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The Development of Methods for the Early Identification of Heart Disease and Related Job Stresses

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I. Aims of the research

The purpose of this research is to obtain more complete knowledge about the relationship between the stresses of organizational environments, the personality of the individual, and physiological variables believed related to cardiovascular disease. A number of studies have already indicated that there appear to be certain types of work conditions which are correlated with risk factors such as serum cholesterol level, in heart disease.

Job characteristics such as overload and deadlines, for example, have been shown to be associated with heart disease and related physiological risk factors in studies of a number of occupational groups. These include tax accountants (Friedman, Rosenman, & Carroll, 1958), medical students (Czaczkes & Dreyfuss, 1959; Grundy & Griffin, 1959; Horwitz & Bronte-Stewart, 1962; Thomas & Murphy, 1958; Wertlake et al., 1958), white collar workers administering contracts and handling personnel transactions (Caplan & French, 1968; French, 1968), and in professions which are typified by general rather than specialist responsibilities (Russek, 1960, 1962, 1965).

Personality has also related to incidence of coronary heart disease in a series of studies on Personality Type A-B carried on by Friedman and Rosenman and their colleagues over the past ten years (for example see Friedman & Rosenman, 1960). Interestingly enough the Type A person is characterized by a number of traits which would seem to attract such a person into a job with deadlines and role overload. These traits include excessive drive, ambition, involvement in competitive activities, pressure for vocational activity, and a noticeable sense of time urgency (Jenkins et al., 1967). This Type A personality syndrome is also associated with high serum cholesterol (Friedman et al., 1960; Friedman et al., 1964; Rosenman & Friedman, 1963), a biochemical we have already noted to be associated with deadline pressures and role overload.

A recent laboratory study by Sales (1968) now shows that the relationships between personality and serum cholesterol level and between overload and risk factors are not simple but interactive. Sales suggests that the relationship between overload conditions of the work environment and psychological and physiological reactions to those conditions is conditioned by personality traits of the individual. It is the intent of this study to obtain more complete information on the nature of these interactive relationships.

Our basic notion will be that it is the lack of fit between the needs and abilities of the individual and the supplies and demands of the environment which constitutes the basic source of strain for the individual. This notion of person-environment fit (P-E fit) is not new to the literature and has been developed and conceptualized by a number of theorists (for example Barker, 1960; Jahoda, 1961; Lewin, 1951, Murray, 1938; Pervin, 1968; Rodgers, 1968). The concept of interaction here is central for we assume that within certain limits, there are individual differences in need structure and personality which determine the extent to which certain conditions of the objective, external environment will produce psychological and physiological strain in the person.

In studying P-E fit, we will want to distinguish between the objective and subjective fit. Subjectively, a person may indicate to us that he feels overloaded, rushed, wanting more time than there is; but objectively we may observe that he has plenty of time and not too much work given his intellectual abilities. This distinction between the objective stressors of the work environment and the subjectively observed stressors of the work environment is important because objective and subjective measures of stress input relate differently to the same measures of strain. For example, Kraut (1965) in a study of over eight hundred salesmen and their sales managers finds that subjective role conflict, as reported by salesmen, is substantially related to

satisfaction with one's manager (r=.54) and with job-related tension (r=.39); however, objective role conflict is not related to these dependent variables when the effects of subjective role conflict are partialled out or controlled for.

Further support for the distinction between the subjective and objective environments comes from a study of 22 white collar personnel at NASA's Headquarters. Objective quantitative workload, as measured by trained observers, and subjective quantitative overload, as reported by the Ss showed different relationships to the same physiological strain measures (Caplan & French, 1968). While the two measures of workload correlated .64 with each other, their correlations with heart rate of the men on their jobs was quite different. Subjective quantitative overload, a six item factor in which the respondent indicated the extent to which various aspects of his work were sources of stress for him, correlated .68 ($p < .001$) with heart rate. On the other hand, objective quantitative workload, an index of the number of phone calls and office visits the person had during a standard time period, showed no relation to heart rate when the effects of subjective overload were partialled out. The multiple correlation of objective quantitative workload and subjective quantitative overload with heart rate were .68--exactly the same as the first order correlation of the subjective measure with heart rate. Thus, all of the effects of the objective quantitative work environment seem to occur via the subjective perceptions of the individual. On the other hand, both the objective and subjective measures of the work environment were found to relate to serum cholesterol level (r's=.33 and .42 respectively; $p < .05$ and $p < .01$ respectively).

Finally, Sales (1969) in a laboratory study of the effects of workload on serum cholesterol levels, induced both objective overload and objective underload and obtained measures of subjective feelings of overload-underload

at the end of the experiment. Changes in serum cholesterol level depended on an interaction between objective conditions of the experiment and subjective feelings about the workload. Ss who were objectively overloaded and reported feeling that way and Ss who were objectively underloaded and reported feeling that way showed increases in cholesterol in a one hour time interval. Ss whose feelings about the workload did not agree with the actual objective conditions (i.e., persons who reported being overloaded in an objectively underloaded condition) showed decreases in serum cholesterol level. The same study also showed that task enjoyment reported by Ss depends on the interaction between subjective work load and objective work load.

Unfortunately, there are not many studies which make these distinctions between the objective and subjective work environment. The few investigations just cited, however, do make a strong argument for measurement of the person's work environment both in terms of his self-report and in terms of some measures which independently survey his work environment. It is our intention, where feasible, to gather both types of measurements.

Coping and defense as responses to threatening aspects of the environment are also of interest to us. Perhaps one of the reasons that some people are more likely to fall victim to cardiovascular disease relates to their use of inadequate modes for coping with certain environmental stressors. In addition to strain as a response to stressors in the organizational environment, we are also interested in coping and various defenses as responses to threatening aspects of the environment. It may be, for example, that persons who show certain patterns of response which are in the direction of active mastery of the environment (Jahoda, 1958), rather than passive adjustment to it, are less likely to develop cardiovascular disease. Furthermore, persons who have highly defensive personalities may be more likely to take on adaptive-defensive rather than

active-offensive moves against threats in their work environment. We will examine some of the differences in types of responses people report they make to conditions of role overload and conflict to see whether they lead toward active mastery or passive adaptation. We will also examine some of the social and psychological conditions which may relate to the use of these strategies.

Now, let us turn to an important distinction between threat and confrontation. Threat is the situation in which the individual is anticipating the onset of some potentially noxious stimuli (such as an exam, battle, or a visit to the dentist). On the other hand, confrontation is the actual occurrence of the stimuli (taking the exam, etc.). A number of studies now suggest that the strain reaction of people may be greater to the threat or anticipated harm, than to the actual confrontation with the stressor (Grinker & Spiegel, 1945; Shannon & Isbell, 1963; Mechanic, 1962; Lazarus, 1966). We would like to keep threat and confrontation as two separate concepts in our study of organizational stress and cardiovascular disease. For example, while work overload may be stressful in that it is physically and psychologically immediately exhausting, it may also put strain on the person because it threatens him with a future confrontation with an outcome called role failure. Role failure has other future consequences such as lowered esteem, demotion, being fired, and so on.

Most of the organizational variables will be examined in terms of the person's confrontation experiences with them. We will be unable to talk about their threat value in any objective sense, although we will surely want to conjecture about what possible threats certain types of confrontations do pose. Nevertheless, we do want to take some exploratory look at what types of threats are found in conditions of work which relate to risk factors in cardiovascular disease.

Our interests in threat at this stage are rather exploratory and somewhat minimal, but we do want to accomplish the following two goals: (a) first we want

to identify the extent to which the person thinks future conditions in the organization will pose greater threats, such as more role conflict, and (b) we want to know the extent to which the person thinks these happenings are threats to his overall well-being and health.

Because we have the cooperation of NASA for this study, and because we have some preliminary evidence which shows that NASA is a good place to study risk factors of coronary heart disease (there is a good deal of role overload and deadlines), our study will concern itself with target populations at NASA's Goddard Space Flight Center. Furthermore, we have reason to suspect that three occupational groups at NASA, - administrators, scientists, and engineers - differ in their respective incidences of heart disease because their jobs are dissimilar in certain important ways having to do with deadlines, role conflicts, and other aspects of person-environment fit.

Some earlier analyses of results from medical examinations of volunteers at Goddard have shown some interesting differences in coronary heart disease among these three groups. Dr. Villafana and a colleague of his, Jean Mockbee, have found that persons who appear to be primarily administrators have a higher incidence of hypertension and cardiovascular diseases than persons who appear to be primarily engineers and primarily scientists. The administrator group smokes more and is more overweight than the engineers and scientists. Overall, the scientist group is the healthiest.

Comparisons of cardiovascular disease incidence at two other bases of NASA for the same three occupational groups show similar results: The administrator group consistently has the highest prevalence of cardiovascular disease (the incidence ratios are 6:1* at Goddard, 4:1 at Electronics Research Center,

*A more recent study places this ratio at 3:1.

and 2:1 at NASA Headquarters using engineers as the comparison group).

The percent of persons with cardiovascular disease is, of course, sufficiently rare as to make it difficult to study persons with and without the disease in a population the size of Goddard's (approximately 3600 government salaried workers in the population). For this reason we are concentrating on continuous variables like blood pressure, heart rate, and cholesterol level. Of course, continuous variables also allow for finer discriminations with one's measuring instruments - an added advantage over dichotomous measures.

Some additional data gathered on men at NASA's Headquarters and Goddard Space Flight Center by Jean Mockbee also suggests that continuous variables like blood pressure provides additional data on the differences between administrative and non-administrative jobs. In a retrospective study using this data, it appears that scientists or engineers who have been transferred into administrative jobs and administrators transferred back to engineering or scientific jobs show the following trends in their physiological characteristics: change to an administrative work environment is accompanied by increases in heart rate cholesterol and systolic blood pressure; transfer out of an administrative environment is accompanied by decreases in these three physiological variables. These findings are highly tentative, however, since the physiological measures were sometimes obtained during the same year bracketing the job transfer and sometimes obtained two or three years before and after the transfer. The effects of these inconsistencies in measurement, however, should be in the direction of giving us conservative data. At any rate, the data have peaked curiousity more for what they suggest than for what they demonstrate. They suggest that we should explore the possibility that working in an environment for which you

were not initially trained may constitute a source of poor P-E fit. As is not uncommon in many modern organizations, persons are often promoted into administrative positions from positions which utilize an entirely different set of skills. It is not uncommon for an organization to cope with its "deadwood" by pushing them "upstairs". Thus, we want to look at the job history of the individual to see whether or not the skills he originally developed are commensurate with the duties he is being called upon to perform.

One very intriguing notion that was set off by this data on changes in jobs is the possibility that promoting persons who are Type A, hard-driving, competitive individuals into quieter climates may yield a contagion phenomena. Risk personalities may act as carriers who then find hosts who also enter a state of risk. Argyris (1964) for example gives a rather striking summary of a study of a bank in which

> "1. The lower the self-actualizing score a person has, the greater are the chances that he will be a carrier of the "illness" low morale, and the greater are the chances of his infecting others.
> 2. Every carrier of "low morale" is also a "host" for further infection of "low morale." ...
>
> 5. Categorizing people in terms of high, medium, and low self-actualizing scores, we find that a low-score individual tends to be a carrier of the ineffectiveness. The host tends to be a medium score individual. Apparently the high-score individual is perceived by the carrier as being immune to infection" (p. 143).

Such an epidemiological approach to social-psychological risk factors in cardiovascular disease is not out of the realm of possibility. Perhaps the proposed research will enable us to identify potential "communicable" social-psychological risk factors which could then be examined in a prospective study.

It is also conceivable that working in an environment where most of the other people are not carrying out the same or similar tasks, and therefore have markedly different needs, may also lead to poor P-E fit. For example, the administrator who works in an environment which is primarily made up of

engineers may experience considerable conflict. The administrator's and engineers' philosophies about goals and means to ends may come into direct conflict. Similarly, the engineer in a world of administrators may also suffer from lack of support on his approach to organizational life. We want to see whether these types of poor P-E fit also are related to risk factors of cardiovascular disease.

What about self-selection processes? In any situation where one finds a link between the nature of the environment, such as role overload, and some health-related variable, such as serum cholesterol level, there is always the possibility that the individual brought these deadlines or overload upon himself. That is, he self-selected himself into a job where there would be these stress situations. Some persons may intentionally move through an organization towards jobs which they know have characteristics which we think are deleterious for the person. To test out this possibility, we want to take the following steps:

(a) First we need to discover whether certain jobs such as administrative ones have more deadlines, overloads, and role conflict than other jobs.

(b) Then we should identify the modal personality characteristics of occupants in these overload and non-overload jobs.

(c) And finally, we should predict that persons with personalities which agree with the modal pattern found in their type of work (be it a high or low overload job) will prefer to remain in that type of job, while persons with personalities which are not the same as the modal pattern for their type of job will indicate a preference for eventually moving to the job most in keeping with their personality.

For example, suppose we find administration to be the high overload job which also has a modal personality pattern roughly like that of Type A. Then we would predict that Type A persons who are in non-administrative, technical jobs like science or engineering will indicate that they hope to move towards administrative positions while their Type B colleagues will indicate that they are quite content to stay where they are.

Similarly, to continue the example, Type B persons in administration should indicate that they want to move into science or engineering. Of course, movement between occupations is certainly more difficult when one wants to move from administration to science or engineering. Thus, we may find no Type B administrators who want to move towards science or engineering simply because they correctly perceive how formidable it would be to tackle such a career path. Therefore, we have to take a slightly different approach with this latter group of men.

We would instead predict that Type B administrators, who were once engineers or scientists, moved into administration somewhat against their own preference. On the other hand, Type A administrators, who were once scientists and engineers, should indicate that their movement into administration was more in keeping with their own career plans.

In summary, this study can be more specifically viewed as research on risk factors of heart disease found in specific types of occupations. While the results should strictly be expected to hold only for personnel at Goddard, we hope that some of the findings will be generalizeable and useful for other organizations engaged in similarly creative and stimulating types of endeavor.

II. Methods

Through the cooperation of Dr. Carlos Villafana, head of the Goddard Space Flight Center Health Unit, we are presently recruiting volunteers to give a

blood sample and other physiological data and fill out a questionnaire on their work environment.

Sample. A pool of potential male volunteers will be randomly selected representing each of the following sub-populations at Goddard Space Flight Center:

a) administrators in an administrative environment.

b) administrators in an engineering environment.

c) engineers in an engineering environment.

d) engineers in an administrative environment.

e) scientists in a science environment.

We will attempt to obtain approximately 50 male volunteers from each sub-sample. Females will be excluded. There are few women in the occupations under study.

The characteristics of these sub-samples have been chosen to enable us to explore some notions of P-E fit which we discussed earlier. We want to see whether working in environments non-commensurate with one's skills brings about strain. Furthermore, we want to find out whether it is the type of environment per se that creates strain irrespective of one's job and/or is it the occupation which is a major source of strain. Thus we have an analyses of variance design with job and environment as main effects, and a job-environment interaction.

Unfortunately there are no scientists working in an administrative environment at Goddard. We also are not confronted with any previous data which makes it as compelling to look at scientists in engineering environments and vice versa. We have noted, however, that the scientists are the healthiest group of the three occupations. Therefore, we have included the scientists in their own work environment as an additional sub-sample.

At this point a few comments should be made about the concept of "work environment" as used in describing these sub-samples. We will define the

objective occupational work environment as the ratio of the number of persons from one occupation to the number of persons from another occupation working in the same organizational unit. In searching for environments which are either most purely administrative or most purely engineering, an attempt will be made to find those units of the organization where the ratio of administrators to engineers is highest or where the ratio of engineers to administrators is highest. The former constitutes an administrative environment; the latter is an engineering environment. Incidentally, we should note here that Goddard is organizationally divided up into directorates, divisions, branches, and sections as one moves down the formal hierarchy. Because of sample size considerations which call for a minimum N in each cell of 50, the most basic unit of organization which can be examined in this study is the division. In other words, in some instances we shall be able to talk about administrative versus engineering work environments at the division level of organization.

Rather than rely solely on these criteria of occupational work environment, which were derived from job description records of NASA, we will also obtain information from each volunteer on the extent to which he sees his environment as being administrative, engineering, or scientific, and the extent to which he sees himself as being an administrator, engineer, or scientist.

Measures. The paper and pencil measures will include both assessments of the subjective work environment of the S and measures of personality. The item content for these measures of subjective work environment comes from a number of studies including previous work carried out at NASA on job stress and heart disease. Research, for example, by Kahn et al (1964) on role conflict, by Pelz and Andrews (1966) on creativity and productivity among scientists and engineers, and the literature on supervisory climate and satisfaction (e.g., Likert, 1961; Mann, 1965; Porter, 1962, 1963) have been drawn upon, in the

construction of indices and item content. A list of all measures is given in Appendix A.

One important class of variables to be measured is overload. A study of university professors by French, Tupper, and Mueller (1965) isolated by factor analysis two major types of work overload which we will include in the questionnaire. The first type is subjective quantitative overload which is the condition in which the S perceives that he has more work than he can complete in a given period of time. Subjective qualitative overload, on the other hand, is the condition in which the S perceives that the work he has been given is beyond his ability to complete because he lacks the knowledge, talent, training, etc., that is required. Even if he was provided with an unlimited fund of time, he would be unable to complete the task. The study of university professors shows that the main source of workload strain for professors comes from qualitative overload, but for college administrators the main source is quantitative overload. In NASA we may conceivably have a similar situation. We have administrators, engineers, and scientists whose job responsibilities seem analogous to those of university administrators and professors.

In the proposed study we also find it feasible to measure objective quantitative workload. You will remember that an earlier study at NASA (Caplan & French, 1968) found that objective quantitative overload related positively to cholesterol, one of our coronary heart disease risk factors. The earlier study measured objective quantitative workload by having trained observers record the number of phone calls and office visits which each person had over approximately 2 1/2 hours of time. The disadvantage of this method was that we had to have at least one observer with every subject during some portion of the work day. This was costly. In the study proposed here, our sample is quite large and therefore it would be exorbitant to use the same procedure.

Therefore, we will ask each S to obtain the cooperation of his secretary as an observer of the phone calls and office visits the S has for three days. Pre-tested, straightforward instructions and a tally sheet are included in the last part of the questionnaire along with a cover letter to the secretary for this purpose.

Other measures which are being incorporated in the questionnaire include a theoretically-derived role conflict index, which was shown to relate to pulse rate in an earlier NASA study (French, 1968), and measures of role ambiguity from research by Kahn et al. (1964). Both role conflict and ambiguity have been noted as major sources of strain for individuals in the American work force (Kahn et al, 1964; Kahn & Quinn, 1968).

According to the responsibility hypothesis in cardiovascular disease (Caron, Wardwell, & Bahnson, c. 1960), responsibility for the futures and well-being of self and others is stressful. On the other hand responsibilities for more impersonal aspects of one's work such as for budget, projects, equipment and facilities should constitute less of a source of stress. Several items have been included to measure the extent to which these hypothesized relationships between types of responsibility and stress are true.

While various types of overload appear to be stressful, underload or under-utilization of one's skills and abilities also appears to be a source of stress (Mann & Hoffman, 1960; Kasl & French, 1962; Kornhauser, 1965). Sales (1969) finds that college students solving anagrams who were underloaded, and also reported being so (this is interpreted to mean they felt "bored") showed increased cholesterol in the objective underload condition. Therefore, we have included under-utilization in the study as a variable.

Other subjective aspects of the work environment which are also being measured include a series of dimensions describing relationships with one's

superiors, peers, and subordinates including recognition, respect, support, and help. General control over one's work environment, the nature and extent to which the individual is involved in boundary contacts, the resources available for discharging one's responsibilities, and organizational-professional complexification are also being measured.

The latter variable, complexification, refers to the rate at which the environment becomes progressively more complex. A recent doctoral dissertation by Shirley Terreberry (1968) searches retrospectively for the relationship between complexification and system breakdown. She argues that as complexification increases, the individual experiences greater demands for adaptation to the rapidly changing environment. The greater the rate of complexification, the more difficult it becomes to meet these demands; and the organism or system experiences strain and breakdown (typical dependent variables cited include suicide, illness, and businesses filing bankruptcy). In addition to items measuring complexification, we are also including measures of the present complexity of the job.

Several questionnaire measures will also attempt to obtain respondent estimates of the percent of time he spends in various job activities and settings. Such settings include meetings, contacts across boundaries of the organization, and working alone. A previous study at NASA (French, 1968) suggests that it may be important to distinguish between the <u>percent</u> of time a person spends in activities and the <u>number</u> of times he engages in such activities like meetings, for example. The following relationships were found to consistently hold across three separate observation periods. <u>Percentage</u> of time spent on the phone and in office visits was found to correlate higher than <u>number</u> of phone calls and office visits per unit time with pulse rate (average r's=.31 vs. .15). For serum cholesterol level the reverse was true.

The number of office visits and phone calls correlated more highly with cholesterol than the percent of time measure (average r's = .39 vs...17).

Note that individuals cannot control the number of people they encounter nor the number of phone calls they have as well as they can control the percent of time they spend on these phone calls and with such people. It seems reasonable to assume, therefore, that the percentage of time measure may represent the extent to which the individual is predisposed to engage in social interaction (i.e., the extent to which he wants to maintain long phone calls and other conversations with people).

With many of the work conditions which we have briefly described here, we will obtain measures both of the perceived need for them (such as for support from colleagues) by the respondent, and the extent to which that need is actually met. Likewise we will obtain respondent estimates of the demands that he feels are being made on him, and the extent to which he can meet those demands. These pairs of questions will help us construct P-E fit scores for the respondents, which can then be related to biochemical and personality variables. The P-E fit scores will focus on the nature of perceived confrontations.

Measures of threats, as compared with confrontations, will be obtained in a couple of ways. First of all, respondents will be asked to indicate the extent to which aspects of their work environments on which they have indicated varying P-E fit may affect their future needs for good health, emotional well being, safety, security, and so forth. Thus, we are attempting to get a measure of anticipated consequences of present trends in organizational stress conditions.

Second, in order to get a picture of future types of organizational stresses, the person will be asked to examine pairs of descriptions of persons

in roles which vary from being very stressful to not very stressful. The person will then indicate to what extent his job will be more like "Job A" or "Job B" at some time in the future.

As was mentioned earlier, we are interested in the manner in which people cope with stressors in their work environment. There are two types of measures of coping in the questionnaire. One measure asks the respondent to indicate the extent to which various types of alternate coping behaviors are sources of relief from the stresses of the job. These alternatives range from day dreaming, which involves cutting oneself off from the external environment, to chatting with one's immediate superior or colleagues, which is a more arousal-seeking orientation. Schubert (1964, 1965) presents evidence which shows that smokers score high on a personality dimension he calls arousal seeking. This personality tendency is measured by use of a number of scales which interestingly enough characterize a person much the way Friedman and Rosenman would describe the Type A coronary prone personality. The arousal seeker prefers more stimulating social environments, is more bored with routine type of activities, and exhibits more dominance. Smoking, of course, is also a well-known risk factor in cardiovascular disease. Therefore, we are quite interested in looking at how people respond to the list of coping alternatives (the list includes smoking as one of the behaviors).

A second measure of coping presents descriptions of pairs of persons caught up in the same overload or other occupational stressor condition. One person copes in a manner we believe is more typical of a person who would be prone to get cardiovascular disease. The other person copes in a manner quite different. For example, given a sudden deadline "Bill" may work extra hours or faster or harder, while "Jim" may get some colleagues or additional

secretaries to help ease the burden. Some of these pairs of strategies can also be seen as representing more active, masterful attempts at overcoming the stressor while others represent more defensive, adaptive attempts at bearing with the situation. Theoretical approaches to mental health would suggest that the former strategy is more likely to be most beneficial for the health and well-being of the individual.

We have also included measures of occupational self-esteem in the study. The links between self-esteem and health are not well established although there are some theories which relate self-esteem to stress (Lazarus, 1966) and some studies which imply that there are links. Kasl and French (1962), for example, found that self-esteem and frequency of visits to medical dispensaries in industrial environments were negatively related. In a study of job loss, a condition which we would expect would bring about a lowering of self-esteem, Kasl, Cobb, and Brooks (1968) found that cholesterol levels of men who became unemployed went up and showed a later drop when they found jobs. Furthermore, men showed increased serum uric acid levels in anticipation of the job loss (i.e., during a period in which threats to self-esteem could occur); these uric acid levels remained high in the men who were unable to find quick re-employment. Serum uric acid, a blood chemical, is also believed to be a risk factor in cardiovascular disease.

Our measures of self-esteem are based on the theoretical work of French and Sherwood (1963) and Miller (1963). The respondent is presented with a set of dimensions representing a sub-identity of total self-evaluation. We have chosen the sub-identity surrounding the person's job, since we are most interested in how well he thinks he stands as an administrator, engineer, or

scientist. One measure of self-esteem centers on promotion criteria, and asks the S first what it takes to get ahead in the organization, and then asks the S to what extent he has what it takes. As we shall note in the next section, we have measures of achievement to determine the extent to which getting ahead is important for the S.

We have included a number of personality measures in the study because of their relevance for the study of risk factors in heart disease. The Marlowe-Crowne Scale of need for social approval is one of those measures. In an analysis of some of the data gathered by Kasl et al (1968) this writer found that blue collar workers scoring high on the Marlowe-Crowne Scale showed negative correlations between serum cholesterol level and measures of P-E fit while persons who scored low on the Scale showed consistently lower correlations between these measures of P-E fit and cholesterol level which were either around zero or slightly positive. These relationships are shown in Table 1. In addition to its use

Table 1. Correlation of P-E fit measures with cholesterol for high and low Marlowe-Crowne respondents

P-E fit dimension	Marlowe-Crowne low	Marlowe-Crowne high
Interesting things to do on job	.25	-.35[1]
Opportunities to learn new things and skills	.03	-.22
Time filled with enough things to do to keep busy	-.14	-.46
Adequate authority and responsibility	.15	-.26

[1] N=28; each dimension is a single item pair asking the S "how much is there?" and "how much would you like?" A difference score is then computed for the pair. A low score on P-E fit indicates poor reported fit.

as a measure of personality, the scale has been used to correct for response bias in direction of giving socially desirable responses on other measures.

In addition to the Marlowe-Crowne, we have also included the flexibility-rigidity scale of the CPI, an adaptation of the sensitization-repression scale (Byrne, Golightly, & Sheffield, 1965), emotional dependence-independence (Sampson, 1960), the best clusters of items from Sales (1969) personality measure of variables related to risk factors in cardiovascular disease, and a short-form measure of Type A-B.

Both the importance of flexibility-rigidity and emotional dependence-independence come from the research by Kahn et al. (1964) on role conflict. Persons who are flexible tend to engage in more role conflict situations and report greater stress. Furthermore, persons who are emotionally dependent on others in their role set may have difficulties in breaking off from stressful interpersonal interactions; their dependence may lead to greater involvement in the psychological meaning of their relationships with colleagues, and they, therefore, may be more likely to experience strain.

Sensitizors, compared with repressors, are persons who are more likely to experience strain due to their heightened awareness of the more stressful components of their environment. Weinstein, Opton, and Lazarus (1968) have shown that sensitizors show greater self-report reactions than repressors to a subincision stressor film. Repressors respond primarily via more unconscious, autonomic reactions. We may find similar patterns of response with regard to heart rate, cholesterol, and other types of physiological responses related to cardiovascular disease.

The Sales Personality Clusters are the product of research on personality variables relating to heart disease. They include many of the dimensions from Type A syndrome including competitive orientation, sense of time urgency, aggression, and the tendency to overload oneself at work. This measure has

already been tried out in a previous sample at NASA Headquarters and with a set of university students. The Headquarters population showed significant correlations between many of the dimensions and heart rate and cholesterol. This was not true for the student sample. It may be that the items, which center on work environments, were not relevant to the occupational world of the student. Goddard will provide another opportunity to further develop and refine this measure. We should point out that the Sales Clusters correlate quite highly with the Jenkins Activity Scale (average correlation across 14 clusters = .47), an already validated predictor of coronary heart disease.

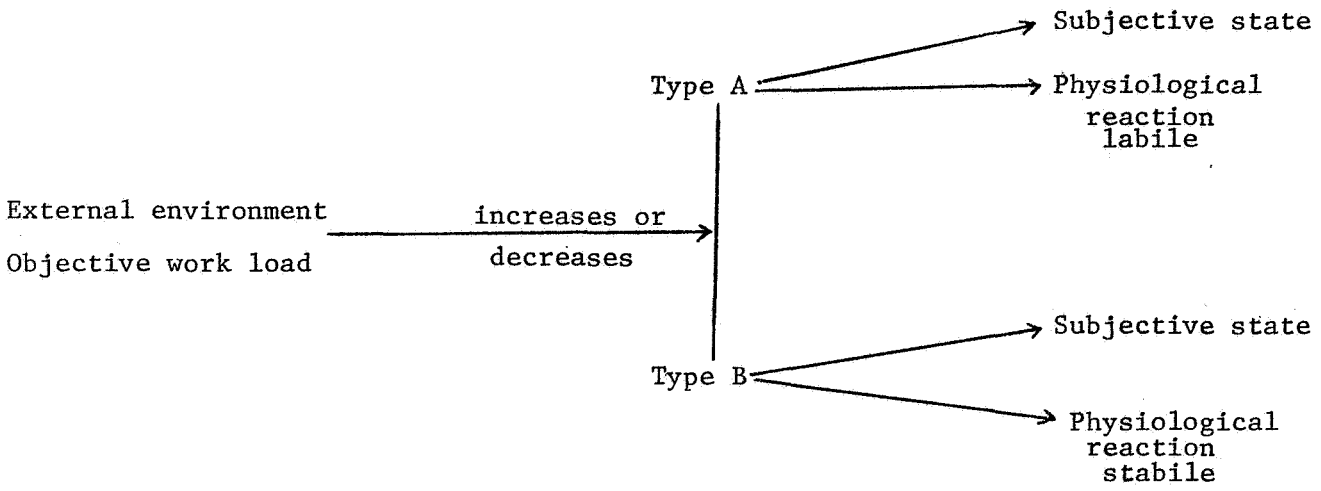
In addition to the Sales Clusters, a three item measure of Type A personality, "What I am like", which was developed in earlier NASA research at NASA Headquarters, will also be included. This measure correlates .80 with the Jenkins Activity Scale and has an average correlation of .67 with 10 of the 14 Sales Clusters. The three items are pairs of vignettes constructed by the writer where one member of the pair describes a Type A person and the other a Type B person.

In addition to these variables, we are of course obtaining blood samples to allow analyses of a number of blood chemicals including serum cholesterol and serum uric acid. Since there is a good deal of evidence pointing to hyperglycemia as a risk factor in coronary heart disease (Epstein, 1967), we may also want to examine "casual" blood sugar. Since we will have some estimate of how long after meals each respondent's blood was drawn, we may be able to correct for short term effects of food consumption. "Casual" blood sugar, of course, is a less desirable determination than the more controlled glucose tolerance tests that are commonly used but is the best determination method available given the procedures for our medical interview. Given that we have

adequate budget and interest, determinations of free fatty acids, triglycerides, and beta-alpha lipoprotein ratios could also be performed.

Finally, we shall obtain systolic and diastolic blood pressure levels and variabilities and pulse rate and its variability. Height and weight will be self-reported by the respondent on the questionnaire.

Our interest in the variability of blood pressure and pulse is as follows. It is conceivable that lack of internal inhibitory controls, whether physiological or psychological, may lead some persons to show more reactive physiological patterns than others to organizational stress. There is some evidence to suggest that labile versus stabile blood pressure reactivity, for example, is related to psychological background conditions of the individual (Harburg, McGinn, & Wiggle, 1965). Exploratory research on 22 white collar men at NASA Headquarters has suggested that heart rate variance may be related to personality traits found in the Type A syndrome (Caplan, 1968). Persons with higher heart rate variance tended to have higher scores on the Jenkins Activity Scale measure of Type A-B and a three item measure of Type A-B developed for the study which correlated .80 with the Jenkins. These relationships were computed after age and objective workload effects were partialled out (statistically controlled for). An examination of blood pressure and pulse rate variabilities may provide us with some additional information on the reactions of persons to various types of psychological stresses on the job. We may then be able to construct specific causal models such as the following:



Finally, we shall obtain measures of smoking habits of the participants, the use they have made of annual medical check-ups at Goddard, the frequency of dispensary visits they have had during the previous year, family history of heart disease; and demographic data including age, income, government grade level, education, and length of time in the organization and in their present position.

Procedure. A letter to volunteers ~~(see appendix A)~~ will be sent out informing them of the purpose of the study, the manner in which respondent confidentiality is to be maintained, and telling them that they will be expected to give a blood sample and fill out a questionnaire as part of the research, should they volunteer. The letter will further tell them that a woman from the Institute for Social Research will contact them in person to see if they would like to volunteer.

These letters will be sent out in a staggered manner so that there is hopefully no more than a week's lag between the time the prospective volunteer receives the letter and the time when he is contacted.

Next, Miss Judy Hrushka, a laboratory technician from the Health in Industry biochemical analyses laboratory at the Institute, will contact each person in their office at Goddard to see if the individual would like to volunteer. If the

individual agrees to participate, she will then take two pulse readings from the left arm. Two readings, each 30 seconds long, will be taken to insure reliability. Furthermore, the difference between the two readings will give us a measure of pulse rate variability. She will then take two sets of diastolic and systolic blood pressure readings from the left arm for the same methodological reasons, and finally draw a 30 cc. sample of blood. The blood will then be spun down in a centrifuge, and the serum frozen for analyses back in Michigan.

Before leaving, the technician will hand the questionnaire to the volunteer and tell him to fill it out, preferably at his desk, and preferably on the same day or as soon as possible thereafter. A prepaid, self-addressed envelope will be provided so that the volunteer can mail the questionnaire directly to the Institute when it is completed.

Should the person refuse to volunteer, the technician will note this and the visit will be terminated. In this way, we may be able to search for some occupational differences between volunteers and non-volunteers. (At present, roughly 7 persons out of 100 contacted have refused to volunteer so the problem of obtaining a representative sample does not appear very acute).

While the data gathering is expected to take about a month, the statistical analyses will take up most of the time for the study. Blood analyses will be carried out by George Brooks in the Institute's biochemical laboratory using a Techicron "auto-analyzer". Multivariate analyses will be used to examine relationships between the personality variables, the subjective environment of the job, the objective nature of the work environment, and biochemicals related to cardiovascular disease. The bulk of the operations will be carried out on the computer at the University of Michigan.

The basic research strategy will involve two steps. Hypotheses will first be tested using analyses of variance and of covariance designs comparing the

different sub-samples on a number of dimensions and variables. For example, we may find that administrators report more role conflict than engineers, and that furthermore, administrators have higher serum cholesterol levels. The second step will be a within-group analysis to validate findings from step one. Thus, continuing our example, we will attempt to replicate our findings by carrying out a correlational study within the administrative group and within the engineer group examining the relationship between role conflict and cholesterol level. More complex relationships using partialling and multiple correlation techniques will be tested in a similar manner particularly where an examination is being made of the conditioning effects of various personality variables on relationships between variables such as organizational strain and physiological responses to that strain. Completion of analyses and submission of a final report is planned for May, 1970.

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APPENDIX A

LIST OF MEASURES AND VARIABLES

Objective Work Environment

Objective quantitative overload
Number of meetings with more than one person
Number of meetings with only one other person
Number of incoming versus outgoing phone calls
Administration, engineering, or science job and environment

Subjective Work Environment

Person-environment fit (on a number of the variables listed below).
Subjective quantitative overload
Subjective qualitative overload
Role conflict
Role ambiguity
Utilization of skills, talents, abilities
Opportunities for advancement
Responsibility for careers of others, mission, budget, equipment
Resources for discharging responsibilities
Organizational-professional complexification
Relationships with peers, superiors, subordinates including support, recognition, closeness of supervision, technical skill, participation in decisions, and social-interaction competence
Contacts across organizational boundaries
Control over the work environment
Percent of time in different types of activities such as administration, research and design
Quality and quantity of deadlines
Sources of deadline pressures
Perception of the work environment as administrative, engineering or science
Sources of relief from pressures (coping styles and modes)
Perception of aspects of job which are harmful to well-being and health of self
Extent to which future of organization poses undesirable work conditions (threat).
Extent to which the individual feels he can cope with certain conditions
Extent to which the individual feels he can change certain conditions

Career History

Career path up to the present (extent to which it was as intended)
Career plans for the future
Education

Personality

Flexibility-rigidity (Gough, 1957)
Emotional dependence-independence (Sampson, 1960)
Need for social approval (Crowne & Marlowe, 1964)
Repression-sensitization (adapted from Byrne et al., 1965)
Sales Clusters for CHD risk factors (Sales, 1969)
What I Am Like--Type A-B adaptation (Caplan, 1968b)
Occupational self-esteem (based on French & Sherwood, 1963; Miller, 1963).

Physiology

Systolic blood pressure
Diastolic blood pressure
Systolic blood pressure variability
Diastolic blood pressure variability
Pulse rate
Pulse variability
Serum cholesterol level
Serum uric acid level
Casual blood sugar
Height
Weight

Non-occupational Health-related Behaviors

History of smoking
Type of smoking
Number of units smoked daily
Age
Family history of coronary heart disease including identification of which members (sister, aunt, father, etc.).
Participation in yearly NASA medical exams
Number of visits to medical dispensary for purposes other than yearly exam.

Other Data

Government salary level
Income from all sources
Educational background
Amount of time in organization
Amount of time in present position.

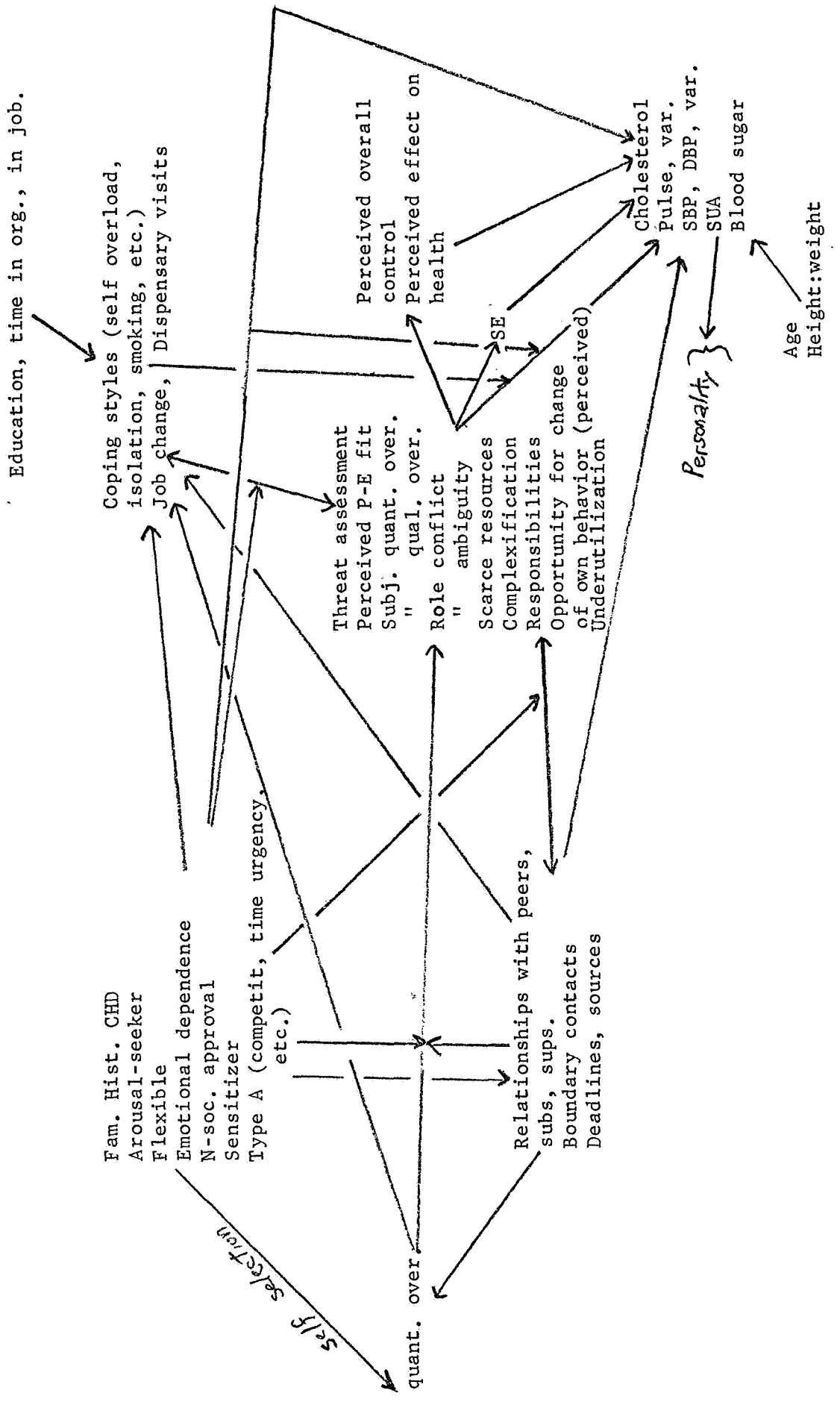

Figure. Model of relationships between clusters of variables in the person and work environments.