

Theoretical Models of Control and Health

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INTRODUCTION

The issue of control at work in health psychology has been made plausible in experimental work and in epidemiological research but has now come under criticism, as noted in some of the articles in this book (e.g. Kasl, in this volume). Some of the problems with control at work have been conceptual. In contrast to the notion of control in experimental work, the issue of control at work needs additional conceptual clarification. I would like to pursue the theoretical and conceptual discussion, first discussing conceptual issues, and then potential mechanisms of how control influences (psychological) ill health. Occasionally, I shall refer to some empirical findings on control and work, and/or stress effects of work. The empirical results are taken from a project on stress at work.¹ This project is unique because we have two reasonably objective measures of control at work and stressors at work: first, observers rated the workplaces; second, three or more blue-collar workers who were doing the same work filled out our questionnaire; we can take their median rating as a fairly objective rating because idiosyncratic responding has been eradicated. Of course, there were also subjective ratings by the individual job holders. Additionally, there are some other measures related to control cognitions. The dependent variable is a measure of psychosomatic complaints. Finally, one part of the project is a longitudinal study over 16 months (for more details, see Frese, 1985; Semmer and Frese, 1989). I shall concentrate on the first cross-sectional and on the longitudinal study; I shall also restrict myself to the discussion of psychological stressors because they have proved to be more important (Frese, 1985).

CONCEPTUAL ISSUES OF CONTROL AT WORK

Control means to have an impact on the conditions and on one's activities in correspondence with some higher-order goal (Frese, 1977). It is important to

emphasize the goal-related nature of control. Without a goal, there is no issue of control. This concept is somewhat different from other definitions, for example, the one by Seligman (1975) in which control is defined as non-contingency of events (an event appears or disappears regardless of a person's actions). Such a definition, not bound to the goals of a person, produces some conceptual difficulties: according to this definition, a person would, for example, have control if he accidentally knocked over a vase. Although contrary to his intention, his behaviour produces a certain contingency and would therefore be assumed to be controllable on the basis of Seligman's definition.

A person exerts control when he has influence over his actions and over the conditions under which he acts. Control in this sense can be differentiated into various components, as shown in Table 1. An action consists of a certain sequence (this sequence is variable, of course): goal development and goal decision; plan development and decision; execution of the action and use of feedback (Frese and Sabini, 1985; Norman, 1986). Having influence means being able to decide which goals, which plans and what kind of feedback a person is using, under which conditions. If the environment does not provide the freedom to decide, the person does not have any control. Decision possibilities can appear with regard to sequencing, timeframe and content. Decision points with regard to sequence may, for example, mean that people are able to determine which tasks they do first and which ones second, in which sequence plans are being formed and executed, or in which sequence they call on signals to inform them of the success of their activities. Timeframe refers to two sets of decision possibilities: first, the decision, as to *when* a certain task is tackled or a particular plan is performed; second, deciding on *how long* it will take to work on a task or on a plan. Similarly, the timing of the signal indicates when it will appear and how long it is displayed. Content refers to the substances of the decisions with regard to task, plan, signal and conditions: which particular task is performed, which plan is formed, which kind of signals one chooses to use and which conditions exist for work.

Several issues are worth emphasizing in this context. First, the *goal-oriented nature of control*: the decisions must refer to a goal (or in the case of a task, to a superordinate goal). One makes a decision with some goal in mind. As long as something is irrelevant to a person's goals, non-control does not matter. So, for example, if a worker does not have any goals with regard to his job, there are no negative consequences of not being able to decide anything (however, such a case is quite unlikely to happen). Similarly, the purely legal right of being able to quit a job implies no control, as long as the worker is not sure to find another one that is at least as good as the present one (since we assume that the worker does not have the goal to get a job worse than the present one).

Second, *hierarchy of goals*: there is a hierarchy of goals within any one person at any one time (there may, of course, be multiple and conflicting goals). The higher up in this hierarchy a particular goal is, the more important

Table 1 Aspects of control

Action sequence	Decision possibilities		
	Sequence	Timeframe	Content
Tasks (Goals)	-	-	-
Plans	-	-	-
Feedback Signals)	-	-	-
Conditions	-	-	-

and central the decisions become (e.g. life or career plan decisions). Thus, control and non-control must be weighted by the importance of the goal. However, a caveat has to be made here: for most people, higher-order goals are not at their disposal any more after they have been committed to them for some time. For example, a life goal cannot be re-decided at any one point. Therefore, the more practical day-to-day activities stand in the foreground of one's attention. There is actually little need to think consciously about the higher-level goals. After a while, this may lead to a reduction of their conscious 'importance', whereas lower-level goals remain in the foreground of attention and thinking and, therefore, achieve high importance.

Third, *exposure time*: aside from the above points about the significance of goals and goal hierarchy, it is important to ask the question as to how much of the time a person is exposed to non-control or control situations. The theory predicts that exposure time is an important variable (Frese and Zapf, 1988, discuss some variants of the exposure time model). If one is constantly under conditions of non-control (little decision-making power) even in small matters, there is an impact even if the goals are not very important. The longer one is exposed to these conditions, the stronger their impact on experienced control, even if higher-order goals (like life goals) are still under the individual's influence.

Fourth, *control and risks*: freedom to decide has a positive quality only when the decision alternatives do not involve high risks. If all the alternatives involve high risks, then controllability may lead to an aversive situation. For example, if a blue-collar worker is paid by a piece rate system, he seems to have some degree of control. However, the risks to reduce the output may be too high (the money may not be enough, he also might be reprimanded and even get fired). At the same time, the risks of increasing the output beyond a certain point are

also high (co-workers might object or the worker might not be able to keep up the production for a long time at a constant high rate).

Fifth, *objective and subjective control*: there are several different meanings of 'objective' and 'subjective' (cf. Frese and Zapf, 1988). We think of subjective as meaning that the job holder has done some cognitive and emotional processing in the process of perceiving and assessing the objective situation. 'Objective' is used in the sense of not being related to the 'target' individual's processing. While control has to be seen with reference to a goal (of the target person) in any case, there may be objective ways to achieve this goal and objective decision alternatives that the person might not perceive to exist—in this case the perceived level of control is lower than objective control. Furthermore, the person might 'perceive' alternatives that actually do not exist in reality—in such a case perceived control is higher than objective control (illusion of control). I assume that illusions of control are lower in the work situation because feedback conditions are usually more obvious in work life than in other areas of life.

Sixth, *potential control*: potential control was studied by Glass and Singer (1972). In their experiments the subjects had a button that could turn off a loud noise (the stressor). The subjects were, however, asked not to use this button (and all of them complied). This condition produced less stress than not having a control button. A similar (although not identical) concept is *hope for control* in the future which might serve the same purpose as control itself, e.g. the blue-collar worker hoping to become a supervisor and having more control then. Hope for control complicates the issues because non-observable future control may influence health. In our study scales for individual control cognitions and hope for control were developed (hope for control was simply the same questions referring to the future: 'I expect that my chances of being able to influence will become stronger (or weaker) in the future'). These two scales have a cumulative effect when they are related to psychosomatic complaints (shown in Table 2).

Seventh, *differentiation between individual and collective control*: this is of particular importance for blue-collar workers, because blue-collar workers often exert power by collective means. Thus collective control implies individual control that is exerted via collective avenues. For example, a blue-collar worker on the assembly line may be able to influence the speed of the line only if other co-workers protest as well. Note that collective control in this sense is not the same as control by representation, where a representative is elected and then comes to a decision on the basis of his or her conscience and knowledge. There is some overlap of collective control with social support by co-workers (in our study the correlation between generalized collective control cognitions and social support by co-workers was .30, $p < .01$, $N = 175$).

In our study, we have measured individual and collective control cognitions. Although these two concepts are highly correlated ($r = .57$, $p < .01$, $N = 176$),

Table 2 Control cognitions and psychosomatic complaints (median partitioning of subgroups; means of psychosomatic complaints displayed)

		Individual control	
		Low	High
Hope for control	low	2.38	2.25
	high	2.06	1.88

Table 3 Control cognitions and psychosomatic complaints (median partitioning of subgroups; means of psychosomatic complaints displayed)

		Individual control	
		Low	High
Collective control	low	2.39	2.33
	high	2.07	1.93

there is a cumulative effect when they are related to psychosomatic complaints (cf. Table 3). Apparently, it is positive for blue-collar workers to exert both types of control.

Eighth, *personal prerequisites of control*: the control conditions in Table 1 represent only *potential* decision points with regard to some goal. To realize this potential, one needs to have knowledge and skills as personal prerequisites. This concept is not identical to skill requirements of the job (i.e. the demands made by the job on the skills) but it may be affected by them.

Skills imply that a person is able to act in an efficient manner (Semmer and Frese, 1985; Volpert, 1974); this means that goals, plans and the use of feedback must be realistic, stable-flexible and organized. The goals and plans must be realistic in terms of timeframe and sequence, i.e. the plans have to have realistic 'time tags' associated with them and have to be represented in a realistic order. Stability implies that goals and plans are not immediately given up when there is some negative feedback. On the other hand, plans should be executed in a flexible way, i.e. they should be adjusted to the environmental conditions. Therefore, skilful action proceeds in a stable and flexible way. Finally, organization implies that those plans that are used very often in redundant circumstances should be psychologically automated so that one has central processing capacity free to deal with other work demands.

Ninth, *areas of functioning of control*: control may refer to direct work activities. It may also relate to the social and organizational situation at work.

Table 4 Levels of functioning of control

Area	Objective		Subjective		
	Individual	Collective	Individual	Collective	Hope for control
Work content	-	-	-	-	-
Product	-	-	-	-	-
Workplace/ environment	-	-	-	-	-
Work group	-	-	-	-	-
Supervision	-	-	-	-	-
Organization	-	-	-	-	-
Change of technology and workplace	-	-	-	-	-

In Table 4, different areas of control are shown. The areas described are important in the work situation. It is possible to differentiate between subjective and objective control, as well as between individual and collective control and hope for control in the future with reference to each of these areas.

CONTROL AT WORK AND OTHER CONCEPTS IN THE LITERATURE

The concept of control, defined in this way, can now be compared with other notions in the literature. Workplace-oriented concepts are, for example, mentioned by Kasl (in this volume): repetition, machine pacing and autonomy; other authors have discussed participation in decision making (e.g. Jackson and Ganster, this volume), occupational self-direction (Kohn and Schooler, 1982), and job decision latitude (Gardell, 1971; Karasek, this volume):

If *repetition* means that one is forced to repeat a certain procedure over and over again, it implies that the sequence and the content of the tasks, plans and feedback stay the same—therefore there are no chances to make decisions here. However, one is able to make decisions with regard to timeframe and it might be possible to influence the conditions (in all likelihood, however, repetitive jobs do not actually allow influence over conditions).

Machine pacing implies that the sequence, timeframe and content of the plans and feedback are fixed by the machine (e.g. Smith, 1985). However, it would be possible in principle to have influence over the task (e.g. if the workers in a worker-managed firm decide who does which type of task on the assembly line) although this is not likely in most cases. Decisions with regard to conditions can still be made under conditions of machine pacing.

Autonomy is defined as 'the degree to which the job provides substantial freedom, independence, and discretion to the employee in scheduling the work and in determining the procedures to be used in carrying it out' (Hackman and Oldham, 1975, p. 162). Clearly, this refers to the timeframe and the content of tasks and plans. It also seems to imply that one has freedom to decide on the sequence of tasks and plans. It is a little less clear whether or not the concept implies decisions with regard to conditions and feedback.

Participation in decision making 'refers to the extent to which employees are given opportunities to control or influence their job environment' (Jackson, this volume). This concept is, therefore, usually less strongly related to the action sequence (tasks, plans, feedback) and more to the conditions under which one works. The content and where applicable the sequence and timeframe of conditions are (co-)decided here.

The German term *Handlungsspielraum* (Ulich, Groskurth and Brugemann, 1973) should be briefly mentioned here because German stress at work research has been quite active (although it is little noticed in the English-speaking world) and has produced a number of books and collections of articles (e.g. Frese, 1981; Frese *et al.*, 1978; Marstedt and Mergner, 1986; overview in Udris and Frese, 1988). A second reason is that the empirical indicator of control at work used in our studies is the concept of *Handlungsspielraum* (a literal translation would mean 'scope of action') (Semmer, 1982, 1984, has developed the scale). This concept will be abbreviated as 'control/H' from now on. It implies that there are decision points as to sequence and timeframe with regard to tasks and plans. The other aspects are not considered within this concept.

Occupational self-direction (Kohn and Schooler, 1982) is not really the same as control, as it is composed of complexity, closeness of supervision and routinization. Only the subconcept *closeness of supervision* is related and implies that the supervisor determines the content of the tasks (and probably of the plans).

Karasek (1979) uses the term *job decision latitude* to signify complexity (more on this later) and the decisions of the content of tasks and plans. The questionnaire items used by him do not explicitly mention the issues of sequence, timeframe, feedback and conditions (although the statement 'allows a lot of decisions' may refer to them as well).

Many authors do not differentiate between *complexity* and control, and compose one index that embraces control and complexity of work (Karasek, 1979; Kohn and Schooler, 1982; Volpert *et al.*, 1983). While there is a clear correlation between these concepts (we find $r=0.70$ on the observer level and $r=.43$ on the perceived level between the two concepts control/H and complexity), they are conceptually distinct. Both complexity and control refer to decision points, but instead of *decision possibilities* (as in control), there is a *decision necessity* in a complex situation. Furthermore, complexity implies that

Table 5 Correlations of control/H with psychosomatic complaints; complexity as a moderator (*N* in parentheses)

Level	Psychosomatic complaints					
	Study 1 Complexity		Longitudinal study ^a Complexity		Study 2 Complexity	
	Low	High	Low	High	Low ^b	High ^b
Control/H	.07	* -.11	.12	* -.20	-.03	-.04
Observed	(91)	(82)	(36)	(40)	(109)	(87)
Group	.21	*** -.30	.48	*** -.33	-.03	-.05
	(84)	(89)	(36)	(39)	(226)	(246)
Perceived	-.01	** -.26	-.09	-.23	-.04	-.10
	(84)	(87)	(37)	(42)	(264)	(329)

* $p < .10$
 ** $p < .05$
 *** $p < .01$ } for differences between subgroup correlations.

^a All variables t_1 , except psychosomatic complaints.

^b Low (Study 2) = lowest third on complexity; high (Study 2) = highest third on complexity.

decisions pertain to a problem with a large number of elements to be considered, a large number of relationships between these elements, and a large number of conditional relationships between the elements. There is probably a curvilinear relationship between control and complexity. At a very low level of complexity, there are no decisions to be made; ergo control is low as well. At a very high level, complexity is overwhelming and the decisions cannot be made adequately—control cannot be realized. Thus, at least on the subjective level, control is low when complexity is very high.

With regard to health outcomes, complexity may actually be a moderator of the relationship between control and ill health. I do not necessarily presuppose that there is a simple linear relationship between control and ill health, but there may be one if complexity is high. If complexity is high, non-control is particularly negative: one has to do complex work without being able to influence the way it is done. Frankenhaeuser and Gardell (1976) have described their non-control group in a similar way: The blue-collar workers had to make complex decisions but without any leeway, under high time pressure and machine pacing. Complexity and control/H seem to interact empirically in two of our studies as well (the first cross-sectional study and the longitudinal study—the same results do not appear in the second cross-sectional study). Table 5 shows that many correlations between control/H and psychosomatic complaints are significantly different depending upon whether they are computed for the low- or for the high-complexity subgroup (a median split procedure was used for Study 1 and the longitudinal study; the correlations for

the lower third and the upper third on complexity are shown for Study 2; only significances *between* subgroups are displayed). This result is not quite so clear in Study 2 as it is in Study 1 and the longitudinal study.

In summary, our conceptual discussion has developed a differentiated picture of the control concepts. This allowed us to map other overlapping concepts into Table 1. Finally, it is necessary to differentiate conceptually between control and complexity in spite of a high empirical correlation between them. After this conceptual discussion, it is possible to turn to the question of how control can affect health outcomes.

MECHANISMS OF CONTROL EFFECTS AND HEALTH

It is less interesting to ask the simple question whether or not control directly relates to health. Such a question only refers to the outcome but an answer does not tell us anything about the underlying processes. Whenever interventions are attempted, we need to know something about the processes by which stress and control at work affect ill health. The potential mechanisms (processes) are described in Table 6.

It is possible and necessary to distinguish different moderating and direct effects, as shown in Figure 1. The stress process can be differentiated into objective stressors (not influenced by the target individual's cognitive and emotional processing), stressor perception (noticing the existence of the stressor), stress appraisal (the stressor being perceived to be stressful; primary appraisal in Lazarus' 1966 sense), short-term stress reactions (e.g. stomach cramps), and ill-health effects (Frese and Zapf, 1988). (In our study, the observed and group level measures of stressors can be conceptualized to be objective stressors; the measures of perceived stressors are something in between subjective perception of stressors and stress appraisal, see Zapf, in preparation, for details). Although it is not always possible to differentiate these aspects empirically, it is useful to keep them conceptually apart. Direct effects and moderating effects can impact on any of these variables (direct effects have an arrow pointing to the top of a box, moderating effects have a dotted line on the arrow between the boxes). Thus, different direct effects or different moderating effects can be postulated. With this in mind, we now turn to the discussion of the hypothesized mechanisms, described in Table 6.

Mechanism 1: Stressor Reduction

Since control implies that one can change environmental conditions, certain stressors can be reduced or even abolished. A trivial example is that a person can keep out some noise by shutting a door (thus controlling the stressor noise). Another example is that a person with a high degree of control at work may influence the design of his or her job, thus minimizing the stressors. If this design can be done according to individual needs (Ulich, 1983), even idio-

1. *Stressor reduction*: Control reduces stressors:
objective control → perceived control → reduction of objective stressors
→ (reduction of perceived stressors) → reduction of ill health
2. Stressors stay intact but control decreases the impact of stressors on ill health
 - (a) *Fitting*: Fitting the stressful environment to psychophysical prerequisites:
objective stressors — /control/ → perceived stressors → ill health or
objective stressors → perceived stressors — /control/ → ill health
 - (b) *Safety signal* (minimax hypothesis):
objective stressors — /control/ → perceived stressors → ill health or
objective stressors → perceived stressors — /control/ → ill health
 - (c) *Persistence in coping*:
stress appraisal — /control/ → persistence in coping efforts → ill health or
stress appraisal — /control/ → objective stressors
3. *Need for control*:
 - (a) *Direct need effect*: non-control → ill health
 - (b) *Indirect need effect*: non-control — /stressors (or stress)/ → ill health or
 - (c) Stress appraisal — /control/ → stress reaction

Note: read → as a causal path and — /control/ → as a moderator effect of control

syncratic stressors can be affected. This mechanism implies a direct effect of control on stressors. Empirically, control may affect objective as well as perceived stressors. Objective stressors can be changed objectively, if one is able to influence the conditions of work. However, not all stressors are perceived in the same way by all people; since no study can really observe all the potential objective stressors at work, and since scales of perceived stressors probably represent a more holistic approach (as a result of the cognitive and emotional processing by the target individual), there will also be an empirical effect of control on perceived stressors. Thus, control should be negatively correlated with objective and perceived stressors. This correlation should be stronger for perceived control because only perceived control leads the person to change the work situation (this relationship is signified as M1 in Figure 1). Unfortunately, most scales on control cannot really be used to test this hypothesis because they do not include control over conditions. This is also true of our control/H scale. Table 7 presents the correlations of control/H with psychological stressors.

Apparently perceived control/H is essentially unrelated to stressors. Observed control/H even shows a positive correlation with observed stressors. Since control/H does not measure control over conditions, these results are not surprising. To be able to test the hypothesis, it would be necessary to have a scale of control over conditions.

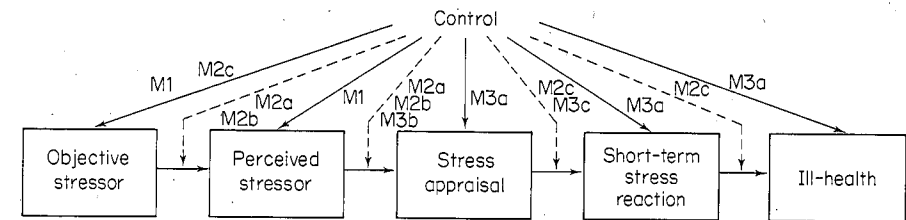


Figure 1 The potential direct and moderating effects of control in the stress process:
M1 Mechanism 1: stressor reduction
M2a Mechanism 2a: fitting the environment to the person
M2b Mechanism 2b: safety signal
M2c Mechanism 2c: persistence in coping effort
M3a, b and c need for control

Mechanism 2a: Fitting the Stressful Environment to the Psychophysical Prerequisites of the Person

According to this mechanism, the stressors at work are not changed or abolished but their impact on ill health is reduced. The fitting of the stressful environment to the psychological and physiological state of the person is achieved mainly through the person having control over timeframe and sequencing of tasks and plans. An example is that the most stressful tasks can be performed when a person feels particularly able to do them. Some people prefer to do tedious and stressful tasks in the morning when they are not yet tired. Others prefer to do them in the evening because they can rest afterwards. In any case, given decision possibilities over timeframe and sequencing, people can adjust the situation according to their needs and are, therefore, more relaxed in their work. This hypothesis implies a moderator effect of objective and perceived control on the relationship between objective and perceived stressors. When a person is more relaxed he is less likely to perceive objective stressors. Moreover, there is also a moderator effect on the relationship between perceived stressors and stress appraisal (as well as short- and long-term stress effects). These effects are signified as M2a in Figure 1.

Control/H in our studies is particularly geared towards measuring the timeframe and sequencing aspects of control. The moderating effect of control/H on the relationship between observed and perceived stressors can, therefore, be tested. In our studies there is no consistent moderating effect on control/H on the relationship between observed and perceived stressors (there is a slight tendency in the longitudinal study).

The second moderator effect of control/H is on the relationship between stressor and stress appraisal. Since we did not measure stress appraisal, we can only test the effect on the relationship between stressors and psychosomatic complaints. Semmer (1984) has presented evidence that control at work

Table 7 Correlations of control/H and stressors

Stressors	Control/H at work					
	Study 1			Study 2		
	Observed	Group	Perceived	Observed	Group	Perceived
- Observed	.18**	.05	.00	.13**	.07	.05
- Group level	.01	-.07	-.11	.09	.20**	.08**
- Perceived	-.02	-.05	-.10	.16**	.08*	.07*

Note: Observations and group level data in Study 2 are based on smaller samples.

* $p < .05$.

** $p < .01$.

measured with his scale moderates the relationship between stressors and psychosomatic complaints. Semmer and Frese (1989) have shown this to be true in the longitudinal study as well. We are unable to present detailed results here; however, Figure 2 presents a typical result. The figure is based on the longitudinal study; control at work and stressors are both measured at t_1 , and psychosomatic complaints at t_2 , 16 months later. An arbitrary cut-off point of 2.75 on the five-point scale of psychosomatic complaints was used to give an easier reading (this corresponds to those 25% of the sample who show the highest psychosomatic complaints). According to Figure 2, control has a moderating effect on the relationship between stressors and psychosomatic complaints (the data are similar for the perceived but not for the group level measures). Thus, there is some evidence that this hypothesized mechanism is found to operate in work settings (Semmer and Frese, 1989, also present a methodologically more sophisticated analysis).

Mechanism 2b: Safety Signal (Minimax Hypothesis)

According to this hypothesis (Miller, 1979; Seligman, 1975), control enables a person to determine the worst possible outcomes. It is not always useful or feasible to use one's control, because asserting control may be a difficult task and it might also lead to unwanted side effects (Schönplflug, 1985). However, even if one does not change the stressful conditions at any one point in time, the person with a high degree of control knows that he is able to change the conditions should they become too bad. Thus, he knows that the situation will never be worse than he is willing to take. Being able to exert control is a safety signal because the maximal stressor can be minimized. Presumably, he is, therefore, more relaxed even in stressful situations. Consequently, stress at work has few negative effects given such a level of control. More technically, having perceived control stands as a safety signal and acts as a moderator for the relationship between objective and perceived stressors and the relationship

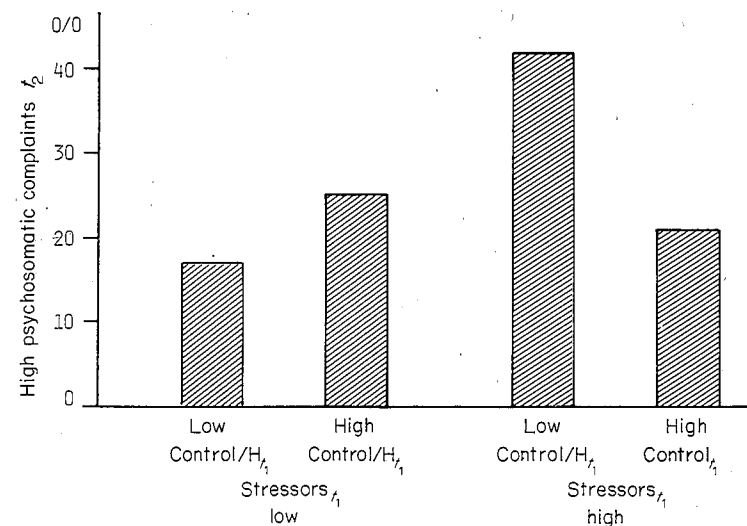


Figure 2 The interaction of observed stressors and observed control/H at work on psychosomatic complaints (stressors and control measured at time 1 and rate of psychosomatic complaints at time 2, $N = 90$)

between perceived stressors and stress appraisal (as well as the short- and long-term stress effects); this effect is displayed in Figure 1 as M2b. For example: if a person knows that he can leave the workplace and find another, equally good, job he can be assured that the stressors at work will never get out of hand. If stress becomes too great, he can leave the job and find another one. This makes him more relaxed in dealing with the existing stressors than a person with no alternatives.

We have developed a scale (Frese, 1989) on 'alternatives in the job market' which measures this aspect of control: how many alternatives does a person have in case he wants to change his job? There are two effects that can be tested here: the moderator effect on the relationship between perceived and objective stressors and the relationship between perceived stressor and ill health.

A moderator effect of alternatives on the job market (t_1) on the impact of earlier objective stressors on later perceived stressors appeared in the longitudinal study (computed with a moderated regression analysis, cf. Frese, 1986a). This indicates that perception of stressors is influenced by whether or not a person has a safety signal available.

The second moderator effect on the relationship between perceived stressors and psychosomatic complaints (as a proxy variable for the stress effects) is not significant when using a moderated regression analysis and when contrasting subgroups. Thus, the safety signal process does not function for the relation-

ship between stressors and psychosomatic complaints. (There is a significant direct correlation between alternatives on the job market and psychosomatic complaints ($r = -.29$, $p < .01$, $N = 195$). However, there is no longitudinal impact of alternatives on the job market on psychosomatic complaints, tested with cross-lagged panel correlation).

In summary, there is evidence for the positive effect of control allowing a fitting of the situation to one's psychophysical prerequisites. There is also evidence that the mechanism of safety signal has some impact, but these moderators have different functions. The safety signal process moderates the relationship between objective and perceived stressors, while the fitting process moderates the relationship between stressors and psychosomatic complaints.

Mechanism 2c: Persistence in Coping

Folkman (1984) has suggested another way that control can have an effect on ill health. If feeling under stress (stress appraisal in the sense of Figure 1), a person with high control is more likely to persist in his effort to cope with the situation. If the person exerts little control, he gives up and does not persist in attempting to cope.

This mechanism is interesting because it suggests that there may be short- and long-term negative consequences of control as well. The long-term negative consequences result from a person unrealistically assuming control when he does not have it or when the person's coping skills are limited. Persistence for coping under these conditions tends to be high but coping effectiveness is low. Additionally, there may be a short-term negative effect: in the beginning of the coping process, there might actually be more stress than when a person does not persist in the face of stressors. Since additional activation is necessary to face the stressors and to try out various coping strategies, there will be a high level of stress and there might actually be a negative stress reaction. Thus, control might moderate the relationship of short-term stress reaction with ill health. Those people with high control might show strong short-term stress reactions because of their persistence but will experience little ill health (given that they realistically perceived their chances to cope with the situation). Another effect (also noted in Figure 1) is the moderation of the relation between stress appraisal and short-term stress reactions; this would be so if coping turns out to have a positive function even in the short term.

Additionally, the persistence mechanism might also explain a direct effect of control on objective stressors: If a person has control, he will persist in trying to reduce the stressor and might succeed under certain conditions. We tried to test this aspect of control. I have attempted to measure coping strategies and styles but I am not very satisfied with those coping scales developed from questionnaire strategies (Frese, 1986b).

Mechanism 3: Need for Control

A need for control has been variously postulated (Frese, 1977; Oesterreich, 1981; White, 1959). If this need is not fulfilled in the workplace, negative short- and long-term health effects may follow. Perceived control perceptions are most relevant here. This would explain a direct effect of control at work on ill health (shown as M3a in Figure 1).

Empirically, it is possible to compute the correlation of perceived control/H with psychosomatic complaints. However, it is necessary to partial out perceived stressors because a correlation might be due to the correlation between stressors and control/H. We find the following partial correlations between perceived control/H and psychosomatic complaints (partialling out perceived stressors):

Study 1:	-.11 ($p = .09$, d.f. = 168)
Longitudinal study:	-.09 (n.s.)
Study 2:	-.11 ($p < .001$, d.f. = 813)

Thus, there are consistent cross-validated partial correlations of perceived control/H with psychosomatic complaints. However, these correlations are quite small; therefore, the need for control hypothesis is not favoured strongly by the data. Moreover, a causal effect (with cross-lagged correlations) could not be shown in the longitudinal study: apparently, given the time period of the longitudinal study, there are reciprocal effects of control/H and ill health on each other. When interpreting these results, it has to be taken into consideration that control/H is not the best empirical indicator of control because it does not encompass control over conditions, which is probably an important aspect of the need for control mechanism.

The need for a control hypothesis can also be taken to account for a moderator effect of control. It could be argued that stress conditions trigger the need for control. If a person is stressed in a situation of non-control, an attempt is made to control the situation. In the case of non-control, a stressful situation becomes more aversive. This aversiveness is not just the result of the stressor but of the interaction between the perceived stressor and perceived non-control. Therefore, the existence of both perceived non-control and perceived stressors leads to stress appraisal (the appropriate moderating effect is displayed as M3b in Figure 1). There is a variant of this hypothesized mechanism: the relationship between stress appraisal and short- and long-term stress effects (ill health) could be moderated, because a need for control might be especially stimulated by stress appraisal (M3c in Figure 1).

The empirical existence of a moderator effect has already been discussed. Thus, the empirical moderator effect of control/H could be explained with the fitting or with the need for control mechanism.

Table 8 Median splits of control/H and control rejection and the correlation of stressor and psychosomatic complaints (perceived level) (*N* in parentheses)

	Control			
	Low		High	
	Control rejection Low	Control rejection High	Control rejection Low	Control rejection High
Correlations of stressor with psychosomatic complaints	.60** (35)	.61** (33)	.24 (41)	.03 (24)

* $p < .05$.

** $p < .01$.

The need for control may be a result of either phylogenetic or ontogenetic development. In the latter case, people may develop a certain aspiration level for control depending upon cultural and societal conditions. Hulin and Blood (1968) have, for example, argued that only middle-class workers have a high aspiration for control, while lower-class workers are not interested in a high degree of control at work. This idea has never been tested directly. In our data some evidence was collected that seems to speak against Hulin and Blood's (1968) hypothesis (Frese, 1984). A scale called control rejection was developed. This scale measures whether a person does not want to have control at the workplace. A high score on this scale can be interpreted in two ways: (1) a low level of aspiration for control; or (2) a defence of the type 'I am struggling to keep down my aspirations; I try to convince myself that I really am not interested in control.' We already showed that control/H had a moderator effect on the relationship between stressors and psychosomatic complaints. We can now ask the question whether not wanting to have control reduces this moderator effect of control. If interpretation (1) is correct, people with high control rejection should not show a moderator effect of control/H because they really do not want any control at work. If interpretation (2) is correct, control rejection should have no influence—only control should show its characteristic moderator effect. Table 8 gives the correlations between perceived stressors at work and psychosomatic complaints for four groups: those with high and low levels of perceived control; each subgroup split again into those with high versus low control rejection. A median split partitioning was used. Frese (1984), using a moderated regression approach to show the same results, presents additional results on the observed level and also discusses the theoretical implications in more detail. Each cell displays the correlation between perceived stressors and psychosomatic complaints for the respective subgroups. The important cell is the one for the subgroup with high control rejection and low control. According to interpretation (1) its correlation should be low; according to interpretation (2), its correlation should be high.

The data point to the correctness of interpretation (2). Thus, rejecting control is more of a defence than a 'cool' low level of aspiration level (other data also point in the direction of this interpretation). Rejecting control does not help if a person does not have control. Some need for control may be 'hard-wired' and not so easily changeable.

CONCLUSION

In this final section, I want to summarize which theoretical and methodological factors can affect moderation or direct effects. In terms of theory, Figure 1 summarizes the different mechanisms. Both direct as well as moderating effects are possible and all of them may operate simultaneously. No study has produced data that could tell us the viability of all of these mechanisms. It may be harmful to try to test these potential mechanisms against each other as long as the different aspects of control have not been adequately operationalized. Additionally, it is likely that more than just one mechanism is operative and different aspects of control might have different types of effects. The different hypothesized mechanisms are not contradictory. It is well possible that control has a direct effect on stressors, that the remaining stressor-ill-health relations are moderated by the safety signal mechanism and that time and sequence fitting and persistence in coping operate, and that a need for control has to be met. Moreover, the different mechanisms refer to different aspects of control, as displayed in Table 1. The direct effect is most clearly related to control over content of tasks, plans, feedback and, most importantly, conditions. Fitting concerns the influence on timeframe and sequencing. The safety signal mechanism refers most probably to the content of tasks, plans, feedback and condition. Additionally, this mechanism applies to a person having the chance to leave a certain stress situation altogether (as in the example of leaving a job). Persistence in coping is probably related to control over conditions. The need for control mechanism concerns all areas of the control concept.

Given the complexity of the area and the fact that most studies only measure certain parts of the control concepts (and of the stressors involved), it is not surprising that different studies find different results.

One reason is certainly that most empirical indicators of control do not encompass all the aspects of control. Moreover, different indicators measure different aspects, which makes it hard to hope for reliable data.

It is also far more difficult to get a moderator effect than a direct effect. This is partly due to the complex nature of the moderator effect. Most researchers implicitly or explicitly assume a moderator effect of the 'switch-on, switch-off' kind. If control is absent, stressors should have an impact on ill health; if present, there should be no impact. However, the moderator effect may be more complicated, depending on the time course of the stressors affecting ill health. Frese and Zapf (1988) have differentiated six different models of how

stressors can have an effect on ill health. For example, there is the adjustment model, which implies that a person can get used to a stressor. A second model is the accumulation model, that assumes that ill health becomes worse the longer one is exposed to the stressor; moreover ill health continues to exist even when the stressor has been taken away. A third model is the stress reaction model, according to which ill health vanishes after the stressor is reduced. Rather than shielding the person completely from the harmful effects of stressors, control might just lead to an adjustment model type reaction, while a situation of non-control may affect the person in the sense of the accumulation model. To have control would still be advantageous insofar as it allows the development of coping strategies, but it does not buffer all stress effects.

Empirically, this would mean that we sometimes find a correlation between stressors and ill health even when there is control—in all those cases where people have not been exposed long enough to the stressor to be able to develop effective adjustment. On the other hand, under conditions of non-control, there should be a more reliable effect of stressors on ill health empirically. Such a structure would imply, however, that the moderator effect of control will only occasionally show up in the data. Each time adjustment has not taken place yet, people with control will not exhibit the positive effects of control. An additional problem leading to underestimations of the importance of work stress is that stressors are not always constant at work. If the stressors have been reduced, there is no correlation between stressors and ill health, although those stressors that are removed may in the meantime have been operative to develop ill health in the first place (given the accumulation model).

The problems of finding moderator effects are exacerbated by methodological difficulties. One of the important problems in research on stress at work is the little use it makes of objective measures of stressors and control. Most studies have only used a subjective summary measure of stress (usually only measuring stress appraisal) and an even less differentiated measure of perceived control. This may be one reason why experimental and field studies lead to different results. While experimental studies regularly find moderating effects of control at work, field studies have had grave difficulties. Experimental studies have usually used an objective measure of control over conditions (Glass and Singer, 1972 excepted). Field studies have used subjective measures for the most part, usually not referring to conditions but to timeframe and sequencing. Our studies used objective measures of control (unfortunately only oriented to timeframe and sequencing). Even the so-called subjective measures attempted to ask questions as objectively as possible (thus they are akin to the concepts of stressor and control perception). Comparing these to Karasek's (1979) more subjective measures, for example, our studies seem to support a moderating effect better than his. I therefore suggest that using more objective measures will lead to showing more (moderating or direct) effects of control in stress research.

An additional methodological problem arose with the use of moderated regression analyses. Although, theoretically, a moderated regression analysis approach should be more powerful than subgroupings (and comparing correlations between these subgroups), it turns out that this is not so (as Zedeck himself shows in his article, 1971). Detecting moderators has also been shown to be difficult in meta-analyses (Sackett, Harris and Orr, 1986). The moderated regression analysis is quite conservative in showing interaction effects because the usual approach of hierarchical-wise regression (Cohen and Cohen, 1975) is biased against the interaction effect in favour of the direct effects. While easy solutions like those proposed by Morris, Sherman and Mansfield (1986) do not seem to be upheld (Cronbach, 1987), it may be useful to pursue new ways of analysing data in this area.

Thus, there are ample reasons why it is difficult to reproduce and produce significant results on control at work and health: conceptual unclarity; non-systematic approaches to the mechanisms; measurement of only parts of the concept; power problems in moderator analyses; etc. However, the concept of control has reliably produced interesting and important results in the laboratory. Moreover, field research has been able to establish many facets of why control is important to keep up health. As is true of science in general, approximations have to be used because measurement is always unreliable to a certain extent and there is always a certain degree of 'noise' in the field that disturbs any research. There is some danger that the 'baby gets thrown out with the bathwater' in the present critical discussion of control. While it is useful to discuss critically the available evidence, there is the danger that the scientific discussion just takes another turning point, more because fashion has changed than because there were good scientific reasons. Control at work and health has been of great interest for a certain amount of time but the danger is that enthusiasm for the concept of control might be diminished before scientific research can really get on its way. This would be a particular problem for epidemiological research in the workplace because longitudinal studies take a long time to complete (and to get published). It is hard to use objective indicators of control and stressors. It is necessary to look at various alternative hypotheses and this takes time and competing studies. Thus, the process of understanding more about control at work and health has barely got under way. Control is still a central variable in research on stress at work. It is useful and possible to study the issues of control at work and health empirically. It is my contention that, with more emphasis on conceptual and theoretical issues, we shall be able to advance our understanding and achieve more knowledge on the function of stress and control at work for health and in the development of illnesses.

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