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# Stress factors and health: A multicausal relationship

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## 1. IMPORTANCE OF PSYCHOLOGICAL STRESS AT WORK

Psychological problems are quite widespread in the general population. Of course, they are not completely determined by work stressors. However, work stressors play a certain role in the development of psychological disturbances.

About 15 to 25% of the population at any one moment show psychological disturbances. In the US, 11% of all occupational disease claims were based on mental stress and this constitutes the fastest growing type of compensations claims (Sauter, 1992a). Psychological and psychosomatic problems constitute not only a high degree of human suffering but they also imply economic costs. The losses due to stress at work may be in the range of 100 billion dollars in the US (Sauter, 1992a). Reasons for this economic loss can be found in absenteeism, in reduced motivation and, therefore, reduced productivity, and in the payment for compensation claims, insurance, and medical expenses.

Quite obviously, stressors at work are not the only factor producing psychosomatic problems or psychological disturbances. It is naive to assume that the only effective stressors could be operative at work; there are other factors, for example, constitutional factors, factors in family and leisure life, factors of education and upbringing, etc. that all contribute to the development of ill health. Thus, we are talking about a multicausal phenomenon.

## 2. THE RELATIONSHIP BETWEEN STRESSORS AT WORK AND PSYCHOSOMATIC PROBLEMS: A FIRST LOOK

Table 1 shows in which way psychological stressors ascertained with a questionnaire are related to the probability of having serious psychosomatic problems. The stressors included uncertainty (e.g. unclear commands; a small error leads to large damage), time pressure, organizational problems (e.g. material does not come on time), danger of accidents (both to oneself and to others), and environmental problems (e.g. noise, heat, etc.).

In this table, one can recognize two results. First, there is a clear-cut relationship between stressors and psychosomatic problems. Second, not everybody is affected. Even in the highest stress-cell, only 18% of the people really show serious psychosomatic problems.

Thus, stressors are risk factors, similar to other known risk factors, e.g. smoking.

Again, this relates to the issue of multicausality. In the following, various aspects and implications of multicausality are discussed. Three different issues will be discussed:

stressors

context factors: resources

time as a factor in the stress process.

## 3. STRESSORS

The stressors are the input variables in the stress process (Semmer, 1984). Two issues are of importance here; first, the interrelationships and different relationships of stressors with the stress outcomes and second, the issue of subjective versus objective stressors.

### 3.1. Interrelationships between stressors

Four different interrelationships of stressors exist: (1) additive impact, (2) interactive impact, (3) reciprocal relationships among stressors, and (4) masking relationship.

(1) *Additive impact.* A simple model of an interrelationship is the additive impact. Given one could develop a common metric, an example would be: 3 units of social stressors and 3 units of speed at work produce 6 units of psychosomatic problems.

(2) *Interactive impact.* A more complicated sort of interrelationship is the interactive impact. Our example above would now read: 3 units of social stressors and 3 units of speed at work interact to produce 9 units of psychosomatic problems. An example from the area of new technology is the following. In research on video display units (VDU), a number of authors have attempted to relate VDU use time and eye strain. This has sometimes resulted in significant correlations (Gunnarson, 1984), sometimes not (Hartmann and Zwahlen, 1985; Howarth and Instance, 1985). If one looks at the process in a little more detail, one finds that eye strain is produced by an interaction of VDU use time and psychological stressors. The argument might go like this; when there is high background psychological stressors, higher muscular tension ensues as a general psychological response and a higher pain perception may follow. This kind of reaction happens in that organ that is used most frequently in a certain job, for example, eye use in VDU work. Empirical results show that time spent using a VDU is related to eye pain in 'bad' jobs (e.g. data entry) and not in 'good' jobs (e.g. computer programmers or secretaries with a wide range of tasks) (Coe et al., 1980; Dainoff et al., 1981; Läubli et al., 1980; Smith, 1984; Cakir, 1981).

Interactions are of particular importance for our field, e.g. interactions between smoking and asbestos or interactions between the immunological system and psychological stressors. In a study by Visintainer, Volpicelli, and Seligman (1982), rats received a helplessness training. This meant that they were treated with uncontrollable electric shocks. Some other rats did not receive this helpless training — they could control the shocks. Tumor cells were implanted in the rats. The result was that only helpless animals showed a growth of the tumor cells.

These kinds of interactions, particularly interactions between psychological and physical stressors should be studied much more frequently — it is a surprisingly neglected area in our field.

(3) *Reciprocal impact of stressors on each other.* Let us take again social stressors and speed of work. It is plausible that people who have to work speedily will also have more social problems with each other. Any mistake has more damaging results when working under high speed than under low speed; therefore there will be higher negative sanctions in such a work group, which results in more social stressors.

(4) *Masking.* Sometimes single stressors may be so important that they overshadow all other potential stressors. I once observed converter brick layers who had to work under extreme heat — about 60 to 70 °C. For them the stressor heat overshadowed everything else, the problems with supervisors, difficulties with night shifts, etc. Thus, this major stressor masked the importance of others.

### 3.2. Objective versus subjective measurement of stressors

The issue of objective versus subjective measurement of stressors is again related to the question of multicausality. Some stress researchers have suggested one cause for the relationship between psychological stressors and ill health: negative affectivity (e.g. Burke, Brief, and George, in press). The concept of negative affectivity implies that the relationship between stressors and ill health is simply due to a general negative outlook on life. Thus a person variable is conceived to be all important. This is a futile attempt to reduce the complexity of stress research; it leads to wrong answers, invariably.

Reality is more complicated. If one looks at Table 2, one sees the same variables as in Table 1 but this time the stressors are measured by observers. Thus, a more objective conceptualization of stressors is used — objective in the sense that the cognitive and emotional processing of the target person is not involved in measuring the stressors (Frese and Zapf, 1988). One can see that the relationship between stressors and psychosomatic complaints is somewhat reduced but still significant. In terms of correlations the relationship between stressors and psychosomatic complaints is 0.31 involving subjective stressor-measurement and 0.19 involving observers' stressor measurement.

Thus, there is some truth to a factor like negative affectivity — the correlation is reduced. But negative affectivity cannot explain the whole correlation between stressors and psychosomatic complaints. This is also true if the stressor side is only measured by a questionnaire filled out by the workers themselves. In careful analyses Zapf (1987) has shown that these correlations cannot be completely explained by a factor such as negative affectivity. Thus, a full conceptualization of the multicausal stress process works against the use of variable explanations that invariably turn out to be wrong.

## 4. CONTEXT FACTORS: RESOURCES

Resources in psychology have a similar function as in economics. For example, oil gives revenues and makes a country independent from others. Similarly psychological resources help to achieve one's goals and to deal with aversive conditions and potential difficulties. Thus, they help to deal with stressors. Probably the most important finding of the last 20 years of psychological stress research is that resources have to be considered when analysing the stress process.

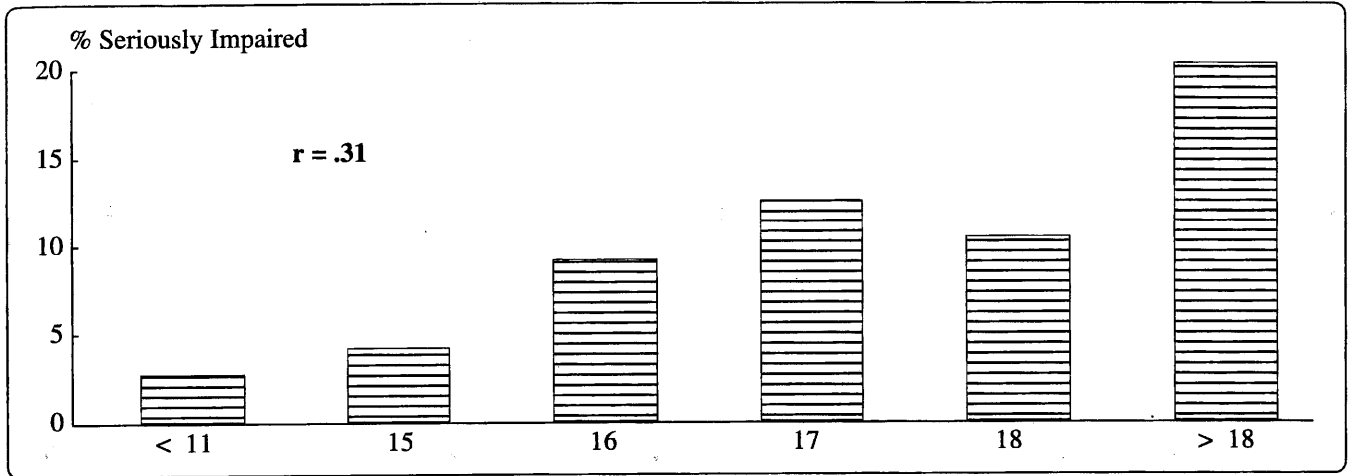
### 4.1. Resources and the stress process

There can be internal (within the person) and external resources. Skills, knowledge and meaning of the tasks are important internal resources and control at work and social support are important external resources. I shall concentrate on the two external resources here. Control means that a person is able to influence his actions and the conditions under which he acts. Thus, all aspects of actions can be affected, e.g. goal development, plan development and decisions and processing of feedback (Frese, 1989). Social support is characterized by three factors: affective support (love, liking, respect), confirmation (confirming the moral and factual 'rightness' of actions and statements) and direct help (aid in work, information, receiving money) (Kahn and Antonucci, 1980).

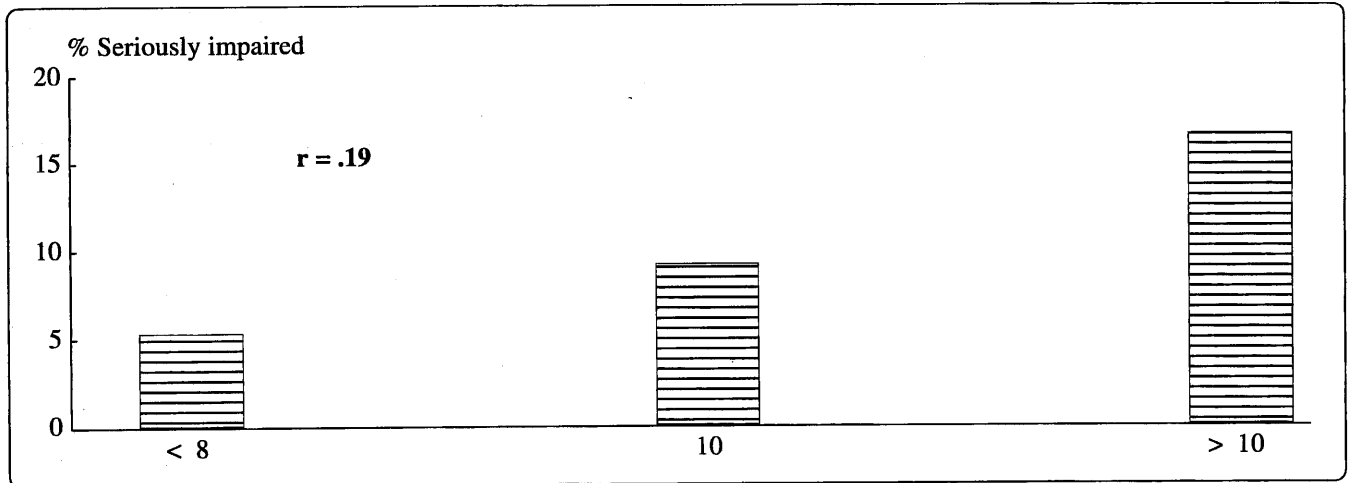
Resources play an important role in the stress process. Table 3 presents potential effects of resources in this process. Let us first concentrate on the stress process at the bottom of the table. An objective stressor means, for example, that one has to react quickly to a danger signal. Stressor perception implies that I perceive and know, that I have to react quickly when there is a danger signal. Stress appraisal is characterized according to my knowing that it is stressful to have to react quickly when there is a danger signal. A stress-reaction is that I have a bad feeling in my stomach when I have to be vigilant for this danger signal. The long range effects of the stressor may implicate ill health.

The empirical importance of resources — control at work and social support — has been demonstrated numerous times (a summary of control is given in the volume edited by Sauter, Hurrell and Cooper, 1989 and by Karasek and Theorell, 1990 and on social support by Cohen and Wills, 1985). Some of the studies have been criticized because they did not use objective indicators of stress and resources and have not relied

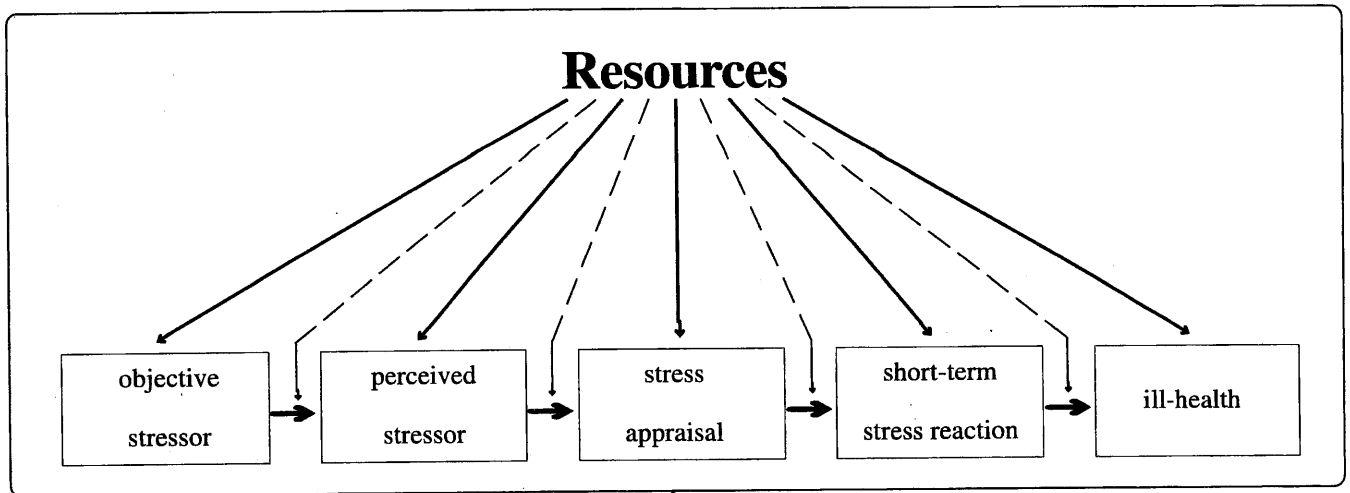
**Table 1. Perceived psychological stressors.**



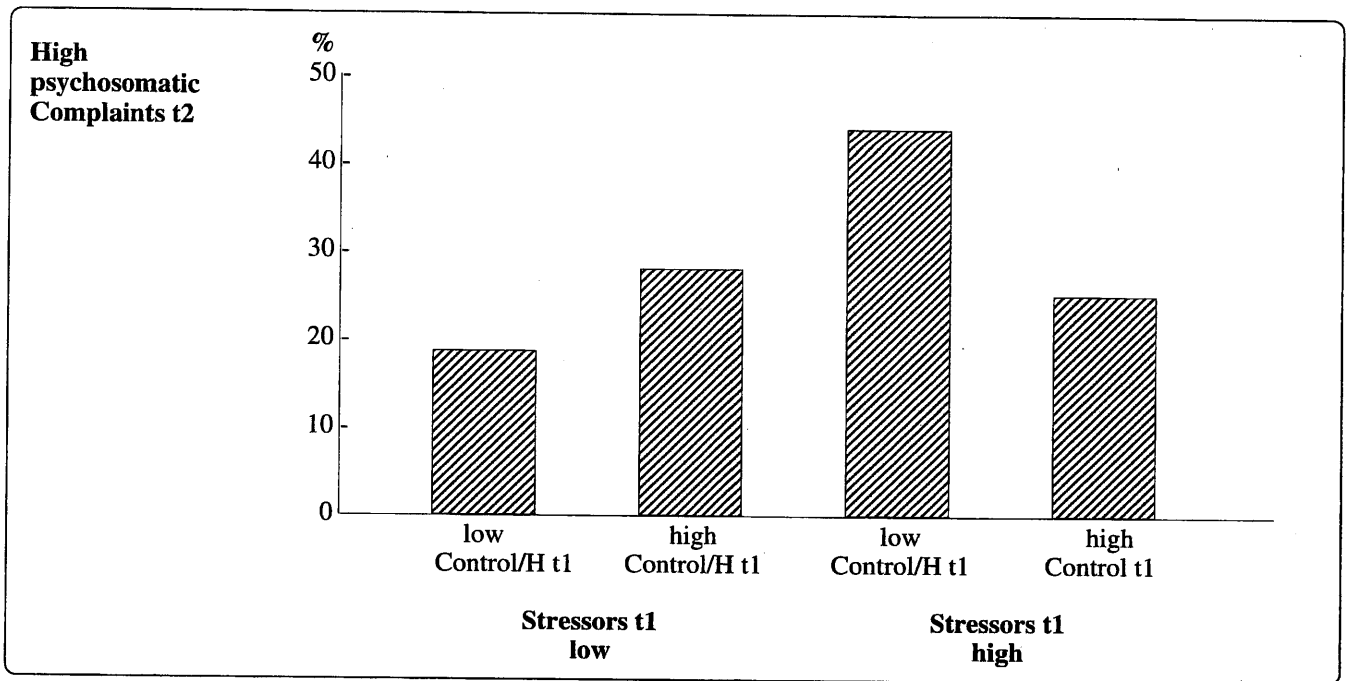
**Table 2. Observed psychological stressors.**



**Table 3. The stress process and potential impact of resources.**



**Table 4. Correlation between stressors observed and percentage of individuals with high-level of psychosomatic complaints depending on the degree of control observed.**



**Table 5. Two longitudinal studies of the correlation between subjective psychological stress / perceived psychological stressors and psychosomatic complaints. Figures indicate correlation coefficients, i.e. a high value (close to 1.0) indicates a strong correlation. Vertical dimension describes the above correlation. Horizontal dimension describes correlation over time.**

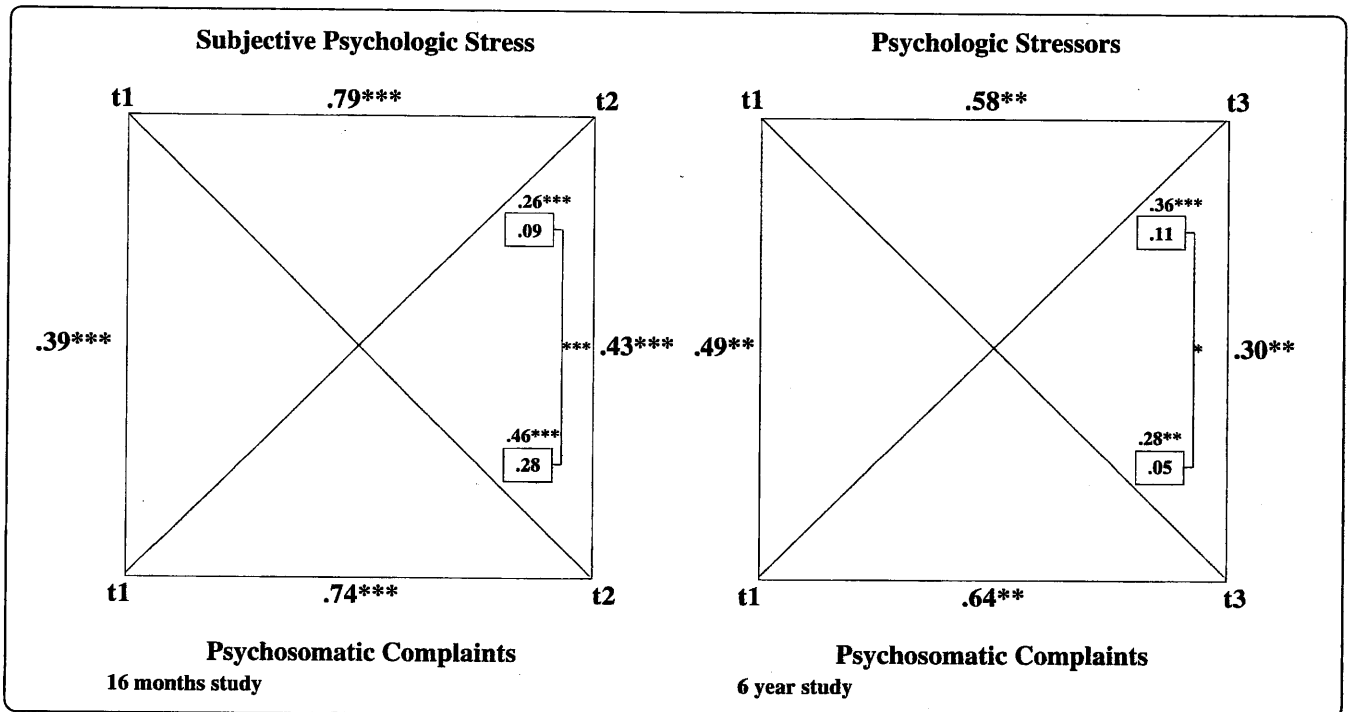


Table 6. Stress prevention.

	Individual	Institutional
Resource oriented	training for competence	increasing job discretion work (e.g. job enrichment)
Stressor oriented	decrease stressor	decreasing stressor e.g. noise level at work
Stress/Strain oriented	relaxation training	rest periods

on longitudinal studies. Table 4 shows a result of a study in which trained observers rated the stressors at work and control at work. A high degree of psychosomatic complaints appeared more frequently in the group with high stressors and low control (this study has been analysed with more sophisticated methods as well, leading essentially to the same results, see Semmer and Frese, 1990), see Table 4.

**4.2. Why do resources play a role in the stress process**  
Thus, resources have an impact on the stress process. The question is now, how this impact can unfold. There are several pathways by which resources have an impact. They will be discussed in the following (we concentrate on control but similar arguments can be made for social support as well).

**(1.) Stressor-reduction.** Surprisingly there is not much evidence in the literature that social support or control impacts on stressors directly. This may be due to the fact that the resources are usually used in the very beginning of a job to reduce stressors. Thus, studies that do not concentrate on the first phase of a job but rather on the long-term employed cannot show this effect. In an experimentally induced increase of participation in decision making, Jackson (1983) has empirically shown on the reduction of role ambiguity and role conflict (moreover, by decreasing the stressors, participation in decision making also reduced absence frequency and turnover intention).

**(2.) Moderators.** There are three moderator effects:

**(2.1.) fitting the stressor to psychophysical prerequisites.** According to this mechanism, the stressors at work are not changed but their impact on health is reduced. If a person has control, she can do stressful tasks when she prefers to do them. Some people prefer tedious and stressful tasks in the morning, others in the evening because they can rest afterwards. If one can decide on the time frame, one can adjust the situation according to one's needs. This leads to a more relaxed approach to stressful tasks.

**(2.2.) safety signal.** According to this hypothesis (Miller, 1979; Selimgan, 1975), control enables a person to determine the worst possible outcome. For example, if a person knows that she can leave the work place and find another equally good job she can be assured that the stressors at work will never get out of hand. If the stressors become too imposing, she can leave the job. This makes her more relaxed in dealing with the existing stressors than a person who does not have control of this kind. In our studies, alternatives in the job market indeed showed a moderator effect of the relationship between observed stressors at work and perceived stressors. Thus, a person does not perceive the stressors if she has control in the sense of a safety signal.

**(2.3.) persistence in coping.** Folkman (1984) has suggested that control could affect persistence.

**(3.) Direct effect on ill health.** Since people are social animals, it is quite likely that there is a need for social support. Similarly, people are active and search for control (Oesterreich, 1981; White, 1959). Thus, it is likely that there are direct effects of lack of control or social support on the development of ill health.

## 5. TIME AS A FACTOR IN THE STRESS PROCESS

Time is of particular importance in stress research. In another article, we have at length discussed this issue (see Frese and Zapf, 1988). At this point, we just want to touch one aspect, causation versus selection effects. The great question of research on stress at work is whether or not stressors causes ill health or ill health causes people do get bad jobs with high stressors. The latter is possible because sick people will be absent more often and will be seen to be less able to work hard. This may lead to an assignment of work places with little responsibility and higher stressors.

We have done two longitudinal studies (see Table 5), one over 16 months and one over six years. In the 16-month study there was a clear-cut effect of stressors on psychosomatic complaints. However, in the six-year study, the picture pointed more in the direction of selection effects (although the latter data are not absolutely clear-cut). This makes sense because it takes longer for a socialization effect to develop. The supervisor has to perceive the problems of a person, jobs have to be created or other colleagues may at least get the better jobs that are developed with time.

These results suggest the existence of a vicious circle. Stressors have an impact on the development of psychosomatic complaints, these again may lead to worse jobs with higher stressors, etc.

Thus, again, we have seen that a multicausal conceptualization allows us to understand the complexity of the stress process better.

## 6. CONSEQUENCES OF THIS VIEWPOINT

By way of summary, our discussion has pointed out that the viewpoint of multicausality implies that one

has to look at complex interrelationships amongst stressors, between stressors and resources, and in addition the relationship between stressors and ill health may be quite different depending upon the time the study looks at.

The complexity of this picture should not lead to the conclusion, however, that nothing can be or is known about stress at work. We do know quite a bit and we can be quite sure that stressors (and lack of resources) are in fact important risk factors for ill health.

In the following pages we will talk about the implications of this multicausal point of view for lawmaking, for research and for interventions at the work place.

### **6.1. Consequences for lawmaking and societal regulations**

Lawmakers have difficulty with taking into account multicausality. It seems to contradict the intuition that the law should be very clear. In some countries, the law on occupational diseases is explicitly monocausal (e.g. in Germany). The problem is that multicausal relationships are at work in reality and, therefore, the law cannot be founded in reality as long as multicausality is not taken into consideration. A multicausal concept implies that probabilities have to be weighed as well. In law, one could use the notion of stressors leading to ill health with a certain probability. In the example of a compensation claim, a company would have to pay a certain amount of the total costs (the amount being equal to the probability if its stressors lead to ill health). If psychological stressors and resources have a 40% impact on psychosomatic symptoms, the company would have to pay 40% as well.

This approach has to be connected with a 'reversal of prove' concept, however. The company would have to prove that its working conditions are responsible for less than 100%. If this 'reversal of prove' position would not be upheld, those companies that allow research would have a worse position than those not allowing research. Moreover, the reversal of prove position in accident prevention has contributed strongly to the companies improving safety conditions at work in the past.

Of course, there has to be a reasoned suspicion that the working conditions are in fact causally related to some psychological conditions, e.g. depression or psychosomatic complaints.

Those companies that provide good working conditions (low stressors and high resources) and good stress management programmes could be exempt from such compensation claims if they can prove that stressors are not important contributors to ill health. All large companies would be asked to keep epidemiological registers to show to which extent stressors contribute to ill health.

There are certainly many difficulties with the position just outlined and one needs to look into the issues

related to multicausality in more detail (and from various disciplines, e.g. medicine, engineering, law, and psychology). But a beginning should and can be made.

### **6.2. Research**

In terms of research, multicausality implies that one should 'let 1 000 flowers bloom', but one also has to make sure that each gardener takes care of more than just his one favourite flower. Thus, more multidisciplinary research is needed, particularly with regard to physical and psychological stressors and their potential interactions and interactions between stressors and resources. Also, more research is needed on how different strategies of stress prevention can improve working conditions.

### **6.3. Intervention**

Multicausality implies, of course, that one should not be 'blind in one eye', but should take the full multicausal picture into consideration. Thus, the plea is for occupational physicians to take up psychological issues — in cooperation with professionals from psychology (otherwise only dilettantism results). Similarly, psychologists should cooperate with physicians to a higher degree, see Table 6.

Since multicausality implies that various factors contribute to the development of ill health, one can also have multiple avenues to intervene in this stress process at work. Table 6 presents the psychological factors that can be the targets of intervention. Thus, I advocate a radical departure from the concept of one or the other to the concept of one and the other. I plea for multiple avenues to intervention to prevent stress.

Interventions may be resource, stressor or stress/strain oriented. Moreover, they can take the individual as the target person or the company.

Examples of resource oriented interventions are to increase control at the workplace or training the competence of individuals. Control at work was, for example, enhanced in a study by Wall and Clegg (1981). Semi-autonomous work groups were introduced and one of the results was that ill health significantly decreased and productivity increased even long after the experiment had been ended. This is another indicator that productivity gains and stress prevention do not have to contradict each other but may result from the same change in the work place.

Stressor oriented institutional approaches have been described by Slesina (19..) and Bru and Mykletun (1993). In these studies, health circles (very similar to quality circles) were introduced. Here workers were asked to think about ways to make the work easier and less stressful. In one example (Slesina, 19..) crane operators complained about the stressfulness of their work because the ground personnel frequently violated the safety regulations, for example, by crossing the no-cross zones without checking the cranes above. After discussions in the health circles, the crane operators

asked the ground personnel to ride along in the crane to find out for themselves how difficult it was to recognize operators from above and that their former behaviour was accident prone. This measure reduced their stress producing behaviour.

Individual stress strain oriented prevention strategies are certainly most common because stress management programmes fall under this rubric. These include relaxation training, work-site counselling, stress inoculation training, etc. (e.g. Neidhardt, Weinstein, & Conry, 1985). An overview of such programmes and their efficacy is given by Shapiro, Cheesman & Wall (1993). Stress management programmes are often quite effective but they should not be the only strategy of stress prevention (Ganster, Mayes, Sime & Tharp, 1982). A somewhat separate field is the Employee Assistance Programmes (EAPs). These programmes which are particularly common in the US and somewhat less common in the United Kingdom combine stress management with lifestyle changes, e.g. changes in smoking, drinking and exercise. Typical evaluation studies show a high benefit for the employee and for the employer. For example, one study argued (Maiden, 1988) that there was a five-year return of USD 7.01 for every dollar invested into the EAP for the company.

There are also institutional strain oriented approaches, most notably the introduction of rest periods. Surprisingly, there are very few recent studies on this issue, although as Frankenhaeuser (this volume) has pointed out, there is a high necessity to reduce the negative effects of stressors on the ability to unwind. Rest periods may be one important answer in this area.

## 7. CONCLUDING REMARKS

Sometimes, people have argued that expenditures on health promotion at the workplace are simple expenditures without returns for the companies. This is certainly not the case. In many ways, investing in health does not only alleviate human suffering, it also pays off for the companies that do it. In the case of stress at work this is particularly so. For example, job restructuring often means job enrichment. Job enrichment has been shown to increase productivity (Guzzo, Jette, and Katzell, 1985) and it increases the resources at work. Thus, increasing resources very often leads to productivity gains. The results by Wall and Clegg (1981) have shown that productivity gains and reduction of psychological ill health go hand in hand. Many times, the introduction of quality circles also led to a reduction of stressors (if they were combined with health circles, this could even be achieved quite easily).

Moreover, there are many costs of stressors at work that lead to a reduction of productivity. The most important ones are absenteeism (a particularly important problem in Europe) and fluctuation. But in addition, indirect costs are important. The concept of 'resistance to change' (Coch and French, 1948) has been used to understand that changes find stiff resistance if there are no resources to cope with these changes. Thus, stress issues should not be pitted against productivity issues.

This article has argued that the concept of multicausality can explain research results from the area of stress at work and that certain conclusions for law making, research and interventions follow from such a view. The stress process should not be conceived as an overly simple process. Moreover, any intervention and regulation should not make the mistake of underestimating the complexity of this area.

However, the psychological stress field is not different from the other fields represented at this conference. As a matter of fact Carter (in this volume) has discussed similar issues in toxicology. Since psychology has always been forced to tackle multicausal processes, other lines of research in ergonomics and toxicology may possibly learn from the experiences psychology has in this area.

One should not misread this contribution to mean that there is no positive knowledge in the area of stress at work and ill health. There is ample evidence that work stressors have an impact on ill health (e.g. Frese, 1985) and that there is an interaction between stressors and between stressors and resources. Thus, the issue of multicausality has to be tackled in the area of work and health.

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