwise regression is used to determine a most parsimonious set of both objective job characteristics and perceived stress for predicting each health outcome. Beginning with an equation predicting health from control variables and objective job characteristics (identical in form to equation (4) but with health outcome as the dependent variable), perceived stress variables are allowed to enter the prediction equation until no variable makes a significant increment to the explained variance. Again, the effects are allowed to be linear or curvilinear. The result is an equation of the form:

$$H_x = a + \Sigma b_j X_j + \Sigma b_k O_k + \Sigma b_l O_k^2 + \Sigma b_i P_i + \Sigma b_m P_i^2 \qquad (7)$$

This analysis not only shows how perceived stress affects health, but by comparison with the analysis of effects of objective job characteristics on health it also indicates how the effects of objective job characteristics are (or are not) mediated through the perceived stresses in this study. Three "health" outcomes (job satisfaction and occupational self-esteem, which are viewed as job-specific indicators of mental health, and smoking) are also treated as additional predictors of some of the subsequent health outcomes in the analysis since, for example, job satisfaction is one source of life satisfaction and smoking is one cause of respiratory symptoms.

The effects on potential conditioning variables on the relationship of perceived stress to health are then tested using methods identical to those used in assessing the impact of potential conditioning variables on the relationship between job characteristics and perceived stress. For each health outcome, the analysis begins from an appropriate version of equation (7) and the interaction of each conditioning variable with each independent variable is tested by first forming interaction terms (i.e., the product of the conditioning variables and perceived stress and then estimating the significance and nature of these effects of these interaction terms in the same manner as was done in equations (5) and (6) above. The interpretation and presentation of the results are also analagous to the discussion above.

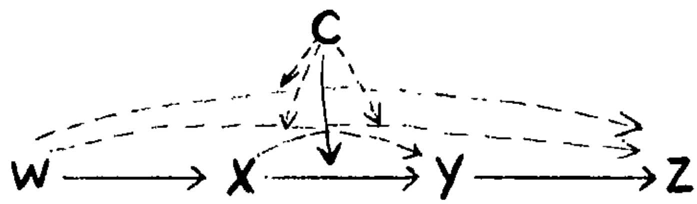
Two Cautionary Notes

The Assessment of Conditioning Effects

Theoretically, evidence of conditioning effects derives from evidence of statistical interaction. However, conditioning variables may have main or additive effects on a dependent variable apart from any interactive effects they may have. Such main or additive effects of conditioning variables may be interpreted in several ways. First, they can be interpreted as simply additional causes of the dependent variable. For example, most symptoms of ill health increase with aging and thus age is treated as a control variable in all analyses. But the conditioning effects of age will be over and above, and quite independent of, the main effects noted here.

Second, a main effect of a conditioning variable on a dependent variable may be the result of a conditioning effect, the independent variable of which has been omitted from the analysis. For example, if C conditions a relationship between X and Y, but X is not measured and/or not analyzed in conjunction with Y and C, then we may observe a main effect of C on Y rather than a conditioning effect of C on the $X \rightarrow Y$ relationship.

Finally, consider what will be manifest empirically when a conditioning variable (C) conditions a relationship (X → Y) which is in the middle of a causal chain:



How would C affect other variables and relationships in the chain? First, C will have no necessary conditioning effect on other direct causal relationships in the chain, since these are either causally prior (W → X) or subsequent (Y → Z) to the effect of C. In contrast, C should condition (as indicated by the <u>dotted</u> arrows) all indirect causal relationships (indicated by the <u>dashed</u> arrows) in which the X → Y relationship is one link (i.e., W → Y, X → Z, or W → Z), though the conditioning effect may be attenuated (and even statistically nonsignificant) depending on how strong the links are in the causal chain and how C affects other relationships in the chain.

Importantly, however, the conditioning variable should be associated with all variables in the causal chain subsequent to the point of impact of the conditioning variable. In our example, C should be correlated with Y and Z. The sign, strength, and significance of this relationship will depend on the nature and strength of the conditioning effect of C on the X → Y relationship and the strength of the Y → Z relationship.

These considerations are especially important in a cross-sectional study. W, X, Y, and Z in the above diagram may represent not only con ceptually distinct variables with a causal ordering (e.g., job characteristics → perceived stress → general job evaluations → health outcomes);

they may also represent measures of the same variable at two or more points in time. For example a conditioning variable may act to modify an initial perception of stress in response to objective job characteristics and this will in turn alter health outcomes (W = job characteristics → X = perceived stress at time 1 → Y = perceived stress at time 2 → Z = health). If our cross-sectional study assesses perceived stress at time 1 rather than time 2, we will draw quite different conclusions as to the presence or absence of statistical interactions involving C. With a time 1 measure of perceived stress we would observe no conditioning effect of C on the relationship of job characteristics to perceived stress (i.e., W → X), but C would condition the impact of perceived stress on health (X → Z). An exactly opposite pattern of effects occurs if we measure perceived stress at time 2.*

The moral of all this is that if we find significant interactions between a putative conditioning variable (C) and an independent variable in predicting a dependent variable, we can be reasonably confident that C does exert true conditioning effects. But if we do not find such interaction effects, the inference task is not so easy. We must also pay attention to direct and indirect (i.e., mediated by some other independent variable) main or additive effects of the conditioning variable on the dependent variable, as these <u>may</u> be evidence of true conditioning effects which are not adequately caputured in our study due to the omission of an independent variable in a conditioned relationship or to the time of measurement of

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*These problems are inherent to cross-sectional studies but not unique to them. Longitudinal designs do not necessarily resolve the dilemma since one might measure perceived stress, for example, at two points in time, but both are prior (or subsequent) to the impact of the conditioning variable.

the independent or dependent variable in a conditioned relationship. (They may also merely indicate an independent direct effect of the conditioning variable on the dependent variable). Of course, the absence of both additive (main) and interactive ("conditioning") effects of a putative conditioning variable would constitute strong evidence against its having conditioning effects or direct effects on the dependent variable.

The Meaning of r^2 and R^2

One of the most useful characteristics of correlation-regression analysis is that it yields estimates of the proportion of variance (r^2 or R^2) in the dependent variable explained by a given independent variable or set of independent variables. Thus, one can go beyond estimates of statistical significance to talk of the magnitude of relationships. This is useful and important when the sample size of a study is as large as ours. Quite small relationships (e.g., any Pearson correlation around .047 or larger) can be "statistically significant" ($p \leq .05$).

However, it is important to remember that what constitutes a "good" or "large" or "important" r^2 (or R^2) depends on many factors and that r^2 (or R^2) is not the only indicator of the magnitude of relationships. One might assume, for example, that any relationship which explains less than 1 percent of the variance in a dependent variable is substantively trivial, even if statistically significant. Such an assumption would render many of the results of this study trivial, along with many results from other work on occupational stress and health and from social science more generally.

This would be a mistake, at least in the present study, for two reasons. First, r^2 and R^2 are artificially depressed in some cases, for example, when we use highly skewed dichotomous dependent variables (cf. Nunnally, 1967:132-33).

The magnitude of this effect is evident from comparisons between correlations involving a continuous and dichotomous (mean = .147) measure of neurotic symptoms present in Chapter 9 -- the same independent variables explain twice as much variance in the continuous variable as in the dichotomous variable. (The effect of dichotomizing is even greater as the mean of the dichotomy declines.) Second, a quite different estimate of the magnitude of relationships is given by the unstandardized regression coefficients and the differences on the dependent variable predicted on the basis of these coefficients for different levels of the independent variable. Thus, for example, a stress variable may explain 1 percent or less of the variance in a dichotomous measure of ulcer symptoms, yet the rate of ulcer symptoms rises by a factor of 2 or 3 as the level of stress goes from lowest to highest. Is that a trivial relationship? Probably not. Thus, at a number of points associations will be discussed which appear small in terms of variance explained, but consequential on other grounds.

PART II

OBJECTIVE JOB CHARACTERISTICS AND PERCEIVED STRESS

Chapter 5

THE IMPACT OF OBJECTIVE JOB CHARACTERISTICS ON PERCEIVED STRESS

Chapters 2 and 3 described the development of a series of reasonably commensurate measures of perceived occupational stress and objective job characteristics conducive to stress. Having both objective and subjective measures of occupational conditons, this study can address issues of both scientific and practical importance which have received little attention in prior research on occupational stress and health. We know little about how, why, and to what extent objective conditions of work, or of life more generally, influence individuals' perceptions of stress and satisfaction. Yet, in much existing theory and practice, modification of objective job characteristics, what is often called job enrichment or enlargement, constitutes perhaps the major strategy for improving the quality of work and reducing occupational stress. Intelligent decisions as to what job characteristics, if any, should be changed and how much they should be changed require understanding of the extent to which various objective job characteristics affect particular perceived occupational stresses and satisfactions.

Chapter 2 described the development of measures of several distinct types of the two major forms of perceived stress -- job rewards (lack of which is stressful) and job pressures. Four types of rewards were assessed, though three of these (intrinsic, extrinsic, and importance) rewards proved highly related and were combined into a single index of perceived "work" rewards. Control rewards (freedom to vary one's attention to and pace of work) constituted a fairly independent type of rewards. Three major types of job pressures emerged from the analyses: (1) interpersonal and responsibility pressures (combining indices of role conflict, responsibility, and quality concern), (2) quantitative workload, and (3) job-nonjob conflict.*

A separate analysis of objective job ratings in Chapter 3 yielded a very similar set of measures: (1) objective "work" rewards (composed of ratings of job prestige and potential intrinsic rewards such as the skill, ingenuity, and initiative required by the job), (2) interpersonal and responsibility demands, (3) quantitative workload demands and (4) qualitative workload demands. Two other objective job characteristics will also be considered here -- the worker's shift and whether the job was paid on an individual piecework basis.

Shift was included because previous research suggests that working other than the day shift can disrupt workers' nonwork lives (Mott, et al., 1965). The evening shift (3 p.m. - 11 p.m.) in Whitewall Plant is particularly disruptive because it prevents the worker (especially in a smaller city) from partaking of many recreational and leisure activities which occur during those hours and takes workers with families away from home during the hours other family members are usually home and awake. Reports of job-nonjob conflict were highest among evening shift workers, markedly lower among night shift workers and lowest among day shift workers. To simplify the analyses and reporting of the data, most analyses compared evening shift workers with all others (and this dichotomous shift variable explained almost as much variance in relevant dependent variables as a set of two dummy variables representing all three shifts).

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*Many analyses reported in this and subsequent chapters have also used the components of the composite work rewards and interpersonal and responsibility pressure indices. Sizable differences in results for these components vis-a-vis each other or the composite index were rare but will be noted. Similar disaggregation of the indices of objective conditions was generally not possible due to the high intercorrelations among components of those measures.

In contrast to other large manufacturing industries, many jobs in tire and rubber production involve piecework modes of payment. Two forms of piecework payment existed in Whitewall Plant -- individual piecework and group or pool piecework. In both cases workers receive a basic hourly wage determined by collective bargaining and above that are paid per unit of production by the individual or group. In group or pool piecework, production of a group of about 4-8 workers involved in a single process with a single product (e.g., calendering) is monitored and the pay of each is adjusted in accordance with the production of the group. The process of determining any worker's pay is more complex and less a function of individual effort than with individual piecework, and the piecework mode of payment has less influence on the worker's total rate of pay. Thus, although pool pieceworkers generally fell between pure hourly workers and individual pieceworkers on many dependent variables, for simplicity in analyses and presentation they are combined with hourly workers. As with our decision to use a dichotomous measure of shift, little explanatory power is lost.

Thus, our analyses and results will look at the effects of individual piecework versus hourly wages and group piecework. The pay of individual pieceworkers over and above their hourly rate was totally a function of their own effort and their piecework pay constituted half or more of their total pay. For each piecework job, a base rate (number of units expected from an average worker) and piece rate (pay per unit) were determined through negotiations between union and management. If a worker's production fell too far below the base rate he or she could be removed from the job. Otherwise workers set their own production rate and pace. As soon as they achieved their base rate they could slow or even halt their production for the day (though not leave the plant until their shift was up). By producing over the base rate they could substantially increase their income. In general, individual piecework jobs (of which tire builidng was the best paid and hence prototypical in many workers' minds) were viewed as opportunities to work hard to earn more money, and workers in such jobs tended to work very rapidly. Thus piecework was a factor which could alter workers' behavior and hence perceptions of their jobs from what was formally required (the base rate).* In later chapters it will also be considered as a conditioning variable.

Objective Job Characteristics and Perceived Stress

Bivariate (or zero-order) Relationships

Table 5.1 shows the intercorrelations of the major indices of both perceived stress and objective job characteristics conducive to stress. The triangle formed by the first six rows of the table shows the bivariate (zero-order) Pearson correlations among indices of rated objective job characteristics and the dichotomous variables indicating whether a person worked the evening shift or had an individual piecework job. As Table 3.6 would lead us to expect, objective work rewards are substantially positively correlated with both qualitative workload demands ($r = .66$) and interpersonal and responsibility demands ($r = .55$) -- blue collar jobs that are rewarding are also demanding, at least in a qualitative sense. Quantitative workload demands, however, are modestly negatively correlated ($r = -.28$) with objective work rewards. The three objective ratings of job

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*It should be noted that objective ratings of quantitative workload, etc., for piecework jobs were made in terms of the base rate rather than in terms of the prevailing work rate for workers in the job.

TABLE 5.1

INTERCORRELATIONS OF OBJECTIVE JOB CHARACTERISTICS
AND PERCEIVED STRESS

Variable	1	2	3	4	5	6	7	8	9	10	11
<u>Objective Job Characteristics</u>											
1. Objective Work Rewards	(.96)[a]										
2. Interpersonal and Responsibility Demands	.55	(.84)									
3. Quantitative Workload Demands	-.28	--[b]	(.88)								
4. Qualitative Workload Demands	.66	--	.15	(.91)							
5. Evening Shift	--	--	.05	.05	(--)						
6. Piecework	.21	-.27	-.22	.39	.08	(--)					
<u>Perceived Stress</u>											
7. Perceived Work Rewards	.31	.23	-.18	.12	-.06	-.05	(.90)				
8. Perceived Interpersonal and Responsibility Pressure	.12	.12	-.08	--	--	--	-.10	(.84)			
9. Quantitative Workload Pressure	.09	-.07	--	.17	--	.29	-.09	.37	(.73)		
10. Job-Nonjob Conflict	.06	--	-.08	--	.11	.06	-.28	.47	.23	(.56)	
11. Control Rewards	--	--	-.19	--	--	.06	.28	-.23	-.21	-.14	(.54)

[a]Reliability coefficients (α) in the diagonal, except for measures based on only a single item or rating.

[b]-- = Correlation does not achieve minimal level of statistical significance (i.e., $r \geq .05$, $p \leq .05$, two-tailed). All correlations shown are significant at this level.

demands -- interpersonal and responsibility demands and qualitative and quantitative workload demands -- are essentially independent of each other, with the slight exception of a .15 correlation between the two types of workload. As might be expected, shift shows no correlation greater than .05 with the other objective ratings (since most types of jobs are represented on all shifts). Finally, piecework correlates moderately positively with objective work rewards and qualitative workload demands, somewhat negatively with interpersonal and responsibility demands and quantitative workload demands, and very slightly positively with shift. In sum, except for the confounding of job rewards with interpersonal and responsibility pressures and qualitative workload, the various objective characteristics of jobs are largely independent, being at most moderately correlated with each other.

The lower right hand triangle formed by the last five variables in the table shows the intercorrelations of perceived stress to have a somewhat different pattern. Perceived job rewards and control rewards are moderately positively correlated ($r = .28$) as are the three indicators of perceived job pressures (r's = .23 to .47), but perceived rewards and perceived pressure variables always correlate slightly to moderately negatively. Two implications follow from perceived rewards and pressures being modestly negatively correlated while objective rewards and pressures are often fairly highly positively correlated. First, the relationship between objective job characteristics and perceived stresses cannot be very strong. Second, the effect of a particular objective job characteristic on any perceived stress must finally be analyzed while controlling for other objective ratings.

The zero-order correlations between the objective job characteristics and the perceived stresses appear in the block in the lower left-hand corner of Table 5.1. Considering the high intercorrelations among some of the objective job characteristics, the pattern of these correlations suggests that objective job characteristics have meaningful effects on perceived stresses, but the magnitude of these effects is very modest indeed. The strongest objective predictor of a perceived stress measure is almost always that objective rating expected a priori to be most commensurate with that perceived stress. The clearest example is perceived job rewards which correlates .31 with objective job rewards, but manifests lower correlations (both positive and negative) with the other job pressures.

Perceived interpersonal and responsibility pressure correlates .12 with interpersonal and responsibility demands and with objective job rewards. Corrected for unreliability, the correlation with interpersonal and responsibility demands would be larger since it is less reliable than the index of objective work rewards. Perceived workload pressure is highly correlated (.29) with piecework and moderately correlated with qualitative workload demands (.17), though uncorrelated with quantitative workload demands. As will become clearer below, the effects of quantitative workload demands on perceived workload pressure are masked in the zero-order correlation by the effects of piecework. As expected, shift is the strongest correlate ($r = .11$) of perceived job-nonjob conflict; and quantitative workload demands (which includes a rating of control over work pace) is by far the best predictor ($r = .19$) of perceived control rewards.

In sum, the zero-order correlations in Table 5.1 reveal a meaningful but modest effect of objective job characteristics on perceived stresses. For a number of reasons, however, zero-order correlation constitute an inadequate assessment of the effects of objective job characteristics on perceived stress. The high intercorrelations between some objective job characteristics make it difficult to see their independent effects and may actually suppress some of the zero-order correlations between job characteristics and perceived stress. Similarly, the effects of a given objective characteristic on a perceived stress may be spuriously inflated or suppressed by its correlations with other personal or environmental factors which also affect that perceived stress. Given perceived stresses may also be affected by multiple job characteristics, and hence a measure of the cumulative effect of all objective job characteristics is needed. Finally, the Pearson correlations in Table 5.1 reflect only linear relations among variables, and there is good reason to believe that some effects of objective job characteristics on perceived stress are curvilinear. For example, moderate amounts of certain objective sources of pressures such as workload demands may produce maximum perceptions of job rewards or satisfaction while very low levels (i.e., underload) and very high levels (i.e., overload) adversely affect these perceptions (cf. Kahn and French, 1970).

Multivariate Analyses

These problems with the data in Table 5.1 were overcome by performing stepwise multiple regression on each perceived stress index in Table 5.1 on the objective characteristic indices in that table and an appropriate set of control variables, allowing for curvilinear as well as linear effects of job characteristics on perceived stress. Operationally, each perceived stress was first regressed on two personal characteristics (age and education) and two job characteristics (self-reported exposure to physical-chemical agents* and physical effort required by the job) which might also markedly affect perceptions of job stress. Then the objective job characteristic (if any) from Table 5.1 which produced the largest statistically significant increment to prediction (i.e., the largest R^2 increment) was added, then the next largest, and so on until no predictor could significantly increase the explained variance. Then, quadratic or squared terms for each of the objective characteristics were similarly allowed to enter the equation if they produced a significant increment to R^2, net of both the linear component of that variable and any other job characteristics (linear or quadratic) or control variables already in the equation. The resulting final equation represented the most parsimonious set of significant linear or curvilinear effects of objective job characteristics on each perceived stress.

Table 5.2 presents the resulting equations predicting each of the five perceived stress variables. The note at the bottom of the table explains the scaling of the variables which is important in interpreting the coefficients. As indicated in Chapter 4 all variables are standardized except the control variables, piecework and shift. The results in Table 5.2 are generally more consistent with expectations and more meaningful than those in Table 5.1. Let us consider the predictors of each major perceived stress.

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*The measure of self-reported exposure to hazardous physical-chemical agents is presented in Appendix D.

<u>Perceived work rewards</u>. Net of all other variables in Table 5.2, perceived work rewards increase with age, decrease with education and exposure to agents, and are unrelated to physical effort. These control variables account for 6.6 percent of the variance in perceived rewards, while an additional 15.1 percent is explained by four potentially stressful objective job characteristics. Objective work rewards constitute by far the strongest predictor of perceived job rewards, though our analyses here show the effect to be curvilinear. Recalling the discussion in Chapter 4, the coefficients for the linear (.321) and quadratic (-.099) objective rewards terms in Table 5.2 define a slightly negatively skewed parabola. The nature and extent of this curvilinearity is, however, somewhat deceptive for two reasons. Within the actual range of the objective rewards variable (noted in Figure 3) the left-hand tail of the U does not rise as far as its right-hand tail, and the rise in the left tail is produced largely by two job groups -- cleaning-routine service and compounders-mixers -- whose perceived rewards are moderate to high despite low objective rewards (i.e., prestige, skill and education requirements). Essentially these workers who are not tied to machines seem to perceive their jobs as more rewarding than many low to moderate skill machine operators. Thus, this relationship might best be viewed as one in which perceived rewards decline somewhat as objective rewards rise through their lower range (i.e., below the mean) and then rise sharply as objective rewards increase further.* The relationship is presented graphically in Figure 3.

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*With the variable in standard form, it is relatively easy to determine the shape of the curve in any curvilinear relationship, by simply plotting the predicted values of the dependent variable at values of +2, +1, 0 (the mean), -1, and -2 of the independent variable, assuming all other independent variables are set to 0 (which is the mean of standardized variables). For example, the shape of the relationship between objective job rewards (X) and perceived job rewards (y) is found by substituting these values in the equation $Y = -.099X + .321X^2$. The point where the parabolic curve reaches its minimum or maximum is $\frac{-(-.099)}{2(.321)}$ or more generally $\frac{-b_1}{2b_2}$.

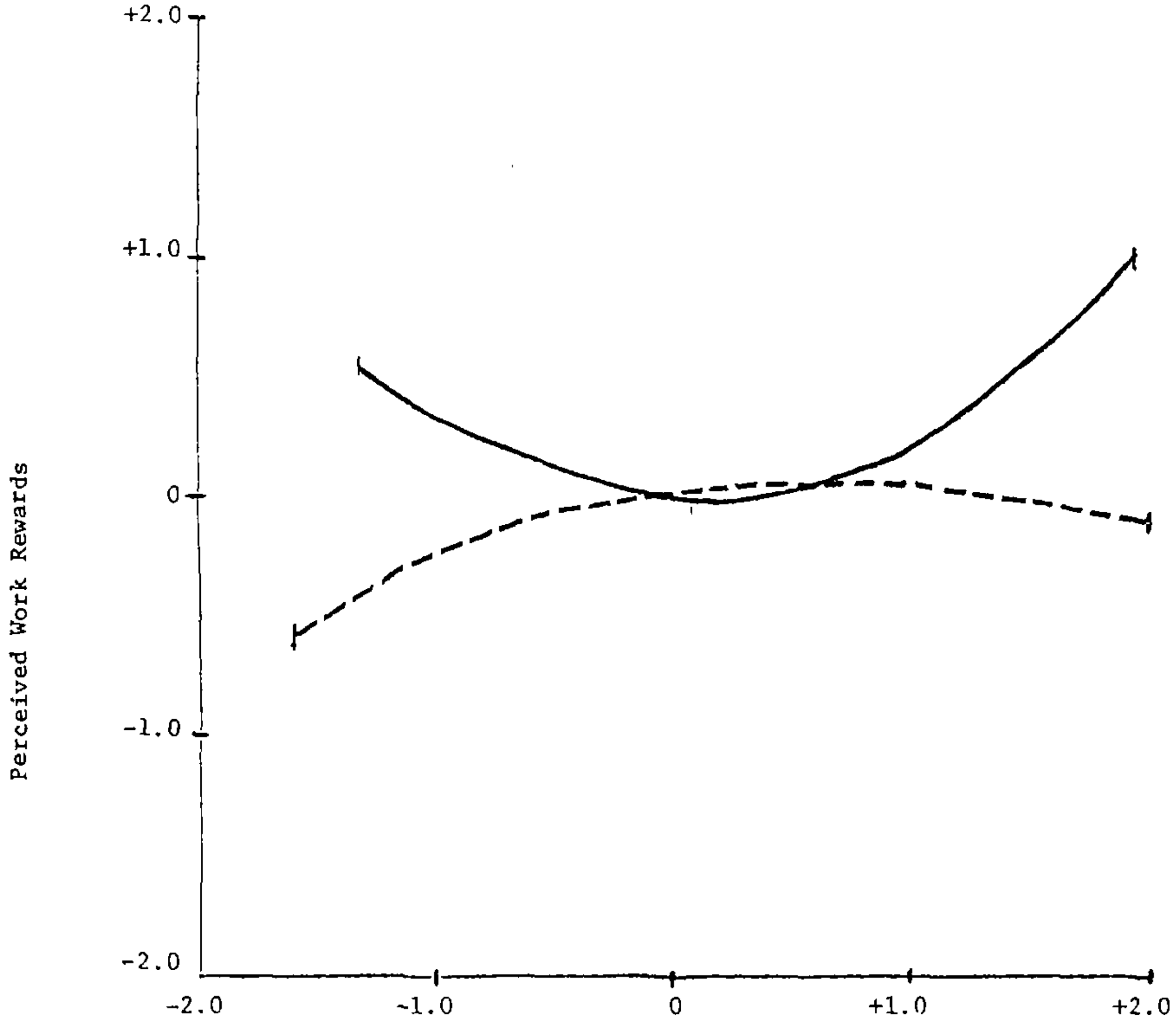
TABLE 5.2

METRIC REGRESSION COEFFICIENTS FOR NET ADDITIVE (LINEAR AND CURVILINEAR) EFFECTS OF OBJECTIVE JOB CHARACTERISTICS ON PERCEIVED JOB STRESSES

Control Variables and Objective Job Characteristics	Perceived Job Stress Indices (Dependent Variables)				
	Work Rewards	Control Rewards	Interpersonal & Responsibility Pressure	Quantitative Workload Pressure	Job-Nonjob Conflict
Control Variables					
1. Age (years)	.015*	(-.001)	(.002)	(-.003)	-.013*
2. Education (years)	-.048*	(-.008)	(.007)	(-.012)	(.006)
3. Number of Agents Exposed to (0-3)	-.074*	-.082*	.191*	.128*	.186*
4. Physical Effort (1-5 scales)	(.114)	(-.147)	.333*	.353*	(.121)
Objective Job Characteristics					
5. Objective "work" Rewards (linear)	(-.099)				.155*
(quadratic)	.321*				.124*
6. Interpersonal & Responsibility Pressure	.102*	-.109*	.209*	.080*	
7. Quantitative Workload Demands	-.106*	-.239*		.079*	
8. Qualitative Workload Demands (linear)	.172*	(.003)	(.004)		(-.060)
(quadratic)	-.115*	-.105*	.060		.065*
9. Piecework			.143+	.725*	
10. Evening Shift					.155*
R^2 explained by:					
Control Variables	.066	.008	.043	.034	.078
Job Characteristics (net of control variables)	.151	.052	.031	.080	.015
All Variables	.217	.060	.074	.114	.093
Multiple R	.466	.244	.272	.337	.304

Note: Variables 1-4 in each equation are scaled as indicated in the table. Piecework and evening shift are dummy variables. All other variables except quadratic (squared) terms are in standard form (mean=0, std. dev.=1.0). Squared terms are derived by squaring the appropriate standardized variables but are not in standard form (since their std. devs. $\neq 0$). Where no entry appears, that independent variable has no significant effect on the dependent variable net of other variables in the equation. Terms in parenthesis are also nonsignificant but are included in the equation because they are control variables or because they are the linear component of a curvilinear effect.

*$p \leq .01$ + $p \leq .05$ (two-tailed)



Objective Work Rewards (——) or Qualitative Workload Demands (- - -)

Figure 3

Graphic Representation of Regression of Perceived Work Rewards on
(a) Objective Work Rewards and (b) Qualitative Workload Demands

Qualitative workload demands also shows a curvilinear relation to perceived rewards, but of a more expected type -- a positively skewed inverted parabolic curve in which perceived rewards increase as qualitative workload rises toward the mean, and then begin to diminish slowly thereafter. In essence, there appears to be an optimally rewarding level of qualitative workload demands. This relationship is also graphed in Figure 3. Finally, interpersonal responsibility demands and quantitative workload demands have equal but opposite effects on perceived job rewards. An increase of one standard deviation (SD) in workload demands decreases perceived job rewards by about .1 SD while a 1 SD increase in interpersonal and responsibility pressure increases perceived job rewards by about the .1 SD. Job demands which involve great complexity and challenge in work have somewhat positive effects on perceived work rewards, while demands for a greater quantity of work adversely affect perceived work rewards. But as we will see below, all of these job demands produce increases in perceived job pressures, and have a largely negative impact on control rewards.

Control rewards. Control rewards are affected by only one of the control variables (negatively by exposure to agents) and that relationship is small. Objective job characteristics have a greater, but still moderate effect on control rewards, explaining 5.2 percent of the variance net of the control variables. The negative linear effect of objective quantitative workload demands (b = -.239), which includes a rating of control, accounts for the vast bulk of this effect. Objective interpersonal and responsibility demands have a similar but weaker negative linear effect. Qualitative workload demand has an almost perfect inverted parabolic relationship to control rewards. That is, control rewards increase modestly as qualitative workload demands increase toward their mean, but decline modestly as these demands increase beyond the mean. Thus, except for a slight rise in control rewards as qualitative workload rises toward its mean, increases in objective job demands consistently decrease perceived control rewards.

Interpersonal and responsibility pressure. Perceived interpersonal and responsibility pressure increases as exposure to physical-chemical agents and physical effort increase, though the rationale for these efforts is not clear. Net of these effects, objective job characteristics conducive to stress explain only 3.1 percent of the variance in interpersonal and responsibility pressure. The bulk of this is due to a positive and linear effect of objective interpersonal and responsibility demands (b = .209). Piecework and qualitative workload demands also have slight positive effects on this pressure. The curvilinearity of the objective workload effect is more apparent than real. Within the actual range of this variable in our sample, the regression line has a small, largely linear and positive slope.

Quantitative workload. Perceived quantitative workload increases with exposure to agents and with the level of physical effort demanded. Since one item in the perceived workload index asks about working hard (physically or mentally) the latter finding is not surprising. Net of these effects, the other objective job characteristics explain 8.0 percent of the variance in perceived quantitative workload. Piecework accounts for most of this, with individual pieceworkers being almost three-quarters of a standard deviation (i.e., .725) higher on perceived quantitative workload than other workers. Controlling for other variables in Table 5.2, rated quantitative workload demands have a modest positive linear effect (b = .079) on perceived workload, while rated interpersonal and responsibility demands have a very similar effect (b = .080).

Job-nonjob conflict. As might be expected, this perceived stress is the most strongly affected by the control variables (R^2 = .078), and most weakly affected by other job characteristics, since this variable reflects tensions between work and nonwork. Job-nonjob conflict decreases clearly with age presumably due both to better adaptation to such conflicts over time and to a reduction in nonwork demands (e.g., for parenting) with which the amount or timing of work may interfere. Exposure to agents also increases this stress, reflecting perhaps the greater amount of shiftwork (including night shifts or rotating shifts) involved in some dirty production jobs. A similar phenomenon probably explains the modest positive impact of objective job rewards on job-nonjob conflict. Key personnel who receive higher rewards and are critical to maintaining production (e.g., certain craftsmen, operators of large production equipment) may more often have to work rotating shifts and/or overtime when they do not want to.* Qualitative workload demands have a slight effect on job-nonjob conflict which is curvilinear, but largely linear and negative within the range of qualitative workload demands in this study. As expected, evening shift workers are higher than other workers on job-nonjob conflict by about .16 standard deviation units.

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*After the data were already collected, we learned that a few such workers (i.e., chemical operators) in fact worked rotating shifts, which have shown to be the most socially and psychologically disruptive in prior work (Mott et al., 1965).

It is also useful to consider how various independent variables affect the dependent variables in Table 5.2. Some have effects which are confined to one or two perceived stresses while others significantly affect almost all of them. Among the control variables, reported exposure to physical-chemical agents consistently decreases rewards and increases pressures. To a considerable extent these relationships may reflect common methods variance -- a tendency of some workers to say bad things about all aspects of their jobs. They may also reflect the fact that some of the "dirtier" jobs are actually less rewarding and more pressured. Finally, with increasing apprehension among workers about physical-chemical hazards, workers in jobs with high exposure to such hazards may tend to perceive many aspects of their job more negatively. In any event controlling for agents should control both for effects of exposure to agents and for tendencies to report negative things about jobs.

The other control variables have quite specific and meaningful effects. Perceived rewards increase with age, probably both because seniority improves access to better jobs and because workers tend to adapt to their jobs over time and become more accepting and even more positive toward them (cf. Hamilton and Wright, 1978). Similarly perceived job-nonjob conflict decreases with age for reasons noted above. Education tends to lower perceived rewards, probably by creating higher expectations (cf. O'Toole, 1974). Finally, physical effort appears to increase perceived workload and interpersonal and responsibility pressures, perhaps because it is a source of such feelings of pressure or perhaps because it tires and strains workers and makes them more senstitive to other pressures.*

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*In general, whether the control variables are included or excluded in the analyses of Table 5.2 does not greatly alter the pattern of effects of job characteristics and perceived stress.

Among the objective job characteristics, the indices of qualitative workload demands and interpersonal and responsibility demands have the most pervasive, though generally modest, effects. With two qualifications, both variables tend to enhance perceived pressures and adversely affect perceived rewards. There is one clear exception to this in the positive impact of interpersonal and responsibility demands on perceived rewards which, as noted above, may reflect the greater challenge and intrinsic rewards produced by such demand. Secondly, the effects of qualitative workload are always curvilinear -- a moderate level of objective qualitative workload produces maximum perceived rewards and minimum perceived pressures -- though within the range of qualitative demands in this study population, these relationships are substantially linear as noted above. The effects of objective quantitative workload demands are similar but less pervasive: it is positively associated with perceived workload and inversely related to perceived job and control rewards.

Objective job rewards, which were correlated with almost all perceived stresses in Table 5.2 affect only perceived job rewards and job-nonjob conflict in this multivariate analysis. Finally, the effects of shift and piecework are quite specific and as expected. Working the evening shift increases job-nonjob conflict, while individual piecework greatly increases perceived workload and also increases perceived interpersonal and responsibility pressure somewhat.

In sum, the multivariate analyses reveal a more parsimonious and generally meaningful pattern of relationships between objective job characteristics and perceived stress than was evident in the bivariate relationships alone. The strongest relationships are almost always between perceived stresses and objective characteristics expected _a priori_ to be closely associated or commensurate. Thus, it is clear that we can measure objective job characteristics, and that perceived stresses are meaningfully affected by these characteristics.

However, the most striking aspect of Table 5.2 is that the relationships between objective characteristics and perceived stresses are hardly isomorphic, nor even strong. The combined linear and nonlinear effects of the six objective job characteristics in Table 5.2 explain between 1.5 percent (in the case of job-nonjob conflict) and 15.1 percent (in the case of perceived job rewards) of the variance in perceived job stress characteristics, net of the effects of four control variables. Examination of the regression coefficients in Table 5.2 also shows most to be consequential but moderate in size. Given the emphasis that is often placed on job redesign in theoretical and applied discussions of the impact of job characteristics on worker attitudes and our own, perhaps naive, expectation that objective job characteristics of industrial workers would explain a substantial portion of the variance in perceived stress, it is essential to understand why the relationships in Table 5.2 are not stronger. There are potentially both methodological and substantive explanations.

Are Methodological Problems Attenuating the Impact of Objective Job Characteristics on Perceived Stress?

The reader may be saying at this point, "But, of course, we can't expect a very strong relationship between objective job characteristics and perceived stress since both sets of variables, but especially the objective job characteristics, are measured in very crude and preliminary ways." Problems of unreliability and invalidity at first seem to be the obvious explanation for the weak relationships in Table 5.1 and 5.2. They appear less important, however, in light of further data presented in Table 5.3.

Recall that ratings of objective job characteristics were made for 21 job groups. Thus, the variance in perceived stress lying between these job groups represents the maximum amount of variance that could be explained by any rating, no matter how valid or reliable, of characteristics of these job groups. Table 5.3 presents, for each perceived stress, the variance explained (η^2) by, or lying between, the 21 job groups, and the square root of this variance or what is sometimes called the correlation ratio (η). These figures are modest in absolute size, and not much greater than the variance explained by the rated job characteristics in Table 5.2. The variance lying between job groups ranges from 3.1 percent (job-nonjob conflict) to 17.4 percent (for perceived job rewards). Comparing these figures to the variance explained by objective characteristics in Table 5.2 (third line from the bottom) shows that objective characteristics account for between 71 percent and 87 percent of the total variance between job groups except in the case of job-nonjob conflict (only 48%, i.e., .015/.031). And the figures in Table 5.2 are net of a range of control variables, while the data in Table 5.3 are gross effects.

Thus, the objective rating scales developed for rating job groups account for the bulk of the variation in perceived stress between job groups. Improvements in the reliability, validity, or commensurability (with perceived stress) of the objective ratings used here and/or the addition of new ratings could only modestly increase the variance in perceived stress explained by the analysis in Table 5.2.

TABLE 5.3

VARIANCE IN PERCEIVED STRESS EXPLAINED BY JOB GROUP
BEFORE AND AFTER CORRECTION FOR UNRELIABILITY
IN MEASURES OF PERCEIVED STRESS

	Variance Explained by Job Group (Uncorrected)		Reliability	Variance Explained by Job Group (Corrected)	
Perceived Stress	η	η^2	α	η	η^2
Work Rewards	.418	.174	.90	.441	.194
Control Rewards	.252	.063	.54	.343	.118
Interpersonal & Responsibility Pressure	.210	.044	.84	.229	.052
Workload	.307	.094	.73	.359	.129
Job-Nonjob Conflict	.177	.031	.56	.236	.056

Unreliability in the dependent variables also may attenuate the relationship between objective characteristics and perceived stress. But again, the effects in this case are quite small. Table 5.3 also shows the reliabilities (coefficient α) of the perceived stress measures, and "corrected" values of η and η^2 for the effects of job group obtained by applying the formula for correction of attenuation in correlations (assuming perfect reliability of the job group classification). Even these hypothetical values suggest that only between 5.2 percent and 19.4 percent of the variance in perceived stresses lies between job groups. In sum, neither the quality of the independent nor the quality of the dependent measures seems to account for the relatively modest impact of objective job characteristics on perceived stress. One other aspect of our method, however, undoubtedly plays some role here: by grouping more specific jobs into 21 job groups we have placed some variation in objective job characteristics within the job groups. Any variance in perceived stress explained by such within group variation in job characteristics cannot be explained by ratings of differences between groups which assign the same rating to all members of a job group. Our evidence suggests, however, that the within group variation in job characteristics is small relative to that between groups. The description and nature of the 21 job groups in Chapter 3 indicate that differences between groups are great, while differences within groups are relatively small. This suspicion is confirmed by data on company job ratings which are available for jobs within our 21 job groups (cf. Chapter 3 and Table C.1 in Appendix C). A finer grained grouping of jobs would undoubtedly have slightly increased the variance in perceived stress explained by objective job characteristics.

But the gain would be small both absolutely and relative to the greater costs involved in generating such ratings (i.e., more time needed for both actual ratings, training raters, and ensuring them familiarity with all job groups, etc.)

The finding that objective job characteristics have only a modest impact upon perceived stress does not appear to be an artifact of inadequacies in our procedures for measuring objective job characteristics, nor the reliability of our perceived stress measures. Nor is this an isolated finding. Jenkins et al. (1975) report only slightly higher correlations between objective job characteristics rated for individual jobs and workers' perceptions, using only the six most valid and reliable ratings from over thirty they tried. Students of the subjective quality of life more generally have found only modest relationships between objective conditions of and measures of subjective satisfaction in various domains of life (Andrews and Withey, 1976; Campbell et al., 1975). The data in Tables 5.2 and 5.3 pose a problem of substantive importance for which we must seek a substantive solution: why is the impact of objective job characteristics on perceived stress modest in these analyses?

Toward Understanding the Relation Between Objective Job Characteristics and Perceived Stress

The theoretical paradigm outlined in Chapter 1 suggests why objective job characteristics might not explain large proportions of variance in perceived stress in analyses like those in Table 5.2. As indicated in Figures 1 and 2, the relation between objective job characteristics and perceived stress will generally be conditioned by a variety of individual and social/situational factors. The perception of stress involves not only perceiving the level of workload, for example, in a job, but also interpreting that workload to be excessive or bothersome. Depending upon the characteristics of the individual doing the perceiving and the social context in which this perception takes place, the same objective characteristics may be perceived very differently. Thus, analyses such as those in this chapter which do not take account of conditioning factors should find relatively modest relationships. Chapter 6 will explore the extent to which such conditioning effects can improve our ability to predict perceived job stress in this study. However, these analyses provide only a very partial explanation of the weak relationships in Tables 5.2 and 5.3. Thus in Chapter 7 we return to the substantive issue of why these relationships are weak.

Chapter 6

FACTORS CONDITIONING THE IMPACT OF OBJECTIVE JOB CHARACTERISTICS ON PERCEIVED STRESS

As was emphasized in Chapter 1 and just reiterated, the stress paradigm which provides the framework for this study predicts that the impact of objective job characteristics on perceived stress (and of both of these on health) will often be conditioned by the characteristics of individual workers, their interpersonal relationships, and the larger structure and setting of their work environment. Many factors might condition the relationships of interest here. As indicated in Chapter 1 this study focuses on several individual attributes of workers and several aspects of their interpersonal and occupational setting that prior theory and research suggest are most likely to condition these relationships. This chapter will first briefly review how and why these factors might condition the impact of job characteristics on perceived stress, and then will determine the extent of their conditioning effects in Whitewall Plant.

Individual Characteristics

Potential Conditioning Variables

The stress paradigm essentially posits that "stress is in the eye of the beholder," in that the same job characteristics may be perceived quite differently by different persons (cf. McMichael, 1978). However, this may be more or less true depending upon the type of job characteristics or perceived stress in question and the nature of the beholders. Some job characteristics may be perceived similarly by most people, while the perception of others varies greatly. Similarly, some individual attributes may have little effect on how job characteristics are perceived, while others greatly affect such perceptions. This issue has practical as well as scientific importance since it suggests whether efforts to alleviate job stress can be directed at modifying job characteristics, modifying personal characteristics, or channeling persons with certain characteristics toward some jobs and away from others. What should be done, of course, depends also on considerations of ethics, feasibility, cost-effectiveness, etc. As discussed in Chapter 1, four characteristics of workers are treated as conditioning variables in this study. Here we will briefly indicate why they might be expected to condition the impact of job characteristics on perceived stress.

Age. As indicated in Chapter 1, as people grow older they gain experience and perspective which may allow them to more easily handle potentially stressful aspects of their job and to accommodate their aspirations to the opportunities inherent in their work situation. This view would predict that potentially stressful job characteristics would be less likely to lead to perceived stress among older workers compared to younger workers. In contrast, it can also be argued that as workers grow older they become less able to adapt to and tolerate many sources of stress in their jobs. This view is often used especially to justify earlier retirement for blue collar factory workers, who are felt increasingly less able to tolerate time pressures, monotony, or other potential stressors in their work. The present study provides some of the first direct evidence on whether and how the impact of job characteristics on perceptions of stress changes with age.

Education. Chapter 1 reviewed literature suggesting that objective work rewards should be more strongly correlated with perceived rewards among more educated compared to less educated workers. However, better educated workers may be better able to cope with high levels of work load, responsibility, and interpersonal demands and hence may be relatively unaffected or even positively affected by increases in these job demands, while lower educated workers would find such demands taxing and hence stressful. Again, prior data on these issues is generally lacking or fragmented, and thus the present study can provide important evidence regarding the validity of these various assertions.

Type A. Friedman, Rosenman, and Jenkins (1967) have demonstrated that what persons they term "Type A behavior-pattern" -- characterized by heightened levels of time urgency, competitiveness, and need for social achievement -- are more prone to coronary disease and perhaps other diseases as well (Glass, 1977). The reasons for this, however, are not clear. One hypothesis, implicit in the conception of Type A as a "behavior-pattern" or "a style of overt behavior with which some people confront life situations" (Jenkins, 1975:6), is that Type A people respond to potentially stressful situations in ways that are especially productive of perceived stress and/or disease. Thus, it may be that given a job with high levels of workload, responsibility, or interpersonal demands, Type A persons are more likely to perceive the situation as stressful. Alternatively, Type A may not condition the impact of job characteristics on perceived stress, but rather may lead workers to seek out jobs with more stress and/or to create more stress for themselves within a given job situation. This should lead to a correlation between Type A and job characteristics or perceived stress, rather than an interactive or conditioning effect. Again, the present study can provide some of the first direct data on these questions, though, as noted below, our measure of Type A is somewhat exploratory.

Work motivations. Chapter 2 described measures of work motivations parallel in content to measures of perceived job rewards and perceived control rewards. These measures were introduced to allow us to test whether the impact of objective job rewards on perceived rewards and of both of these on health would be greater for workers who viewed these rewards as important. This chapter will present the results of these tests.

Measurement of the Conditioning Variables

The measurement of age and education was straightforward. Age was assessed in years and education by years of schooling completed. For these analyses, age was trichotomized into young (age $\leq$ 39, N = 725), middle-aged (age = 40-49, N = 434), and older (age = 50-65, N = 649), and three dummy variables were created to represent these categories, with the dummy identifying the young omitted from the analyses. Three dummy variables were similarly created to distinguish between workers who did not graduate from high school (N = 625), high school graduates (N = 894), and workers with schooling (either college or trade school) beyond high school (N = 267), with the dummy for non-high-school graduates omitted from the analyses. The measures of work motivation were described in Chapter 2. The distribution of scores on the index of work motivation (combining intrinsic, extrinsic, and importance motivation) were highly skewed toward the high end of the scale which ranged from 0-51 in its nonstandardized form. Dummies were created for workers who scored relatively low (0-39, N = 528), medium (40-46, N = 633), and high (47-51, N = 569) on this scale.

The index of control motivation was more normally distributed across its nonstandardized range of 0-9. Dummy variables were created to identify workers with low (0-4, N = 416), medium (5-6, N = 750), and high (7-9, N = 569) levels of this motivation. In both cases, the dummies for low motivation were omitted from regression analyses.

The measure of the Type A behavior-pattern is an exploratory one, though it is both conceptually and empirically related to the more widely used Jenkins Activity Survey (Jenkins _et al_., 1967) and clinical interview of Friedman and Rosenman (1971). The present study included five items Caplan _et al_. (1975) found to correlate highly with a larger inventory of Type A traits developed by Sales (1969), which in turn has been shown to be correlated highly with the Jenkins Activity Survey, the most valid and widely used questionnaire measure of the Type A syndrome. Workers in Whitewall Plant were asked to indicate "how true each of the following statements is of you" (using a seven-point scale anchored at the extremes and midpoint with the phrases "not at all true of me," "neither very true nor very untrue of me," and "very true of me"):

1. Sometimes I feel I shouldn't be working so hard but something drives me on.
2. I thrive on challenging situations. The more challenge, the better.
3. In comparison to most people I know I'm very involved in my work.
4. It seems as if I need 30 hours a day to finish all the things I'm faced with.
5. I've often been asked to be an officer of some group or groups.

These items emphasize involvement in work and achievement which is seen to arise more out of the worker than his situation. Although this is clearly related to, and probably an integral component of, the Type A behavior-pattern, the limited and exploratory nature of the measures should be kept in mind in evaluating the results. Responses to these items were coded 0 ("not at all true") to 6 ("very true") and summed. The resulting scale is normally distributed and has modest reliability ($\alpha = .57$). Dummy variables were created to identify workers who were low (0-13, N = 590), medium (14-19, N = 653) and high (20-30, N = 536) with the dummy for low Type A omitted from regression analyses.

Results

Additive (Main) Effects of Conditioning Variables

First, let us consider the additive relationship of these putative conditioning variables to objective job characteristics and perceived stress. Table 6.1 shows the zero-order correlations of the continuous forms of these conditioning variables with each other and the objective job characteristics and perceived stresses. The relationships in Table 6.1 provide a very close approximation to what obtains when the relationships of the conditioning variables to perceived stress are examined using dummy variables and net of the standard set of control variables and the objective job characteristics in the appropriate baseline equation in Table 5.2. Thus, since the relationships in question are essentially linear and little affected by controls for other variables, the data in Table 6.1 provide a concise yet accurate picture of additive effects of the conditioning variables on perceived stress, which, as noted at the end of Chapter 4, may represent, at least in part, the residue of conditioning effects from some earlier time. This issue will be considered in more detail after we have reviewed not only these additive effects but also the interactive effects of the conditioning variables in more detail.

Looking first at the intercorrelations among the conditioning variables, age and education are moderately highly correlated (-.371) in the expected manner: older workers are less educated than younger ones. Work motivation is also moderately correlated in the expected ways with all the other conditioning variables (r's = -.196 to .410): work motivation is greater among better educated and Type A workers but declines with age. It is also positively associated with control motivation. Otherwise, the correlations among the conditioning variables are low to negligible. The higher correlations noted do not seem to pose serious problems for the interpretation of the effects of the conditioning variables on perceived stress, since the effects of each conditioning variable are fairly distinctive.

Secondly, Table 6.1 shows that these conditioning variables are weakly, if at all, correlated with objective job characteristics. The few modest correlations that do appear are as might be expected. Older workers are (due to their seniority and experience) less likely to work the evening shift and hold piecework jobs and more likely to hold jobs with higher levels of responsibility and interpersonal demands. Better educated workers and those higher on Type A are somewhat more likely to hold jobs which are more difficult but also provide greater intrinsic and extrinsic rewards. Yet all of these relationships are quite modest. What seems most striking is the relative lack of association between these conditioning variables and the characteristics of workers' jobs. Although the conditioning variables might be expected to be important bases for

TABLE 6.1

SIGNIFICANT (p< .05, two-tailed) ZERO-ORDER CORRELATIONS OF INDIVIDUAL CONDITIONING VARIABLES WITH EACH OTHER AND WITH OBJECTIVE JOB CHARACTERISTICS AND PERCEIVED STRESS

Variable	Age	Education	Work Motivation	Control Motivation	Type A
Conditioning Variables					
Age (years)	--				
Education (years)	-.371	--			
Work Motivation	-.196	.225	--		
Control Motivation	-.081	--	.410	--	
Type A	--	.124	.198	.054	--
Objective Job Characteristics					
Work Rewards	--	.131	--	-.058	.126
Interpersonal & Responsibility Demands	.138	.058	--	-.063	.088
Quantitative Workload Demands	--	-.055	--	--	--
Qualitative Workload Demands	-.055	.075	--	--	.072
Piecework	-.147	--	--	--	--
Evening Shift	-.246	--	--	--	--
Perceived Stresses					
Work Rewards	.248	-.127	--	.057	.160
Control Rewards	--	--	--	.301	-.080
Interpersonal & Responsibility Pressure	--	--	.108	--	.283
Quantitative Workload	-.067	--	.138	--	.227
Job-Nonjob Conflict	-.181	.096	.124	--	.185

selection by self or others into jobs (and hence exposure to specific job characteristics), this does not appear to occur to any great extent.

Finally, the correlations between the conditioning variables and the perceived stresses, though always modest in size, are generally consistent with aspects of the prior discussion of their potential direct and conditioning effects. Older workers are more likely to report their jobs provide general "work" (i.e., intrinsic and extrinsic) rewards, though they are no more likely to hold jobs which are objectively rated as more rewarding. They are also less likely to report job-nonjob conflict, probably because they are less likely to have undesirable work schedules (such as the evening shift), less likely to have family obligations (e.g., to young children) with which work might interfere, and more likely to have worked out stable patterns of balancing work and non-work relations. Education is slightly negatively related to perceived rewards despite being positively related to holding jobs objectively rated as having such rewards. This probably reflects the higher aspirations or motivations of more educated workers seen in the top triangle of Table 6.1. Education is also positively related to job-nonjob conflict, but as was seen in Table 5.2 this relationship disappears once controls are introduced for objective job characteristics (espcially more difficult and rewarding jobs) which are positively correlated with education but also increase job-nonjob conflict. Workers with high control motivation report higher control rewards, presumably reflecting both real reciprocal causation between these elements and some common methods factor (i.e., responding similarly to similar questions). Finally, Type A and to a lesser extent (intrinsic and extrinsic) work motivations, are positively related to perceived stress, despite being weakly or unrelated to potential stressful objective characteristics. Thus, high levels of work motivation and especially Type A appear to enhance workers' feelings of stress regardless of the objective characteristics of the job. How this may occur will be discussed after considering the interactive effects of the conditioning variables.

Interactive Effects of Conditioning Variables

Analysis procedure. The methods for testing the interactive effects of conditioning variables were described fully in Chapter 4. Briefly, for each perceived stress the regression equations in Table 5.2 were the starting point for the analysis. A baseline equation was formed by adding to these equations two dummy variables for the appropriate conditioning variable (and the objective job characteristic involved in the interaction being tested if it is not in the equation in Table 5.2). Then each set of interaction terms formed by multiplying the conditioning variable by each objective job characteristic was added to this baseline equation, and the significance of each tested against this baseline using a standard R^2 increment test (Cohen, 1968). Depending on whether interactions involving significant quadratic terms from Table 5.2 had to be tested, six to eight interactions were tested for each pairing of a conditioning variable and a perceived stress. A total of 35 interactions were tested for each conditioning variable.

Overall results. Only education produced a pattern of significant conditioning effects which were both clearly more numerous than might occur by chance and substantively and theoretically interpretable. Neither the Type A nor work motivation variables (which were tested only with respect to their respective perceived rewards) were involved in more significant interactions than might occur by chance. There were marginally more interactive effects involving age than might occur by chance (three and five out of 35 tests were significant at the $p \leq .05$ and $p \leq .10$ level, respectively). Only two of the conditioning effects, however, were theoretically and substantively interpretable and they were the two weakest effects (explaining only 0.3% additional variance). Piecework jobs produced greater feelings of interpersonal and responsibility pressure among middle-aged and older workers (b's = .293 and .253 respectively), but not among younger workers (b = .018). Working the evening shift produced job-nonjob conflict among both younger (b = .227) and older workers (b = .209) but not among middle-aged workers (b = .076) who are perhaps freer of family obligations yet still able to adjust to the disruptions in daily physical and social rhythms associated with working evenings.

In contrast, the conditioning effects of education are significant much more often than could occur by chance and consistently meaningful. Seven of the 35 tests for conditioning effects of education were significant at the $p \leq .05$ level; another was significant at the $p \leq .10$ level. Although the additional variance explained by these conditioning effects appears quite small (0.25% to 0.4%), the effects are hardly trivial when examined closely. Table 6.2 shows the significant ($p \leq .10$) conditioning effects of education on relationships between job characteristics and perceived stress. Where a job characteristic was curvilinearly related to perceived stress, both its linear and quadratic coefficients are shown though only one of them was significantly conditioned by education. Education conditions the relationship of at least one job characteristic to every perceived stress except job-nonjob conflict. The overall pattern of results suggests that, as expected, higher educated workers are both more affected (generally positively) by degree of complexity, skill, and responsibility, and less likely to find large quantities of work a source of perceived pressure or stress.

The effect of objective job rewards on perceived rewards is significantly curvilinear at all levels of education, but the relationship is about twice as strong among workers with education beyond high school (quadratic b = .477) as among other workers (quadratic b's = .267 and .264).* Further, Table 6.2 shows that the positive effect of interpersonal and responsibility demands on perceived job rewards observed in Table 5.2 is due largely to the existence of such a positive effect among the highly educated workers (b = .222). Similarly, the negative impact of these same demands on perceived control rewards is also evident primarily among the better educated (b = -.232). These results are consistent with the view that more educated workers respond positively to greater challenge, compexity, responsibility, and autonomy in work and negatively to the lack of these factors, while less educated workers are simply less affected by these factors. The almost perfectly quadratic effect of objective rewards is, as noted in Chapter 5, probably somewhat artifactual, in our data. Within the actual range of the objective rewards in our data the relationship is generally linear and positive. The better educated workers do, however, experience a greater decline in perceived control over work pace in response to interpersonal and responsibility demands than do the less educated workers.

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*The nature and source of the coefficients in Table 6.2 and subsequent tables of significant conditioning effects are described in Chapter 4. Essentially, the coefficients are the metric regression coefficients which would obtain if the dependent variable were regressed on the independent variable within the levels of the conditioning variable, after having first adjusted for all variables in the appropriate equation in Table 5.2 (and the independent and conditioning variables if they are not included in the appropriate equation in Table 5.2).

TABLE 6.2

CONDITIONING EFFECTS OF EDUCATION ON RELATIONSHIPS BETWEEN JOB CHARACTERISTICS AND PERCEIVED STRESS

Perceived Stress (Dep. Var.) Job Characteristic (Indep. Var.)		Effect of Job Characteristic When Education Is: <12 yrs.	12 yrs.	>12 yrs.	Significance of Interaction
Perceived Job Rewards					
Objective Job Rewards	(linear)	-.130	-.083	-.170	n.s.
	(quadratic)	.267	.264	.477	$p \leq .05$
Interpersonal & Responsibility Demands		.065	.099	.222	$p \leq .10$
Control Rewards					
Interpersonal & Responsibility Demands		-.042	-.108	-.232	$p \leq .05$
Quantitative Workload Demands		-.100	-.150	+.042	$p \leq .05$
Qualitative Workload Demands	(linear)	-.031	.007	.127	n.s.
	(quadratic)	-.169	-.072	.004	$p \leq .05$
Interpersonal & Responsibility Pressure					
Piecework		.345	.046	.088	$p \leq .05$
Workload Pressure					
Qualitative Workload Demands		.063	.021	-.145	$p \leq .05$
Piecework		.882	.717	.389	$p \leq .05$

Note: Entries in first three columns are estimated metric regression coefficients within each educational level net of all variables in appropriate equation in Table 5.2. Both the independent and dependent variables are standardized on the basis of the standard deviation on the total study group (not the separate standard deviations within educational levels) except that piecework is a dummy variable. Thus regression coefficients express standard deviation unit changes in the dependent variable which would result from a one standard deviation unit in the independent variable.

There is also evidence, however, that better educated workers are little affected by those job characteristics (i.e., piecework and workload demands) exerting a pressure for high rates of production. Whereas piecework jobs induce marked perception of workload (b = .882) and interpersonal and responsibility perssures (b = .345) among the least educated workers, piecework has little or no effect on these variables among the most educated. Note that in the case of workload pressure high school graduates resemble the most educated, while in the case of interpersonal and responsibility pressure they resemble the least educated. Similarly, quantitative workload demands adversely affect perceived control among the less educated (b's = -.100 and -.150) but have no such effect among the highly educated (b = .042). Thus, higher educated workers appear to cope more easily with demands and pressures for higher production.

The conditioning effects of education on the two relationships involving qualitative work demands in Table 6.2 are not so readily interpretable but appear to provide further evidence of the positive response of highly educated workers to job challenges. First, the impact of qualitative workload demands on control rewards changes from curvilinear to linear positive as education increases. Second, higher qualitative workload demands are actually associated with decreased perceptions of quantitative workload among the most educated workers, but not among less educated workers.

Situational Factors

This study has analyzed the effects of two major types of interpersonal or organizational factors on the relationship between job characteristics and perceived stress: 1) individual piecework vs. hourly or group incentive modes of payment and 2) social support from persons inside and outside of work. Both proved to have pervasive conditioning effects though the theoretical and substantive meaning of the results is not always so clear.

Piecework as a Conditioning Variable

As explained in Chapter 5, a large number of jobs in the tire and rubber industry are paid largely on a piecework basis and piecework has been shown to be a source of stress in experimental and field research in Scandinavia (e.g., Levi, 1964). Analyses in Chapter 5 showed that piecework is also a source of perceived stress in Whitewall Plant, being the major source of perceived quantitative workload pressures.

Piecework may also act as a conditioning variable modifying the impact of other job characteristics on perceived stress. First, ratings of work-load demands should be more highly related to perceived workload pressure among workers paid on an hourly or group incentive basis, since their pace of work is governed mainly by technical and managerial demands which were the basis of the objective quantitative workload rating. In contrast, pieceworkers' pace of work is more self-regulated. Second, the effects of other job pressures may be exacerbated under piecework, since these would interfere with the worker's ability to produce at his desired level. Challenges and complexities which might even be perceived as pleasant by hourly workers may be stressful in a piecework job where quantity of output is the major objective.

These expectations were generally confirmed by our analysis of the interactive effects of piecework.* Nine of 30 tests for interactions

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*As in Chapter 5, piecework has been defined here as a single dummy variable. Thus our interaction tests compared the effects of other job characteristics on perceived stress for individual pieceworkers vs. other workers.

between piecework and objective job characteristics in predicting perceived stress proved significant at the .05 level (and no additional tests were significant at the .10 level) -- substantially more than would be expected by chance. Table 6.3 shows these nine significant conditioning effects of piecework, which explain from 0.2 percent to 1.1 percent additional variance in job pressures.

These effects seem to be of two main types. First, rated job demands seem to have more effects on perceived stress among hourly workers than among pieceworkers. This difference is evident in the fact that the effect of quantitative workload demands on perceived workload perssure is significantly positive (b = .138) only among workers who are not in individual piecework jobs. For pieceworkers, there is, in fact, an unexpected negative effect (b = .132), the reasons for which are not obvious. It may be that where the expected or base production rate for piecework jobs is fairly high (which is what was captured in the ratings of workload demands for piecework jobs), the piecework incentive is less likely to induce high levels of effort and perceived workload pressure. In a sense these workers behave more like hourly workers and hence they experience lower perceived workload pressure than pieceworkers in jobs with a lower base rate who see greater opportunity to increase their earnings by working very hard. The greater negative impact of externally imposed job pressures is also evident in that interpersonal and responsibility demands are positively related (b = .226) to perceived interpersonal and responsibility pressure only among hourly and group incentive workers. Similarly, objective quantitative workload demands have an adverse effect (b =-.178) on perceived job rewards only in this same group.

TABLE 6.3

CONDITIONING EFFECTS OF PIECEWORK ON RELATIONSHIP BETWEEN JOB CHARACTERISTICS AND PERCEIVED STRESS

Perceived Stress (Dep. Var.) Job Characteristic (Indep. Var.)	Effect of Job Characteristic Under: Individual Piecework	Hourly Wage or Group Piecework	Significance of Interaction
Perceived Job Rewards			
Objective Job Rewards (linear)	-.246	.003	$p \le .01$
(quadratic)	.231	.231	n.s.
Quantitative Workload Demands	-.021	-.178	$p \le .05$
Qualitative Workload Demands (linear)	.066	.194	$p \le .05$
(quadratic)	-.282	-.096	$p \le .05$
Control Rewards			
Objective Job Rewards	.080	-.096	$p \le .05$
Qualitative Workload Demands (linear)	.148	-.031	$p \le .05$
(quadratic)	-.111	-.111	n.s.
Interpersonal & Responsibility Pressures			
Interpersonal & Responsibility Demands	.034	.226	$p \le .05$
Quantitative Workload Pressures			
Job Rewards	.167	.001	$p \le .05$
Quantitative Workload Demands	-.132	.138	$p \le .01$

Note: Entries in first two columns are metric regression coefficients estimated separately for individual pieceworkers and nonpieceworkers and net of all variables in appropriate equation in Table 5.2. All independent and dependent variables are standard scores.

A second pattern of effects in Table 6.3 indicates that increases in the qualitative difficulty and complexity of work tend to increase perceived job pressures and reduce perceived job rewards among pieceworkers, while having a neutral or even positive effect among the nonpieceworkers. Thus, increases in objective job rewards (greater skill, initiative, and ingenuity required) tend to increase perceived workload among pieceworkers ($b = .167$). Similarly increases in qualitative workload have a largely positive linear effect on perceived job rewards among nonpieceworkers (linear $b = .194$, quadratic $b = -.096$), while the effect is markedly curvilinear among pieceworkers (linear $b = .066$, quadratic $b = -.282$) with increases in qualitative workload above the mean leading to sharp declines in perceived job rewards. Finally, although the relation of objective job rewards to perceived job rewards follows the same basic curvilinear pattern for all workers, among pieceworkers the curve is sharply steeper at the negative end of the distribution (due to the large negative linear term in that group, (i.e., $-.246$). That is, among pieceworkers there is a greater tendency for increases in objective rewards to lead to declines in perceived rewards than among nonpieceworkers. In sum, increases in the difficulty and complexity of work are more likely to be perceived negatively by pieceworkers, probably because more complex and difficult tasks are not easily performed quickly, yet greater speed is the object of the piecework system.

The conditioning effects of piecework on the relation of job characteristics to perceived control rewards are less obviously interpretable, though they may say something about the conditions which give workers a greater sense of control over their pace of work under piecework vs. non-piecework modes of payment. Thus, objective job rewards, which again indicate increases in the skill level and initiative demanded by the job, are slightly positively associated with a perceived control rewards among pieceworkers (b = .082), but slightly negatively associated with perceived control among nonpieceworkers (b = .096). Similarly, increases in qualitative workload demands among pieceworkers generally lead to increases in perceived control though the rate of this increase levels off at the higher levels of qualitative workload demands; among nonpieceworkers the increases in qualitative workload demands beyond the moderate level lead to clear declines in perceived control. Overall, though the trends are not strong, it appears that among piecework jobs, more complex and demanding jobs allow workers greater control in setting their pace of work, while among nonpiecework jobs there is a tendency for more demanding and complex jobs to allow somewhat less control of work pace.

Although there appear to be meaningful patterns in the conditioning effects of piecework, these results should be viewed with some caution for two reasons. First, a number of the effects involve conditioning of curvilinear relationships which are more complex to interpret than conditioning effects on linear relationships. Second, piecework, more than any other conditioning variable is confounded with the objective job characteristics. That is, piecework is concentrated in a limited number of the job groups on which the ratings of objective job characteristics were made (e.g., tire building, compounders and mixers, banbury operators). Thus, the effects of job characteristics among pieceworkers are largely a function of a small number of job ratings, and may be idiosyncratic to the specific set of piecework jobs in the Whitewall Plant. Nevertheless, it is clear that piecework does substantially condition associations between job characteristics and perceived stress in Whitewall Plant, and in ways which may have significance for industrial workers more generally.

Social Support

As discussed in Chapter 1, social support has received increasing attention in the last decade as a potential factor which can mitigate the deleterious impact of potentially stressful situations or events on individual health and well-being (Cassel, 1976; Cobb, 1976). Though, social support should have important direct effects on perceived stress and individual well-being, recent interest in social support has focused on it as a resource which can "buffer" people against the deleterious impact of potentially stressful situations and events. That is, the presence or absence of social support can modify or condition the relationship between potential stressors and individual health and well-being. The stress paradigm suggests that this can occur in two ways in the case of occupational stress. First, social support may modify or condition the relationship between objective job characteristics and perceived stress. Second, support may condition relationships between perceived status and well-being.

Although the buffering effects of social support are central to most recent discussions of social support (e.g., Cassel, 1976; Cobb, 1976), empirical evidence for such effects is quite limited and fragmented (Pinneau, 1976). Further, no work has explicitly tested whether support primarily conditions relationships between objective social conditions and perceived stress or those between perceived stress and health, or both. The present study provides further evidence on the conditioning effects of social support and clearly distinguishes between these two kinds of conditioning effects. The present chapter considers the conditioning effects of social support on relationships between job characteristics and perceived stress.

Measures of social support. Respondents were asked two questions adapted from Caplan et al. (1975) about four sets of significant other people in their lives -- "your immediate supervisor," "other people at work," "your wife (or husband)," and "your friends and relatives." The questions were:

(1) "How much can each of these people be relied on when things get tough at work?"

(2) "How much is each of the following people willing to listen to your work-related problems?"

In addition the following item was asked about "your immediate supervisor" and "other people at work":

"How much is each of the following people helpful to you in getting your job done?"

Responses to all the above items were "not at all" (scored 0), "a little" (scored 1), "somewhat" (scored 2), or "very much" (scored 3). Finally, three additional items (from Quinn et al., 1973) asked about supervisors were highly conceptually and empirically related to the direct questions about supervisor support and were included in the final index of supervisor support:

"Please indicate how true each of the following statements of your immediate supervisor (0 = "not at all true," 1 = "not too true," 2 = "somewhat true," and 3 = "very true"):

a. My supervisor is competent in doing (his/her) job.

b. My supervisor is very concerned about the welfare of those under him.

c. My supervisor goes out of his/her way to praise good work.

Responses to appropriate items were summed into indices of supervisor support (6 items, range 0-18, coefficient alpha = .88), coworker support (3 items, range 0-9, alpha = .75), friend and relative support (2 items, range 0-6, alpha = .83), spouse support (2 items, range 0-7*, alpha = .92), and *total support* (the sum of the other indices, range 0-40, alpha = .78). Although the items were constructed to distinguish between instrumental and socioemotional forms of support from supervisors and coworkers, the instrumental items (e.g., "helpful in getting job done") were not empirically distinguishable in inter-item correlation analyses.

Main Effects of Social Support

Table 6.4 shows the zero-order correlations of the social support variables with each other and with the measures of objective job characteristics and perceived stress. Supervisor and coworker support correlate .303 and spouse and friend and relative support correlate .392, indicating some positive association between support from different sources at work and outsife of work, but with the exception of a .32 correlation between friend and relative and coworker support, work and nonwork sources of support are very weakly correlated. Coworkers and friends are very likely overlapping categories.

Perceived social support is generally very weakly, if at all, related to objective job characteristics. The only correlations greater than .10 in absolute magnitude can be interpreted as an adverse effect of piecework jobs, which are highly individual, on coworker support (r = -.113), and of shiftwork on spouse support (r = -.125). Thus, perceived social support and job characteristics are essentially independent of each other.

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*Non-married persons were given a score of zero on the spouse support index, and the scale for married persons equalled the sum of the component items, plus one. Analyses indicated that unmarried persons were generally similar to, or worse off than, married persons reporting the lowest possible level of spouse support.

TABLE 6.4

SIGNIFICANT ($p < .05$, two-tailed) ZERO-ORDER CORRELATIONS OF SOCIAL SUPPORT VARIABLES WITH EACH OTHER AND WITH OBJECTIVE JOB CHARACTERISTICS AND PERCEIVED STRESS

Variable	Coworker Support	Friend & Relative Support	Spouse Support	Supervisor Support	Total Support
Conditioning Variables					
Coworker	--				
Friend & Relative Support	.322	--			
Spouse Support	.123	.392	--		
Supervisor Support	.303	.164	.081	--	
Total Support	.599	.596	.543	.778	--
Job Characteristics					
Work Rewards	--	--	--	--	--
Interpersonal & Responsibility Demands	.089	--	--	--	.059
Quantitative Workload Demands	--	--	--	-.075	-.051
Qualitative Workload Demands	--	--	--	--	--
Piecework	-.113	--	--	--	-.057
Evening Shift	--	--	-.125	--	-.053
Perceived Stresses					
Work Rewards	.231	.131	.071	.458	.419
Control Rewards	.057	.056	--	.150	.130
Interpersonal & Responsibility Pressure	-.098	--	--	-.297	-.217
Quantitative Workload Pressure	-.080	--	--	-.123	-.087
Job-Nonjob Conflict	-.102	--	--	-.233	-.180

Since perceived support also shows little relation to our standard control variables (age, education, physical effort, exposure to agents), the zero-order correlations between support and perceived stress are very similar to the partial relationships which obtain net of appropriate objective job characteristics and other control variables. These data confirm the expectation that work-related sources of support are most likely to affect perceived occupational stress. Both supervisor support and coworker support tend to enhance perceptions of work and control rewards and to decrease perceptions of job pressure, with the effects of supervisor support being two to three times larger in most cases (some, by no means all, of this greater effect reflects the higher reliability of the supervisor support measures). In contrast, support from friends and relatives, who probably overlap with coworkers, has weaker positive effects on job rewards and no effect on pressures, while spouse support has only a weak effect on perceived work rewards.

Conditioning (Interactive) Effects of Support

Analysis procedure. The conditioning effects of the support variables on relationships of job characteristics to perceived stress were tested by the methods described in Chapter 4, with one modification. Rather than using dummy variables to represent the social support effects, interaction terms were created by simply multiplying the continuous support indices by the continuous job characteristics measure (and continuous support variables were used to control for the main effects of support). This method provides a slightly more restrictive interaction test but one that is statistically more powerful and theoretically more consistent with the idea of buffering by social support. That is, a significant interaction test indicates that the slope of the regression of a perceived stress on a job characteristic increases or decreases a constant number of units for each unit increase in support. This procedure was adopted only after initial analyses using dummy variables for social support indicated that most conditioning effects of social support involved a monotonic increase in the slope of the conditioned relationship. Thus the continuous product variables capture all of the theoretically meaningful conditioning effects of social support and virtually all of the effects which would be detected using dummy variable product terms. The conditioning effect of each social support variable was tested for each of 35 possible relationships between a job characteristic and a perceived stress (including significant quadratic terms in Table 5.2). All tests were net of the variables in the appropriate equation in Table 5.2 and the main effects of the variables in the interaction.

The number of significant ($p \leq .10$) conditioning effects of social support varies depending on the source of support. Neither coworker nor spouse support significantly conditions more relationships than might occur by chance (one and four significant conditioning effects, respectively, out of 35 tests). Friend and relative support, supervisor support, and total support each condition somewhat more relationships than might occur by chance (five, eight, and seven out of 35, respectively), but the substantive meaning of these effects is not clear. Table 6.5 shows each of the significant effects of total, supervisor, and friend and relative support -- the coefficients presented indicate the estimated slope of the

TABLE 6.5

CONDITIONING EFFECTS OF TOTAL SUPPORT, SUPERVISOR SUPPORT AND FRIEND AND RELATIVE SUPPORT ON RELATIONSHIPS BETWEEN OBJECTIVE JOB CHARACTERISTICS AND PERCEIVED STRESS

Perceived Stress (Dep. Var.) Job Characteristics (Indep. Var.)	Source of Support	Effect of Job Characteristic Under: Lowest Support	Highest Support	Significance of Interaction
Perceived Job Rewards				
Objective Job Rewards (linear component)	TOTAL	.151	-.117	$p \leq .05$
	Supervisor	.184	-.104	$p \leq .01$
Interpersonal & Responsibility Demands	Supervisor	.177	.037	$p \leq .10$
Qualitative Workload Demands (linear component)	TOTAL	.230	-.001	$p \leq .05$
	Supervisor	.233	-.035	$p \leq .01$
Piecework	Supervisor	.016	-.277	$p \leq .10$
Control Rewards				
Shift	TOTAL	.661	-.467	$p \leq .05$
	Supervisor	.386	-.242	$p \leq .05$
Interpersonal & Responsibility Pressure				
Objective Job Rewards	Friends/Relatives	.103	.024	$p \leq .05$
Quantitative Workload Demands	TOTAL	-.208	.084	$p \leq .05$
	Friends/Relatives	-.086	.051	$p \leq .10$
Shift	Supervisor	-.263	.070	$p \leq .10$
Quantitative Workload Pressure				
Objective Job Rewards	TOTAL	.183	-.077	$p \leq .05$
	Friends/Relatives	.122	-.070	$p \leq .01$
Interpersonal & Responsibility Demands	TOTAL	.380	-.132	$p \leq .01$
	Friends/Relatives	.155	-.012	$p \leq .05$
Quantitative Workload Demands	TOTAL	-.054	.181	$p \leq .10$
	Friends/Relatives	-.012	.191	$p \leq .01$
Job-Nonjob Conflict				
Objective Job Rewards	Supervisor	.020	.218	$p \leq .05$
Qualitative Work Demands (linear component)	Supervisor	-.163	.017	$p \leq .05$

Note: See text for interpretation of coefficients indicated perceived stress on the indicated job characteristic at the highest and lowest levels of the support variable.*

The clearest result in Table 6.5 is that total support has a significant effect only when one of its component sources of support has such an effect. Thus, the effects of total support tend to reflect the impact of one significant source of support, rather than a cumulation of small effects from several sources -- a pattern which will recur in the conditioning effects of support on relationships between perceived stress and health.

There is also an apparent tendency for job characteristics to have less impact on perceived stress when support is high as opposed to low. For 16 of the 20 conditioning effects in Table 6.5, the absolute value of the effect of job characteristics on perceived stress is larger under lowest support than under highest support. But this lessening of the effects of job characteristics does not consistently involve what is conventionally termed buffering -- the alleviation of deleterious (i.e., stress-inducing) effects of job characteristics. For example, the effects of job characteristics on perceived job rewards and control rewards are always positive (usually significantly so) under low support, but near zero or negative under highest support. Thus support tends to mitigate positive (i.e., stress-reducing) effects of job characteristics on

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*The coefficient under lowest support is the metric regression coefficient for the job characteristic variable in a regression equation containing that variable, the support variable and their interaction (plus all other variables in the appropriate equation of Table 5.2). The estimated slope under highest support is obtained by adding to this coefficient the product of the maximum value of the support variable (e.g., 18 for supervisor support) and the metric regression coefficient for the significant interaction term which estimates how much the slope of the job characteristic effect changes for each unit change in social support.

job rewards. In contrast, support also tends to mitigate positive effects of job characteristics (except quantitative workload demands) on perceived quantitative workload pressure, thus "buffering," in the usual sense of that term, workers against a potential stressor.

Not only do the conditioning effects of social support tend to mitigate both stress-inducing and stress-reducing effects, the conditioning effects are sometimes unexpected ones.* For example, support conditions the relationship between shift and control rewards, but it is unclear why or how shift should affect control rewards, much less how or why this relationship should vary with social support. In a number of cases support conditions only the linear component of a curvilinear relationship.

Thus, although social support does appear to condition the impact of job characteristics on perceived stress, the substantive meaning of these interactive conditioning effects is not transparent. The most plausible general interpretation seems to be that the effects of objective characteristics on perceived stress are lessened by social support, though the net result is not necessarily to reduce stress. It appears that if workers experience social support from supervisors or friends and relatives (who may in many cases overlap with coworkers), they are simply less affected by objective characteristics. This is buffering in a sense, but buffering against positive as well as negative effects of job characteristics. Thus we would propose to term this effect "dampening" to distinguish it from pure buffering. Wells (1978) presents additional evidence that support reduces the impact of (or variance explained by) the type of job a worker does.

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*In the four cases where the effects of job characteristics increase in absolute magnitude as social support increases, the effect in all cases is for support to enhance stress-inducing effects of job characteristics.

This notion of the dampening effects of social support is also consistent with another property of the present data -- the variance in all perceived job stresses except perceived work rewards is substantially lower when total social support is high as opposed to low. However, it is important to note that these lowered variances and the apparent "dampening" effects in Table 6.5 could be produced by a variety of social processes. Our notion of dampening suggests that workers experiencing high levels of social support are less affected by the characteristics of their jobs. This might occur because supportive social relationships develop shared conceptions of social reality which are increasingly impervious to all but larger changes in the surrounding physical reality or "objective" social environment. Thus, for example, supportive social relationships act as a kind of homeostatic mechanism maintaining perceived stress at a moderate or low rate in spite of the presence of potentially stressful objective conditions.

It is also possible, however, that support could sometimes sharpen the impact of objective characteristics on perceived stress, yet yield the results we obtained here. This would occur if subgroups in Whitewall Plant tended to converge within themselves on conceptions of social reality, yet there was divergence between groups about this social reality even in the face of similar objective job characteristics. That is, the variance in perceived stress within such groups would be low, the variance between groups would be high and the relation of the group perception to actual job conditions would be highly variable. Only analysis of the perception of stress in relation to job characteristics at the level of meaningful social groups will clarify these issues.

Summary and Conclusions

As noted at the end of Chapter 4, a cross-sectional design is not optimal for detecting interactive effects of conditioning variables. Thus, in evaluating the impact and importance of the conditioning variables considered here, attention must be paid to the main or additive effects of the conditioning variables on perceived stress, as well as their interactions with objective job characteristics in predicting perceived stress. The evidence for interactive effects of conditioning variables is not generally strong; the evidence of their additive effects is often stronger.

Individual Factors

The data suggest that a number of individual characteristics of workers affect their perception of stress either net of or in conjunction with the objective characteristics of the job.

Age. There was no direct evidence (i.e., statistical interactions) of significant conditioning effects of age on relationships between job characteristics and perceived stress. Age did, however, exert an independent additive effect on job rewards (positive) and job-nonjob conflict (negative). These effects may well reflect conditioning effects of age not detectable in the present data. Thus, as workers grow older their orientations and expectations may change so that they perceive the same objective job rewards more positively. If such adaptations have already occurred prior to this study, they appear in these data as additive effects. The negative effect of age on job-nonjob conflict is more likely a simple direct effect of decline in family (e.g., child rearing) responsibilities as workers age.

Type A. Our measure of Type A behavior pattern also has no significant interactive conditioning effects, but is substantially positively correlated with perceived job pressures, especially interpersonal and responsibility pressure. Since Type A is only weakly correlated with the objective characteristics of workers' jobs, there is only slight evidence that Type A workers select more stressful jobs or that more stressful jobs make workers Type A. Rather, the Type A workers appear to experience comparable jobs as more stressful. This probably reflects a tendency for Type A workers, more than Type B workers, to take on responsibility, workload, etc. within a given job. If Type A's behave this way regardless of the characteristics of the job, as seems plausible, Type A would be exerting a pure main or additive effect. Future research should attend to this issue. The present data clearly suggest that the stress-inducing effects of Type A are largely independent of job selection processes.

Work motivations. Neither the additive nor interactive effects of work motivations on perceived stress are very apparent in these data. No evidence was found of significant interactive conditioning effects of either general work motivation or control motivation. General work motivation had a modest additive effect on perceived job pressure and control motivation was substantially correlated only with control rewards. The lack of effect of general job motivations may be due to the relative lack of variance of this measure (cf. Chapter 2). The lack of impact of control motivation is more likely due to the lack of salience of such motivation to workers' behavior and feelings.

Education. Education was the only individual characteristic to show significant interactive conditioning effects. Compared to the less educated, more educated workers (especially those with more than high school education) are more strongly affected by the level of challenge and other rewards in jobs, but less adversely affected by job demands for a higher quantity of production. Thus, education appears to increase workers' perception of stress in response to some types of potential stressors (e.g., lack of gratifications) but also enables them to cope more effectively with some job demands (here quantiative workload demands) and hence experience less perceived pressure.

Situational Factors

Two situational factors -- piecework and social support -- also have a substantial additive and interactive effect on workers' perceptions of stress.

Piecework. Piecework was shown in Table 5.2 to directly increase perceived workload and interpersonal and responsibility pressure. In addition, piecework modified the impact of potentially stressful job characteristics in two major ways. First, certain objective job demands -- specifically quantitative workload demands and interpersonal and responsibility demands -- affect commensurate perceived pressures only among nonpieceworkers, presumably because pieceworkers have more autonomy to vary their work pace and interpersonal contacts and hence perceive stress more in response to self-induced task demands. Second, more complex and qualitatively demanding work increases perceived pressures and reduces perceived rewards among pieceworkers, since they make a rapid work pace more difficult to maintain, whereas these same job characteristics have no effect or even a slight positive affect (by increasing job challenge and variety) on the level of perceived stress among nonpieceworkers. Since piecework is concentrated in a few job groups in the plant, one should be cautious about generalizing from these results.

<u>Social support</u>. Social support from work supervisors and coworkers had a consistently negative main or additive effect on perceived stress. Support also had some pervasive, but perplexing, interactive conditioning effects on relationships between job characteristics and perceived stress. It was generally, but not always, true that job characteristics had less impact on perceived stress among workers reporting high levels of supervisor support compared to those with low support, but among workers with low support the effect of job characteristics were both to increase and to decrease perceived stress. As will be discussed in Chapter 7, positive support and interpersonal relationships may tend to override or cancel out many effects of job characteristics. This is a plausible but still speculative interpretation, however, and more research is needed on the potential conditioning effects of social support on relationships between job characteristics and perceived stress. Such research should, if possible, be longitudinal in nature and focus on how interpersonal relationships and groups affect the perception of job characteristics.

Overall, the data in this chapter suggest that characteristics of individuals and of their job situations help to account for additional variance in perceived stress that is not directly explained by potentially stressful job characteristics. In the present data, these individual and situational factors generally have more substantial main (additive) effects than pure conditioning (or interactive) effects. The conditioning effects of these variables may be greater than it might first appear, however, since the main or additive effects at least partially reflect the residue of prior conditioning effects. Chapter 7 will briefly discuss the relevance of all this for our ability to predict perceived stress as a function of the job characteristics considered here.

Chapter 7

OBJECTIVE CHARACTERISTICS AND PERCEIVED STRESS: RECAPITULATION AND ASSESSMENT

The attempt of this study to relate objective job characteristics to perceived stress is virtually unique in the literature on occupational stress and unusual even in the broader literature on job characteristics and worker attitudes. As already suggested, the results of this attempt bear on important scientific and applied issues and thus deserve careful assessment.

Chapter 5 showed that objective job characteristics have a significant and meaningful impact on workers' perception of stress. Such perceptions do not arise out of thin air but clearly depend on objective conditions of work. Each objective job characteristic had consequential impacts on one or more perceived stresses, and the results are generally consistent with prior theory and research. Being paid on a piecework basis increases perceptions of pressure, especially workload pressure (cf. Levi, 1964). Shiftwork increases feelings of conflict between work and nonwork activities (Mott _et al_., 1965). Jobs involving greater interpersonal and responsibility demands increase felt job pressures, especially interpersonal and responsibility pressure and decrease perceived control over work pace, while also producing (or at least going along with) a modest increase in perceived work rewards (cf. Kahn _et al_, 1964). Quantitative workload demands enhance perceived workload pressures and adversely affect perceived job rewards. Objective job rewards (intrinsic and extrinsic) have a major impact on perceived rewards. In our study the effect is somewhat curvilinear due to the higher perceived rewards of workers in simple manual laboring jobs (e.g., cleaning and janitorial work) who are not tied to machines relative to operators of simple machines whose objective rewards (skill, level, prestige, expertise required etc.) are rated somewhat higher. Otherwise the relationship is essentially linear and positive. Finally, as qualitative workload demands increase to a moderate level, perceived stress declines (i.e., rewards increase and pressures decline), but beyond that point such demands increase perceived stress -- both too little and too much qualitative workload appear stressful. Thus the findings indicate that piecework, shiftwork, lack of intrinsic and extrinsic rewards and excessive levels of quantitative and qualitative workload and interpersonal and responsibility demands are all <u>objective</u> features of jobs which produce feelings of occupational stress among workers in Whitewall Plant.

However, the magnitude of the effects of job characteristics on perceived stress are quite modest, and much lower than aniticipated at the inception of this research. Thus, by the criterion of sheer statistical significance, the impact of job characteristics on perceived stress is quite marked and pervasive. By the criterion of variance explained the impact of job characteristics appears much more limited. Job characteristics can, at most, account for between three percent (in the case of job-nonjob conflict) and 17.4 percent (in the case of perceived work rewards) of the variance in perceived stress. Further, the low proportion of variance explained is largely <u>not</u> attributable to unreliability or invalidity in the measures of objective job characteristics or perceived stress, though these measures could certainly be improved (see Ch. 5). It is simply the case that the vast bulk of the variance in perceived stress lies within jobs rather than between them.

The effects of objective job characteristics on perceived stress appear somewhat larger if we consider, as the stress paradigm of Figure 1 suggests we must, both individual and situational conditioning variables. However, as shown in Chapter 6, only some of these variables have true conditioning (i.e., interactive) effects on relationships between job characteristics and perceived stress, and these effects are generally also modest in size. Among five individual characteristics only education had substantial interactive conditioning effects, with higher educated workers being more adversely affected in terms of perceived stress by lack of job rewards, but less adversely affected by demands for greater quantitative workload. Both situational characteristics considered, piecework and social support, significantly conditioned the relationship of job characteristics to perceived stress. Among pieceworkers compared to non-pieceworkers, the level of perceived pressures, especially workload pressures, are generally less a function of the rated demands of the job, but job characteristics which increase the complexity of work (i.e., increased objective intrinsic rewards and qualitative workload demands) are more likely to lead to increased perceptions of stress. The effects of social support, which are both complex and interesting, are discussed in more detail below.

In sum, conditioning effects are pervasive and meaningful, particularly the conditioning effects of situational characteristics. However, by the criterion of variance explained, they also appear modest -- each significant interaction increases the explained variance by only about 0.2 percent and 1.0 percent. If such effects are cumulated and we focus only on the groups which are particularly vulnerable to the effects of job characteristics, the variance explained by job characteristics increases by a somewhat larger amount.

The pattern of results in Chapters 5 and 6 in many ways supports and extends existing scientific wisdom about the nature and sources of occupational stress and existing practical wisdom about the potential of job redesign as a mechanism for reducing occupational stress. Changes in objective job characteristics such as increased opportunities for using skill and initiative, reduced piecework and shiftwork, and reduction of excessive interpersonal responsibility and workload demands all should be effective mechanisms for reducing feelings of occupational stress at Whitewall Plant and probably among blue collar and even white collar workers more generally.

However, the magnitude of the effects in Chapters 5 and 6 also poses a substantial challenge to conventional scientific and practical wisdom. "Job" characteristics, even if considered in conjunction with appropriate conditioning variables appear to have only quite modest potential for predicting or controlling levels of perceived occupational stress.* Since, as will be seen in Part III, perceived stress appears to have consequential effects on a wide range of mental and physical health outcomes our modest understanding of its roots in the characteristics of jobs must not be dismissed lightly. But we also must recognize the need to move beyond "job" characteristics, at least as they have been conceptualized in this and most other studies. The experience of the present study suggests two fruitful directions for further work.

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*As noted in Chapter 5, a wide range of studies examining the relationship between objective social conditions and perceived quality of life have found similarly modest associations. Thus, the problem here bears on a wider range of concerns.

First, increased attention should be, and to some extent is being, paid to how characteristics of the person have main effects, as well as interactive or conditioning effects on the perception of stress. Although they did not have significant interactive conditioning effects, a number of individual characteristics manifested sizable direct associations with perceived stress (cf. Table 6.1). As noted, in Chapters 4 and 6 some of these relationships may, in fact, reflect the residue of conditioning effects from some earlier time. However, a substantial portion of these relationships probably represents simple main effects -- tendencies of workers to behave, think, feel, and perceive in ways conducive to perceptions or feelings of stress regardless of their objective job conditions.

Thus, perceived occupational stress in Whitewall Plant declines with age, and generally increases as a function of Type A characteristics (and to a lesser extent the motivation) of the worker. These findings are not surprising in light of prior research (see Wright and Hamilton, 1978 and Gurin _et al._, 1960 on age; Jenkins, 1975 and Glass, 1977 for reviews regarding Type A). But the reasons for these associations have not been clear in prior research. They could plausibly be due to: (a) an effect of age and Type A on the type of jobs people select or are selected for; (b) conditioning effects of age or Type A on relationships between job characteristics and perceived stress; or (c) an effect of these variables on the perception of stress apart from (a) and (b) and hence independent of objective job characteristics. Because the present data, unlike most studies, include assessments of the objective nature of jobs, we can say that we find little evidence supporting interpretations (a) and (b), and hence must lean toward (c).

Exactly why and how age reduces perceived stress and Type A increases it, it is a fruitful topic for future research. Here we can only speculate that with age people become more adapted (or resigned) to their state in life and also better able by virtue of experience and adjustments already made to cope with or defend against the stress-inducing consequences of job demands. Thus they perceive higher rewards and less pressure than younger workers in the same job situation. Similarly Type A's, regardless of their job, may behave and perceive in ways that induce feelings of stress (e.g., they may set unrealistic deadlines for themselves or allow and encourage, perhaps without awareness, others to do this for them).* Whatever the reason, in our data these variables together can explain about five percent additional variance in perceived stress net of job characteristics. Future research and practice should attend to how and why these and other individual characteristics raise or lower worker's perceptions of occupational stress (and probably stress in other areas of life) regardless of job (or life) conditions.

A second major direction for future research and practice is to broaden the conception of "jobs" which underlies most research on the effects of job characteristics and most applied efforts at job redesign as a means for reducing stress and improving satisfaction. The working definition of a "job" here and in most related work is as a set of activities carried out in relation to other people, machines, and materials, e.g., what is depicted in a "job" description. Further, it is generally

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*Two points should be noted about Type A. First, the self-report nature of the measure results in a methodological confounding between reports of Type A and reports of perceived stress. Still, we suspect that a substantial portion of the relationships observed here and elsewhere between Type A and stress reflect an impact of a stable personal attribute on perceptions of the world. Second, although Type A may be an individual attribute, it may and probably does have social and cultural origins. Thus, individual treatment or therapy are not the only or even best routes to altering it.

assumed that these activities, people, machines and materials are the major inputs that affect perceived stress and other subjective reactions to work, and that these inputs are relatively invariant for different individuals performing the same job, such as two tire-builders making identical tires on identical machines.

Such a conception fails to capture what might be termed the "context" of jobs. This context is both physical and, more importantly, interpersonal in nature. The effects of exposure to hazardous agents and the physical effort involved in a job on perceived stress observed in Table 5.2 suggest that physical-chemical factors can have social psychological effects as Ashford (1976:124-126) has suggested.* However even with these factors considered, if only partially, the bulk of the variance in perceived stress remains unexplained.

The interpersonal context of jobs may be an especially important determinant of perceived stress for several reasons. Job characteristics and demands, even in highly mechanized jobs, are largely communicated to individuals through an interpersonal network of supervisors and other workers. The quantity of job demands and rewards experienced by the worker will be influenced by the nature of this interpersonal process. Two tire builders building the same tires on the same machines with the same base rate for piecework pay may set for themselves and/or perceive quite different workloads not only because of their own personality characteristics but also because their different supervisors or coworkers may communicate, explicitly or implicitly, quite different standards.

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*As noted in Chapter 5 some of the effect of exposure to agents on perceived stresses is undoubtedly due to the common self-report nature of the measures. But some probably reflect a tendency of "dirty" and "hazardous" working conditions to reduce perceived rewards and heighten perceived pressures.

Some supervisors and coworkers may strive more than others to achieve maximum rates. Hence the quality of actual workload demands may vary considerably across supposedly identical "jobs". Similarly the quality or tone with which such demands are conveyed may make them seem more or less stressful. Further, significant others are a source of social comparison which may alter the worker's evaluation of how much is "too much". Finally, the individual worker is an actor who influences how others relate to him. Thus "job" characteristics and the perception thereof are the outcome of a complex process of social interaction and negotiation.

Neither this study nor others has paid sufficient attention to this interpersonal process. There has been a justified reaction against the almost solely interpersonal emphasis of the "human relations" approach to organizations which has led to a healthy recognition on the impact of structural features of jobs and organizations on individual attitudes and behavior. But it may also have led to a neglect of the interplay of interpersonal and structural forces. Although this study like others lacks adequate data on these issues, the results on the effects of social support in Chapter 6 are highly suggestive.

Table 6.4 showed that social support from supervisors and coworkers had a consistent, and sometimes substantial, inverse association with perceived stress which was largely independent of the effects of job characteristics.* Further, results in Table 6.5, though complex, suggested

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*Again there are problems of causal ordering and methodological confounding between self-reports of stress and of social support. But the patterns of associations in Table 6.4 (especially the lack of association between perceived stress and nonwork sources of support) suggests that support may have important effects on stress.

perceived stress was less affected by job characteristics among workers with high, as opposed to low social support, as manifested both in lower variances on the perceived stress variables and reduced regression coefficients for the regression of perceived stress on job characteristics. Thus, social support has important effects in both directly reducing perceived stress and making workers less susceptible to the impact of job characteristics. In short, the interpersonal context is a major factor which both explains additional variance in perceived stress and conditions the impact of job characteristics on perceived stress.

A little reflection tells us that people do a good deal of job changing aimed not only at improving the characteristics of their jobs but also the interpersonal context of their work. Further, many of the most effective experiments in organizational change and job redesign are those where the changes have had a major impact on interpersonal relations as well as "job" characteristics per se, e.g., the Tavistock experiments with sociotechnical systems and Scandanavian experiments with autonomous work groups, (cf. Katz and Kahn, 1978:Ch. 19 & 20). Further research should attend more closely to the interplay between "job characteristics" and the interpersonal context of work in determining perceived stress. It would not be surprising if the interpersonal context often proved more important than job characteristics.

PART III

THE IMPACT OF JOB STRESS ON
ON MENTAL AND PHYSICAL HEALTH

PART III

THE IMPACT OF JOB STRESS ON MENTAL AND PHYSICAL HEALTH

Chapters 8-13 analyze the relationship of both potentially stressful objective job characteristics and perceived job stresses to a variety of indicators of mental and physical health: a) general job satisfaction and self-esteem as indicators of job-related mental health (Chapter 8); b) neurotic symptoms and life satisfaction as indicators of general mental health (Chapter 9); c) cigarette smoking and alcoholic drinking as indicators of substance abuse (Chapter 10); d) self-reported symptoms of disorders in four different bodily systems -- angina pectoris, peptic ulcer, persistent cough and phlegm (or chronic bronchitis), and itch and rash on skin (Chapter 11); and e) signs of cardiovascular, respiratory, and dermatological conditions from medical examinations and tests (Chapter 12). The specific health measures will be described as they are presented except for job satisfaction and occupational self-esteem which were described in Chapter 2.

Each chapter will focus on several issues. First, the relationship of objective job characteristics to each health outcome will be examined. Such relationships are generally viewed as reflecting the impact of job conditions on health, though the possibility that persons with certain health problems are selected into certain types of jobs must also be entertained in some cases. Second, we examine the relationship of perceived stress on health and the degree to which the effects of objective job characteristics are mediated through such perceptions of stress. Finally, effects of potential conditioning variables on health are considered, including both main or additive effects and true conditioning or interactive effects, i.e., interactions between the conditioning variables and either job characteristics or perceived stress in predicting health. As noted in Chapters 4 and 6, in a cross-sectional study prior conditioning effects can be manifested in either additive or interactive effects. The conditioning variables considered here are the same as those analyzed in Chapter 6 with the addition of self-reported exposure to physical and chemical agents (described in Appendix D).

The health outcomes are not considered to be ordered causally with two exceptions. First, job satisfaction and self-esteem are considered causally prior to other health outcomes and their effects on other health outcomes are estimated. Second, smoking is considered a potential cause of all health outcomes except job satisfaction and self-esteem, since smoking has physiological effects which may produce symptoms and signs of other ailments. We considered treating drinking behavior like smoking, but the measure of drinking was less adequate and seemed more subject to short-term fluctuations. Analyses not presented here which controlled drinking behavior while examining the effect of perceived stress on other variables showed that controlling drinking behavior had little effect on the results.

Chapter 8

THE RELATION OF STRESS TO JOB SATISFACTION AND SELF-ESTEEM

A major aspect of positive mental health is feeling positively about the job one does (i.e., job satisfaction) and about oneself as a worker (i.e., occupational self-esteem). Thus our analysis of the health consequences of occupational stress begins with job satisfaction and self-esteem. Considerable prior research shows that perceived job stress (i.e., perceived pressures and/or lack of perceived rewards) is negatively associated with job satisfaction, and to a lesser extent occupational self-esteem (e.g., Kornhauser, 1965; Kalleberg, 1974; Caplan et al., 1975; Campbell et al., 1976). The impact of objective job characteristics on job satisfaction and occupational self-esteem has been less extensively studied, though existing evidence suggests that higher status jobs and those involving higher levels of skill and autonomy are more satisfying (cf. Kahn, 1972; Kohn, 1969; Kornhauser, 1965). Finally, although some evidence has been presented that job motivations condition the effect of job characteristics on job attitudes including satisfaction (e.g., Hackman and Lawler, 1971), no systematic analysis has been done of the effects of a range of potential conditioning variables on relationships of objective or subjective indicators of work stress to job satisfaction and self-esteem. The present chapter will provide further evidence of the effects of perceived stress on job satisfaction and self-esteem while focusing on the impact of objective job characteristics and potential conditioning variables.

The Impact of Job Characteristics and Perceived Stress on Job Satisfaction and Self-Esteem

Zero-Order Correlations

Table 8.1 presents the zero-order correlations of job satisfaction and self-esteem with both objective job characteristics and perceived stress. The pattern of zero-order correlations is similar for both satisfaction and self-esteem, but stronger for satisfaction. This difference in strength of relationships partially reflects the higher reliability of the job satisfaction index (α = .83) compared to self-esteem (α = .64), but also suggests, as might be expected, that both actual and perceived job conditions have a greater impact on feelings about the job than on feelings about the self.

The most striking result in Table 8.1 is that job characteristics have an even weaker impact on satisfaction and self-esteem than they had on perceived job stresses in Chapter 5. Objective work rewards and interpersonal and responsibility demands are both positively correlated with satisfaction and self-esteem. Both qualitative and quantitative workload demands are weakly positively associated with self-esteem and unrelated to satisfaction; piecework is negatively related to satisfaction but unrelated to esteem; and working the evening shift is negatively related to esteem but unrelated to satisfaction. As in Chapter 5, the nature of these relationships changes somewhat when we turn to multivariate analyses below. As already seen in Chapter 2, perceived job stresses are moderately to strongly related to both satisfaction and self-esteem, positive in the case of perceived rewards and negatively in the case of perceived pressures. Perceived work rewards (i.e., intrinsic, extrinsic, and importance rewards)

TABLE 8.1

SIGNIFICANT ($p \leq .05$) ZERO-ORDER CORRELATIONS OF
JOB SATISFACTION AND OCCUPATIONAL SELF-ESTEEM WITH EACH OTHER
AND WITH OBJECTIVE JOB CHARACTERISTICS AND PERCEIVES STRESS

	Job Satisfaction	Self-Esteem
General Job Evaluations		
Job Satisfaction	--	.412
Occupational Self-Esteem	.412	--
Objective Job Characteristics		
Objective Work Rewards	.108	.060
Interpersonal & Responsibility Demands	.144	.063
Quantitative Workload Demands	--	.065
Qualitative Workload Demands	--	.072
Piecework	-.120	--
Evening Shift	--	-.080
Perceived Job Stresses		
Perceived Work Rewards	.606	.416
Perceived Control Rewards	.199	--
Interpersonal & Responsibility Pressure	-.268	-.133
Quantitative Workload Pressure	-.244	--
Job-Nonjob Conflict	-.445	-.257

and job-nonjob conflict stand out as the strongest correlates of both satisfaction and self-esteem, the effects of job-nonjob conflict having been relatively neglected in prior research.

Multivariate Analyses

To clarify the nature of the independent effects of job characteristics and perceived stress on job satisfaction and self-esteem and to establish a baseline equation for testing effects of conditioning variables, a series of stepwise multiple regression analyses were performed. The first set of analyses considered only control variables (age, education, exposure to agents, and physical effort) and job characteristics. The control variables were entered first into the equation and then linear and quadratic effects of job characteristics were added until additional job characteristics would not explain significant additional variance. The resulting equations are shown as Model 1 in Table 8.2.

The results for self-esteem are very simple. Self-esteem rises with age but declines with increased education, exposure to agents, and physical effort demanded by the job. Workers in jobs with higher qualitative workload demands have higher self-esteem, but no other job characteristics explain significant additional variance net of the control variables (two of which are, of course, themselves job characteristics) and qualitative workload demands. Thus, the effects of job characteristics on self-esteem appear slight, with jobs which are dirty and physically taxing (and hence generally lower prestige) having a small negative impact and jobs which are demanding in a mental sense having a small positive impact. Only 5.9 percent of the variance in self-esteem is explained by Model 1 (and only 1.2% is attributable to qualitative workload demands).

TABLE 8.2

MULTIPLE REGRESSIONS OF JOB SATISFACTION AND OCCUPATIONAL SELF-ESTEEM ON CONTROL VARIABLES, JOB CHARACTERISTICS, AND PERCEIVED STRESS AND MOTIVATIONS

	Job Satisfaction		Self-Esteem	
	Model 1	Model 2	Model 1	Model 2
Control Variables				
Age (years)	.012*	(.000)	.015*	.007*
Education (years	-.042*	(-.012)	-.022+	(-.012)
Number of Agents Exposed to (0-3)	-.154*	-.045*	-.070*	(-.024)
Physical Effort Demanded by Job (1-5 scale)	(-.088)	(-.069)	-.148+	(-.029)
Objective Job Characteristics				
Objective Work Rewards (Linear)	(-.032)	(-.035)		(-.004)
(Quadratic)	.505*	(.050)		-.066°
Quantitative Workload Demands		.060+		.081*
Qualitative Workload Demands (Linear)	.091+	(.007)	.092*	
(Quadratic)	-.089*	(-.014)		
Piecework	-.225*	(-.052)		.110°
Evening Shift				-.090°
Perceived Job Stress				
Perceived Work Rewards (Linear)		.520*		.436*
(Quadratic)				-.081*
Perceived Control Rewards				-.088*
Interpersonal & Responsibility Pressure		-.054+		-.062+
Quantitative Workload Pressure		-.096*		
Job-Nonjob Conflict		-.225*		-.095*
Work Motivations				
Work Motivation (Linear)		-.061*		.134*
(Quadratic)				.025+
Constant		.353		.087
Multiple R	.341	.695	.234	.496
Multiple R^2	.117	.483	.059	.246

Note: Entries in table are metric regression coefficients. All variables are in standard form (mean=0, std. dev.=1) except for: (a) the control variables which are scaled as indicated in the table, (b) piecework and shift which are dummy variables and (c) quadratic terms which are obtained by squaring the standardized variables. Metric coefficients should be interpreted accordingly.

* $p \leq .01$

+ $p \leq .05$

° $p \leq .10$

Coefficients in parentheses are nonsignificant.

By comparison, Model 1 for job satisfaction explains 11.7 percent of the variance, with 4.2 percent uniquely attributable to the psychosocial job characteristics. The effects of the control variables on job satisfaction are similar in direction to those on self-esteem, with the effects of education and agents being stronger on satisfaction than on self-esteem, and the effects of age and physical effort being weaker. The impact of psychosocial job characteristics on satisfaction is greater than on self-esteem though still modest. These effects are also somewhat different from what the correlations in Table 8.1 would lead us to expect. Whereas interpersonal and responsibility demands were the strongest correlate of satisfaction in Table 8.1, they do not enter the multiple regression equation, while qualitative workload demands do despite having a nonsignificant zero-order correlation in Table 8.1. These anomalies occur because net of the control variables objective work rewards have a larger effect on satisfaction than interpersonal and responsibility demands, and these two variables are highly positively correlated (cf. Table 5.1). Once objective rewards enter the equation, interpersonal and responsibility demands would account for no significant additional variance. As would be expected from Table 8.1, piecework adversely affects job satisfaction. The effects of objective work rewards and qualitative workload demands are both curvilinear. Job satisfaction tends to be higher in jobs with both very low and very high rewards than in those with moderate levels of rewards. As noted in Chapter 5, this result is due to the relatively high perceived rewards and satisfaction in manual laboring and janitorial jobs, which have low skill and prestige, vis a vis most simple machine operating jobs. Job satisfaction also rises as qualitative workload demands increase toward a moderate level, but declines gradually with increases beyond that level. Both of these curvilinear effects on job satisfaction closely resemble, are essentially a function of, and are mediated through, the curvilinear effects of objective work rewards and qualitative workload demands on perceived work rewards (cf. Chapter 5, Table 5.2 and Figure 3).

Model 2 of Table 8.2 incorporates those perceived job stresses and work motivations which explain significant additional variance in job satisfaction and self-esteem, with resulting changes in the effects of job characteristics and control variables. Perceived work rewards relate strongly positively to job satisfaction, while perceived pressures (especially job-nonjob conflict) and work motivation have small to moderate negative effects. With these effects controlled, agents is the only variable from Model 1 which continues to exert a significant, but much reduced, effect. A very weak and anomalously positive effect of quantitative workload demands on job satisfaction emerges in Model 2. Thus, it appears that the effects of job characteristics (and control variables) on job satisfaction are almost entirely mediated by perceived job rewards and pressures, with perceived work rewards mediating most of the effects and perceived quantitative workload mediating the effects of piecework.

The impact of the perceived stress variables on esteem is generally similar to but weaker than their effects on satisfaction, with a couple of exceptions. Work motivation which is negatively associated with satisfaction is positively (and slightly curvilinearly) associated with esteem. Strong work motivation is a positively valued attribute in our society and hence may contribute to self-esteem (though self-esteem may also enhance expectations and aspiration for work rewards). The effect of work rewards on esteem is slightly curvilinear, while control rewards, which bore no relation to satisfaction, are slightly negatively associated with esteem, perhaps reflecting lower respect for jobs allowing such control. The perceived stress and motivation variables mediate most of the effects on esteem in Model 1, only the age effect remaining significant in Model 2. However, a number of job characteristics have marginally significant effects on esteem once perceived stresses are controlled. These are weak effects but suggest that certain types of jobs may produce greater or lesser feelings of esteem which are not mediated through the measures of perceived stress used here. The negative effect of the evening shift is not surprising, but the slight curvilinear effect of objective work rewards is puzzling. It appears that piecework and high workload jobs induce some feeling of self-respect and importance despite their greater pressures and lesser rewards.

Overall, these data suggest that potentially stressful objective job characteristics, including both the lack of rewards and the pressures for high performance generally reduce job satisfaction, though some of these effects are curvilinear. As the stress paradigm posits, these effects are almost entirely mediated by perceptions of stress which are the most proximal and important correlates of job satisfaction. Satisfaction, like stress, is largely though not entirely in the eye of the beholder. Self-esteem is even more a product of individual appraisal. Job characteristics have only a very slight effect on self-esteem, but these effects indicate that demanding jobs are conducive to higher self-esteem, presumably since they demand and indicate some degree of competence. Perceived work rewards have a strong positive effect on esteem, and the effect of perceived pressures is clearly adverse. Thus, having an objectively demanding job can enhance self-esteem if those demands are handled without undue feelings of pressure. Perceived work rewards are, however, by far the strongest correlate of both satisfaction and self-esteem, with job-nonjob conflict also having a moderately strong negative effect on both job evaluations. Feeling you have an unrewarding job and/or one that interferes with non-work life is associated with negative evaluations of the job and of one-self as a worker.

The Impact of Potential Conditioning Variables

Using procedures described in Chapters 4 and 6, tests were run for interactive conditioning effects of the variables listed in Table 8.3 on relationships of job satisfaction and self-esteem to both objective job characteristics and perceived stress. Considering all conditioning variables except social support, the overall number of significant interactive conditioning effects did not clearly exceed the proportion that might occur by chance alone, and a number of even the significant effects made little substantive sense. Thus, if piecework, exposure to agents, or any of the individual characteristics in Table 8.3 condition relationships of objective or perceived occupational stress to job satisfaction or occupational self-esteem, such conditioning effects must have occurred prior to the current study and be reflected in the main or additive effects of the variables which are shown in Table 8.3. The additive effects on job satisfaction and self-esteem of all these variables except Type A have already been considered in Table 2. The results show their effects to be modest and largely mediated through the perceived stress variables. The data on Type A in Table 8.3 and from multivariate analyses not reported here reveal a similar picture. Thus, there is no compelling evidence that these variables sharply condition the impact of objective or perceived stress on job satisfaction and self-esteem.

TABLE 8.3

SIGNIFICANT ($p \leq .05$) ZERO-ORDER CORRELATION OF CONDITIONING VARIABLES WITH JOB SATISFACTION AND OCCUPATIONAL SELF-ESTEEM

	Job Satisfaction	Occupational Self-Esteem
Individual Characteristics		
Age	.215	.195
Education	-.139	-.115
Type A	--	.114
Work Motivation	-.128	--
Control Motivation	--	--
Situational Factors		
Piecework	-.120	--
Exposure to Agents	-.128	-.075
Social Support from:		
Supervisor	.377	.231
Coworker	.220	.116
Friends & Relatives	.135	--
Spouse	.080	.053
Total of All Sources	.368	.210

Of all the variables in Table 8.3, social support, especially from persons at work, has the strongest zero-order correlations with satisfaction and self-esteem. These effects are largely mediated through the effects of support on perceived stress (i.e., most of the effects become nonsignificant when incorporated in an equation such as Model 2 in Table 8.2). Supervisor and total support, however, explain some additional variance (about 1-2%) in job satisfaction net of all variables in Model 2 of Table 8.2. There is no clear evidence, however, that support interacts with perceived stress in predicting job satisfaction and self-esteem. Yet support does interact with objective job characteristics in predicting satisfaction and self-esteem. The interactive conditioning effects of each of the five social support measures were tested with respect to eight relationships between objective job characteristics (including two quadradic terms) and satisfaction and six relationships of job characteristics to self-esteem -- a total of 14 tests. Four (or 29%) of these 14 tests involving the index of total support were significant at the .05 level and an additional one was significant at the .10 level. Of the 56 tests involving the four separate sources of support, eight (or 14%) and 13 (or 23%) were significant at the .05 and .10 levels, respectively, with 70 percent of these effects due to coworker and especially supervisor support. Thus, in the present data social support from supervisors and coworkers clearly conditions relationships of objective job characteristics to job satisfaction and self-esteem. The results for spouse and friend and relative support, however, could easily have occurred by chance.

Table 8.4 shows the effects (i.e., metric regression coefficients) of job characteristics on satisfaction and self-esteem at the highest and lowest levels of support for each of the relationships which was significantly conditioned by the measures of supervisor, coworker, or total support. As with the results in Table 6.5, the meaning of these results is not obvious, though the consistent trend is again for the impact of objective job characteristics on satisfaction and self-esteem to be stronger among workers with low social support at work compared to those with high support (i.e., the absolute values of the effects in Table 8.4 are almost always lower under highest support compared to lowest support). However, in addition, in Table 8.4, the impact of potentially stressful job characteristics on satisfaction and self-esteem is consistently positive under low support, but weak or negative under high support. Thus, both objective job rewards and objective job demands seem to have a moderate positive impact on satisfaction and self-esteem if social support is low, but these effects are much weaker and often slightly negative among workers with high levels of support.

The results in Table 8.4 are largely a function of those already observed in Table 6.5. That is, social support dampens the impact of job characteristics on job satisfaction and occupational self-esteem because it dampens the impact of these job characteristics on the perceived stresses which are the proximal determinants of job satisfaction and self-esteem. When these perceived stresses are controlled (i.e., included in the baseline equation against which the relevant interaction terms are tested), none of the interactive conditioning effects in Table 8.4 remain significant ($p \leq .10$), and a number of the differences in Table 8.4 disappear almost entirely.

TABLE 8.4

SIGNIFICANT ($p \leq .10$) CONDITIONING EFFECTS OF SOCIAL SUPPORT ON RELATIONSHIP OF JOB CHARACTERISTICS TO JOB SATISFACTION AND SELF-ESTEEM

Independent Variable	Source of Support	Effect on Job Satisfaction When Support is: Lowest	Highest	Effect on Self-Esteem When Support is: Lowest	Highest
Objective Work Rewards	TOTAL			.257	-.211
(linear component)	Supervisor	.093	-.087	.162	-.144
	Coworker	.054	-.144		
Objective Work Rewards (quadratic component)	Coworker	.072	.279		
Interpersonal & Responsibility Pressure	TOTAL			.218	-.126
	Supervisor			.156	-.060
Quantitative Workload Demands	TOTAL	.159	-.081		
	Coworker	.076	-.077		
Qualitative Workload Demands	TOTAL	.177	-.019	.268	-.056
(linear component)	Supervisor	.158	-.004	.198	.000
	Coworker	.170	-.001		

Note: Entries are estimated metric coefficients for regression of job satisfaction or self-esteem on the indicated job characteristics at the highest vs. lowest level of indicated support variable. See text here and in connection with Table 6.5 for further information on the nature and source of entries in this table.

Summary and Conclusion

Perceived occupational stress has a substantial adverse effect on job satisfaction and a lesser but still sizable impact on self-esteem among workers in Whitewall plant. Multiple regression analyses accounted for over 48 percent of the variance in job satisfaction and almost 25 percent of the variance in self-esteem. Although the relationships between perceived stress and job satisfaction or self-esteem undoubtedly reflect some degree of reciprocal causation and common methods variance, it is plausible and logical to assert that the relationships do, in fact, reflect a substantial causal impact of occupational stress on these two indicators of occupational mental health and well-being. Lack of general work (i.e., intrinsic, extrinsic, and importance) rewards and, to a lesser extent, job-nonjob conflict have the strongest and most pervasive effects in this regard.

As we might expect for the results in Part II, objective job characteristics have a modest, but meaningful, impact on job satisfaction and small effects on self-esteem, with virtually all of these effects (along with those of the control variables) being mediated through perceived stress. Thus, in accord with the stress paradigm, job characteristics give rise to perceived stress which in turn is the major determinant of job satisfaction and occupational self-esteem.

Although a number of individual and situational characteristics have a modest zero-order relationship with job satisfaction and self-esteem (cf. Table 8.3), the effects of most of these variables (e.g., age, education, perceived exposure to physical-chemical agents) were mediated almost completely through perceived stress. Thus, they made no independent contribution to explaining variance in job satisfaction and self-esteem, nor did they exert any interactive conditioning effects on the relationships of either objective job characteristics or perceived stress to satisfaction and self-esteem.

In contrast, social support had substantial positive zero-order correlations with job satisfaction and self-esteem (cf. Table 8.3), and in the case of job satisfaction, support still exerted a positive effect net of both objective job characteristics and perceived stress. Support also exerted significant interactive conditioning effects on relationships between objective job characteristics and both job satisfaction and self-esteem, though relationships between perceived stress and satisfaction or self-esteem were not similarly conditioned. The significant interactive conditioning effects were similar in nature to, and essentially a function of, those for relationships between job characteristics and perceived stress discussed in Chapter 6. Thus, support appears to insulate people against the effects of objective job characteristics on perceived stress and hence on job satisfaction and self-esteem as well, while also tending to reduce perceived occupational stress and enhance occupational mental health.

Chapter 9

MENTAL HEALTH: LIFE SATISFACTION AND NEUROTIC SYMPTOMS

At least from the time of Karl Marx, the work people do has been considered a major factor in their general sense of well-being and mental health, as well as in job satisfaction and self-esteem. Lack of intrinsic and extrinsic rewards and feelings of job pressure have all been found to be associated with poorer mental health and life satisfaction, though the empirical evidence is fragmentary in places (cf. Gurin _et al_., 1960; Kahn _et al_., 1964; Kornhauser, 1965; Caplan _et al_., 1975; and Kasl, 1974 and 1978). Kornhauser provides the most thorough analysis of the effects of work rewards and pressures on the mental health of blue collar workers, focusing especially on the effect of skill level. He found lack of meaningful, interesting (i.e., skilled) work to be the major determinant of poor mental health, while a variety of other pressures and tensions also exerted negative effects. Caplan _et al_., (1975) identify a range of perceived job stresses similar to those in the present study that are inversely correlated with indicators of mental health among both blue collar and white collar workers.

The current study replicates and extends earlier analyses of the impact of job characteristics and perceived stress on mental health. Further it provides an opportunity to explore the degree to which these relationships are conditioned by individual or situational factors. Two measures of mental health are utilized here -- an index of life satisfaction and an index of neurotic symptoms which have previously been validated against psychiatristic ratings. After describing these measures, the chapter presents data on their relationship to objective job characteristics, perceived stress and the indicators of job specific mental health (job satisfaction and esteem) and considers how these relationships are conditioned by relevant individual and situational factors.

Measures of General Mental Health

Life Satisfaction

Workers' general life satisfaction was assessed by two items widely used in studies of mental health and the quality of life (e.g., Gurin *et al.*, 1960; Bradburn, 1969; Withey and Andrews, 1976; Campbell *et al.*, 1976). The respondents were specifically instructed to "take into account your *whole life*, not just your job." The two items (and their coding) were:

(a) Taking all things together, how would you say things are these days? Not too happy (0), pretty happy (1), or very happy (2)?

(b) In general, how satisfying do you find the ways you're spending your life these days? Not very satisfying (0), pretty satisfying (1) or completely satisfying (2)?

Since the two items were highly intercorrelated (r = .60), responses were summed into an index of life satisfaction which was normally distributed (range = 0-4, mean = 1.97 and standard deviation = 1.01) and quite reliable (alpha = .75).

Neurotic Symptoms

The measure of neurotic symptoms was a recent revision by Dorothea Leighton of the Health Opinion Survey (HOS) originally developed in the Stirling County Studies (Leighton *et al.*, 1963). Fourteen of the eighteen items used here were included in the original version for which

MacMillan (1957: Table 3) showed that a dichotomy which classified 85 percent of community samples as "well" as and 15 percent as "neurotic" agreed closely with (i.e., had 90% specificity and 86% sensitivity against) a psychiatrist's evaluation of "well" vs. "sick" (mainly neurotic). The specific items composing the index are given in Appendix E. Although the exact meaning of such indices of psychological and physiological symptoms are much disputed, the label "neurotic symptoms" seems appropriate because the items tap the presence of symptoms associated with psychological states (anxiety, depression) often labelled as "neurotic" (cf. Dohrenwend, 1975:376-78).

Respondents indicated whether they experienced these eighteen symptoms "often" (coded 2), "sometimes" (coded 1) or "never" (coded 0), and the items were initially summed into an index with a range of 0-36. For most analyses, however, scores on the scale have been dichotomized at the level ($\geq$ 13) which classified approximately the same proportion (i.e., 14.7%) of Whitewall Plant workers "neurotic" as the cutting points used by MacMillan (1957) in validating the scale against psychiatric ratings. Thus, the dichotomous version of the measure contrasts persons with relatively high symptom levels, whom psychiatrists readily classify "sick", with all others. Thus, the variance of the dichotomous measure reflects only substantial levels of psychological distress.

For methodological reasons, initial analyses in this chapter present results using both the continuous (0-36) and dichotomous (0-1) versions of the index. All of the health outcome measures in subsequent chapters except smoking are dichotomous variables with means less than or about equal to the .147 mean of the dichotomous neurotic symptoms index. These measures were dichotomized in a manner that would increase the probability that the variance in them reflects real health problems and not simply a tendency to to detect or report symptoms (i.e., an attempt to minimize false positives or maximize the "specificity" of the measure). Thus, to score positively on these measures one had to indicate the presence of numerous and/or relatively severe symptoms. However, such dichotomous variables considerably restrict the potential variance which can be explained in them in correlation-regression analysis. The comparison of results for the continuous and dichotomous neurotic symptoms measure will give the reader a feel for the extent of this restriction.*

Job Characteristics, Perceived Stress and Mental Health

Zero-order Correlations

Table 9.1 presents the zero-order correlations of the measures of general mental health with each other and with objective job characteristics, perceived stress, and job evaluations (or job-specific indicators of mental health). Life satisfaction is moderately negatively correlated with neurotic symptoms. Objective job characteristics have little or no effect on mental health. Piecework and working the evening shift have small adverse effects on life satisfaction, and we will see in Table 9.2 that these effects persist even controlling for perceived stresses. No objective job characteristic is significantly correlated with the dichotomous index index of neurotic symptoms, while piecework and interpersonal and responsibility demands each manifest a small correlation with the continuous form of this index.

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*Nunnally (1967:131) shows that the maximum Pearsonian correlation (r) of a normally distributed continuous variable (or linear combination of such variables) with a dichotomous variable declines sharply as the mean of the dichotomous variable falls below .15. Thus when the mean of the dichotomous variables is .15, the maximum r is about .60; when the mean is .10, the maximum r is about .50; and when the mean falls to .05, the maximum r is about .40.

TABLE 9.1

SIGNIFICANT ($p < .05$) ZERO-ORDER CORRELATIONS OF MENTAL HEALTH INDICES WITH EACH OTHER AND WITH OBJECTIVE JOB CHARACTERISTICS AND PERCEIVED STRESS

	Life Satisfaction	Neurotic Symptoms (Continuous)	Neurotic Symptoms (Dichotomous)
Mental Health Indices			
Life Satisfaction	--		
Neurotic Symptoms (Continuous)	-.371	--	
Neurotic Symptoms (Dichotomous)	-.275	.728	--
Objective Job Characteristics			
Objective Work Rewards	--	--	--
Interpersonal & Responsibility Demands	--	-.058	--
Quantitative Workload Demands	--	--	--
Qualitative Workload Demands	--	--	--
Piecework	-.088	.071	--
Evening Shift	-.090	--	--
Perceived Stress			
Perceived Work Rewards	.256	-.169	-.104
Perceived Control Rewards	.089	-.077	-.074
Interpersonal & Responsibility Pressure	-.166	.264	.162
Quantitative Workload Pressure	-.093	.152	.097
Job-Nonjob Conflict	-.262	.282	.183
Job Evaluations			
Job Satisfaction	.362	-.282	-.195
Occupational Self-Esteem	.210	-.203	-.121

Perceived stresses, job satisfaction and occupational self-esteem relate to life satisfaction and neurotic symptoms as would be expected: perceived rewards, job satisfaction, and self-esteem are associated positively with life satisfaction and inversely with neurotic symptoms, while job pressures are negatively related to life satisfaction and positively with neurotic symptoms. Among the perceived stresses, the strongest correlates of mental health are perceived work rewards, interpersonal and responsibility pressures, and job-nonjob conflict. The strong impact of job-nonjob conflict is especially notable, as it is the least reliable (alpha = .58) of the perceived stress measures. Even without correcting for its relatively greater unreliability it is the strongest correlate of mental health among the perceived stress measures. Job satisfaction, which summarizes and, as we will see, largely mediates the effects of perceived stress on mental health, is the strongest correlate of both life satisfaction and neurotic symptoms in Table 9.1, with occupational self-esteem also manifesting a sizable relationship with the general mental health indices.

Comparing the correlations in the second and third columns of Table 6.1 shows the impact of having a skewed dichotomous variable rather than a continuous, fairly normally distributed one. The pattern (i.e., relative size and direction) of the correlations of perceived stresses and job evaluations with neurotic symptoms is very similar for the continuous and dichotomous measures, but the variance explained in the dichotomous measure is usually half or less of that explained in the continuous measure. Thus, in this chapter and later ones, it should be recognized that variance explained is a very conservative indicator of the effect of job stress. When looking at dichotomous dependent variables we will concentrate on metric regression coefficients as indicators of effects.

Additive Multivariate Analyses

Table 9.2 presents the results of a series of stepwise multiple regressions of the general mental health indices on job characteristics, perceived stress, job motivations and job evaluations. Model 1 in each case includes the standard control variables and all job characteristics which explained significant additional variance net of the control variables and other significant job characteristics. Model 2 is formed by adding to Model 1 any perceived stresses or motivations which significantly increase the explained variance. Model 3 is formed by adding job satisfaction and self-esteem to Model 2.

Life Satisfaction. Model 1 shows that life satisfaction increases with age, declines with perceived exposure to noxious physical-chemical agents, and is lower among pieceworkers and those on the evening shift,* though the total variance explained by all these factors is small (R^2 = .026). In Model 2 life satisfaction is affected by all perceived stresses except quantitative workload and control rewards (the latter is omitted from the table because it also has no impact on neurotic symptoms), net of the effects of control variables and job satisfaction. Perceived work rewards have a generally linear positive impact on life satisfaction (linear b = .188, quadratic b = .049), job-nonjob conflict has a linear negative effect (b = -.169), and interpersonal and responsibility pressure has a curvilinear effect (linear b = -.089, quadratic b = .050) in which life satisfaction declines as pressures increase up to a moderate level but is largely unaffected by

*Although the life satisfaction variable was not standardized, its standard deviation happens to be 1.01. Thus, the metric regression coefficients for predictors of life satisfaction can be interpreted as standard deviation unit changes in life satisfaction produced by each unit change in the predictors. Thus, for example, pieceworkers are two-tenths of a standard deviation lower on life satisfaction than other workers, net of all other variables in Model 1.

TABLE 9.2

MULTIPLE REGRESSIONS OF MENTAL HEALTH INDICES ON CONTROL VARIABLES, JOB CHARACTERISTICS, AND PERCEIVED STRESSES, MOTIVATIONS AND JOB EVALUATIONS

	Life Satisfaction			Neurotic Symptoms(Dich.)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Control Variables						
Age (years)	.009*	(.003)	(.002)	(-.001)	(.001)	(.001)
Education (years)	(.004)	(.010)	(.015)	-.012*	-.013*	-.014*
Number of Agents Exposed to (0-3)	-.049$^+$	(.007)	(.021)	.034*	.018$^+$	.015$^+$
Physical Effort Demanded by Job (1-5 scale)	(.092)	(.123)	.156$^+$	.051$^+$	(.039)	(.032)
Number of Cigarettes Smoked per Day	X	X	X	.002*	.002*	.002*
Objective Job Characteristics						
Piecework	-.203*	-.163*	-.123$^+$			
Evening Shift	-.129$^+$	(-.102)	-.109$^+$			
Perceived Stresses						
Perceived Work Rewards (linear)		.188*	(.032)		-.027*	(.003)
(quadratic)		.049°	.058$^+$			
Interpersonal & Responsibility (linear)		-.089*	-.060$^+$		.028*	.025*
Pressure (quadratic)		.050*	.044$^+$			
Quantitative Workload (linear)					(.009)	(.005)
Pressure (quadratic)					-.014$^+$	-.013$^+$
Job-Nonjob Conflict		-.169*	-.102*		.042*	.029*
Job Motivations						
Control Motivation					.018$^+$	.018$^+$
Job Evaluations						
Job Satisfaction			.257*			-.047*
Occupational Self-Esteem			.062$^+$			-.017°
Constant	1.444	1.35	1.22	.098	.126	.152
Multiple R	.162	.356	.409	.155	.261	.284
Multiple R^2	.026	.127	.167	.024	.068	.081

Note: Entries are metric regression coefficients. All variables are in standard form (mean=0, std. dev.=1), except for: (a) control variables which are scaled as indicated in the table, (b) piecework, shift, and neurotic symptoms which are dummy variables, (c) the quadratic terms which are obtained by squaring the appropriate standardized variables, and (d) life satisfaction which has a standard deviation of 1.01 but a mean >0. Metric coefficients should be interpreted accordingly.

* $p \leq .01$ $^+$ $p \leq .05$ $^\circ$ $p \leq .10$

X = Variable not in the equation

Terms in parentheses are nonsignificant

further increases in these pressures. Perceived stresses increase the variance explained in life satisfaction by 10.1 percent, completely mediate the impact of age and exposure to agents on life satisfaction, and partially mediate the effects of piecework and shiftwork. Job satisfaction and occupational self-esteem, which are added to the prediction equation in Model 3, both have positive effects on life satisfaction and increase the variance explained by 4.0 percent. A substantial portion of the effects of perceived stress, especially work rewards, are mediated through self-esteem and especially job satisfaction. The effects of piecework and evening shift remain significant in Model 3, however, indicating that their impact operated substantially through social psychological mechanisms other than the perceived stresses and job evaluations included in this study, perhaps for example, their effects on interpersonal relationships.

In sum, both potentially stressful objective job characteristics (i.e., piecework and shiftwork) and perceived stress (especially general work rewards, job-nonjob conflict, and global job satisfaction) adversely affect general life satisfaction. These job related factors explain a substantial portion (16.7%) of the variance in life satisfaction, though other life domains and activities may be even more important (cf. Andrews and Withey, 1976; Campbell et al., 1976). The strong effect of job-nonjob conflict suggests that the interrelation of work and nonwork is an important area for further research.

Neurotic Symptoms. Multivariate analyses showed that both neurotic symptoms measures are similarly affected by the predictor variables, but that their impact in terms of variance explained is twice as great on the continuous variable. Only the results for the dichotomous measure, which is more analagous to the biomedical health variables analyzed in subsequent chapters, will be presented and discussed. Model 1 indicates that marked neurotic symptoms are positively associated with perceived exposure to hazardous physical-chemical agents, physical effort demanded by the job and cigarette smoking, but inversely associated with education. Net of these effects, potentially stressful job characteristics have no effect on neurotic symptoms.* However, Model 2 shows that all perceived stresses, except control motivation (which is omitted from the table) are related to neurotic symptoms, much as expected. The proportion of workers with marked neurotic symptoms declines with increased work rewards ($b = -.027$) and increases with responsibility pressure ($b = .028$) and job-nonjob conflict ($b = .042$). The small effect of quantitative workload pressure is puzzlingly curvilinear, with the rate of marked neurotic symptoms rising steadily as perceived workload rises to its midpoint, but then declining (though at a very modest rate) as workload increases further. Given the mean level of perceived workload in this sample, this effect may largely reflect the fact that the increases beyond the mean have diminishing negative effects on well-being.**

Since the regression coefficients indicate the change in the proportion of persons with marked neurotic symptoms for each standard deviation unit change in the perceived stress variables, the combined effect of the perceived stress variables is quite substantial. For example, a rise in all

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*Recall from Chapter 4 that when the dependent variable is a dichotomy (as in the case of neurotic symptoms), the regression coefficients express the change in the expected proportion scoring positively on the dichotomy for each unit change in the independent variable. Thus, in Model 2 the expected proportion with marked neurotic symptoms declines by .013 for each additional year of education and by .027 for each increase of one standard deviation on perceived work rewards.

**There is a slight positive effect of control motivation on neurotic symptoms. The meaning and causal direction of this effect is unclear, and since it is an isolated effect it will not be interpreted further.

pressures from one standard deviation below the mean to the mean would increase the proportion with marked neurotic symptoms by over .09 and a comparable decline in perceived rewards would raise the proportion by another .026. The net result would be more than twice the rate of neurotic symptoms among the workers who are disadvantaged by just one standard deviation unit on all the variables compared to those who are one standard deviation better off. Thus, the perceived stress variables substantially enhance the prediction of neurotic symptom (R^2 increment = 4.4%). The perceived stress variables also mediate substantial portions of the effects of exposure to agents and physical effort on neurotic symptoms. The addition of job satisfaction and occupational self-esteem in Model 3 further enhances the predictive power and also mediates some of the perceived stress effects (most notably work rewards).

In sum, perceived job stresses and job evaluations appear to substantially increase rates of psychiatrically significant neurotic symptoms as well as adversely affecting perceived life quality. The objective job characteristics of piecework and shiftwork adverseley affect life satisfaction even net of the effects of perceived stress, but job characteristics have no effects on neurotic symptoms. The impact of job stress on neurotic symptoms and life satisfaction are quite comparable when continuous measures of each are used. In terms of the dichotomous neurotic symptoms measure, perceived stress produces a several-fold increase in rates of neurotic symptoms as perceived stress increases from relatively low to relatively high levels.

Effects of Conditioning Variables

Main (or additive) Effects

Table 9.3 presents the correlations of the conditioning variables with life satisfaction and neurotic symptoms. As already seen in Table 9.2, age is positively related to life satisfaction but unrelated to neurotic symptoms, education is unrelated to life satisfaction but negatively related to neurotic symptoms, piecework is negatively related to life satisfaction but unrelated to neurotic symptoms, and reported exposure to physical-chemical agents is positively correlated with neurotic symptoms though uncorrelated with life satisfaction, (an effect which is not significant net of the other variables in the multivariate analyses yielding Models 2 or 3 in Table 9.2), while Type A and control motivation have small positive correlations with neurotic symptoms (both of these effects remain significant net of the variables in Model 3 of Table 9.2). The effect of control motivation, as noted above, is not readily interpretable, but the correlation of Type A with neurotic symptoms suggests that the Type A syndrome may be deleterious for mental as well as cardiovascular health.

Among the conditioning variables social support generally has the strongest and most pervasive pattern of relationships with mental health. All support indices are positively correlated with life satisfaction and the indices of supervisor, spouse, and total support are negatively correlated with neurotic symptoms. Thus social support, especially from work supervisors and spouses, clearly contributes to positive mental health.

TABLE 9.3

SIGNIFICANT ($p < .05$ two-tailed) ZERO-ORDER CORRELATIONS OF POTENTIAL CONDITIONING VARIABLES WITH MENTAL HEALTH INDICES

	Life Satisfaction	Neurotic Symptoms (Dich.)
Individual Characteristics		
Age	.118	--
Education	--	-.060
Type A	--	.078
Work Motivation	-.057	--
Control Motivation	--	.049
Situational Factors		
Piecework	-.088	--
Exposure to Agents	--	.099
Social Support from:		
Supervisor	.185	-.072
Coworker	.106	--
Friends & Relatives	.145	--
Spouse	.173	-.068
Total of All Sources	.252	-.092

Conditioning (or interactive) Effects

The impacts of both objective job characteristics and perceived stress on mental health, especially the index of neurotic symptoms, were significantly conditioned by two individual characteristics (control motivation, Type A) and by social support; otherwise the conditioning variables exerted no more significant interactive effects than might appear by choice alone. These conditioning effects of Type A and control motivation represent relatively isolated effects and will be described briefly. The effects of support are part of a pervasive pattern of results and will be presented and discussed more fully.

Type A had no more significant conditioning effects than might occur by chance on relationships of objective job characteristics to life satisfaction. Similarly, Type A had only chance level conditioning effects on relationships of job characteristics or perceived stress to neurotic symptoms. However, Type A did significantly ($p \leq .10$) condition the relationships of three (out of nine) perceived stress and job evaluation variables to life satisfaction. Two of these significant effects appear closely related -- among workers in the upper third on the Type A measure life satisfaction is slightly positively affected ($b = .082$) by perceived control rewards and negatively affected ($b = -.057$) by quantitative workload pressure, while among workers in the lower third on Type A the effect of perceived control rewards is negative ($b = -.065$) and the effect of workload is positive ($b = .067$). Thus the life satisfaction of Type A's is greater when quantitative workload is lower and perceived control is higher, while almost the reverse is true for "Type B's". (i.e., those low on our Type A measure). Although, as seen in Chapter 6, Type A workers generally experience more job pressures than their less Type A counterparts, this is the only case where they react more adversely to such stresses.* It is interesting that this occurs around the issue of lack of control (due here to excessive quantitative workload pressure) which predisposes Type A's to depression in Glass's (1977) experimental analyses.

The issue of control is also involved in a somewhat different way in the impact of job stress on neurotic symptoms. Control motivation significantly conditions the relationship of three job characteristics (out of six) and two perceived stresses (out of eight) to neurotic symptoms. Both perceived stresses -- lack of perceived control rewards and job-nonjob conflict -- increase neurotic symptoms among workers with high motivation for control of work pace while having no effect on neurotic symptoms when control motivation is low. Similar conditioning effects occur with respect to the impact of quantitative and especially qualitative workload demands on neurotic symptoms -- these objective job demands increase neurotic symptoms among workers high in control motivation, but tend to decrease neurotic symptoms when control motivation is low. The effect of piecework on neurotic symptoms is also conditioned by control motivation, but the effect has no apparent substantive interpretation (piecework significantly decreases neurotic symptoms only among workers with medium control motivation). With the exception of this last result, however, control motivation acts, as expected, to heighten the deleterious impact on neurotic symptoms of objective and perceived job conditions which are inimicable to maintaining a sense of control over work pace.

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*The third conditioning effect of Type on relationships between perceived stress and life satisfaction involves interpersonal and responsibility pressure -- the effect of which is curvilinear among those low on Type A (cf. Table 9.2) but becomes linear and negative among Type A's.

In sum, Type A and control motivation, which have relatively few conditioning effects in this study, do condition the impact of job characteristics and perceived stress on mental health. Compared to other Whitewall Plant workers, those with high needs for control, which Glass (1977) asserts is a part of the Type A syndrome, are much more likely to experience poor mental health in response to job conditions which threaten or impede control over work pace. Though isolated, these findings are consistent with a growing interpretation of depression as an affective response to feelings of helplessness or lack of control (e.g., Seligman, 1975).

Effects of Social Support

The significant (interactive) conditioning effects of social support are somewhat more pervasive and are closely linked with a pattern of conditioning effects of support reported in other chapters (e.g., Ch. 5, 6, 8, 10, and 11). Quite different results obtain, however, for life satisfaction and neurotic symptoms. Social support conditions the impact of objective job characteristics on life satisfaction in a manner similar to the "dampening" effects observed with respect to the impact of job characteristics on perceived stresses and general job evaluations in Chapters 6 and 8, but social support has no interactive conditioning effects on relationships of perceived stress to life satisfaction. In contrast, social support has conditioning effects on the relationship of perceived stresses to neurotic symptoms which conform almost perfectly to the idea of support as a "buffer" against the deleterious health consequences of stress, but there are no more significant interactive conditioning effects of support on relationships between objective job characteristics and neurotic symptoms than might occur by chance.

Spouse, supervisor, and total support each significantly ($p \leq .10$) conditioned two of the six possible relationships between an objective job characteristic and life satisfaction, substantially more than would be expected by chance. Coworker and friend and relative support each significantly conditioned one such relationship and the effects were quite weak -- results which might occur by chance alone. Thus Table 9.4 presents only the significant conditioning effects of total, spouse and supervisor support on relationships between job characteristics and life satisfaction. Like Tables 6.5 and 8.4, Table 9.4 shows the estimated metric coefficient for the regression of life satisfaction on the indicated objective job characteristic at the highest and lowest level of the indicated support variable. The right-hand column gives the level of statistical significance of each interactive conditioning effect (none of which account for more than 0.5 percent additional variance in life satisfaction).

The results in Table 9.4 generally resemble what we have come to describe as the "dampening" effects of social support on the relationship between objective job characteristics and perceived job stresses (cf. Table 6.5) and job evaluations (cf. Table 8.4), though the results are not quite as clear and consistent here as in the earlier chapters. In five of the six effects in Table 9.4, the absolute value of the effect of objective job characteristics on life satisfaction is smaller under high social support than under low social support, though only in the case of the effects of piecework are these differences at all sizable. Unlike the effects in Table 8.4, the differences in Table 9.4 remain sizable and significant net of the effects of perceived stresses and job evaluations. Thus, the precise nature and meaning of these effects is not clear.

TABLE 9.4

SIGNIFICANT CONDITIONING EFFECTS OF SOCIAL SUPPORT ON RELATIONSHIPS OF JOB CHARACTERISTICS TO LIFE SATISFACTION

Independent Variables	Source of Support	Effect on Life Satisfaction When Support is: Lowest	Highest	Significance of Interaction
Objective Work Rewards	Supervisor	.134	-.100	$p \leq .05$
Interpersonal & Responsibility	TOTAL	.223	-.161	$p \leq .01$
	Supervisor	.175	-.113	$p \leq .01$
Quantitative Workload Demands	Spouse	.056	-.144	$p \leq .10$
Piecework	TOTAL	-.522	.118	$p < .10$
	Spouse	-.412	-.062	$p \leq .05$

Note: Entries are estimated metric regression coefficients. Significance of interaction is significance of regression test for differences in effects of independent variable across levels of support. See text here and discussion of Table 6.5 for further explanation.

In contrast, the conditioning effects of social support or relationships of perceived stress and job evaluations to neurotic symptoms represent a new and clear pattern of effects which epitomize what is meant by the "buffering" properties of social support. Of eight relationships of perceived stresses and job evaluations with neurotic symptoms, two (or 25%) were conditioned by the index of total support and three (or 37.5%) were conditioned by spouse support -- clearly more than ought to occur by chance. Supervisor and coworker support each conditioned one such relationship, not clearly more than what might occur by chance, but these effects were strikingly consistent with those of total support and spouse support and thus are presented in Table 9.5.

Each of these significant conditioning effects is presented in Table 9.5 which shows the estimated metric coefficients for the regression of neurotic symptoms on the indicated perceived stress at the highest and lowest level of the indicated support variable. Again the right hand column gives the significance level of the interactive conditioning effects (which account for an additional 0.5 percent or less variance in neurotic symptoms). The pattern of the results in Table 9.5 is strikingly consistent. Among workers with low levels of social support, interpersonal and responsibility pressure and quantitative workload pressure have substantial positive effects on levels of neurotic symptoms while job satisfaction and occupational self-esteem have substantial negative effects. That is, where social support is lacking, workers reporting high levels (e.g., 1.0 - 1.5 standard deviations above the mean) of job pressure and <u>negative</u> feelings about their jobs and selves are up to several times more likely to manifest marked levels of neurotic symptoms than workers reporting relatively low levels of these feelings (1.0 to 1.5 standard deviations below the mean).

TABLE 9.5

SIGNIFICANT CONDITIONING EFFECTS OF SOCIAL SUPPORT ON RELATIONSHIPS OF JOB CHARACTERISTICS TO LIFE SATISFACTION

Independent Variables	Source of Support	Effect on Life Satisfaction When Support is: Lowest	Highest	Significance of Interaction
Interpersonal & Responsibility Pressure	TOTAL	.086	-.030	$p \le .01$
	Spouse	.051	.009	$p \le .05$
	Supervisor	.065	-.005	$p \le .10$
Quantitative Workload Pressure (linear)	Spouse	.035	-.011	$p \le .05$
Job Satisfaction	Spouse	-.080	-.025	$p \le .05$
Occupational Self-Esteem	TOTAL	-.066	.026	$p \le .10$
	Coworker	-.059	.020	$p \le .05$

Note: Entries are estimated metric regression coefficients. Significance of interaction is significance of regression test for differences in effects of independent variable across levels of support. See text here and discussion of Table 6.5 for further explanation.

However, these effects are markedly reduced, and virtually eliminated in a number of cases, when social support is high. That is, the presence of social support somehow buffers workers against the effects of job pressures and negative job evaluations on neurotic symptoms. We will return to the question of exactly how and why this occurs in Chapter 13, after we have observed similar buffering effects of social support in Chapters 10 and 11.

Summary and Conclusion

The data in this chapter show that with the exception of negative effects of piecework and evening shift work on life satisfaction, objective job characteristics have no clear effect on mental health. However, perceived job stresses and general job evaluations (i.e., job satisfaction and self-esteem) have sizable relationships with both general life satisfaction and rates of reported neurotic sympomotology. Although the causal direction of these relationships is open to some question, for reasons discussed at the end of Chapter 1 it is likely that a substantial part of the causal flow is from perceived stresses and job evaluations to general mental health.

These data, then are generally consistent with work of Kornhauser (1965) and others who find a substantial negative effect of job deprivations and pressures on mental health. It should be noted, however, that Kornhauser found a clear effect of objective skill level of jobs on mental health among workers in the auto industry. His analysis, however, mainly compared craftsmen with assemblyline workers. In contrast, the present study includes both skilled automated machine operators and low skilled manual workers not tied to machines -- groups with levels of perceived rewards, satisfaction and mental health which are comparable to each other, lower than skilled craftsmen, and higher than most machine operators and assembly-line workers. Thus, in this study there is no relationship between objective job rewards (incl. skill level) and mental health. More generally, the relationship of skill level to mental health may not be as simple as Kornhauser's data suggest. However, there is no question that feeling that one's work is rewarding and not excessively pressured is a major factor in positive mental health. Indices of perceived work rewards, job-nonjob conflict and job satisfaction manifested especially strong relationships to mental health among Whitewall Plant workers.

Among the conditioning variables, social support again stands out, having strong and pervasive direct effects on mental health and conditioning effects on the relationship of occupational stress to mental health. Social support enhances life satisfaction and reduces rates of neurotic symptoms, somewhat "dampens" the impact of objective job characteristics on life satisfaction, and strongly "buffers" people against the deleterious effects of perceived job stresses and job evaluations on neurotic symptoms. This buffering effect, which occurs over and above any direct effects of support on neurotic symptoms, is particularly striking -- perceived stresses and negative job evaluations substantially increase the rate of neurotic symptoms among workers with little social support but have virtually no deleterious effect on neurotic symptoms among workers with high levels of support. After observing more such buffering effects in Chapters 10 and 11 we will be in a better position to suggest how and why they occur.

Chapter 10

SUBSTANCE ABUSE: SMOKING AND DRINKING

Cigarette smoking and excessive consumption of food, alcoholic beverages and direct and ellicit drugs are now recognized as major sources of physical and mental health problems in the United States. Thus, substance abuse can be considered a health problem and outcome in its own right. The present study included direct measures of current use and abuse of two substances -- tobacco and alcohol.

Stress in general, and occupational stress in particular have been implicated as contributing factors to heavy cigarette smoking and alcoholic drinking (e.g., Caplan, 1971; Sadava, *et al*., 1978), though these habits are generally acquired relatively early in life (often prior to occupational experience) in response to many factors. Yet intensive analyses of the relationship of occupational stress to smoking and drinking behavior are rare. Thus, the present study made an exploratory analysis of the relation of the current smoking and drinking behavior of Whitewall Plant workers to their objective job characteristics and perceptions of job stress.

Measures of Smoking and Drinking

Cigarette Smoking

The questionnaire contained questions about current and past cigarette smoking behavior of workers (cf. Questions 11-17 in Part 3 of Appendix A). The present analysis considered only current smoking behavior and experimented with several different indicators of smoking behavior: (a) a dichotomous variable indicating whether a worker currently smoked cigarettes or not, (b) a variable indicating the number of cigarettes smoked by current smokers (nonsmokers were excluded from analyses of this variable), and (c) a variable combining the information in the first two variables and indicating the number of cigarettes currently smoked, with nonsmokers coded 0. The latter two measures assigned a number of cigarettes to each category of the question on number of cigarettes smoked as follows: less than 1/2 pack per day (5), about 1/2 pack (10), about 1 pack (20), about 1 1/2 packs (30), about 2 packs (40), and over 2 packs (50). Analyses of all three variables suggested that the third measure (number of cigarettes smoked, nonsmokers coded 0) was the most satisfactory as it captured all of the information in the other two. That is, there was little gained from distinguishing between whether workers smoked and how much they smoked. Thus, the measure of smoking in all analyses here is simply the number of cigarettes smoked per day (with nonsmokers coded as 0).

Alcoholic Drinking

Two questions were asked about the frequency and amount of current alcoholic drinking:

(a) How often do you usually drink some type of alcohol (beer, wine, or other liquor)? Response categories = (1) "most days," (2) "once or twice a week," (3) "sometimes," and (4) "rarely or never."

(b) Approximately how many drinks (glasses) do you generally have at one sitting? Response categories = (1) "one - two drinks," (2) "three - five drinks," (3) "more than five drinks," and (4) "never drink alcohol."

The nature of these questions did not allow an exact determination of average amounts of alcohol consumed per day. Thus, a dichotomous variable was created which distinguished between relatively heavy (problem?) drinkers and all others. On this variable persons who drank most days and had three or more drinks each time were coded 1, all other persons were coded 0. By this criterion 17.9 percent of the workers in Whitewall Plant were classified as heavy drinkers.

Relation of Job Stress to Smoking and Drinking

Zero-order (bivariate) Correlations

Table 10.1 presents the significant ($p \leq .05$) zero-order (bivariate) correlations of smoking and drinking with each other and with objective job characteristics, perceived stresses and job evaluations. Smoking and drinking are modestly positively correlated ($r = .198$), but both are only weakly correlated, if at all, with objective job characteristics, perceived stresses and job evaluations. None of the objective job characteristics correlates significantly with smoking, while only one perceived stress and one job evaluation manifest significant, but quite small, correlations with smoking -- the number of cigarettes smoked per day increases as both perceived work rewards and job satisfaction decline. Among all the variables in Table 10.4 only objective work rewards is related (negatively, $r = -.051$) to drinking behavior, though again the relationship is weak.

Multivariate Analyses

The effect of occupational stress on drinking behavior bulks much larger, however, in the multiple regression analyses presented in Table 10.2, though the effects of stress on smoking remain weak. Model 1 in Table 102 includes the standard set of control variables* plus all objective

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*Smoking was included as a predictor of drinking, but not vice versa. This somewhat arbitrary decision was made to facilitate coordination among multivariate analyses for different dependent variables (as drinking was not included as a standard control variable in other analyses for reasons noted in the introduction to Part III).

TABLE 10.1

SIGNIFICANT ($p \leq .05$) ZERO-ORDER CORRELATIONS OF SUBSTANCE ABUSE (SMOKING AND HEAVY DRINKING) WITH EACH OTHER AND WITH OBJECTIVE JOB CHARACTERISTICS, PERCEIVED STRESS, AND JOB EVALUATION

	Smoking	Drinking
Substance Abuse		
Smoking (number of cigarettes per day)	--	--
Heavy Drinking (three or more drinks on most days	.198	--
Objective Job Characteristics		
Objective Work Rewards	--	.051
Interpersonal & Responsibility Demands	--	--
Quantitative Workload Demands	--	--
Qualitative Workload Demands	--	--
Piecework	--	--
Evening Shift	--	--
Perceived Stresses		
Perceived Work Rewards	-.068	--
Perceived Control Rewards	--	--
Interpersonal & Responsibility Pressure	--	--
Quantitative Workload Pressure	--	--
Job-Nonjob Conflict	--	--
Job Evaluations		
Job Satisfaction	--	--
Occupational Self-Esteem	-.059	--

characteristics which have a significant impact on the dependent variable (net of each other and the control variables). Model 2 was generated by adding to Model 1 all perceived stress and work motivation variables which significantly increase the variance explained in drinking or smoking, while Model 3 adds to Model 2 the job evaluation variables (i.e., job satisfaction and/or occupational self-esteem) which similarly increase the explained variance.

Smoking. As would be expected from Table 10.1, no objective job characteristic affects smoking net of the control variables. Thus, in Model 1, smoking is seen to decline as age and physical effort demanded by the job increase and to increase with exposure to physical-chemical agents. The impact of age most likely reflects a cohort or generational effect (the proportion of people smoking rose during this century until very recently), while physically demanding jobs make it physically more difficult to smoke on the job and hence reduce the number of cigarettes smoked per day. The impact of exposure to agents is weak and may be an artifact of it being easier to smoke in some dirty areas of the plant (where the pace of work was less machine paced). Model 2 shows that smoking varies positively with perceived control of work pace (again probably due to the greater ease of smoking on the job) and with work motivation and varies inversely with perceived work rewards. The latter two effects are the only ones which plausibly reflect smoking as a response to stress or tension. As neither job satisfaction nor self-esteem is related to smoking, Model 3 does not differ from Model 2. Overall, smoking behavior among Whitewall Plant workers increases modestly as the opportunity to smoke on the job increases, but is little affected by psychosocial job stress.

TABLE 10.2

MULTIPLE REGRESSIONS OF SUBSTANCE ABUSE (SMOKING AND HEAVY DRINKING) ON CONTROL VARIABLES, JOB CHARACTERISTICS, PERCEIVED STRESS, JOB MOTIVATIONS AND EVALUATIONS

	Smoking			Drinking		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Control Variables						
Age (years)	$-.089^{*}$	(.057)		$.002^{+}$	$.002^{+}$	$.002^{+}$
Education	(.070)	(-.021)		(.002)	(.002)	(.002)
Number of Agents Exposed to (0-3)	$.662^{+}$	$.640^{+}$		(.009)	(.009)	(.012)
Physical Effort Demanded by Job	-2.70^{*}	-2.73^{*}		(.056)	(.056)	$.062^{\circ}$
Smoking (number of cigarettes per day)	X	X	X	$.006^{*}$	$.006^{*}$	$.006^{*}$
Objective Job Characteristics						
Objective Work Rewards				$-.048^{*}$	$-.042^{*}$	$-.041^{*}$
Interpersonal & Responsibility Demands				$.044^{*}$	$.046^{*}$	$.046^{*}$
Piecework				$.051^{+}$	$.046^{\circ}$	$.051^{+}$
Evening Shift				$.042^{+}$	$.041^{+}$	$.041^{+}$
Perceived Stresses						
Perceived Work Rewards		$-.962^{*}$	Same as Model 2		(-.016)	$-.033^{+}$
Control Rewards (linear)		$.902^{*}$			$.017^{\circ}$	$.016^{\circ}$
Control Rewards (quadratic)					$.019^{*}$	$.019^{+}$
Work Motivations						
Work Motivation		1.06^{*}				
Job Evaluations						
Job Satisfaction						$.027^{+}$
Constant	19.99	19.75		-.180	-.205	-.223
Multiple R	.122	.168		.227	.238	.245
Multiple R^2	.015	.028		.052	.057	.060

Note: Entries are metric regression coefficients. All independent variables are in standard form (mean=0; std. dev. = 1.0) except for: (a) the control variables which are coded as indicated in the table, and (b) piecework and shift which are dummy variables. Smoking is coded as number of cigarettes per day, drinking is a dichotomous variable (see text). Metric coefficients should be interpreted accordingly.

* $p \leq .01$

\+ $p \leq .05$

° $p \leq .10$

X = Variable not in equation

Coefficients in parentheses are included in equation but are nonsignificant

Drinking behavior. Due to the intercorrelations among the job characteristic variables, multivariate analysis revealed a much stronger impact of job characteristics on drinking behavior, as shown in Model 1 of Table 10.2. Drinking behavior increases with age and with smoking behavior. More importantly, the proportion of heavy drinkers is significantly greater under a variety of potentially stressful job conditions and these effects are independent of each other. Thus, the proportions of heavy drinkers is .051 greater among pieceworkers than among nonpieceworkers and .042 greater among workers on the evening shift than other shifts. For each one standard deviation change in objective work rewards or interpersonal and responsibility demands, the proportion of heavy drinkers changes by 4 - 5 percent. Combining these effects, the predicted proportion of heavy drinkers among workers holding piecework jobs on the evening shift which are one standard deviation (1 SD) below the mean on objective rewards and 1 SD above the mean on interpersonal and responsibility demands should be .27 greater than the predicted proportion among workers in nonpiecework jobs on other shifts who are 1 SD above the mean on work rewards and 1 SD below the mean on interpersonal and responsibility demands. Given the overall proportion of heavy drinkers in the Whitewall Plant (.174), the rate of heavy drinking under the former job conditions would be about three times greater than under the latter. The effects of job characteristics on drinking are thus both pervasive and strong (though they explain less than 2% of the variance net of the control variables in Model 2).

Models 2 and 3 indicate that perceived stresses and job evaluations have more modest effects on drinking behavior, and the effects of objective job conditions remain virtually unchanged when these additional variables enter the prediction equation. As would be expected theoretically and from Table 10.1, heavy drinking declines as perceived job rewards increase. Paradoxically, however, drinking is positively related to job satisfaction and perceived control rewards (the latter relationship being somewhat curvilinear but largely linear and positive). We have no ready interpretation of these effects.

What is most striking in Table 10.2 is the relatively strong effect of potentially stressful objective job characteristics on drinking, coupled with the relatively weak effect of perceived stresses and job evaluations. One interpretation of these results is that drinking is, for at least some workers in Whitewall Plant, a way of coping with or defending against objectively stressful job conditions. The effect of drinking may be to reduce perceptions of distress and perhaps other deleterious health outcomes in response to objectively stressful job characteristics. That is, drinking is a response to the initial perceptions of stress aroused by objectively stressful job characteristics and modifies the impact of job characteristics on perceived stress.

Effects of Conditioning Variables

Main (or additive) Effects

Table 10.3 shows that the individual and situational conditioning variables also manifest little relationship with smoking and drinking. The correlations of age, work motivation and exposure to agents with smoking have already been observed and discussed in connection with the presentation of Table 10.2. The only new relationship in Table 10.3 is a small negative correlation between smoking and supervisor support. A similar correlation between drinking and spouse support is the only

TABLE 10.3

SIGNIFICANT ($p<.05$, two-tailed) ZERO-ORDER CORRELATIONS OF POTENTIAL CONDITIONING VARIABLES WITH SUBSTANCE ABUSE (SMOKING AND HEAVY DRINKING)

	Smoking	Drinking
Individual Characteristics		
Age	-.074	--
Education	--	--
Type A	--	--
Work Motivation	.097	--
Control Motivation	--	--
Situational Factors		
Piecework	--	--
Exposure to Agents	.062	--
Social Support from:		
Supervisor	-.065	--
Coworkers	--	--
Friends & Relatives	--	--
Spouse	--	-.068
Total of all Sources	--	--

significant relationship of drinking behavior to a conditioning variable. Thus social support tends slightly to reduce smoking and drinking behavior. Overall, however, conditioning variables have little or no additive effect on smoking and drinking.

Conditioning (or interactive) Effects

Analyses of the conditioning effects of the variables in Table 10.3 on relationships of both job characteristics and perceived stress to health were made via the methods described in Chapter 4 and used in previous chapters. Of all variables in Table 10.3 only the social support variables and control motivation had more significant interactive conditioning effects than might occur by chance. The conditioning effects of control motivation were concentrated on relationships with smoking and gain constitute relatively isolated effects. Thus they will be described briefly. Social support conditions relationships with both smoking and drinking and these results, which are part of a wide range of conditioning effects of social support, will be presented in more detail.

Control motivation significantly conditioned the relationship of two (out of six) job characteristics -- piecework and shiftwork -- to smoking behavior. Among workers with high motivation for control of work pace, both piecework and evening shiftwork increased the number of cigarettes smoked per day, but these effects declined as control motivation declined such that among workers with low control motivation piecework and shiftwork tended to decrease smoking somewhat. Control motivation indicates a desire to be able periodically to take it easy on the job and talk to other workers. As will be discussed further below, smoking is a major social-recreational activity of Whitewall Plant workers during breaks. Individual piecework clearly provides opportunities for breaks if workers choose to take them, and such opportunities may also be more common on the second shift (which has, for one thing, a somewhat higher concentration of piecework jobs). Workers high in control motivation appear to avail themselves of these opportunities while those with low control motivation do not.

Control motivation also significantly conditioned more relationships of perceived stresses to smoking behavior (two of seven) and drinking behavior (three of eight) than seems likely to occur by chance, but these effects have no clear substantive interpretation. Among workers with low control motivation, job satisfaction and occupational self-esteem were positively associated with smoking, while these relationships declined to near zero or negative levels as control motivation increased to a high level. In all three significant conditioning effects on relationships of perceived stress to drinking behavior workers with medium control motivation showed a positive impact of perceived stress on drinking, while there was essentially no relationship under either high or low control motivation. These effects have no readily apparent interpretation.

In contrast, the social support variables have meaningful conditioning effects on relationships of objective job characteristics to both smoking and drinking, though the nature of these effects is quite different.* Table 10.4 presents the significant conditioning effects of social support on the relationships of objective job characteristics to heavy drinking. Total support, supervisor support, and spouse support all significantly ($p \leq .10$) conditioned clearly more such relationships than would be expected by chance (2 of 6, 2 of 6 and 3 Of 6 respectively) while coworker support

*Social support had no more significant conditioning effects on relationships of perceived stresses and job evaluations to smoking and drinking than might occur by chance.

also significantly conditioned one relationship (around or a little above chance expectations). In six of these eight significant relationships presented in Table 10.4 (all but the first and last), social support clearly buffers workers against the tendency of potentially stressful job characteristics to lead to drinking behavior. In these six relationships, there is a strong positive association between stressful job characteristics and drinking behavior among workers with low social support, but there is little or no effect of job characteristics or drinking behavior among workers with high social support. The two exceptions to this pattern in Table 10.4 involve the effects of supervisory support on relationships of piecework and interpersonal and responsibility demands to drinking. In both of these cases, there is no relationship when supervisor support is low, but a sizable positive relationship when support is high. Perhaps supportive supervisors are also the source of interpersonal demands and/or production pressures for pieceworkers, thus creating an ambivalent and perhaps tense relationship promotive of drinking. Overall, however, we find that social support, especially from spouses, appears to be an effective buffer against the otherwise consequential tendency of stressful objective job characteristics to increase heavy drinking.

Whereas support protects people from excessive drinking, it may sometimes increase rates of cigarette smoking, as indicated in Table 10.5. Total support, supervisor support and spouse support all significantly conditioned more relationships of objective job characteristics to perceived stress than would be expected by chance (i.e., 2 of 6, 2 of 6 and 3 of 6, respectively), and coworker support conditioned an additional relationship (around or a little above chance expectations). These conditioning effects

TABLE 10.4

CONDITIONING EFFECTS OF SOCIAL SUPPORT ON
RELATIONSHIP OF OBJECTIVE JOB CHARACTERISTICS TO DRINKING BEHAVIOR

Independent Variable	Source of Support	Effect on Drinking Behavior When Support is: Lowest	Highest	Significance of Interaction
Interpersonal & Responsibility Demands	Supervisor	.002	.074	$p \leq .10$
Quantitative Workload Demands	TOTAL	.051	-.029	$p \leq .10$
Qualitative Workload Demands	Spouse	.039	-.003	$p \leq .10$
Shift	TOTAL	.207	-.093	$p \leq .01$
	Supervisor	.128	-.027	$p \leq .10$
	Coworker	.132	-.030	$p \leq .10$
	Spouse	.090	.006	$p \leq .10$
Piecework	Supervisor	-.030	.114	$p \leq .10$

Note: Entries are estimated metric regression coefficients. Significance of interaction is significance of regression test for differences in effects of independent variable across levels of support. See text here and discussion of Table 6.5 for further explanation.

are presented in Table 10.5. The first two independent variables in Table 10.5 -- *quantitative* and *qualitative* workload demands -- are variables which tend to decrease the physical opportunity to smoke on the job by keeping workers tied to their jobs. Smoking was allowed in Whitewall Plant only in designated areas where workers went during break time, and smoking was a major social activity during breaks. Table 10.5 shows that qualitative and quantitative workload demands consistently reduce the number of cigarettes consumed by workers with low social support, while under high social support they actually produce some rise in smoking behavior. Social support from supervisors and coworkers may tend to increase smoking on the job by drawing workers to break areas, and may do this somewhat more in more demanding and stressful jobs. The effects of spouse support cannot be interpreted in exactly the same way, but spouse support may operate outside of work in the same way, thus offsetting any reductions in smoking produced by job demands at work. The conditioning effects of supervisor support on the relationship of shiftwork to smoking follows a similar pattern. The effect of spouse support on *this same relationship is quite different*, however, resembling the buffering effects of social support on the relationship of shiftwork to drinking observed in Table 10.4.

In sum, we find that social support generally buffers workers against the deleterious effects of job characteristics on heavy drinking (though the effects of supervisor support are mixed here). In contrast, social support appears to facilitate smoking behavior, or at least to reduce the tendency of workload demands to reduce smoking (one exception here is an apparent buffering effect of spouse support on the relationship of spouse support to smoking).

TABLE 10.5

CONDITIONING EFFECTS OF SOCIAL SUPPORT ON
RELATIONSHIPS OF OBJECTIVE JOB CHARACTERISTICS TO SMOKING BEHAVIOR

Independent Variable	Source of Support	Effect of Smoking Behavior When Support is: Lowest	Highest	Significance of Interaction
Quantitative Workload Demands	TOTAL	-1.95	1.22	$p \leq .05$
	Spouse	-1.16	0.41	$p \leq .10$
Qualitative Workload Demands	TOTAL	-2.45	1.77	$p \leq .01$
	Supervisor	-1.66	1.08	$p \leq .05$
	Coworkers	-1.61	1.07	$p \leq .05$
	Spouse	-1.21	0.36	$p \leq .10$
Evening Shift	Supervisor	-.249	3.18	$p \leq .05$
	Spouse	2.80	-0.83	$p \leq .05$

Note: Entries are estimated metric regression coefficients. Significance of interaction is significance of regression test for differences in effects of independent variable across levels of support. See text here and discussion of Table 6.5 for further explanation.

Summary and Conclusions

The effects of occupational stress on smoking and drinking behavior are rather selective. Smoking behavior is unaffected by objective job characteristics except as these effects are conditioned by social support and control motivation. These conditioning effects suggest that some job characteristics, especially piecework and workload demands, tend to reduce smoking by making it physically difficult (e.g., keeping the worker tied to a machine where he cannot smoke). These effects are most pronounced when workers are not drawn away from their jobs by personal motivation to control (and vary) the pace of work or the pull of supportive others. When control motivation and social support are high these same job characteristics do not decrease and may even increase smoking. The positive relationship of perceived control rewards with smoking, which holds regardless of the level of conditioning variables, similarly appears to reflect increased opportunity to smoke on the job. Truly tension-related effects of perceived stresses on smoking are very limited, with lack of work rewards and/or strong motivation for them increasing smoking. All in all, occupational stress does not appear to be a major factor in smoking behavior.

In contrast, drinking behavior is markedly increased by potentially stressful objective job characteristics, though only modestly affected by perceived stresses. Heavy drinking is significantly more common among pieceworkers, evening shift workers, and workers with low work rewards and/or high interpersonal and responsibility demands. Social support, however, acts to buffer workers against the effects of some job characteristics, most notably shiftwork, on drinking behavior. Spouse support is especially important in this regard. These effects are very similar to those observed for neurotic symptoms in Chapter 9 and we think are produced by a similar mechanism which will be discussed after further effects of support are observed in Chapter 11. Among perceived stresses only perceived work rewards have the expected effect on drinking behavior -- lack of perceived rewards increases drinking net of both control variables and objective characteristics (cf. Table 10.2). Perceived control rewards and job satisfaction are slightly positively associated with heavy drinking. These results may be due to the fact that drinking is a means of defending against the perception of potentially stressful job characteristics.

Chapter 11

OCCUPATIONAL STRESS AND PHYSICAL HEALTH
I. SELF-REPORTED SYMPTOMS

One of the most important effects of occupational stress, like other forms of stress, is to produce heightened levels of activity in the body's neuroendocrine systems (Mason, 1975a and b). If very intense or prolonged, these neuroendocrine responses can themselves produce what (Selye, 1956) has termed diseases of adaptation or leave people more susceptible to the effects of noxious biological, physical, or chemical agents in their environment (cf. Cassel, 1976; House and Jackman, 1979). Thus, occupational stress may produce physical health outcomes as well as the psychological and behavioral health outcomes considered in Chapters 8-10. This study examined the relationship of occupational stress to two classes of physical health outcomes -- disorders traditionally considered psycho-somatic or stress-related and disorders for which rubber workers may be at special risk due to physical-chemical agents in their environment. Indices of self-reported symptoms of both classes of outcomes were obtained from questionnaire respondents, with biomedical signs of these outcomes also being obtained for the medical examination subgroup. This chapter reports the results for the self-reported symptom measures, while the bio-medical data are presented in Chapter 12.

This chapter considers self-reported symptoms of two outcomes previously associated with the types of occupational stress of interest in this study -- angina pectoris (cf. House, 1974a and b; Jenkins, 1971 and 1976; Kasl, 1978) and peptic ulcer (cf. Kahn and French, 1970; Susser, 1967). It also focuses on two health outcomes that physicians and industrial hygienists associated with this study expected to be especially affected by environmental conditions in the rubber industry -- itch and rash on skin, and persistent cough and phlegm. Whereas the neuroendocrine effects of stress should directly increase levels of angina and ulcers, the effect of stress on itch and rash or cough and phlegm should be more indirect -- stress should exacerbate the effect of irritating physical-chemical agents on dermatological and respiratory functioning. Or, put another way, exposure to physical-chemical agents should condition the relationship of stress to dermatological and respiratory symptoms, with stress having little or no effect on these symptoms among workers with little or no exposure to irritating physical-chemical agents but increasingly strong effects as exposure to agents increases.

This chapter first discusses the self-reported symptom indices of physical health, focusing especially on the evidence of their validity vis a vis independent medical diagnoses. It then examines the impact of objective job characteristics and perceived job stress on symptoms of angina, ulcers, itch and rash, and cough phlegm, including how these relationships are conditioned by exposure to physical-chemical agents and other conditioning variables.

Self-Report Measures of Physical Health

The major limitation of self-report health measures for our purposes is their potential for spurious association with perceived stress due to common self-reporting tendencies or biases. To reduce this potential as much as possible the medical staff of the study chose self-report questions which had the best available evidence of sensitivity and specificity against related medical diagnoses and subsequent morbidity or mortality. Further, we have dichotomized these measures so as to maximize their specificity (even at some slight loss of sensitivity), since lower specificity (i.e., more false positives vis a vis medical diagnoses) is the more important potential contributor to spurious associations between perceived stress and self-report health measures. The prior history and validation of the self-report health measures are as follows (see Appendix E for actual measures).

Angina pectoris. We used the WHO recommended version of the Rose questionnaire (Rose and Blackburn, 1968) modified only as necessary for self-administration. Rose's original interview schedule was validated against diagnoses of angina in 57 patients interviewed by three physicians. Specificity was 100 percent and sensitivity was 82 percent for 43 cases (17 positive, 26 negative) on which all three physicians agreed (Rose, 1965). Cederlof et al. (1966) found a slightly modified self-administered version of Rose's questionnaire to have (for males) 98 percent specificity and 67 percent sensitivity against physicians' diagnoses based on detailed medical history and 98 percent specificity but only 12 percent sensitivity against evidence of segmental S-T depression or previous infarction in post-exercise electrocardiograms. Several studies (Cederlof et al., 1966; Rose, 1971; Rose et al., 1977) have also shown that those whose questionnaire responses indicate angina have three to five times greater risk of further CHD morbidity or mortality than those free of angina (and myocardial infarction) in three- to seven-year followups.

Ulcers. Our questionnaire included two items assessing those symptoms (stomach pain coming on two hours or so after eating which is relieved by taking milk, antacids, or food, and stomach pain waking the person at night) which previous work has shown to be most predictive of radiologic diagnoses of ulcers. Varying forms of these questions have been validated against diagnoses from radiologic examination in three different studies. Dunn and Cobb (1962) report the two items to have a specificity of 98 percent, and a sensitivity between 32 percent and 50 percent; Epstein (1969) finds only 60 percent specificity but 76 percent sensitivity; and Popeila *et al*. (1976) estimate the items' specificity and sensitivity to be 84-93 percent and 60-73 percent, respectively. Our questions are not identical to those in any of these studies, but are quite similar to those of Popeila *et al*. In any case, these items appear to be only fair indicators of radiologically confirmable ulcers.

Dermatological problems. The two items assessing occurrence of itching skin and rashes were written for this study and no prior evidence on validity is available. The measure had 88 percent specificity but only 24 percent sensitivity against physicians' diagnoses of "dermatitis or exzema" for the medical examination subsample in our study. The specificity of the measure is moderately good. Its low sensitivity in part stems from several factors: dermatological symptoms and diagnoses are often transient phenomena widely scattered over the body; the questionnaires and health exams were collected several months apart; and the dermatological diagnosis was a relatively minor aspect of the physician's exam. This measure and the ulcer measure appear to be less valid and more subject to effects of sheer symptom reporting than the other two self-report health outcomes.

Persistent cough and phlegm. Questions here are taken from the widely used British Medical Research Council (1960) Bronchitis Questionnaire, with the modifications noted in Appendix E to take account of workers on afternoon or night shifts, and have been validated against measures of respiratory signs, functioning and sickness absence. For example, Cederlof et al. (1966) found a modified version of the cough items had 97 percent specificity and 67 percent sensitivity against physicians' diagnoses and 96 percent specificity and 11 percent sensitivity against lung function tests. They also found higher mortality among those with persistent cough in a three-year followup.

Results

Zero-order Correlations

Table 11.1 presents the significant zero-order correlations of the four self-report indices of physical health with each other and with objective job characteristics, perceived stress, and general job evaluations. The intercorrelations among the four self-report indices of physical health (.065 to .183) indicate a significant, but slight, tendency for workers who report positive symptoms of one health outcome to report positive symptoms of other health outcomes. For the most part, however, the various health outcomes are rather independent of each other.

The zero-order correlations in Table 11.1 show objective job characteristics to be unrelated to angina, ulcers, and cough and phlegm and a similar result obtained in the multivariate analysis presented below in Table 11.2. In contrast, symptoms of itch and rash are positively associated with qualitative workload demands, piecework, and working the evening shift. Most of these associations persist even after controls for exposure to physical-chemical agents and other factors in the multivariate analyses of Table 11.2. Thus, objective job characteristics affect only one of four self-report indices of physical health.

In contrast, perceived stresses and job evaluations are rather pervasively associated with the self-report indices of health, although there are some suggestive patterns in these relationships. Most, though not all, of these relationships remain significant in the multivariate analyses in Table 11.2. Table 11.1 shows that itch and rash correlated as expected with all five perceived stresses and both job evaluations -- a pattern of results similar to those observed for neurotic symptoms in Chapter 9. The cough and phlegm index correlated as expected with three perceived stresses and job satisfaction. Thus symptoms of dermatological, and to a lesser extent respiratory, problems are pervasively correlated with perceived stress and general job evaluations.

Ulcer symptoms also correlate significantly with four of the perceived stress and job evaluation variables in Table 11.1, but the multivariate analyses in Table 11.2 and analyses reported elsewhere (House, et al., 1979) suggest that the occupational stresses associated with ulcer symptoms form a somewhat unique syndrome consistent with prior research and theory on the psychosocial etiology of ulcers. In Table 11.1 ulcer symptoms are correlated positively with interpersonal and responsibility pressure and job-nonjob conflict and negatively with job satisfaction and occupational self-esteem. In the multivariate analyses of Table 11.2, only the effect of job-nonjob conflict and occupational self-esteem are significant net of each other and the control variables.

TABLE 11.1

SIGNIFICANT ($p \leq .05$) ZERO-ORDER CORRELATIONS OF SELF-REPORT INDICES OF PHYSICAL HEALTH WITH EACH OTHER AND WITH OBJECTIVE JOB CHARACTERISTICS AND PERCEIVED STRESS AND JOB EVALUATIONS

	Angina	Ulcers	Itch & Rash	Cough & Phlegm
Physical Health Indices				
Angina Pectoris	--			
Peptic Ulcer	.176	--		
Itch & Rash on Skin	.093	.109	--	
Persistent Cough & Phlegm	.183	.088	.065	--
Objective Job Characteristics				
Objective Work Rewards	--	--	--	--
Interpersonal & Responsibility Demands	--	--	--	--
Quantitative Workload Demands	--	--	--	--
Qualitative Workload Demands	--	--	.068	--
Piecework	--	--	.061	--
Evening Shift	--	--	.068	--
Perceived Stresses				
Perceived Work Rewards	--	--	-.081	--
Perceived Control Rewards	--	--	-.056	--
Interpersonal & Responsibility Pressure	.075	.081	.136	.093
Quantitative Workload Pressure	--	--	.114	.070
Job-Nonjob Conflict	--	.082	.156	.053
Job Evaluation				
Job Satisfaction	--	-.056	-.121	-.082
Occupational Self-Esteem	--	-.072	-.088	--

Further, House et al., (1979) show that it is the role conflict component of interpersonal and responsibility demands which largely accounts for the significant zero-order correlation in Table 11.1, and other analyses indicated this effect of role conflict would be significant in the multivariate analyses as well. Thus, ulcers appear to be affected by variables which involve significant interpersonal conflicts or tensions with persons at work (i.e., role conflict) or between persons at work and outside of work (i.e., job-nonjob conflict) and/or which indicate uncertain self-esteem. Both interpersonal conflict and tension and low self-esteem have been associated with ulcers in prior research, and both are consistent with theoretical hypotheses that see ulcers as especially as responsive conflict and insecurity in interpersonal relationships (cf. Susser, 1967; Kahn and French, 1970).

Among the four health outcomes considered here, angina has the most highly specific set of correlates. In both the bivariate relationships of Table 11.1 and the multivariate analyses of Table 11.2, only interpersonal and responsibility pressures correlate with angina; and analyses reported by House et al., (1979) show that it is the responsibility and quality concern components of that index which produce these relationships. These results suggest that angina is especially affected by task and achievement related pressures, again consistent with prior theory and research (cf. Jenkins, 1971 and 1976).

Multivariate Analyses

Table 11.2 presents a series of stepwise multivariate analyses, like those in preceding chapters. For each health outcome Model 1 shows the effects of the control variables and any objective job characteristics which explain significant additional variance net of the control variables.

Model 2 adds to Model 1 any perceived stresses or work motivations which explain significant additional variance net of each other and the variables in Model 1. Finally, Model 3 adds to Model 2 the job evaluation variables which explain significant additional variance.

As suggested above, the results in Table 11.2 are generally consistent with those in Table 11.1. The effects of the control variables are largely, though not entirely as might be expected. Although health problems tend to increase with age, only cough and phlegm shows such an effect in Table 11.2. The lack of effect of age on other variables may reflect that McMichael et al., (1975) have termed the "healthy worker effect" -- a tendency for physical health to be only weakly, if at all, related to age in cross-sections of working populations due to the death and/or disability retirement of the most unhealthy members of the population. Education is negatively associated with angina and ulcers, perhaps reflecting the ability of better educated workers to cope with work stresses, a phenomenon which has been noted above in Chapter 6 and in other research (Hinkle et al., 1968). These results may also reflect educational differences in the identification and/or reporting of some symptoms. Reported exposure to agents is related to all health outcomes in Table 11.2, but especially itch and rash and to a lesser extent cough and phlegm and ulcers. These results undoubtedly reflect a combination of actual physiological effects of environmental agents (discussed more fully below) and common tendencies to report both symptoms and exposure to hazardous agents. Controlling for this measure of exposure to agents thus tends to control for both the physiological effects of agents and tendencies to report "bad things", either of which might produce spurious associations between stress and health. Physical effort has no effect on any of these health outcomes, while, as would be expected, smoking increases rates of angina and especially cough and phlegms.

TABLE 11.2

MULTIPLE REGRESSIONS OF PHYSICAL HEALTH SYMPTOM INDICES ON CONTROL VARIABLES, JOB CHARACTERISTICS, PERCEIVED STRESSES, AND JOB MOTIVATION AND EVALUATIONS

	Angina Pectoris			Peptic Ulcer			Itch & Rash			Cough & Phlegm		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Control Variables			Same as Model 2									
Age (years)	(.001)	(.001)		(.000)	(.000)	(.000)	(.001)	(.000)	(.000)	.001$^+$	.001$^+$	.002$^+$
Education (years)	-.007*	-.007*		-.010*	-.011*	-.011*	(-.008)	-.008$^+$	-.008$^+$	(.001)	(.000)	(-.001)
Number of Agents Exposed to (0-3)	.017*	.014$^+$		.030*	.025*	.024*	.064*	.054*	.054*	.031*	.026*	.025*
Physical Effort Demanded by Job (1-5 scale)	(.127)	(.010)		(.028)	(.024)	(.023)	(.001)	(.009)	(.007)	(.028)	(.021)	(.017)
Number of Cigarettes Smoked per Day	.002*	.002*		(.000)	(.001)	(.001)	(.001)	(.001)	(.001)	.006*	.006*	.006*
Objective Job Characteristics												
Quantitative Workload Demands (linear)							(-.004)	(-.001)	(-.001)			
Quantitative Workload Demands (quadratic)							.021$^+$	.023$^+$	.023$^+$			
Qualitative Workload Demands							.026*	.024*	.026*			
Shift							.044$^+$	.042$^+$	.041$^+$			
Perceived Stresses												
Interpersonal & Responsibility Pressure (linear)		.050$^+$						.019$^+$	.018°		(.015)	(.011)
Interpersonal & Responsibility Pressure (quadratic)								.013$^+$	.014$^+$		.021*	.021*
Job-Nonjob Conflict					.024*	.020$^+$		.030*	.027*			
Motivations												
Work Motivation											.019$^+$	.018$^+$
Job Evaluations												
Job Satisfaction												-.018$^+$
Occupational Self-Esteem						-.020$^+$			-.019$^+$			
Constant	.037	.050		.142	.147	.145	.080	.090	-.093	-.141	-.120	-.114
Multiple R	.142	.156		.115	.134	.145	.234	.272	.277	.273	.303	.307
Multiple R^2	.020	.024		.013	.018	.021	.055	.074	.077	.074	.092	.094

Note: Entries are metric regression coefficients. The dependent variables are all dichotomous dummy variables. The other variables are coded as indicated in notes to comparable tables of preceding chapters (i.e., Tables 8.2, 9.2, and 10.2). Coefficients in parentheses are included in the equation but are not statistically significant.

$^+$ $p \leq .05$

* $p \leq .01$

As in Table 11.1, only itch and rash symptoms are related to objective job characteristics (cf. Model 1 in Table 11.2 for each outcome). Quantitative workload has a curvilinear effect on itch and rash, consistent with the hypothesis that both underload and overload at work may have deleterious consequences (cf. French et al., 1974; McGrath, 1970:Ch. 1). Dermatological symptoms are also greater among evening shift workers and those with higher qualitative workload demands. The combined effect of these three variables is consequential -- the proportion with itch and rash in evening shift workers one standard deviation above the mean on both types of workload demands would be over .09 higher than (or about twice as great as) among workers on other shifts with average workloads. Since these effects occur net of reported exposure to irritating physical-chemical agents (i.e., dust, fumes and chemicals, cf. Appendix E), it is unlikely that they merely reflect differences between jobs in physical-chemical hazards. Thus, objective psychosocial conditions of work appear to affect dermatological functioning.*

Each health outcome in Table 11.2 is affected by at least one of the perceived stresses or job motivations and evaluations, but the pattern of effects is different in each case. Net of the control variables angina is affected only by interpersonal and responsibility pressures while the ulcers index is affected only by job-nonjob conflict and occupational self-esteem. As discussed above these results are consistent with prior theory and research suggesting that angina (and other coronary disease) is

*It should be noted that these effects are not mediated by the perceived stress or job evaluation variables in Models 2 or 3. Thus the exact mechanism by which these effects occur is uncertain.

affected primarily by task and achievement-related stresses while ulcers are affected primarily by pressures and tensions associated with interpersonal relations.

Itch and rash and cough and phlegm are each affected by a somewhat broader spectrum of perceived stress and job evaluation variables. Rates of itch and rash increase with increasing job-nonjob conflict and interpersonal and responsibility pressure (the effect is only slightly curvilinear within the range of this variable in Whitewall Plant), and decrease as self-esteem increases. Rates of persistent cough and phlegm also vary directly with interpersonal and responsibility pressures (though the effect is somewhat curvilinear, it is largely linear within the range of the variable in this study) and work motivation and inversely with job satisfaction.

In sum, one or more perceived stress or job evaluation variables affects each of the health outcomes in Table 11.2, net of controls for age, education, smoking, physical effort required by the job and exposure to hazardous physical-chemical agents on the job. The number and size of these effects appear modest in some ways. For example, comparisons of Model 2 or 3 with Model 1 indicates that these variables accounting for between 0.4 percent (in the case of angina) and 2.2 percent (in the case of itch and rash) of the variance, net of the effects of the control variables and objective job characteristics. However, as noted in Chapters 4 and 10, the maximum variance explainable in these highly skewed dichotomous dependent variables is limited. The metric regression coefficients, which indicate the change in the proportion with each health outcome for each standard deviation unit change in a perceived stress or job evaluation, indicate that most of these effects are substantial.

For example, a one standard deviation unit rise in interpersonal and responsibility pressures produces a 5 percent increase (or virtually a doubling) in the rate of angina. Changes of 1-2 standard deviations in all of the perceived stress and job evaluation variables significantly affecting a health outcome would similarly tend to at least double the rates of each outcome. Thus, these effects are by no means trivial. In some cases, they appear even more consequential if considered in light of the conditioning variables to which we now turn.

Additive (main effects) of Conditioning Variables

Table 11.3 shows the zero-order correlations of the conditioning variables with the four self-reported health outcome indices. The effects of all the control variables appear modest, with the effects of age, education, the work motivations, exposure to agents, and piecework having been considered in connection with Tables 11.1 and 11.2. Type A is positively correlated in Table 11.3 with angina, itch and rash, and cough and phlegm, while supervisor and total support are negatively correlated with ulcers, itch and rash, and cough and phlegm, and spouse support is negatively correlated with itch and rash. All of these effects persist in multivariate analyses net of all variables in each Model 3 of Table 11.2. Thus, the Type A pattern affects symptoms of heart disease but also is related to symptoms of other health problems -- itch and rash, cough and phlegm, and (in Chapter 9) neurotic symptoms. Social support continues to manifest a quite general positive association with health and well-being, with spouse and especially supervisor support having the greatest effects.

TABLE 11.3

SIGNIFICANT ($p<.05$, two tailed) ZERO-ORDER CORRELATIONS OF POTENTIAL CONDITIONING VARIABLES WITH PHYSICAL HEALTH INDICES

	Angina	Ulcers	Itch & Rash	Cough & Phlegm
Individual Characteristics				
Age	.050	--	--	--
Education	-.074	-.059	--	--
Type A	.081	--	.054	.065
Work Motivation	--	--	--	--
Control Motivation	--	--	--	--
Situational Factors				
Piecework	--	--	.060	--
Exposure to Agents	.080	.088	.190	.117
Social Support from:				
Supervisor	--	-.059	-.072	-.102
Coworker	--	--	--	--
Friends & Relatives	--	--	--	--
Spouse	--	--	-.068	--
Total of all sources	--	-.051	-.091	-.078

Conditioning (interactive) Effects of Conditioning Variables

Using the procedures described in Chapter 4 and used in Chapters 6, 8, 9, and 10, we have tested the interactive conditioning effects of the variables in Table 11.3 on relationships of objective job characteristics, perceived stress, and job evaluations to the four self-report indices of physical health. These analyses revealed no evidence of interactive conditioning effects for relationships of objective stress to the physical health outcomes. In the case of relationships of perceived stress to health, exposure to physical chemical agents and the social support variables had clearly more interactive conditioning effects than might occur by chance, and these effects were generally consistent and interpretable. Type A also had somewhat more significant interactive conditioning effects on the relationship of perceived stress to health than might occur by chance (i.e., 7 out of 30 tests significant at the $p \leq .10$ level), but most of these effects (5 of 7) were concentrated on relationships of perceived stress to cough and phlegm and there was no clear or interpretable pattern to these effects (e.g., in several cases high and low Type A's were similar, but both differed from medium Type A's). Thus, only the conditioning effects of agents and social support will be presented and discussed in detail.

Conditioning Effects of Exposure to Agents

The conditioning effects of exposure to hazardous physical-chemical agents on relationships of perceived stress to the self-report indices of physical health provide striking evidence that psychosocial job stress directly predisposes workers to diseases traditionally considered psychosomatic (e.g., ulcers) while it affects other health outcomes (e.g., dermatological and respiratory problems) primarily by exacerbating the effects of other disease-producing agents or factors. Of a total of 30 relationships between the four physical health outcomes and the perceived stresses and job evaluations (including a couple of quadratic terms) 9 were significantly conditioned by exposure to agents (at the $p \leq .10$ level, with 8 of 9 significant at the .05 level) -- many more than might occur by chance. Further 7 of these 9 effects occurred on relationships involving itch and rash or cough and phlegm, 2 occurred on relationships involving angina, and none occurred on relationships involving ulcers.

Table 11.4 presents all nine of the significant conditioning effects. In the interaction tests for conditioning effects, agents like social support was treated as a continuous variable since other analyses (cf. House *et al.*, 1979; House and Jackman, 1979) showed that this approach accurately and efficiently reflected the conditioning effects of agents. The measure of self-reported exposure to agents involved workers reporting whether they were exposed to levels of dust, fumes, and/or chemicals which were hazardous to their health. Thus the index ranged from 0 to 3 depending on whether a worker reported exposure to none, one, two or all three agents. The entries in Table 11.4 are the estimated metric regression coefficients for the regression of the indicated health outcome on the indicated independent variable (net of other significant variables in the appropriate equation of Table 11.2) among workers with exposure to no agents and all agents (results for those exposed to one or two agents would be intermediate between these). The results consistently show perceived stress to be unrelated to itch and rash, cough and phlegm and angina among workers with no exposure to agents, while stress substantially increases rates of each health outcome among workers exposed to all three noxious physical-chemical agents. That is, psychosocial stress and physical-chemical

TABLE 11.4

SIGNIFICANT ($p \leq .10$) CONDITIONING EFFECTS OF SELF-REPORTED EXPOSURE TO AGENTS ON RELATIONSHIPS BETWEEN PERCEIVED STRESS AND SELF-REPORT PHYSICAL HEALTH OUTCOMES

Health Outcome (Dep. Var.)	Perceived Stress (Indep. Var.)	Effect of Perceived Stress on Health Outcome Under Exposure to: No Agents	All Agents	Significance of Interaction
ITCH & RASH	Interpersonal and Responsibility Pressure (linear)			n.s.
	Interpersonal and Responsibility Pressure (quadratic)	-.007	.032	$p \leq .05$
	Quantitative Workload Pressure	-.010	.053	$p \leq .01$
	Job-Nonjob Conflict	-.014	.064	$p \leq .01$
	Job Satisfaction	.017	-.055	$p \leq .01$
COUGH & PHLEGM	Interpersonal and Responsibility Pressure (linear)	-.010	.038	$p \leq .05$
	Interpersonal and Responsibility Pressure (quadratic)	.000	.036	$p < .05$
	Job-Nonjob Conflict	-.033	.021	$p \leq .01$
ANGINA	Interpersonal and Responsibility Pressure	-.003	.036	$p \leq .05$
	Job-Nonjob Conflict	-.012	.015	$p \leq .10$

Note: Entries are estimated metric regression coefficients for the effect of perceived stress on health for workers reporting exposure to no hazardous physical-chemical agents vs. all three agents (i.e., dust, fumes, and chemicals). Significance of interaction is significance of regression test for differences in effect of perceived stress across levels of exposure to agents.

hazards appear to operate synergistically in affecting dermatological and respiratory symptoms and perhaps symptoms of angina as well.*

It is important to note that no such conditioning effects were found for relationships involving ulcers or other health outcomes considered in prior chapters. Thus, exposure to agents conditions the effects of stress only in relation to health outcomes which are most likely to be induced by exposure to such agents. This is a striking and potentially important finding, though as we will see it is not replicated in the analyses of the biomedical data.

Conditioning Effects of Social Support

As in previous analyses of the conditioning effects of social support, we examined the impact of the five indices of social support on the relationships of each perceived stress variable to each of the four physical health outcomes. Once again, social support produced more significant conditioning effects than would be expected by chance.

All sources of support had more significant ($p \leq .10$) conditioning effects than might be expected by chance, though the effects of total support and friend and relative support were weaker (only 4 significant effects out of 30 tests) than the effects of supervisor, coworker and spouse support (7, 6 and 6 significant effects out of 30 respectively). These effects were fairly evenly distributed across health outcomes. Table 11.5 shows the estimated metric regression coefficients under the highest and lowest levels of the indicated source of support for each

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*The effects on angina were not anticipated, and are not as extensive or strong as the effects on dermatological or respiratory symptoms. They could plausibly, however, reflect a real interaction of stress with agents. Industrial hygienists and epidemiologists associated with the project suspect that exposure to solvents used in rubber manufacturing, which are carbon compounds, can aggravate angina by resulting in the formation of carboxy hemoglobin with consequent decrease in the oxygen-carrying capacity of the blood. Psychosocial job stress may exacerbate this process and/or the chest pains resulting from it.

relationship of perceived stress to a health outcome. The overall pattern of results is consistent with the hypothesis that support buffers the impact of perceived stress on health, though evidence of buffering is most clear and consistent in the case of ulcers and is totally absent in the case of itch and rash.

There is evidence of buffering if stress clearly increases the proportion with reported symptoms of a disorder when social support is low, while this effect diminishes or disappears when support is high. Of the 27 significant conditioning effects of social support in Table 11.5, 19 (or 70%) roughly conform to this pattern, although in a number of these cases the effect of stress under high support is moderately negative (i.e., stress reduces the rates of ill health), something which is not anticipated in most discussions of the buffering effects of social support. The remaining 8 significant effects in Table 11.1 run contrary to the buffering hypothesis, with the deleterious effect of stress on health being greater under high support.

The evidence for buffering effects of social support is clearest with respect to ulcers. There are seven significant conditioning effects involving ulcers and in every one of them perceived stress sharply increases rates of ulcer symptoms among workers with low social support, and these effects disappear under high support. Although in a number of cases, under high support perceived stress tends to decrease rates of ulcer symptoms, these effects are generally much smaller in absolute magnitude than the effects under high support. Thus, social support, especially from supervisors and friends or relatives, clearly buffers workers against the effect of perceived stress on ulcer symptoms, and this conclusion is supported by other analyses of these same data (e.g., Wells, 1978; House and Wells, 1977).

TABLE 11.5

SIGNIFICANT CONDITIONING EFFECTS OF SOCIAL SUPPORT ON RELATIONSHIPS OF PERCEIVED STRESSES AND JOB EVALUATIONS TO SELF-REPORTED PHYSICAL HEALTH OUTCOMES

Health Outcomes	Independent Variable (Perceived Stress)	Source of Support	Effect on Health Outcome When Support is: Lowest	Highest	Significance of Interaction
ANGINA	Perceived "Work" Rewards	Spouse	-.011	.014	$p \leq .10$
	Control Rewards	Supervisor	-.023	.018	$p \leq .10$
		Coworker	-.037	.029	$p \leq .01$
		Spouse	.020°	-.013	$p \leq .10$
	Quantitative Workload Pressure	Supervisor	-.026	.015	$p \leq .05$
		TOTAL	-.035	.021	$p \leq .05$
	Job Satisfaction	Spouse	-.017	.012	$p \leq .05$
	Self-Esteem	Spouse	-.018	.014	$p \leq .05$
ULCERS	Quantitative Workload Pressure	TOTAL	.045	-.039	$p \leq .05$
		Friends/Relatives	.022	-.026	$p \leq .05$
	Job-Nonjob Conflict	TOTAL	.070	-.030	$p \leq .05$
		Supervisor	.062	-.024	$p \leq .01$
		Friends/Relatives	.041	-.007	$p \leq .05$
	Job Satisfaction	TOTAL	-.043	.037	$p \leq .10$
	Occupational Self-Esteem	Supervisor	-.076	.034	$p \leq .01$
ITCH & RASH	Interpersonal & Responsibility Pressure (quadratic)	Coworker	.042	-.012	$p \leq .05$
	Control Rewards	Coworker	-.037	.025	$p \leq .10$
	Job-Nonjob Conflict	Friends/Relatives	.001	.060	$p \leq .05$
	Occuaptional Self-Esteem	Supervisor	-.049	.011	$p \leq .10$
		Coworker	.031	.124	$p \leq .05$
		Spouse	.009	-.034	$p \leq .10$
		Friends/Relatives	.000	-.042	$p \leq .10$
COUGH & PHLEGM	Perceived Rewards	Coworker	-.028	.024	$p \leq .10$
	Interpersonal & Responsibility Pressure (quadratic)	Supervisor	.052	-.009	$p \leq .01$
		Coworker	.048	-.003	$p \leq .05$
	Quantitative Workload Pressure	Spouse	.030	-.008	$p \leq .10$
	Job Satisfaction	Supervisor	.009	-.045	$p \leq .10$

Note: Entries are estimated metric regression coefficients. Significance of interaction is significance of regression test for differences in effects of independent variable across levels of support. See text here and discussion of Table 6.5 for further explanation.

Support also has clear buffering effects in the case of cough and phlegm, with 4 of the 5 conditioning effects on relationship with cough and phlegm conforming to the buffering hypothesis. The effects of social support on relationships of perceived stress to angina are less clearly buffering effects, though the tendency is still in this direction. For 5 of the 8 effects in Table 11.5, perceived stress clearly increases rates of angina symptoms when support is low, but stress tends to have almost equally strong effects in the opposite direction under high support. In the case of itch and rash there is no consistent pattern to the effects.

In sum, these data provide very clear evidence that social support buffers workers against the deleterious impact of stress on ulcers, reasonably strong evidence of similar buffering effects with respect to the effects of stress on cough and phlegm, and suggestive evidence that support may also buffer workers against the effects of stress on angina as well. However, we find no consistent evidence of buffering effects with respect to itch and rash. A possible rationale for this pattern will be suggested in Chapter 13.

Summary and Conclusions

The present chapter provides substantial evidence that occupational stress, especially perceived stress, is significantly associated with self-reported symptoms of physical disorders among workers in Whitewall Plant, even after controls for exposure to physical-chemical hazards and other individual and situational factors productive of disease. These effects of stress are not confined to traditional psychosomatic ailments such as ulcers and angina, but extend to respiratory and dermatological problems as well. In these latter cases, stress appears to exacerbate the effects of irritating physical-chemical agents in the work environment rather than directly causing dermatological or respiratory problems. Thus, psychosocial job stress may be especially hazardous to workers who are also exposed to physical-chemical or biological hazards in their work environment. The results also indicate that social support may buffer workers against the effects or psychosocial stress on ulcers and perhaps respiratory disorders and angina as well.

A major limitation of the results presented in this chapter is that most of them derive from analyses in which all variables are measured through worker self-reports. We have argued here and elsewhere (House _et al._, 1979) that the various measures are reasonably rated and that the results are unlikely to be spurious products of the self-report nature of the measures. Biomedical measures of health can alleviate these problems by providing more independent assessment of health. Although the available biomedical data in this study have substantial limitations, we will examine their relation to stress before making a final assessment of these results.

Chapter 12

OCCUPATIONAL STRESS AND PHYSICAL HEALTH
II. BIOMEDICAL INDICES OF HEALTH

As indicated in Chapter 2, the medical examination data available to us were not collected for the purposes of this study. Rather, they were collected as part of a study to determine the effects of long-term exposure to vinyl chloride among chemical and plastic workers (with a small control group of rubber workers). A total of 447 workers were examined, of whom 353 were white males who also returned questionnaires. Thus, only selected biomedical indices of health were available to us, and these for only a small nonrandom subset of the total study population. Hence, how to utilize these data and how to compare them with data from the total set of questionnaire respondents were major problematic issues at the beginning of the analyses and were considered at length in the course of analysis.

After careful comparison of the characteristics of the data and respondents from the two sources, it was decided to use the medical data primarily to explore the replicability and validity of certain key findings from the total questionnaire group, especially the findings reported in Chapter 11 on the relationship of perceived stress to physical health, and the conditioning effects of exposure to agents and social support on these relationships.

The major strength of the biomedical data is that they provide assessments of physical health status which are independent of workers' self-reports and more closely linked to the functioning of specific bodily organs and systems. However, the medical data used here have a number of weaknesses which should be noted. As already indicated the medical examination group is a small and unrepresentative subset of the total set of respondents. Second, the number of variables from the medical examination which were directly relevant to the concerns of this study were very small in number -- essentially coronary heart disease risk factors and a few indicators of respiratory and dermatological functioning. Third, because these variables were not central to the primary purposes of the medical examination they were assessed more casually than is ideally desirable and no specific evidence on their reliability and validity is available (aside from their being routine physician diagnoses and laboratory tests).

For these reasons, and because the biomedical indices examined in this chapter and the self-report indices analyzed in Chapter 11 were not intended to measure exactly the same disease states (or precursors), it should not be assumed that the results in this chapter are necessarily more valid than those in Chapter 11. Rather, each set of results must be carefully considered on its own merits and in relation to the other. To facilitate comparison with the results in Chapters 11, this chapter first compares the measures and respondents in the medical examination and self-report group, and then turns to the results of analyses relating occupational stress and to the biomedical health outcomes.

Comparing the Biomedical and Self-Report Data

Comparisons of the Groups

Plastics and chemicals workers constituted only 13 percent of all questionnaire respondents, but they comprised 67.5 percent of the workers who both returned questionnaires and received medical examinations. Despite this massive occupational difference, an extensive analysis revealed relatively few differences in either univariate means or bivariate correlations between those who did and did not receive medical examinations on the major variables of interest in this study (cf. Landerman, 1978). What differences did emerge were concentrated in the ratings of objective job conditions, as might be expected given the large occupational differences between the two groups. Because of these differences and the differing distribution of the objective job ratings in the medical and nonmedical groups, objective job conditions will not be considered in the analyses reported in this chapter.

The general lack of quantitative differences between the medical and nonmedical groups in mean levels of, or correlations among the questionnaire measures of perceived stress and health, does not indicate, of course, that the two groups may not differ qualitatively on important variables. For example, although the medical examination group reported being exposed to only slightly more physical-chemical agents than the other questionnaire respondents, the types of agents to which the two groups were exposed were quite different. Vinyl chloride gas and polyvinyl chloride resin and powder were the major environmental hazards for plastics and chemicals workers, while rubber workers were exposed to talc, sulfur and carbon black dust and to solvents, vapors and reaction products associated with rubber production. We will return to this issue below.

In sum, the analysis in this chapter will consider only the relation of perceived stresses and job evaluations to the biomedical indices of physical health, and the effects of selected conditioning variables (i.e., social support and exposure to physical-chemical agents) on these relationships. Essentially, the analyses attempted to replicate the strongest findings from the analysis of self-report measures of physical health in Chapter 11. The outcome of these analyses were ambiguous in meaning and suggested that little clarity would be gained from more exploratory analyses involving objective job characteristics or conditioning variables that had shown no effects in the previous analyses.

Comparison of Measures

Biomedical measures. The medical examination yielded five biomedical indices of physical health which were related to the self-report indices considered in Chapter 11 and to the general concerns of this study with both traditional psychosomatic disorders and other disorders which may be caused primarily by the physical-chemical environment but could be exacerbated by psychosocial job stress. Biomedical indices of cardiovascular, dermatological, and respiratory functioning were obtained, but unfortunately no biomedical indices of ulcer were available. All five biomedical measures were dichotomous diagnoses or classifications: (1) hypertension (systolic blood pressure $\geq$ 150 and/or diastolic blood pressure $\geq$ 95 mm. Hg, based on a single physician's reading in sitting position); (2) high coronary heart disease (CHD) risk -- defined as having elevated levels of two of three major CHD risk factors (Gordon et al., 1971): cigarette smoking (here reporting current smoking of one pack or more per day), high systolic blood pressure (here $\geq$ 150), and high serum cholesterol (here $\geq$ 280 mg/100 ml. based on a single automated analysis); (3) physician's diagnosis of "dermatitis or eczema" from observation; (4) physician's diagnosis of "diminished breath sounds diffusely" from stethoscopy; and (5) impaired lung function (a forced expiratory volume in one second, or FEV_1, which is 70 percent or less of the normal value for the person's age and weight).

Intercorrelations of physical health indices. Table 12.1 shows the means and intercorrelations of both the self-report and biomedical indices of physical health within the medical examination group.* The modest positive intercorrelations among the self-report indices (the upper left triangle of Table 12.1) are generally similar in pattern to, if somewhat larger in magnitude than, the comparable intercorrelations for the total set of questionnaire respondents seen in Table 11.1. The biomedical indices show a similar pattern of small to moderate positive intercorrelations (cf. lower-right triangle of Table 12.1) suggesting a slight tendency for both medical conditions, as well as self-reported symptoms, to cluster in individuals. The rectangle of correlations in the lower left corner of Table 12.1 indicates the relationships of the self-report indices with the biomedical indices. Correlations between measures of the same bodily systems are underlined.

Self reported angina symptoms are slightly negatively correlated with hypertension and CHD risk, but are moderately correlated with diagnosed dermatological or respiratory disorders. The relative lack of correlation of angina and CHD risk factors is not totally surprising given other evidence that they may have distinctive etiologies (cf. Jenkins, 1971). The relatively strong correlation of angina symptoms with signs of respiratory impairment may reflect their common locus in the chest region and/or their being affected by common environmental factors (cf. Chapter 11). The correlation of angina with the physician's diagnosis of dermatitis is

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*The pairwise N's for correlations in this chapter range from 287 to 353. A base N of 300 is used to estimate significance levels. One-tailed significance levels are used and as in previous chapters all correlations $\geq .05$ are shown, since the main purpose of this chapter is to see if biomedical indices reveal patterns of results similar to those involving self-report health measures in preceding chapters.

TABLE 12.1

INTERCORRELATIONS AND MEANS OF SELF-REPORT AND BIOMEDICAL INDICES OF PHYSICAL HEALTH WITHIN THE MEDICAL EXAMINATION SUBGROUP

	1	2	3	4	5	6	7	8	9
Self-Report Indices									
1. Angina Pectoris	--								
2. Ulcers	.216	--							
3. Itch & Rash	.200	.163	--						
4. Cough & Phlegm	.230	.129	.078	--					
Biomedical Indices									
5. Hypertension	(-.051)	-.118	(-.050)	--	--				
6. CHD Risk	(-.064)	-.097	-.106	.192	.384	--			
7. Dermatitis	.209	--	.119	--	--	--	--		
8. Diminished FEV_1	.254	--	-.108	.216	.087	--	(.053)	--	
9. Diminished Breath Sounds	.203	(.066)	--	.344	.084	.111	.144	.297	--
Mean	.072	.157	.135	.155	.204	.135	.136	.070	.060

Note: Only correlations $\geq .05$ in absolute value are shown. Correlations $\geq .074$ in absolute value are significant at the $p \leq .10$ level (one-tailed), while correlations $\geq .094$ are significant at the $p \leq .05$ level (one-tailed). Correlations which are $\geq .05$ but $\leq .073$ are shown in parentheses.

puzzling. Ulcer symptoms tend to relate slightly negatively to signs of cardiovascular disease but show little or no association with the biomedical indicators of dermatological and respiratory disease. Dermatological symptoms show their only positive correlation, although a weak one, with physician diagnosis of dermatitis; while being slightly negatively related to CHD risk factors and impaired lung function. Self-reported cough and phlegm symptoms correlate moderately with signs of respiratory disease and with CHD risk.

Overall, the correlations in Table 12.1 suggest that both the self-report and biomedical indices of similar disorders are modestly positively correlated, but generally at levels which are only somewhat, if at all, higher than the correlation of these measures with dissimilar disorders measured by self-report and/or biomedical methods. Thus, with a couple of exceptions, indices of ill health tend to correlate positively, regardless of the method of measurement. These data and other analyses discussed below and in more detail by House et al., (1979) suggest that the various biomedical self-report indices tend to tap somewhat different aspects of physical health and that both the biomedical and self-report measures have validity as indicators of both specific physical disorders and a more general pattern of health problems.

Associations Between Stress and Health

Table 12.2 shows the relationship of each perceived stress and job evaluation variable to each biomedical health index. The entries in the table are partial correlation and regression coefficients, controlling for individual and environmental determinants of medical conditions (as indicated in the note to Table 2). However, the effects of the perceived

TABLE 12.2

PARTIAL CORRELATIONS (r_p) AND METRIC REGRESSION (B) COEFFICIENTS OF PERCEIVED STRESSES AND JOB EVALUATIONS WITH BIOMEDICAL INDICES OF PHYSICAL HEALTH, CONTROLLING CONFOUNDING VARIABLES

	Hypertension		CHD Risk		Dermatitis		Diminished FEV_1		Diminished Breath Sounds	
	r_p	B	r_p	B	r_p	B	r_p	B	r_p	B
Perceived Stresses										
Perceived Work Rewards	-.094	-.038	-.188	-.064	(.060)	(.021)	--	--	(.071)	(.017)
Perceived Control Rewards	(-.056)	(-.021)	--	--	--	--	(-.064)	(-.016)		
Interpersonal & Responsibility Pressure	.082	.034	.120	.041	--	--	--	--	--	--
Quantitative Workload Pressure	(.067)	(.027)	.101	.034	--	--	--	--	--	--
Job-Nonjob Conflict	.079	.032	(.057)	(.019)	--	--	--	--	--	--
Job Evaluations										
Job Satisfaction	--	--	-.220	-.074	(.062)	(.022)	--	--	(.057)	(.014)
Occupational Self-Esteem	--	--	-.034	-.106	--	--	--	--	.125	.028

Note: Coefficients computed net of age, education, exposure to agents, physical effort demanded by job, cigarette smoking, and obesity (Quetelet ratio). Only correlations (and associated regression coefficients) $\geq .05$ are shown. Correlations (and associated regression coefficients) are significant at the $p \leq .10$ level (one-tailed) if they exceed $\pm .074$ and at the $p \leq .05$ level if they exceed $\pm .094$. Correlations (and associated regression coefficients) $\geq .05$ but $\leq .073$ are shown in parentheses.

stress and job evaluation variables on physical health were not tested net of each other. The pattern of results in Table 12.2 can be easily summarized. Hypertension and CHD risk are quite pervasively affected by perceived stress and job evaluations. The relationships are always in the expected direction, are comparable in magnitude to the effects of perceived stress observed in Chapter 11, and are often statistically significant despite the small sample size. Thus, these data are consistent with a growing body of evidence that occupational stress is associated with increased prevalence, incidence, and/or risk of coronary and cardiovascular disease (House, 1974a and b; Jenkins, 1971 and 1976; Kasl, 1978).*

In contrast, there is little evidence of association between perceived stress and biomedical indicators of dermatological or respiratory disorders. Only one of the relationships is statistically significant and it is contrary to expectation (as are most of the other correlations which are $\geq .05$ but which do not achieve statistical significance). Thus, we find no support in these data for a direct impact of psychosocial job stress on biomedical indices of dermatological and respiratory disorders. But the results of Chapter 11 suggest that we need to examine how such effects may be conditioned by exposure to physical-chemical agents and social support.

Effects of Conditioning Variables

Since social support and self-reported exposure to agents showed the only pervasive and interpretable conditioning effects in Chapter 11, they were the focus of the analysis of conditioning effects in the biomedical data.

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*It should be noted that the relationships of perceived stresses and job evaluations to hypertension and CHD risk are more pervasive, and often stronger, than the comparable relationships with angina in Chapter 11.

Cursory exploration suggested that, except for the obvious association of age with hypertension and CHD risk , the additive and interactive effects of the other conditioning variables were, in fact, slight or non-existent in the biomedical data -- a result generally consistent with their effects on self-report health outcomes in prior chapters. The effects of social support and exposure to agents, however, in Chapter 11 (and earlier chapters in the case of support) were both empirically robust and substantially important and meaningful. Thus, an intensive effort was made to see if these effects could be replicated using biomedical rather than self-report indices of health. The results were negative in both cases, though in the case of social support a perplexing reversal of the expected results occurred.*

Exposure to Agents

Tests for the conditioning effects of self-reported exposure to agents on the relationship between perceived stress and biomedical indices of health revealed about as many significant interactions as would be expected by chance, and the pattern of results was largely contrary to our expectations based on the findings in Chapter 11. Self-reported exposure to agents also had little or no direct, additive effects on any of the biomedical health outcomes. Extensive further analyses and comparisons of the medical examination group with other questionnaire respondents suggested that the lack of correspondence between results regarding the conditioning effects of agents in Chapters 11 and 12, especially the results regarding signs and

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*Tests for the interactive conditioning effects of both exposure to agents and social support in this Chapter were done by the same methods as those in preceding chapters, except that only the control variables indicated in Table 12.2 and the relevant perceived stress and conditioning variable were held constant in these analyses.

symptoms of respiratory disorder, reflected qualitative differences in the composition of the two groups and in the health outcomes measured. That is, neither set of results is necessarily more valid than the other. Rather, the findings in Chapter 11 appear to reflect a real conditioning effect of exposure to agents on relationships of perceived stress with cough and phlegm, and probably itch and rash as well. These results do not replicate in the medical examination group both because different health outcomes are being assessed (i.e., one can experience cough and phlegm without necessarily showing impaired lung function or abnormal sounds via stethoscopy, and vice versa) and because the medical examination group may be exposed to agents which are less irritating to the respiratory or dermatological systems and may differ in other unknown and subtle ways from the total work force of Whitewall Plant. House et al., (1979) discuss these ideas and the analyses which led to these conclusions in more detail.

Thus, at this point, the findings regarding the conditioning effects of exposure to agents in Chapter 11 should be viewed as tentative and suggestive, but should not be dismissed as less valid than the negative results of the present chapter. Future research should more directly address the potential synergistic effects of psychosocial job stress and noxious physical-chemical agents, including more thorough and adequate assessment of both exposure to agents and relevant health outcomes through both self-reports and biomedical methods.

Social Support

Tests for the interactive conditioning effects of social support on relationships between perceived stress and biomedical indices of health yielded clearly more significant results than would have been expected by chance, but the pattern of results was not consistent with either the buffering or dampening effects of social support observed in Chapters 6 to 11. That is, the effects of stress on health proved most adverse under high social support, while under low social support stress tended to improve biomedical indicators of physical health. Simple additive effects of social support on biomedical health outcomes, though weak, were also contrary to expectation -- social support was positively associated with signs of disorder, again especially in the case of hypertension and CHD risk. These latter effects were largely a function of the nature of the interactive conditioning effects.

Table 12.3 presents the significant conditioning effects of total support on relationships between stress and perceived health. For each health outcome, the conditioning effects of total support were tested with respect to the five perceived stress and two job evaluation variables, a total of seven tests. For dermatitis and impaired lung function there were no more significant results than might occur by chance. But the number of significant effects in the case of hypertension (three), CHD risk (two), and diminished breath sounds (three) clearly exceeded chance expectations. These conditioning effects are shown in Table 12.3, and the pattern is remarkably consistent -- when support is high stress is positively related to signs of ill health, but under low support stress is inversely related to signs of ill health (recall that for the rewards and satisfaction variables a low score is considered stressful). Among the separate sources of support, supervisor and friend and relative support produced the most significant interactions. These data are not presented since the general pattern of their effects was the same as that in Table 12.3.

TABLE 12.3

CONDITIONING EFFECTS OF TOTAL SOCIAL SUPPORT ON
RELATIONSHIPS OF PERCEIVED STRESSES TO BIOMEDICAL HEALTH INDICES

Health Outcome (Dep. Var.)	Perceived Stress (Indep. Var.)	Effect of Perceived Stress on Health When Total Social Support is: Lowest	Highest	Significance of Interaction
HYPERTENSION	Interpersonal & Responsibility Pressure	-.234	.254	$p \leq .01$
	Quantitative Workload Pressure	-.089	.120	$p \leq .10$
	Job-Nonjob Conflict	-.105	.155	$p \leq .05$
CHD RISK	Interpersonal & Responsibility Pressure	-.132	.180	$p \leq .01$
	Perceived Control Rewards	.096	-.072	$p \leq .10$
DIMINISHED BREATH SOUNDS	Perceived Work Rewards	.104	-.040	$p \leq .05$
	Interpersonal & Responsibility Pressure	-.074	.062	$p \leq .05$
	Job-Nonjob Conflict	-.086	.090	$p \leq .10$
	Job Satisfaction	-.098	-.050	$p \leq .05$

Note: Entries are estimated metric regression coefficients. Significance of interaction is significance of regression test for differences in effects of independent variable across levels of support. See text here and discussion of Table 6.5 for further explanation.

It is unclear, indeed mysterious, why high social support should exacerbate the effects of stress on biomedical signs of ill health, while low social support mitigates such effects to the point that stress appears to improve the health of persons with low social support. Again it is possible that some unique characteristics of the medical examination group produce these effects, (e.g., perhaps low support here means relative isolation from others, and hence stress is a source of positive stimulation and variety for these workers). Given the idiosyncratic nature of the medical examination subgroup and other weaknesses in the medical data, and the lack of an apparent substantive or theoretical rationale for these results, they are best regarded at this point as an empirical anomaly. Only if such anomalous results are replicated in future research should they be accorded more careful theoretical and empirical analysis and interpretation.

Summary and Conclusion

The biomedical data provide further evidence that occupational stress is associated with hypertension and increased risk of coronary heart disease -- a welcome confirmation of findings from prior research. Beyond that, however, the biomedical data yield little evidence that stress affects physical health and fail to replicate major portions of the findings from our self-report indices of physical health. This lack of clear positive results could be viewed as calling into question the validity of the findings in the self-report data. However, as already indicated, the biomedical data have important limitations in both sampling and measurement, which leave their validity open to some question. Thus, for the reasons noted above and elsewhere (House *et al.*, 1979), we tend to accord substantial validity to our questionnaire results and to attribute the more negative results in this chapter to the distinctive nature of the medical examination groups and the biomedical health measures.

The availability of biomedical data collected for other reasons seemed a great advantage at the beginning of this study. However, the analyses of these data have tended to confuse as much as clarify our understanding of the relationship of stress to health. Future studies should concentrate more heavily on valid and reliable assessment of biomedical health outcomes specifically relevant to the problems of stress research for representative samples of the relevant study populations. Data of this type would alleviate the difficult interpretive problems which the biomedical data in this study have posed, and should significantly advance understanding of the impact of occupational stress on health.

Chapter 13

OCCUPATIONAL STRESS AND HEALTH

This chapter will provide an overview of the numerous, sometimes complex results of Chapters 8-12 and hence a more succinct answer to the guiding question of this research -- how did occupational stress affect the mental and physical health of the workers of Whitewall Plant? More specifically, we consider here: (a) how objective job characteristics related to self-report indices of mental and physical health; (b) how perceived stresses and job evaluations related to the same self-report health indices and to biomedical indicators of physical health as well, and (c) how a variety of potential conditioning variables were directly associated with health and how they conditioned the relationships under (a) and (b).

Job Characteristics and Health

Tables 13.1 provides a summary of the basic effects of objective job characteristics on health. The data in this table do not take account of conditioning effects which will be considered below and do not include bio-medical health outcomes due to the idiosyncratic and unrepresentative distribution of job characteristics variables in the medical examination group. The entries in the table derive from the results of the multivariate analyses presented as Model 1 in Tables 8.2, 9.2, 10.2, and 11.2. An entry appears in the table only if an objective job characteristic had a significant effect on a given health outcome net of the effects of age, education, self-reported exposure to hazardous physical-chemical agents, the physical effort demanded by the job, and any other objective job characteristic which had a significant

Table 13.1

Summary of the Significant Effects of Job Characteristics
on Mental and Physical Health

Health Outcomes (Dep. Var.)	Objective Work Rewards	Interpersonal & Responsibility Demands	Quantitative Workload Demands	Qualitative Workload Demands	Piecework	Evening Shift
Job Specific Mental Health						
Job Satisfaction	$\smile$			$\frown$	-	-
Occupational Self-Esteem				+		
General Mental Health						
Life Satisfaction					-	-
Neurotic Symptoms						
Substance Abuse						
Smoking						
Drinking	-	+			+	+
Physical Health						
Physical Health (Self-reported symptoms)						
Angina						
Ulcers						
Itch & Rash			$\smile$	+		+
Cough & Phlegm						

Note: See text for explanation of the source tables on which this summary is based.

+ = Significant positive effect
- = Significant negative effect
$\smile$ or $\frown$ = Significant nonlinear effect (the entry in the table gives the approximate form of the relationship)

impact on that health outcome. Thus, the effects of psychosocial job characteristics indicated in Table 13.1 are robust ones which are significant over and above the effects of a variety of other potential determinants of health, most notably physical and chemical hazards.[*] The entries in the table indicate whether the relationship was linear and positive (+), linear and negative (-), or curcilinear ($\smile$ or $\frown$) with the approximate form of the curvilinear relationship indicated.

Table 13.1 clearly shows that the effects of objective job characteristics on health outcomes are quite limited. Job characteristics have no effect on five of the ten health outcomes (neurotic symptoms, smoking, angina, ulcers, and cough and phlegm), while occupational self-esteem is affected by only one job characteristic and this effect is contrary to expectation, though reasonable after the fact -- objective qualitative workload is positively associated with self-esteem. The other four health outcomes, one from each of the four major classes (and hence one from each chapter) were significantly affected by at least two of the six job characteristics and these effects are generally as expected (greater objective potential for stress goes with poorer health).

As expected, job satisfaction was generally positively related to objective work rewards (though the relationship is slightly curvilinear), while piecework and evening shift work adversely affected job satisfaction. Qualitative

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[*] It should be noted that many analyses in Chapters 8-12 were also done with controls for levels of exposure to dust as assessed by industrial hygienists. This variable had weaker effects on health than worker's self-reported exposure, and the effects of both objective and perceived psychosocial job stress on health were even greater in these analyses than in the analyses presented in Chapters 8-12.

workload demands affected satisfaction much the same way they affect self-esteem, again an unexpected but not uninterpretable finding. Other things being equal, more difficult work leads to greater satisfaction with job and self. Life satisfaction was adversely affected by piecework and shiftwork in the same way that job satisfaction was. Itch and rash were increased by shiftwork and excessive qualitative workload and by either too little or too much quantitative workload. Finally, heavy drinking was greater among piece-workers, shiftworkers, and those with high interpersonal and responsibility demands and/or low work rewards. The effects of job characteristics on drinking behavior were especially strong. All of these relationships are most plausibly interpreted as effects of stress on health rather than vice versa.

Overall, then, job characteristics have clear effects on only a limited number of health outcomes, though these effects included all types of health outcomes considered in this study (i.e., job-specific and general mental health, substance abuse, and physical health). Further, only a limited number of job characteristics impacted on each health outcome, with only piecework and shift-work relating to all or most affected health outcomes. Thus, the health effects of potentially stressful job characteristics were somewhat limited, but hardly trivial. As indicated in Chapters 8-12, the differences in pro-portions of people in poorer health on each outcome generally varied by a factor of two or more as a function of changes in job characteristics. Part II documented a moderate, but significant effect of job characteristics on perceived stresses which in turn, as will be seen in Table 13.2, impacted on a broad range of health outcomes. In sum, although the effects of potentially stressful job characteristics on health were limited and selective,

Table 13.2

Summary of the Significant Effects of Perceived Stresses and Job Evaluations on Mental and Physical Health

Health Outcomes (Dep. Var.)	Perceived Work Rewards	Perceived Control Rewards	Interpersonal & Responsibility Pressure	Quantitative Workload Pressure	Job-Nonjob Conflict	Job Satis-faction	Work Self-Esteem
Job-Specific Mental Health							
Job Satisfaction	+		-	-	-	x	x
Occupational Self-Esteem	⌒	-	-		-	x	x
General Mental Health							
Life Satisfaction	⌣		⌣		-	+	+
Neurotic Symptoms	-		+	⌒	+	-	-
Substance Abuse							
Smoking	-	+					
Drinking	-	⌣				+	
Physical Health (Self-reported symptoms)							
Angina			+				
Ulcers					+		-
Itch & Rash			⌣		+		-
Cough & Phlegm			⌣			-	
Physical Health (Biomedical Signs)							
Hypertension	-		+		+		
High CHD Risk	-		+	+		-	-
Dermatitis							
Diminished breath sounds							+
Impaired FEV_1							

Note: See text for explanation of the source tables on which this summary is based.

+ = Significant positive effect
- = Significant negative effect
⌣ or ⌒ = Significant nonlinear effect (the entry in the table gives the approximate form of the relationship)
x = No relationship tested

these characteristics are clearly a significant source of occupationally induced health problems and hence a significant target for efforts at making work more healthful. The deleterious health effects of piecework and shiftwork were particularly notable in these data and hence ways should be sought to eliminate these occupational health hazards where possible or to alleviate their effects where they cannot be eliminated.

Perceived Stress, Job Evaluation and Health

Table 13.2 provides a summary of the relationships of perceived stress and job evaluations to health, including the biomedical indices of physical health. The entries in the Table derive from Tables 8.2 (Model 2), 9.2 (Models 2 and 3), 10.2 (Models 2 and 3) and 11.2 (Models 2 and 3). In the case of the perceived stress variables (the first five variables across the top of Table 13.2) an entry appears if a perceived stress variable had a significant effect on a given health outcome net of the effects of age, education, self-reported exposure to hazardous physical-chemical agents, the physical effort demanded by the job, smoking (in the case of drinking and physical health outcomes only), any objective job characteristics which significantly affected the health outcome (cf. Table 13.1), and any other perceived stress (and also work motivation) which had a significant effect on that health outcome.* Thus, the effects of perceived stress in Table 13.2 are also robust ones which exist

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*Note that the indicated effects of perceived stresses may be largely mediated through one or both job evaluation (or job-specific mental health) variables, and hence may not be significant after job satisfaction and/or self-esteem are added to the prediction equations in Model 3 of Tables 9.3, 10.3, and 11.3. Also, the effects of perceived stress on biomedical health outcomes are estimated net only of the set of control variables indicated in Table 12.2.

over and above the effects of a variety of other individual, environmental, and psychosocial determinants of health, again notably including exposure to physical-chemical hazards. The meaning of the entries in the table is the same as in Table 13.1.

Table 13.2 clearly indicates that perceived stresses and job evaluations were substantially and pervasively related to mental and physical health. Most health outcomes were affected by a number of perceived stresses and/or job evaluations, and each perceived stress or job evaluation tended to affect a number of health outcomes. Almost all of the effects noted in the table are in the expected direction -- greater perceived stresses (i.e., greater pressure and/or lower rewards) are associated with poorer mental or physical health. As might be expected, the effects of perceived stress are stronger and more pervasive at the top and become weaker and/or less pervasive as we move down the table.

Job satisfaction and occupational self-esteem were affected by four of the five perceived stresses, and these perceived stresses explained 36.6 percent and 18.7 percent, respectively, of the variance in job satisfaction and self-esteem, net of the control variables and objective job characteristics. Only one of these effects was contrary to a priori expectations -- perceived control rewards were negatively associated with self-esteem. Jobs allowing a high degree of control of work pace are probably less respected and hence do not enhance self-esteem. Otherwise, perceived work rewards were positively related to satisfaction and self-esteem, while control rewards, as we will see, accounted for three of the five effects in Table 13.2 which run contrary to expectation. Life satisfaction and neurotic symptoms were also strongly and pervasively affected by perceived stress. Life satisfaction was affected by three perceived stresses and neurotic symptoms by four. These effects of perceived stress were all in the expected direction, (though some were slightly curvilinear), and explained 19.4 percent and 4.4 percent of the variance in life satisfaction and neurotic symptoms, respectively, again net of the effects of control variables and job characteristics.* Job satisfaction and self-esteem also affected life satisfaction and neurotic symptoms as expected, and accounted for an additional 5.3 and 2.3 percent of the variance, respectively, in the general mental health outcomes. In sum, perceived job stresses had a substantial impact on both job-specific and general mental health, while job-specific mental health substantially affected general mental health, often mediating the effects of perceived stresses (especially perceived work rewards) on general mental health.

The effects of perceived job stresses on behavioral and physiological indicators of health were not as strong. Smoking and drinking were little affected by perceived stress or general job evaluations, and the significant effects that did appear were often contrary to expectation. Job stress may have played some role in the development of the smoking habits of Whitewall Plant workers, but smoking patterns once acquired become rather habitual and hence appear little affected by even variations in stress. The lack of relationships between perceived stress (or job evaluations) and drinking behavior should probably be interpreted differently. Since drinking was rather strongly

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*The variance explained figures are for the dichotomous version of the neurotic symptoms scale and would be about double for the continuous version of the scale.

affected by potentially stressful objective job characteristics, it appears that drinking occured in response to objective stress, but that one effect of drinking was to blur or color perception of these objective job stresses so that little perceived stress was experienced and/or reported.

All the physical health outcomes except the biomedical dermatological and respiratory diagnoses are affected by perceived stress and general job evaluations, but only a few variables at most affect each health outcome.* Thus, perceived job stress affected a wide range of physical health outcomes, but the effects were selective and moderate in magnitude. However, as noted in Chapters 11 and 12, these effects were not trivial when viewed in terms to the probability of having symptoms or signs of physical disease at high and low levels of stress -- in most cases increases in perceived stress at least doubled the proportion of workers manifesting ill health. The effects of perceived stress on angina, ulcers and biomedical indicators of heart disease risk largely confirm findings from prior research, while the effects of stress on itch and rash and cough and phlegm suggest that the health consequences of stress extend beyond traditionally psychosomatic diseases. The results of the analyses of conditioning effects suggest why and how these latter effects occur.

Looking at the various types of perceived stress, interpersonal and responsibility demands and job-nonjob conflict affected the widest range of health outcomes, while quantitative workload pressure, the most prevalent source of pressure in Chapter 2, had only limited health effects. The importance

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*The number of effects on the biomedical indicators of cardiovascular functioning in Table 13.2 stem largely from these effects not having been estimated net of each other.

of job-nonjob conflict reinforces Kasl's (1978) suggestion that future research consider the interplay between occupational stress and other life domains.

Effects of Conditioning Variables

For reasons discussed in Chapters 4-6, we were interested in both the additive and interactive effects of conditioning variables, though the strict definition of a conditioning effect involves statistical interaction. Of all the conditioning variables considered, exposure to physical-chemical agents and social support stand out in terms of their additive and interactive effects on health. No other conditioning variables had more than very scattered interactive conditioning effects; and even the additive effects of these other variables were weak or non-existent. Thus, this review will focus on the additive and interactive effects of social support and exposure to hazardous physical-chemical agents.

Exposure to Physical-Chemical Agents

Adverse additive (or main) effects of self-reported exposure to hazardous physical agents (i.e., dust, fumes, and chemicals) were evident on almost all health outcomes in the multivariate analyses as well as the zero-order correlations. Thus, exposure to agents was negatively related to job satisfaction and self-esteem and positively related to smoking, neurotic symptoms, angina, ulcers, cough and phlegm and especially itch and rash. Even if some of these relationships are a spurious product of the self-report nature of all variables, a substantial portion of these effects undoubtedly reflects the direct negative impact of exposure to physical-chemical hazards on mental as well as physical health.

Exposure to agents also had clear interactive conditioning effects on certain key relationships between perceived stress and physical health. Specifically, analysis indicated that perceived stresses bore little or no relationship to reported symptoms of dermatological or respiratory disorders among Whitewall Plant workers who reported no exposure to hazardous physical-chemical agents, but perceived stress and job evaluation variables were increasingly positively related to these same health outcomes as reported exposure to these hazardous agents increased. Viewed another way, perceived stresses and job evaluations exacerbated the effects of hazardous agents on self-reported symptoms of dermatological and respiratory disorders. No such conditioning effects of exposure to agents were found for other health outcomes in Chapters 8-11, with the possible exception of angina.

The potential theoretical and practical importance of these results is great. They suggest that psychosocial stresses and environmental hazards in the workplace may combine synergistically in affecting health. Theoretically, the results lend support to those (e.g., Cassel, 1976; Syme, 1974) who have argued that psychosocial stress increases susceptibility (or decreases resistance) to noxious physical, chemical, and biological agents in the environment. Practically, it suggests that psychosocial job stress is a significant health hazard not only because it causes diseases traditionally considered psychosomatic, but because it may exacerbate the effects of other occupational health hazards such as physical-chemical irritants.

Enthusiasm for the potential significance of these results must be tempered somewhat, however, because similar effects of exposure to agents were not observed with respect to any of the biomedical indices of dermatological or respiratory functioning. That is, self-reported exposure to agents had no additive effects on the biomedical health outcomes, nor did such exposure condition the relationship of the perceived stresses or job evaluations to these outcomes. There is good reason, however, to attribute the failure of the effects of agents to replicate in the medical examination data to idiosyncracies of the biomedical data set (cf. House et al., 1979). The additive and interactive effects of agents on the self-reported health outcomes appear valid and important, though further research is needed which will examine such relationships with more complete and appropriate biomedical, as well as self-report, data.

Social Support

Social support had substantial, salutary additive effects on job-specific mental health (i.e., job satisfaction and occupational self-esteem) and to a lesser extent general mental health, while also having smaller, more isolated beneficial effects on smoking, drinking, and self-reported physical health outcomes. Some of these effects largely or entirely reflected the tendency of social support to reduce perceived stress, but many persisted, if in diminished form, even in multivariate analyses controlling for perceived stress. These additive effects of support on health probably reflect both the direct tendency of support to meet important human needs and a residue of past interactive conditioning effects.

More striking, however, than the additive effects of support are its pervasive interactive conditioning effects. Support conditions relationships of job characteristics and/or perceived stresses to almost every health outcome. Support tended to "dampen" the impact of objective job characteristics on job satisfaction, occupational self-esteem and life satisfaction much as it dampened the impact of job characteristics on perceived stresses in Part II. That is, job characteristics had less impact (positive or negative) on satisfaction and self-esteem among workers with high support compared to those with low support. A significant portion of these dampening effects were, in fact, due to support's dampening of the impact of job characteristics on the perceived stresses which were the more proximate causes of satisfaction and self-esteem. Support, however, had no more interactive conditioning effects than might occur by choice on the relationship of these perceived stresses to job satisfaction, occupational self-esteem or life satisfaction.

Social support also had significant interactive conditioning effects on the relationship of objective job characteristics (but not perceived stresses) to smoking and drinking behavior. The nature of the effects, however, were quite different in the two cases. Under high social support, potentially stressful job characteristics (especially quantitative workload demands) tended to increase smoking, while the same characteristics tended to reduce smoking when support was low. Smoking (especially on work breaks) is a major social activity in Whitewall plant, and social support may facilitate both taking work breaks with others and smoking during such breaks, while lack of social support makes it more likely that workers will remain tied to their jobs where they are unable to smoke. This is one of only two instances in our data where social support produced deleterious health consequences (the other was an anomalous set of results in the medical examination group). In contrast, social support played a major role in protecting or "buffering" workers against the impact of job characteristics on drinking behavior. Among workers with high social support, potentially stressful job characteristics generally had little effect on drinking, while among workers with little support these same job characteristics markedly increased heavy drinking.

Support also buffered workers against the effect of perceived stresses on self-reported symptoms of mental and physical health (job characteristics had little effect on these measures regardless of levels of support). Buffering was most apparent with respect to neurotic symptoms, ulcers, and cough and phlegm. That is, perceived stresses and negative job evaluations were associated with markedly higher levels of symptoms of these health outcomes among workers with low social support, but the same perceived stresses and job evaluations had little or no effect on health among workers with high levels of social support. A similar, but less clear-cut pattern of results appeared for angina, but the interactive conditioning effects of support on relationships between perceived stress and itch and rash exhibited no clear pattern.

The conditioning effects of social support, like those of exposure to agents, have great potential theoretical and practical importance. Again, however, the pattern of results obtained with the self-report data in Chapters 8-11 failed to replicate in the analyses of the biomedical data reported in Chapter 12. Social support neither had additive effects in the direction of improving health, nor did it buffer workers against the effect of perceived stresses on biomedical health indicators. In fact, perceived stresses tended to increase hypertension and CHD risk among workers with high social support, while tending to reduce these same outcomes among workers with low support. These anomalous results again seemed likely to result from idiosyncracies in the medical examination data set, and substantive interpretation of them would be premature until they are replicated. In contrast, the congruence of the results in Chapters 8-11 with prior theory and research suggests they deserve a more thorough discussion and interpretation.

How and Why does Social Support Operate?

Social support was a focal conditioning variable in this study because of prior research and theory suggesting that support could buffer the effects of stress on health (e.g., Cassel, 1976; Cobb, 1976). Exactly how and why such buffering occurs is, however, not well understood. Clear buffering effects were observed in this study only with respect to selected health outcomes -- drinking and symptoms of neurosis, ulcers, cough and phlegm, and possibly angina. This pattern of results is notably consistent with one interpretation of how the buffering effects of support occur -- what has been termed "strain-responsive" social support.* The concept of social support as a buffer against stress conceives of support as a stock or resource which can be drawn on in the face of stress to aid and bolster the person's adaptation to stress. But effective activation of this resource requires supportive acts by others. How is such supportive behavior activated? The person under stress may request support and/or the givers of support may provide it when they see a need. Manifest symptoms of health problems widely felt to be stress-related are one set of cues which may elicit supportive behavior aimed at reducing those symptoms and facilitating more constructive ways of adapting to stress. Drinking, recurrent stomach pains indicative of ulcers, persistent cough and phlegm, and the physical,

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*This and other potential explanations of the buffering effects of social support were developed by John R.P. French, Jr. (1978) to whom I am indebted.

affective and behavioral symptoms of neurotic anxiety and/or depression would all constitute manifest symptoms which could elicit supportive behavior where it is available. Exactly what kind of behavior is elicited and how it buffers the health outcomes is a problem for future research, but it is clear that social support has buffering effects in our data only in relation to such manifest symptoms of distress. The somewhat more subtle, momentary, and often less public symptoms of angina, and even more so of itch and rash, do not show buffering effects, nor do job and life satisfaction, the expression of which is more socially normative and acceptable.

Besides its buffering effects with respect to health outcomes, we have also seen that support "dampens" the impact of potentially stressful job characteristics on perceived stresses and life and job satisfactions. Presumably in these cases, the social support operates via social comparison or judgment mechanisms. That is, the perceptions and affects of persons in supportive relationships or networks may be simply less affected by objective environmental events, because the supportive network establishes its own definitions of social reality. Many studies of the adaptive potential of a small cohesive group (e.g., Shils and Janovitz, 1948) in the face of severe objective stresses are consistent with such a view. Again, future research should examine such mechanisms of social support in more detail.

The present study also sheds light on another neglected issue in prior research on social support. From whom or what does one gain effective support? Some theoretical analyses of support have emphasized the importance of an accumulation of support from a wide range of sources, what is sometimes termed a supportive network. Others have focused on the effects of one or two significant others or confidants. Cassel (1976) and Cobb (1976) provide examples of both. The results in Chapters 8-11 (and also in Part II) generally suggest that one or two significant others can produce significant additive and interactive conditioning effects of social support, and that the effects of a cumulative index of total support generally reflect the impact of one or more specific sources of support. That is, it appears more critical to have solid support from one or two significant others than to have a little support from a lot of people.

Thus, efforts to enhance social support would be most efficiently focused on strengthening certain key relationships rather than providing persons with a diffuse network of support. Considering both the additive and interactive effects of support in this study, the work supervisor is the most consistent source of effective social support, followed by spouses and coworkers. The effects of coworker support, however, are most prominent with respect to job related variables (e.g., job satisfaction) while the effects of spouse support are most evident for the more general health outcomes (e.g., drinking, neurotic and ulcer symptoms). Friend and relative support, as might be expected, has less consequential additive or interactive effects on health.

Conclusion

Part III has revealed a significant and pervasive impact of occupational stress on physical and mental health. As the stress paradigm would lead us to expect, perceived stresses are generally more strongly related to health than are objective job characteristics. And the effects of job characteristics on health are generally mediated through perceived stresses, though piecework and shiftwork have consequential effects on self-reported mental and physical health which are partially independent of the perceived stresses assessed in this study. The adverse effects of stress are evident for a wide range of health outcomes -- mental health, drinking behavior, and both self-report and biomedical indices of physical health. Thus, working conditions and worker attributes giving rise to stress are important targets for both future research on, and future attempts to improve, occupational health.

Two conditioning variables -- social support and exposure to physical-chemical agents -- had both additive and interactive conditioning effects with respect to self-reported health outcomes. Both psychosocial job stress and exposure to physical-chemical hazards adversely affects a wide range of health outcomes, and they appear to act synergistically in affecting some aspects of dermatological and respiratory functioning. Social support tends to have beneficial additive effects on a wide range of health outcomes and to buffer workers against the adverse effects of job characteristics and perceived stress on a number of health outcomes. It is important to note that among the conditioning variables considered in this study, individual characteristics had weak effects on health, while all of the situational variables had important effects. Thus, even efforts to alleviate the impact of stress on health without necessarily alleviating stress itself may need to focus more heavily on the nature of the physical-chemical and social environment of workers, rather than, as is often the case, primarily on the individual worker.

PART IV

CONCLUDING THOUGHTS

Chapter 14

OCCUPATIONAL STRESS AND WORKER HEALTH: RETROSPECT AND PROSPECT

Chapters 7 and 13 provide summaries and discussions of the specific results of this study. Thus, this chapter aims only to highlight the major positive findings of the study and to suggest its limitations and implications for future research and possible applications. This study contributes to our understanding of the effects of work on health among factory workers and of the nature and health consequences of occupational stress more generally. Both the strengths and the limitations of the study suggest a variety of substantive and methodological issues which should be addressed in future research. Although neither this study nor others provides definitive findings with clear action implications, the results do suggest a number of potential strategies for reducing stress and/or improving health. By noting these we hope to stimulate further research and even experimental action programs (the effects of which must be properly evaluated) aimed at reducing stress and/or improving health.

The Impact of Work on Health Among Factory Workers

This study adds to a growing body of evidence that psychosocial forms of occupational stress are a consequential and pervasive threat to the health of workers. As will be discussed below, the present study has methodological limitations, as does any other single study in this area. Nevertheless, the accumulating evidence of the effects of job stress on health cannot be ignored. By focusing on a factory population, the present study clearly shows that psychosocial job stress is not a problem unique to high level professional or managerial jobs, as is sometimes assumed in many popular and even some professional discussions of work and health. Further, the data indicate that the effects of psychosocial job stress on factory workers are not spurious products of exposure to physical-chemical hazards as is sometimes suggested (e.g., Ashford, 1976:124-26). Psychosocial stress has significant adverse effects on physical and mental health which are independent of the effects of exposure to physical-chemical hazards. In some cases, however, psychosocial stress also exacerbates the deleterious health effects of exposure to physical-chemical agents. Psychosocial stress and physical-chemical hazards have tended to be two quite distinct fields in research and practice in the area of occupational health. The present data, although tentative in nature, indicate that these two types of occupational health problems should be more closely connected in future research and practice. Finally, by finding that potentially stressful job characteristics and/or workers' perceptions of stress had deleterious consequences for a wide range of mental and physical health outcomes, this study supports the view that psychosocial stress may increase susceptibility to many or all types of health problems, not just those traditionally considered psychological or psychosomatic in nature (cf. Cassel, 1976; House and Jackman, 1979; Syme, 1974).

The Nature of the Stress Process

This study also confirms a number of important hypotheses and ideas derived from the stress paradigm and literature on occupational stress reviewed in Chapter 1. Because it included assessments of objective job characteristics, the study was able to address certain issues which are seldom, if ever, addressed in the literature on occupational stress.

First, the study showed that perceived stress is meaningfully related to the objective characteristics of workers' jobs. It also showed that both objective job characteristics and perceived stress affect health; but as the stress paradigm would predict, perceived stress has stronger and more pervasive effects on health and largely mediates the effect of job characteristics on health (especially mental health). Finally, the results indicate that the impact of job characteristics on perceived stress and of both of these on health are importantly moderated or specified by conditioning variables. Thus all of the major hypotheses embodied in the stress paradigm were confirmed in a general way.

However, the results also disconfirmed expectations in other ways. The impact of job characteristics on perceived stress was only small to moderate, with or without consideration of conditioning variables. The weakness in these relationships cannot, for the most part, be attributed to problems in the reliability or validity of the measures of job characteristics or perceived stress, though such problems do exist. Thus a major topic for future work is to understand better the psychological and interpersonal conditions and processes through which objective job characteristics do and do not affect perceived stress. The impact of job characteristics and perceived stress on health were clear but selective; generally this pattern of results was readily interpretable, but at times the results were confusing. Particularly perplexing were the relationships of biomedical health indices to perceived stress. Biomedical indices of cardiovascular disease were correlated with perceived stress in much the same way as major self-report health outcomes in this study and to CHD indicators in other studies. But, otherwise, the biomedical data bear little relation to health or, when they do, the relationships are puzzling. These problems appear to stem to a considerable degree from the small, unrepresentative, and idiosyncratic nature of medical examination groups. Thus there remains a major need for research which looks at the effects of stress in relation to more adequate biomedical measures obtained from larger and/or more representative groups of workers.

Finally, there was wide variation in the impact of the putative conditioning variables. The individual characteristics (i.e., age, education, work motivations and Type A behavior pattern) considered here had modest to substantial additive effects on perceived stress and/or health, but almost no interactive conditioning effects. In contrast, the few situational characteristics considered here proved to have relatively potent effects on perceived stress and health. The effects of piecework were largely additive, though it did exert interactive conditioning effects on the relationships of perceived stresses to health. Both the additive and interactive conditioning effects of exposure to physical-chemical agents were widespread, and the especially important interactive conditioning effects of agents were noted above and discussed in detail in Chapters 11 and 13. Of all the conditioning variables, social support clearly has the strongest and most pervasive effects. Despite the probable weakness of cross-sectional designs for detecting interactive conditioning effects, social support conditions the relationship of a significant number of objective or perceived stress factors to virtually every health outcome, as well as conditioning the impact of job characteristics on perceived stress. The nature of these effects are discussed in the chapters and parts where they occur. Thus situational factors, especially social support, seem to offer special promise as potential factors mitigating the impact of job charateristics on perceived stress, and of both of these on health.

Considerable further research and/or field experimentation is needed to establish exactly when and how social support operates. But the pervasiveness of its effects in the present data are truly remarkable and make social support a prime candidate for future research and application.

Some Limitations of the Study and Directions of Future Research

The methodological flaws as well as the substantive findings of this study also suggest directions for further research. The two most serious limitations of the present study have been its purely cross-sectional nature and the lack of more objective (e.g., biomedical) data on health. Future research must be increasingly prospective or longitudinal in nature. Cross-sectional studies make it difficult to establish clear causal priorities and impacts and also constitute weak designs for identifying and studying the impact of conditioning variables. Although the difficulties and costs of longitudinal research are substantial, there are serious questions as to how much more can be learned on many issues from further cross-sectional research.

The ambiguities and peculiarities of the medical examination group and the results deriving from it have constituted the biggest disappointment of this study. Future research must achieve more adequate biomedical measures for at least sizable representative subgroups of a study population if the health consequences of occupational stress are to be fully understood. At the same time, greater efforts should be made to understand (1) the relationship between self-reported health indices and biomedical measures and (2) the ability of both to predict serious morbidity and mortality.

In sum, this study has taught us a good deal about the nature of occupational stress and its effects on health, at least among factory workers and probably more generally. It has also taught us that there is a lot we do not know, both substantively and methodologically. Thus, a number of directions for future research are clear. Some of this future research could take the form of field experiments which attempt to alleviate occupational stress and/or some of its health problems while carefully evaluating the effects of such interventions. The interplay of work and health is a problem that offers great potential for improving the quality of work and life. Research in this area must be both competently done and capable of being translated into practical applications. Similarly, attempts at application must be not only well-conceived and executed, they must also be carefully evaluated. Careful research and judicious applications should enrich each other and hence the quality of work and life. The worth of this present study and other extant research lies ultimately in what it contributes to such future endeavors.

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APPENDIX A

THE MAIL QUESTIONNAIRE

DIRECTIONS: Please record your answers down the right-hand side of each page. Some answers require writing numbers in boxes; others require that you circle a number or a word.

Do not spend a lot of time on any one question. Your first thought will generally be the best. Please try to answer all questions.

PART 1: GENERAL INFORMATION

1. Clock Card Number
2. Social Security Number
3. Sex (Check one) Male [ ] Female [ ]
4. Birth Date (Month) (Day) (Year)
   (Example: Jan. 6, 1917 = 01 06 17)
5. Height ft. ins.
6. Weight (pounds)
7. Education (Circle the one most appropriate number representing the last level of education that you completed.)

Grade School	1
Junior High School	2
Partial High School	3
High School Graduate (or equivalent)	4
Partial College	5
Trade School or Apprenticeship	6
Completed College or University	7

8. Race (Circle the appropriate number at the right.)

White	1
Black	2
Oriental	3
Spanish American	4
Other	5

9. Religion (Circle the appropriate number at the right.)

Baptist	1
Catholic	2
Episcopal	3
Jewish	4
Lutheran	5
Methodist	6
Presbyterian	7
Other religion	8
None	9

10. Marital Status (Circle the appropriate number at the right.)

Married	1
Never Married	2
Divorced	3
Separated	4
Widow(er)	5

PART 2: OCCUPATIONAL INFORMATION

A. PREVIOUS NON-FIRESTONE JOBS:

You may have previously worked in jobs elsewhere. Indicate which of the 7 following types of job you have done, and for how long. (Note: Col. 1 = "Never")

		Time spent in job			
		NEVER	Up to 2 yrs.	2 to 5 yrs.	More than 5 years
1.	Job with regular exposure to dust	1	2	3	4
2.	Job with regular exposure to irritating fumes or chemicals	1	2	3	4
3.	In a steel manufacturing plant	1	2	3	4
4.	In a foundry	1	2	3	4
5.	In a textile mill	1	2	3	4
6.	As a farmer	1	2	3	4
7.	In another tire or rubber plant	1	2	3	4

B. QUESTIONS ABOUT CURRENT OCCUPATION:

1. Department Number [| |]

2. Date Joined Department Month [|] Year [|]

3. Shift (Check One) 7-3 [ ] 3-11 [ ] 11-7 [ ]

4. Current Job Title ....

5. Job Classification Code (Numeric - as on "green-top" clockcard) [| |]

6. Date Began Current Job (as recorded in questions 4, 5) [|] (Month) [|] (Year)

7. Is there any agent or substance in your current work environment that you think is a hazard to your health? (For each of the 6 items, circle the appropriate answer. If "YES", describe agent.)

....	a. Dust	YES	NO
....	b. Fumes (in the air)	YES	NO
....	c. Chemicals (solid or liquid)	YES	NO
....	d. Noise	YES	NO
....	e. Heat	YES	NO
....	f. Poor ventilation	YES	NO
....	g. Other (specify)	YES	NO

8. Do any of the above types of agent regularly irritate your eyes, nose, throat or chest, or make you feel sick? YES NO

If "YES", describe agent(s) ________________________________

9. In your current job, do you frequently have itching skin during or after work?

Yes, over much or all of body	1
Yes, mainly in one area of body	2
No itch	3

10. In your current job, do you frequently have a rash on your skin during or after work?

Yes, over much or all of body	1
Yes, mainly in one area of body	2
No rash	3

11. a. Since starting your current job, have you been seen by a doctor because of a skin problem? YES NO

b. If "YES", was (is) the problem thought to be related to your current job? YES NO

(If so, describe agent responsible, if known: ____________________)

12. a. During previous jobs that you did within the Pottstown plant, were you seen by a doctor because of a skin problem? YES NO

b. If "YES", was that problem thought to be related to the job you were then doing? YES NO

(If so, describe agent responsible, if known: ____________________)

C. QUESTIONS ABOUT WORK HISTORY AT FIRESTONE, POTTSTOWN:

1. Year of first hire (Firestone, Pottstown): |__|__| (Year)

2. Please record, on the opposite page, the types of job you have worked in since joining Firestone. To assist our analysis of this information, we have grouped all the many different jobs into 20 work areas. (See example below.) Hopefully, each job you have held will fit into one of these 20 work areas. (Jobs that do not fit into a work area should be recorded under #21 - "Other".)

For every year that you have worked at Firestone, record the one job that you held for the longest time during that year. You may have difficulty recalling jobs done a number of years ago. If so, please make the best estimate you can.

Example: This is a partial list of jobs included in Work Area #3 ("Milling - warm-up, refine, etc."):

Tread warm-up millman	Utility and Service (milling)
Tube warm-up millman	Power trucker (milling)
Relief warm-up mills	Handle workaway scrap
Tandem calender warm-up millman	Workaway warm-up millman
Refiner millman	Calender warm-up millman
Cracker operator	Innerliner calender warm-up millman

WORK AREA

Each work area includes many different jobs, all related to one process or stage of production. (See example on previous page.) Categories 1-16 refer to the rubber division.

YEAR (1945-1973)

For each year that you have been working at Firestone check the one work area that best describes the job you had during that year. Check only one work area per year.

WORK AREA	(1945) '45	'46	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	'71	'72	(1973) '73	
1. Compounding & Mixing																														1
2. Cutting & Milling (Banbury area)																														2
3. Milling (warm-up, refine, etc.)																														3
4. Tuber (operator, helper, slitter, etc.)																														4
5. Calender operation & service																														5
6. Plystock handling & service																														6
7. Bead building (For service & support jobs in these 2 areas, see work area #9.)																														7
8. Tire building																														8
9. Service to bead & tire building																														9
10. Green tire: inspect, repair, paint, etc.																														10
11. Curing - Tires																														11
12. Finishing, Inspecting, Repairing of Cured Tires																														12
13. Build, prepare - tubes, flaps, bladders																														13
14. Curing - Tubes, Flaps, Bladders																														14
15. Finishing, Inspecting, Repairing of Cured Tubes, Flaps, Bladders																														15
16. Shipping, Receiving, Stores																														16
17. Plant Maintenance - Rubber, Film & sheet (e.g. Welder, Millwright, Machinist, Machine cleaner, etc.)																														17
18. Film & sheet manufacturing																														18
19. Chemicals (or resin) manufacture, and maintenance																														19
20. General Service (e.g. Janitors, Power House, Air conditioning, Grounds, etc.)																														20
21. Others:																														21
(Specify)																														
	'45	'46	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	'71	'72	'73	

PART 3: RESPIRATORY SYSTEM

Directions: Record answers at right. When in doubt, record "NO".

COUGH

1. Do you usually cough several times first thing in the morning (or, on getting up* - see box at bottom of page) in the winter? (This includes coughing with first smoke, or on first going out of doors.) YES NO

2. Do you usually cough during the day (or at night*) in the winter? (Ignore an occasional cough.) YES NO

3. Do you cough like this on most days (or nights*) for as much as three months each year? YES NO

SPUTUM (thick fluid, phlegm)

4. Do you usually bring up any sputum from your chest soon after getting up, in the winter? (Count sputum with the first smoke, or on first going outside. Count swallowed sputum; but not mucus from the nose.) YES NO

5. Do you usually bring up sputum from your chest during the day (or at night*) in the winter? YES NO

6. Do you bring up sputum like this most days (or nights*) for as much as three months each year? YES NO

7. In the past three years have you had a period of cough and sputum (or increased cough and sputum, if you usually have these symptoms) lasting three weeks or more? YES NO

BREATHLESSNESS, WHEEZING

8. Are you troubled by shortness of breath when hurrying on level ground or walking up a slight hill? YES NO

   a. If "YES", do you get short of breath walking with other people of your own age on level ground? YES NO

   b. If "YES", do you have to stop for breath when walking at your own pace on level ground? YES NO

9. Does your chest sometimes sound wheezing or whistling? YES NO

   a. If "YES", do you get this on most days (or nights*)? YES NO

CHEST ILLNESSES

10. In the past 3 years, have you had any chest illness that kept you from your usual activities for as much as a week? YES NO

   a. If "YES", did you bring up more sputum than usual? YES NO

   b. If "YES", how many illnesses like this have you had in the past three years? |__|__|

*Words in parentheses are for those who work on night shift.

SMOKING

11. Do you smoke a pipe or cigar? YES NO

12. Do you use snuff? YES NO

13. Do you use chewing tobacco? YES NO

14. Have you smoked, altogether, as many as five five packs of cigarettes (that is, as many as 100 cigarettes) during your entire life? YES NO

If you answered NO to question 14, skip down to question 18.
If YES, please answer each of questions 15, 16, 17.

15. If you are a current or an ex-cigarette smoker, how many cigarettes do (did) you smoke per day? (Place a check inside the appropriate box at the right.)

1. Less than ½ pack per day (1-5 cigarettes per day) ☐
2. About ½ pack per day (6-14 cigarettes per day) ☐
3. About 1 pack per day (15-25 cigarettes per day) ☐
4. About 1½ packs per day (26-34 cigarettes per day) ☐
5. About 2 packs per day (35-40 cigarettes per day) ☐
6. Over 2 packs per day (more than 40 cigarettes per day) ☐

16. How old were you when you first started smoking? |_|_|

17. If you are an ex-cigarette smoker, how old were you when you last gave up smoking? |_|_|

HAS YOUR DOCTOR EVER TOLD YOU THAT YOU HAD:

18. Heart trouble? YES NO

19. Bronchitis? YES NO

a. If YES, how many times? |_|_|

20. Pneumonia? YES NO

a. If YES, how many times? |_|_|

21. Bronchial asthma? YES NO

22. Emphysema? YES NO

23. Bronchiectasis? YES NO

24. Stomach ulcer, peptic ulcer, or duodenal ulcer? YES NO

25. Diabetes? YES NO

/3

PART 4: CARDIOVASCULAR SYSTEM (heart and blood vessels) [Format 2]

1. Have you ever had any pain or discomfort in your chest? YES NO

2. Have you ever had any pressure or heaviness in your chest? YES NO

If you answered "YES" to either of the above two questions, please describe the pain, discomfort, or heaviness in questions 3-11. (If "NO", skip to question 12.)

3. Do you get it when you walk uphill or hurry? YES NO

4. Do you get it when you walk at an ordinary pace on level ground? YES NO

If you answered "NO" to both questions 3 and 4, skip to question 7.

5. What do you do if you get it while you are walking? Stop or slow down / Carry on

6. If you stand still, what happens to it? Relieved / Not relieved

If relieved, how soon? 10 minutes or less / more than 10 minutes

7. Where do you feel this pain, discomfort, or heaviness? (Please answer each of these 5 items.)

1. Upper mid chest (top half of breast bone) YES NO
2. Lower mid chest (bottom half of breast bone) YES NO
3. Left side of the chest YES NO
4. Left arm YES NO
5. Other (Please specify) ____________________ YES NO

8. Do you also feel it anywhere else? YES NO

If YES, where?________________________________

9. Did you see a doctor because of this pain, discomfort or heaviness? YES NO

If YES, what did he say it was? ______________

____

10. Have you ever had a severe pain across the front of your chest lasting for half an hour or more? YES NO

a. If YES, did you see a doctor because of this pain? YES NO

b. If YES, what did he say it was? ____________

____

c. How many of these attacks of severe pain have you had? |__|__|

11. Has a doctor prescribed pills (nitroglycerine, "heart pills") for you to relieve this type of chest pain? YES NO

12. Has a doctor ever told you that you have high blood pressure (hypertension)? YES NO

13. Individuals differ in the amount of off the job physical exercise they have. On the average, about how many hours a week do you spend (at this time of year) on:

a. Moderate physical exertion (e.g. walking, fishing, golfing, housework, gardening, etc.)?

(Circle the appropriate answer)

1. Less than one hour per week	1
2. 1-3 hours per week	2
3. 3-5 hours per week	3
4. More than 5 hours per week	4

b. Strenuous physical exertion (e.g. vigorous sport, heavy yard-work, other high-effort jobs, etc.)?

1. None	1
2. Less than one hour per week	2
3. 1-3 hours per week	3
4. 3-5 hours per week	4
5. More than 5 hours per week	5

14. Do you regularly get dyspepsia or indigestion? YES NO

15. Do you quite often experience gastric (stomach) pain or discomfort, about two hours after meals, that is relieved by more eating? YES NO

16. Do you often wake up with this type of pain during your normal sleeping hours? YES NO

DRINKING

17. How often do you usually drink some type of alcohol (beer, wine, or other liquor)?

(Check appropriate box)

1. Most days ☐
2. Once or twice a week ☐
3. Sometimes ☐
4. Rarely or never ☐

18. Approximately how many drinks (glasses) do you generally have at one sitting?

(Check appropriate box)

1. One - two drinks ☐
2. Three - five drinks ☐
3. More than five drinks ☐
4. Never drink alcohol ☐

PART 5: WORK STRESSES AND SATISFACTIONS

Work pressures, stresses and dissatisfactions can affect your health, just like dust and fumes, and are important possible causes of heart disease and ulcers. Therefore, a full investigation of the effects of the work environment upon health must take account of these factors.

This part of the questionnaire asks you to describe what your job is like in regard to some of these occupational stress factors. Again, your answers to these questions will remain completely confidential. Please answer all questions as frankly and honestly as you can.

For each question circle the one number that best describes your job, or how you feel. (Please feel free to comment on any of the questions, or to explain your response further in writing.)

A 1. How are you paid:

Straight hourly wage	1
Individual Piecework	2
Group (or pool) Piecework	3

2. If you could work on any shift, which would you most like to work on?

7 AM - 3 PM	1
3 PM - 11 PM	2
11 PM - 7 AM	3

3. Would you like to be a foreman or supervisor some day if that were possible?

Yes, definitely	1
Yes, probably	2
No, probably	3
No, definitely	4

4. How long do you feel a person needs to work in your particular job to be fully trained?

Less than one month	1
1 to 6 months	2
7 months to 1 year	3
1 to 2 years	4
2 to 5 years	5
More than 5 years	6

5. In the space below, please PRINT the name of your immediate supervisor. This information will be used only to identify groups of persons working under the same supervisor, so that we can study their job conditions as a group. (We will assign an anonymous code number to the name you print, and that name will then be obliterated from this page. This will ensure that in our analysis no reference can be made to any named individual.)

   Note: If you have several immediate supervisors, rotating between shifts, print the name of the one that comes first alphabetically.

Immediate supervisor's last name: .... Init: ......

(Print, please)

B. Now we'd like to find out what your present job is like. Please indicate how true you think each of the following statements is of your present job. (Circle one number for each item.)

	Not at all true	Not too true	Some-what true	Very true
1. I am given a lot of chances to make friends	1	2	3	4
2. The chances for promotion are good	1	2	3	4
3. I have an opportunity to develop my own special skills and abilities	1	2	3	4
4. The work is interesting	1	2	3	4
5. I work mainly by myself	1	2	3	4
6. The pay is high	1	2	3	4
7. I am given a lot of freedom to decide how I do my work	1	2	3	4
8. My job is very secure	1	2	3	4
9. The job has status and prestige, that is, people look up to it and think it is important	1	2	3	4
10. I am given a chance to do the things I do best	1	2	3	4
11. The physical surroundings are pleasant	1	2	3	4
12. I do pretty much the same things each day	1	2	3	4
13. The fringe benefits are generous	1	2	3	4
14. I can learn new things	1	2	3	4
15. I can use my skills, knowledge and abilities	1	2	3	4
16. I can really believe in the value of what I am doing	1	2	3	4
17. I can do the work and keep my mind on other things most of the time	1	2	3	4

Section B (Cont.)

	Not at all true	Not too true	Somewhat true	Very true
18. I can talk to other people whenever I want to	1	2	3	4
19. I can usually decide when to work fast and when to take it easy	1	2	3	4
20. I can see the results of my own work	1	2	3	4
21. My job is clearly important to the success of the company	1	2	3	4
22. It takes real skill and experience to do my job well	1	2	3	4
23. I have a good deal of influence over things that affect me or my job	1	2	3	4
24. I have some influence over plant or company policy	1	2	3	4

Section C. Jobs vary in how much they require people to work fast and hard. Please indicate how often each of the following statements is true of your job. (Circle one number, for each question.)

	Never	Rarely	Sometimes	Fairly Often	Very Often
1. How often does your job require you to work very fast	1	2	3	4	5
2. How often does your job require you to work very hard (physically or mentally)	1	2	3	4	5
3. How often does your job leave you with little time to get everything done	1	2	3	4	5

4. When you do have to work very fast or very hard, would you say this is mainly because:

	(Circle one)
You expect a lot from yourself	1
The company, supervisors, or production schedules, require a lot from you	2
You have to keep up with the machines you work with	3
I never have to work very fast or very hard	4

D. All of us occasionally are bothered by certain <u>pressures</u> or <u>stresses</u> in our work. Here is a list of things that sometimes bother people. Please indicate <u>how often you are bothered</u> by each of them in your work.

	Not at all	Rarely	Sometimes	Rather Often	Nearly all the time
1. Not having enough help and equipment to get the job done well	1	2	3	4	5
2. Feeling you have too much responsibility for the work of others	1	2	3	4	5
3. Thinking that you'll not be able to meet the conflicting demands of various people you work with	1	2	3	4	5
4. Having to do or decide things where mistakes could be quite costly	1	2	3	4	5
5. Not knowing just what the people you work with expect of you	1	2	3	4	5
6. Thinking that the <u>amount</u> of work you have to do may interfere with how <u>well</u> it gets done	1	2	3	4	5
7. Feeling that you have to do things on the job that are against your better judgment	1	2	3	4	5
8. Feeling that your job tends to interfere with your family life	1	2	3	4	5
9. Feeling unable to influence your immediate supervisor's decisions and his actions that affect you	1	2	3	4	5
10. Having to deal with or satisfy too many different people	1	2	3	4	5
11. Being asked to work overtime when you don't want to	1	2	3	4	5
12. Feeling trapped in a job you don't like but can't change and can't get out of	1	2	3	4	5

E. In sections A-D, you have described your present job. In this section we would like you to "shift gears" and describe the kind of job you would like to have. Individuals look for different things in a job. Imagine you were applying for a new job, and say how well each of the following statements describes the kind of job you would hope to get.

As a description of the kind of job I would like to have, this statement is:

	Not at all true	Not too true	Some-what true	Very true
1. I would have a lot of chances to make friends	1	2	3	4
2. The chances for promotion would be good	1	2	3	4
3. I would have an opportunity to develop my own special skills and abilities	1	2	3	4
4. The work would be interesting	1	2	3	4
5. I would work mainly by myself	1	2	3	4
6. The pay would be high	1	2	3	4
7. I would be given a lot of freedom to decide how I do my work	1	2	3	4
8. The job would be very secure	1	2	3	4
9. The job would have status and prestige, that is, people would look up to it and think it is important	1	2	3	4
10. I would be given a chance to do the things I do best	1	2	3	4
11. The physical surroundings would be pleasant	1	2	3	4
12. I would do the same things every day	1	2	3	4
13. The fringe benefits would be generous	1	2	3	4
14. I could learn new things	1	2	3	4

Section E (Cont.)

		As a description of the kind of job I would like to have, this statement is: Not at all true	Not too true	Somewhat true	Very true
15.	I could use my skills, knowledge and abilities	1	2	3	4
16.	I could really believe in the value of what I am doing	1	2	3	4
17.	I could do the work and keep my mind on other things most of the time	1	2	3	4
18.	I could talk to other people whenever I wanted to	1	2	3	4
19.	I could usually decide when to work fast and when to take it easy	1	2	3	4
20.	I could see the results of my own work	1	2	3	4
21.	The job would be clearly important to the success of the company	1	2	3	4
22.	It would take real skill and experience to do the job well	1	2	3	4
23.	I would have a good deal of influence over things that affect me or my job	1	2	3	4
24.	I would have some influence over plant and company policy	1	2	3	4

F. The remaining questions again deal with your present job and life-situation. First, other people sometimes help and sometimes hinder a person in his/her work (thereby affecting the amount of job stress that person experiences.) This section asks how people around you are about such things.

1. How much can each of these people be relied on when things get tough at work?

	Not at all	A Little	Some-what	Very Much	
A. Your immediate supervisor (boss)	1	2	3	4	
B. Other people at work	1	2	3	4	
C. Your wife (or husband)	1	2	3	4	Not Married
D. Your friends and relatives	1	2	3	4	

2. How much is each of the following people willing to listen to your work-related problems?

A. Your immediate supervisor	1	2	3	4	
B. Other people at work	1	2	3	4	
C. Your wife (or husband)	1	2	3	4	Not Married
D. Your friends and relatives	1	2	3	4	

3. How much is each of the following people helpful to you in getting your job done?

A. Your immediate supervisor	1	2	3	4
B. Other people at work	1	2	3	4

Section F. (Cont.)

4. For most of us, only some, if any, of our friends are so close that we could tell them just about anything without worrying about what they think. How many close friends like this do you have? |__|__|

5. How many of these close friends, if any, are people you work with at Firestone? |__|__|

6. Some people like to have quite a few close friends, others don't want many at all. How do you feel about the number of close friends you have - do you have too many, about the right number, or not enough?

Too many 1
About right 2
Not enough 3

Please indicate how true each of the following statements is of your immediate supervisor.

	Not at all true	Not too true	Somewhat true	Very true
7. My supervisor is competent in doing (his/her) job.	1	2	3	4
8. My supervisor is very concerned about the welfare of those under him.	1	2	3	4
9. My supervisor goes out of his way to praise good work	1	2	3	4

Section G:

Now we'd like to find out how you feel about your present job overall.

1. All in all, how satisfied would you say you are with your job?

Not at all satisfied 1
Not too satisfied 2
Somewhat satisfied 3
Very satisfied 4

2. Knowing what you know now, if you had to decide all over again whether to take the job you now have, what would you decide?

Decide definitely not to take the job 1
Have some second thoughts 2
Decide without hesitation to take same job 3

Section G. (Cont.)

3. In general, how well would you say that your job measures up to the sort of job you wanted when you took it?

Very much like 1
Somewhat like 2
Not very much like 3

4. If a good friend of yours told you he (or she) was interested in working in a job like yours for your employer, what would you tell him (or her)?

Advise him (or her) against it 1
Have doubts about recommending it 2
Strongly recommend it 3

Section H:

Below are pairs of words (or phrases) which describe how a person might see himself in his work. For each of the 5 pairs, circle the number which best describes how you see yourself in your work.

Example: if you think you are very successful in your work, circle the number 1 next to the word "successful." If you think you are not successful in your work, circle the number 7 next to the words "not successful." If you think you are somewhere in between, circle the number which best describes where you see yourself.

First indicate how you see yourself in your work:

1.	Successful	1	2	3	4	5	6	7	Not successful
2.	Do not know my job well	1	2	3	4	5	6	7	Know my job well
3.	Important	1	2	3	4	5	6	7	Not important
4.	Do my best	1	2	3	4	5	6	7	Not doing my best
5.	Sad	1	2	3	4	5	6	7	Happy

I. Now please indicate how <u>often</u> each of the following is true

	Often	Sometimes	Never
1. Do your hands tremble enough to bother you?	1	2	3
2. Are you troubled by hands and feet sweating so they feel damp and clammy?	1	2	3
3. Are you bothered by your heart beating hard?	1	2	3
4. Do you feel tired when you first get up?	1	2	3
5. Do you have any trouble getting to sleep or staying asleep?	1	2	3
6. How often are you bothered by having an upset stomach?	1	2	3
7. Are you bothered by nightmares (dreams that frighten or upset you)?	1	2	3
8. Are you troubled by "cold sweats?"	1	2	3
9. Do you feel that you are bothered by all sorts (different kinds) of ailments in different parts of your body?	1	2	3
10. Do you have loss of appetite?	1	2	3
11. Does ill health affect the amount of work (or housework) that you do?	1	2	3
12. Do you feel weak all over?	1	2	3
13. Do you have spells of dizziness?	1	2	3
14. Do you tend to lose weight when you worry?	1	2	3
15. Are you bothered by shortness of breath when you are not exerting yourself?	1	2	3
16. Do you feel healthy enough to carry out the things that you would like to do?	1	2	3
17. Do you feel in good spirits?	1	2	3
18. Do you sometimes wonder if anything is worthwhile anymore?	1	2	3

J. Please indicate <u>how true</u> each of the following statements is of you. Answer as quickly as you can, it's your first impressions that are most important.

	Not at all true of me			Neither very true nor very untrue of me			Very true of me
1. Sometimes I feel I shouldn't be working so hard, but something drives me on.	1	2	3	4	5	6	7
2. I thrive on challenging situations. The more challenges, the better.	1	2	3	4	5	6	7
3. In comparison to most people I know I'm very involved in my work.	1	2	3	4	5	6	7
4. It seems as if I need thirty hours a day to finish all the things I'm faced with.	1	2	3	4	5	6	7
5. I have difficulty discussing my problems with other people when I'm feeling low or something is bothering me.	1	2	3	4	5	6	7
6. I've often been asked to be an officer of some group or groups.	1	2	3	4	5	6	7

K. Finally, two more questions about your present life situation in general. In answering, take into account your <u>whole life</u>, not just your job.

1. Taking all things together, how would you say things are these days?

   Not too happy 1
   Pretty happy 2
   Very happy 3

2. In general, how satisfying do you find the ways you're spending your life these days?

   Not very satisfying 1
   Pretty satisfying 2
   Completely satisfying 3

THANKYOU

APPENDIX B

INTERCORRELATIONS OF ITEMS IN TABLES 2.1, 2.2, 2.4, and 2.6

TABLE B.1

Inter-item Correlations of Items in Job Pressures Indices

ITEMS	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
P02	.29													
P03	.34	.28												
P04	.22	.21	.24											
P05	.19	.20	.24	.48										
P06	.22	.25	.26	.43	.39									
P07	.26	.24	.31	.42	.43	.43								
P08	.27	.25	.28	.31	.38	.41	.49							
P09	.33	.26	.32	.36	.40	.47	.43	.47						
P10	.18	.19	.20	.29	.29	.35	.35	.38	.32					
P11	.19	.22	.20	.48	.34	.40	.36	.34	.28	.39				
P12	.16	.19	.08	.31	.30	.29	.29	.24	.16	.21	.36			
P13	.12	.07	.18	.15	.07	.17	.33	.20	.18	.14	.14	.14		
P14	.14	.10	.15	.13	.11	.20	.25	.22	.17	.17	.16	.17	.62	
P15	.13	.16	.17	.21	.19	.23	.32	.27	.23	.31	.24	.21	.39	.41

NOTE: All correlations are significant ($p < .01$, one-tailed)

TABLE B-2

Inter-item Correlations of Items in Job Rewards Indices

Items	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19
R02	53																		
R03	39	37																	
R04	54	55	39																
R05	52	57	29	42															
R06	62	59	35	61	64														
R07	45	54	34	53	49	58													
R08	32	35	31	32	30	32	41												
R09	21	23	20	27	20	23	26	17											
R10	31	30	35	35	25	31	30	23	23										
R11	33	41	30	41	39	35	37	23	28	25									
R12	19	23	21	24	27	25	26	17	41	26	29								
R13	45	54	30	59	46	53	52	29	30	34	36	23							
R14	26	29	12	27	24	32	41	33	15	20	18	16	38						
R15	38	45	18	40	41	52	45	28	18	22	22	17	51	48					
R16	40	40	32	42	37	45	43	32	15	27	27	16	45	36	46				
R17	28	22	18	25	27	29	26	17	11	14	22	15	32	20	26	47			
R18	-02	-09	10	-01	-06	-05	-04	-02	07	05	06	06	-01	-06	72	04	06		
R19	21	22	33	19	13	16	16	25	11	20	18	15	15	10	05	16	09	22	
R20	22	24	38	21	19	23	21	34	17	19	21	18	21	13	16	25	15	17	45

TABLE B.3

Inter-item Correlations of Items in Job Motivation Indices

Items	M01	M02	M03	M04	M05	M06	M07	M08	M09	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19
M02	.60																		
M03	.42	.44																	
M04	.56	.52	.49																
M05	.46	.44	.41	.52															
M06	.60	.51	.43	.63	.57														
M07	.46	.48	.41	.55	.50	.62													
M08	.39	.46	.40	.46	.46	.47	.56												
M09	.39	.44	.48	.47	.42	.41	.41	.34											
M10	.35	.48	.48	.51	.43	.40	.41	.42	.54										
M11	.35	.47	.46	.54	.47	.44	.45	.39	.50	.59									
M12	.30	.39	.42	.43	.47	.37	.40	.33	.58	.57	.56								
M13	.33	.29	.31	.44	.34	.37	.37	.34	.37	.35	.35	.31							
M14	.29	.32	.26	.35	.34	.38	.46	.49	.25	.32	.35	.31	.38						
M15	.41	.36	.32	.43	.39	.52	.47	.44	.27	.30	.29	.25	.41	.50					
M16	.40	.36	.44	.48	.41	.49	.46	.41	.36	.35	.37	.33	.40	.39	.57				
M17	.31	.24	.33	.32	.34	.37	.31	.23	.28	.28	.27	.29	.37	.34	.38	.54			
M18	.01	.02	.12	.09	.04	.07	.09	.08	.09	.08	.09	.12	.13	.09	.02	.13	.17		
M19	.18	.23	.34	.25	.24	.27	.26	.32	.26	.28	.28	.27	.27	.20	.21	.32	.25	.38	
M20	.26	.31	.43	.33	.30	.33	.37	.43	.34	.35	.36	.33	.26	.23	.25	.36	.24	.28	.50

Note: All correlations $>$ .05 are significant ($p < .05$)

TABLE B.4

Inter-Item Correlations of Items in Job Satisfaction
Occupational Self-Esteem and Life Satisfaction Indices

Items	G01	G02	G03	G04	G05	G06	G07	G08	G09	G10
G02	.57									
G03	-.52	-.49								
G04	.55	.61	-.48							
G05	.51	.42	-.35	.40						
G06	-.28	-.24	.23	-.26	-.29					
G07	-.37	-.27	.29	-.30	-.32	.41				
G08	-.17	-.16	.10	-.11	-.15	.39	.32			
G09	.26	.22	-.16	.19	.30	-.16	-.10	-.12		
G10	.33	.25	-.20	.24	.35	-.19	-.18	-.12	.60	
G11	.03	.02	-.04	.02	.21	-.01	-.04	.01	.03	.03

Note: All correlations among items G01 to G10 are significant ($p < .01$, one-tailed)

APPENDIX C

MEANS AND STANDARD DEVIATIONS OF
OBJECTIVE JOB RATING SCALES
BY JOB GROUPS

TABLE C.1

MEANS AND STANDARD DEVIATIONS OF COMPANY JOB RATING FOR THE 21 JOB GROUPS

Job Group	Education or Trade Knowledge		Experience		Skill		Initiative & Ingenuity		Mental Effort		Physical Effort		Responsibility for Material or Product		Responsibility for Equipment or Process		Responsibility for Safety of Others		Responsibility for Work of Others	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Batch Processing Machine Operators	1.74	.44	1.50	0.00	2.29	.46	2.51	.50	2.74	.44	2.59	.49	5.24	1.78	5.76	1.60	2.26	.44	1.26	.44
Compounders & Mixers	1.93	.25	1.47	.13	2.02	.15	2.00	0.00	3.00	0.00	2.91	.29	4.11	.38	3.98	1.34	2.00	0.00	1.00	0.00
Millmen	1.06	.24	1.53	.17	2.86	.35	2.49	.56	2.12	.33	2.93	.36	4.60	.66	4.87	.42	1.60	.85	1.00	0.00
Calendar & Tuber Operators	2.00	0.00	2.93	.26	3.00	0.00	4.00	0.00	3.00	0.00	2.00	0.00	6.00	0.00	4.91	1.01	3.00	0.00	3.00	0.00
Calendar Helpers	1.45	.50	1.72	.53	2.70	.47	2.16	.55	2.69	.47	2.16	.63	4.68	.83	3.92	.52	2.29	.61	1.05	.22
Tube Machine Helpers	1.43	.49	1.46	.21	2.65	.48	2.11	.32	2.92	.28	2.40	.49	3.74	.61	3.69	1.08	1.87	.33	1.08	.28
Tire Builders	2.00	.05	3.00	0.00	4.00	0.00	3.00	.05	3.00	0.00	3.15	.36	5.10	.45	3.89	.47	1.94	.23	1.00	0.00
Bias Cutter & Wire Insulator Operators	1.78	.42	2.32	.31	3.15	.53	3.00	0.00	2.93	.26	2.78	.42	5.15	.53	3.80	1.29	2.93	.26	2.63	.62
Bias Cutter & Wire Insulator Helpers	1.09	.28	1.48	.12	2.76	.43	2.04	.36	2.92	.28	2.61	.49	3.70	.55	3.16	.58	2.28	.83	1.00	0.00
Tire & Tube Curemen	1.02	.12	1.50	.10	2.02	.12	2.64	.45	3.00	.30	2.99	.12	4.52	.47	3.25	.90	1.70	.55	1.00	0.00
Inspectors	1.77	.42	1.83	.24	3.12	.32	3.00	0.00	3.95	.22	3.49	.73	4.40	1.37	3.35	.97	1.68	.52	1.00	0.00
Material Classifiers & Testers	2.42	.58	2.23	.31	2.42	.58	3.12	.33	3.02	.64	2.52	.68	4.08	1.16	3.33	.88	2.04	.41	1.04	.20
Tire & Tube Finishers: Assembly Line	1.06	.25	1.47	.12	2.38	.49	2.18	.39	3.00	0.00	3.31	.59	2.50	1.01	3.38	.70	1.94	.25	1.00	0.00
Tire & Tube Finishers: Batch	1.57	.50	1.67	.42	2.31	.78	2.64	.49	3.00	0.00	2.98	1.20	2.86	.65	4.21	1.09	1.07	.26	1.00	0.00
Tire & Tube Repairmen	1.11	.32	1.88	.37	3.00	0.00	2.89	.32	3.00	0.00	3.00	0.00	3.41	.50	2.89	.32	1.89	.32	1.00	0.00
Cleaners & Routine Servicemen	1.16	.37	1.44	.33	1.86	.35	2.14	.43	2.06	.23	2.78	.54	2.26	.51	3.06	1.72	1.88	.64	1.00	0.00
Skilled Craftsmen	3.14	.45	3.92	.30	3.96	.21	3.90	.30	3.15	.36	2.79	.41	4.34	1.21	4.80	.72	2.82	.38	1.00	0.00
Power Truck & Tractor Drivers	1.97	.18	1.60	.30	3.00	.20	2.10	.30	2.96	.19	2.78	.50	2.61	1.33	5.46	1.16	3.96	.19	1.00	0.00
Utility & Service Workers	1.53	.50	1.29	.25	1.99	.16	2.21	.46	2.02	.30	2.08	.35	2.80	.58	2.60	.61	1.95	.29	1.00	0.00
Chemical & Power Plant Operators	2.88	.33	2.50	.51	3.57	.50	3.77	.43	2.57	.50	1.90	.60	7.85	.53	6.19	1.04	2.85	.78	1.21	.41
Machine Tenders	1.10	.30	1.35	.23	2.48	.50	2.22	.42	2.73	.45	2.42	.67	3.54	1.39	2.77	.80	1.91	.73	1.00	0.00

TABLE C.2

MEANS AND STANDARD DEVIATIONS OF "EXPERT" JOB RATINGS FOR THE 21 JOB GROUPS

Job Group	Work Very Fast $\bar{X}$	Work Very Fast SD	Little Time to get Things Done $\bar{X}$	Little Time to get Things Done SD	Number of Persons $\bar{X}$	Number of Persons SD	Proportion of Time $\bar{X}$	Proportion of Time SD	Requests and Directions $\bar{X}$	Requests and Directions SD	Quality vs. Quantity $\bar{X}$	Quality vs. Quantity SD	Importance & Prestige $\bar{X}$	Importance & Prestige SD	Control of Work Pace $\bar{X}$	Control of Work Pace SD	Technology
Batch Processing Machine Operators	2.89	.93	2.17	.98	3.00	.76	1.75	1.04	2.38	1.30	2.00	.63	2.44	.53	1.89	.78	Craft-Machine
Compounders & Mixers	2.78	.97	1.50	.55	2.50	.76	1.63	.52	2.25	1.28	2.50	.55	2.22	.67	3.33	1.32	Simple manual
Millmen	3.00	.87	2.50	.84	2.63	.52	1.50	1.07	2.25	1.04	1.50	.55	2.67	.71	1.89	.78	Machine tending
Calendar and Tuber Operators	3.00	.87	2.17	1.17	4.38	.52	3.63	1.19	2.75	1.49	2.83	.41	4.22	.44	1.67	.71	Automated machine
Calendar Helpers	3.33	1.00	2.50	.84	3.38	.52	3.38	1.06	2.25	1.16	2.00	.63	2.78	.44	1.78	.67	Machine tending
Tube Machine Helpers	3.67	1.22	3.17	.75	2.50	1.07	1.88	.84	2.00	1.07	2.50	1.22	2.44	.73	1.22	.44	Assembly line
Tire Builders	2.56	1.24	1.67	.82	1.88	.64	1.13	.35	1.88	.64	3.50	1.05	3.89	.78	4.56	.73	Craft-machine
Bias Cutters and Wire Insulator Op.	3.33	1.00	2.17	1.47	3.25	.46	3.50	1.07	2.50	1.07	3.00	1.10	3.22	.83	2.44	1.01	Craft-machine
Bias Cutters and Wire Insulator Helpers	3.56	.73	2.83	1.47	2.50	.76	2.50	1.31	2.12	.99	2.17	.41	2.44	.53	2.33	1.00	Machine tending
Tire & Tube Curemen	3.56	.88	2.67	1.37	1.88	.35	1.38	.52	1.88	.64	2.00	.63	2.22	.44	2.11	.93	Machine tending
Inspectors	3.33	1.12	3.33	1.37	1.75	.71	1.25	.46	1.75	.71	3.50	.84	2.89	.60	2.11	.93	Assembly line
Material Classifiers & Testers	2.33	1.00	2.17	1.17	2.00	.76	2.12	1.13	2.25	1.04	2.67	.82	2.89	.93	3.44	1.01	Material handling
Tire & Tube Finishers : Assembly line	3.56	.88	3.00	.89	1.38	.52	1.25	.46	1.75	.71	3.33	1.03	2.33	.50	1.89	.78	Assembly line
Tire & Tube Finishers: Batch	2.67	1.00	2.17	1.17	1.63	.52	1.38	.52	1.88	.84	2.00	.63	2.33	.50	3.11	.60	Machine tending
Tire & Tube Repairmen	2.67	1.12	2.17	1.17	1.75	.71	1.13	.35	1.88	.84	2.33	.52	2.67	.50	4.11	.33	Craft-machine
Cleaners and Routine Servicemen	1.56	.73	1.67	.82	1.75	.89	1.75	1.16	3.00	1.51	1.17	.41	1.44	.53	4.44	.73	Simple Manual
Skilled Craftsmen	2.33	.50	2.50	.84	2.88	.64	3.38	.74	3.88	.64	2.67	.82	4.44	.53	4.44	.73	Skilled Craft
Power Truck and Tractor Drivers	2.44	.73	2.33	.82	2.63	1.06	2.25	.89	2.38	.92	1.50	.55	2.44	.73	3.00	.71	Material Handling
Utility and Service Workers	2.22	.67	1.83	.41	2.63	.74	2.75	1.16	3.75	1.04	1.33	.52	1.67	.50	3.67	.71	Material Handling
Chemical and Power Plant Operators	2.29	.49	2.00	0.00	3.00	.63	2.50	1.38	2.33	1.21	2.20	.45	4.14	.69	2.71	1.11	Automated Machine
Machine Tenders	2.44	1.01	1.83	.75	1.63	.52	1.25	.46	1.88	.99	2.00	0.00	2.56	.73	2.89	1.17	Machine Tending

APPENDIX D

THE MEASURE OF REPORTED EXPOSURE TO PHYSICAL-CHEMICAL AGENTS

Because little was known prior to this study about the nature and health effects of physical-chemical hazards in the tire and rubber industry, the approach to measuring these hazards in this study was relatively crude. Part 2 of the questionnaire focused on this area and attempted to get two major types of information: (1) workers' self-reports of the area of the plant in which they worked so that questionnaire information could be related to environmental assessments being made in different areas of the plant, and (2) workers' perceptions of whether they were exposed to major physical-chemical hazards in their work. These hazards were stated in very general terms, i.e. "dust," "fumes," "chemicals," etc. The environmental assessments made by industrial hygienists were similarly non-specific, the major one being level of "respirable particulates" (i.e., dust) in the air.

The objective environmental assessments were limited to broad areas of the plant and dust exposure was the only quantitative measure made on a broad scale. In contrast, the workers' self-reports provided information on the exposure of each worker to a broad range of potential irritants. Thus, workers' self-reports (as summarized in an index of "number of agents exposed to") provided thebasic measure of exposure to physical-chemical hazards used in our analyses. The index counts the number of agents circled "YES" in the following question (Of the total sample, 27.8% reported exposure to no hazardous agents, 30.1% to one agent, 22.6% to two agents, and 19.5% to all three.)

Is there any agent or substance in your current work environment that you think is a hazard to your health? (For each item, circle the appropriate answer.)

a.	Dust	YES	NO
b.	Fumes (in the air)	YES	NO
c.	Chemicals (solid or liquid)	YES	NO

Available information suggests that this measure has considerable validity. That is, it appears that workers are reporting their exposure levels fairly accurately, though there is also some tendency for workers to report (or not report) "bad things" about their jobs, both physical-chemical and social psychological. Thus reports of exposure correlate with a wide range of variables in the study as seen in Chapters 5-12. However, the pattern of these correlations is such that reported exposure correlates most strongly with those variables which it should most strongly affect (e.g., reported respiratory and especially dermatological symptoms). Most importantly the workers' reports of exposure correspond quite closely with the objective environmental assessments of exposure to "respirable particulates." Thus, of the eight areas of the plant with highest assessed levels of "respirable particulates," seven also appear among the eight areas in which the greatest proportion of workers report exposure to dust. Similarly, where industrial hygienists ratings showed little exposure, few workers reported exposure. Thus, the self-reported index of exposure to agents was the best available indicator of exposure to physical-chemical hazards, and appears to be a fairly valid indicator of actual exposure.

APPENDIX E

SELF-REPORT INDICES OF PHYSICAL HEALTH

Sources

The symptom schedules used to define health outcomes in this study are found in questionnaire Parts 2, 3, 4, and 5. The questions concerning dermatological symptoms (itch and rash) were developed for this study but the others were designed and validated in previous studies: angina pectoris (Rose, 1965; Rose and Blackburn, 1968), persistent cough and phlegm (Great Britain, 1960; 1965), ulcers (Dunn and Cobb, 1962) and neurosis (MacMillan, 1957).

With the exception of the neurosis scale, these measures differ in form from all of the others reported in this document in that they are not additive indices. They are symptom schedules in which only certain combinations of responses are taken to indicate the "presence" of an underlying disease state. Thus, these variables are dichotomous. Although the neurosis scale can be used as an additive index, it too is dichotomized here to indicate the presence or absence of substantial symptoms of anxiety.

Below are listed the component items of these scales along with their respective scoring algorithms and the percent of the study respondents exhibiting the presence of symptoms.

Measures of Health and Proportions of Sample
with Marked Symptoms of Each

1. Angina Pectoris (5.7% with marked symptoms)

   Marked symptoms of angina were defined as being present in respondents who answered the questions below as follows (cf. Rose and Blackburn, 1968:Annex 6):

Q1	"YES"	Q6	"Relieved"
Q3 and/or Q4	"YES"	Q6a	"10 minutes or less"
Q5	"stop or slow down"	Q7	"YES" to one or more of 7a-7d

1. Have you ever had any pain or discomfort in your chest? YES NO
2. Have you ever had any pressure or heaviness in your chest? YES NO

If you answered "YES" to either of the above two questions please describe the pain or discomfort in questions 3-7

3. Do you get it when you walk uphill or hurry? YES NO
4. Do you get it when you walk at an ordinary pace on level ground? YES NO

If you answered "NO" to both questions 3 and 4, skip to question 7

5. What do you do *if* you get it while you are walking? Stop or Slow down / Carry on
6. If you stand still what happens to it? Relieved / Not relieved
   a. If relieved, how soon? 10 minutes or less / more than 10 minutes
7. Where do you feel this pain, discomfort, or heaviness?
   a. *Upper* mid chest (top half of breastbone) YES NO
   b. *Lower* mid chest (bottom half of breastbone) YES NO
   c. Left side of the chest YES NO
   d. Left arm YES NO
   e. Other (Please specify) ______________________ YES NO

2. *Ulcers* (13.5% with "marked" symptoms)

"Marked" symptoms of ulcers were defined as being present if a respondent answered "YES" to *either* (or both) of the following questions:

a. Do you quite often experience gastric (stomach) pain or discomfort about two hours after meals that is relieved by more eating? YES NO

b. Do you often wake up with this type of pain during your normal sleeping hours? YES NO

3. Dermatological Problems (14.1% with "marked" symptoms)

"Marked" symptoms of dermatological problems were defined as being present if the respondent answered "YES" (codes 1 or 2) to both of the following questions:

a. In your current job, do you frequently have itching skin during or after work?

Yes, over much or all of body	1
Yes, mainly in one area of body	2
No itch	3

b. In your current job, do you frequently have a rash on your skin during or after work?

Yes, over much or all of body	1
Yes, mainly in one area of body	2
No rash	3

4. Persistent Cough or Phlegm (11.8% with "marked" symptoms)

"Marked" symptoms of persistent cough and phlegm were defined as being present in respondents who answered the questions below as follows: (Great Britain Medical Research Council, 1965).

Q1 or Q2	"YES"	Q4 or Q5	"YES"
Q3	"YES"	Q6	"YES"

COUGH

Directions: Record answers at right.
When in doubt, record "NO."

1. Do you usually cough several times first thing in the morning (or, on getting up* - see box at bottom of page) in the winter? (This includes coughing with first smoke, or on first going out of doors.) YES NO
2. Do you usually cough during the day (or at night*) in the winter? (Ignore an occasional cough.) YES NO
3. Do you cough like this on most days (or nights*) for as much as three months each year? YES NO

SPUTUM (thick fluid, phlegm)

4. Do you usually bring up any sputum from your chest soon after getting up, in the winter? (Count sputum with the first smoke, or on first going outside. Count swallowed sputum; but not mucus from the nose.) YES NO

5. Do you usually bring up sputum from your chest during the day (or at night?) in the winter? YES NO

6. Do you bring up sputum like this most days (or nights*) for as much as three months each year? . . . . YES NO

*Words in parentheses are for those who work on night shift

5. Neurotic Symptoms (14.7% with "marked" symptoms)

"Marked" symptoms were defined as being present in respondents whose total score on this index was 23 or less. The index score was obtained by summing the responses to each of the following (response coded "often" = 0, "sometimes" = 1 and "never" = 2, except for Qs 16 and 17 which were coded "often" = 2, "sometimes" = 1 and "never" = 0):

1. Do your hands tremble enough to bother you?
2. Are you troubled by hands and feet sweating so they feel damp and clammy?
3. Are you bothered by your heart beating hard?
4. Do you feel tired when you first get up?
5. Do you have any trouble getting to sleep or staying asleep?
6. How often are you bothered by having an upset stomach?
7. Are you bothered by nightmares (dreams that frighten or upset you)?
8. Are you troubled by "cold sweats?"
9. Do you feel that you are bothered by all sorts (different kinds) of ailments in different parts of your body?

10. Do you have loss of appetite?
11. Does ill health affect the amount of work (or housework) that you do?
12. Do you feel weak all over?
13. Do you have spells of dizziness?
14. Do you tend to lose weight when you worry?
15. Are you bothered by shortness of breath when you are not exerting yourself?
16. Do you feel healthy enough to carry out the things that you would like to do?
17. Do you feel in good spirits?
18. Do you sometimes wonder if anything is worthwhile anymore?

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