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Job stress, fatigue, and job dissatisfaction in Dutch lorry drivers: towards an occupation specific model of job demands and control

E M de Croon, R W B Blonk, B C H de Zwart, M H W Frings-Dresen, J P J Broersen

Objectives: Building on Karasek’s model of job demands and control (JD-C model), this study examined the effects of job control, quantitative workload, and two occupation specific job demands (physical demands and supervisor demands) on fatigue and job dissatisfaction in Dutch lorry drivers.

Methods: From 1181 lorry drivers (adjusted response 63%) self reported information was gathered by questionnaire on the independent variables (job control, quantitative workload, physical demands, and supervisor demands) and the dependent variables (fatigue and job dissatisfaction). Stepwise multiple regression analyses were performed to examine the main effects of job demands and job control and the interaction effect between job control and job demands on fatigue and job dissatisfaction.

Results: The inclusion of physical and supervisor demands in the JD-C model explained a significant amount of variance in fatigue (3%) and job dissatisfaction (7%) over and above job control and quantitative workload. Moreover, in accordance with Karasek’s interaction hypothesis, job control buffered the positive relation between quantitative workload and job dissatisfaction.

Conclusions: Despite methodological limitations, the results suggest that the inclusion of (occupation) specific job control and job demand measures is a fruitful elaboration of the JD-C model. The occupation specific JD-C model gives occupational stress researchers better insight into the relation between the psychosocial work environment and wellbeing. Moreover, the occupation specific JD-C model may give practitioners more concrete and useful information about risk factors in the psychosocial work environment. Therefore, this model may provide points of departure for effective stress reducing interventions at work.

In many sectors of industry, the nature of work has changed considerably over the past decades. Important changes concern making work more flexible, the entry of the 24 hour economy, mechanisation, automation, and the appliance of information and communication technology. In general, these changes have resulted in a decreased exposure to physical and chemical agents and an increased exposure to psychosocial risk factors. In the road transport industry, for instance, the entry of the 24 hour economy has been accompanied by an increased demand for just in time deliveries leading to an intensification of the work of lorry drivers. Furthermore, the appliance of communication technology has led to a decreased feeling of independence and tighter time schedules for these workers.

These changes in the nature of work have gone hand in hand with an increased attention in occupational health research directed at the investigation of the relation between psychosocial work factors and health and wellbeing. Several occupational stress models have been postulated that can serve as a theoretical frame for this category of studies. Without doubt, the most influential and successful is the model of job demands and control (JD-C model) described by Karasek and Theorell.

Initially, the JD-C model was based on the hypothesis that psychological strain result in psychological strain and physical illness only when the level of decision latitude, later referred to as job control, is low. Stated differently, Karasek assumed that decision latitude buffers the harmful effect of high demand jobs (stress buffering hypothesis of job control). Because most studies that examined the JD-C model favour an additive rather than an interactive effect of psychological demands and decision latitude on health and wellbeing, Karasek revised the initial core hypothesis. Presently, the JD-C model posits that the most adverse reactions of psychological strain occur when the psychological demands are high and job control is low. This proposition is generally labelled the psychological strain hypothesis. Furthermore, Karasek and Theorell added a social support dimension to the JD-C model. The extended model of job demands, control, and support (JD-CS model) states that working situations which are characterised by high demands, low control, and low social support have the most negative effects on employee health and wellbeing.

The JD-C(S) model has often been disputed. One important topic of debate concerns the conceptualisation of decision latitude. According to Karasek, decision latitude (job control) consists of two subconcepts: decision authority and skill discretion. Decision authority is defined as the social authority over making decisions. Skill discretion refers to the breadth of skills usable on the job. Whereas decision authority is conceptually equivalent to job control, skill discretion represents a different concept. Consequently, there has been a lack of agreement between the way job control is generally conceived and used in the field of occupational stress research and the way this work feature has been conceived and used in most JD-C(S) studies.

Over the past years, more studies have met this criticism. These particular studies have attempted to improve Karasek’s control construct by omitting items of the skill discretion subconcept and simultaneously enclosing items

Abbreviations: JD-C model, model of job demands and control; JD-CS model, model of job demands, control, and support; VBBA, Dutch questionnaire on the experience and assessment of work
focused clearly on the opportunities provided by the job to exert influence over the work setting. A second criticism raised to the JD-C(S) model involves the conceptualisation and measurement of job demands. According to Karasek and Theorell work load, measured at a general level with subjective items such as “work hard” and “excessive work”, is the central component of this dimension. However, other job demands may be important predictors of health and wellbeing for certain occupations as well. Lorry driving is an exemplary occupation in this respect. As well as a high quantitative workload, the work of lorry drivers is characterised by high physical demands—for example, prolonged sitting in a single posture, loading and unloading of the goods, and unfavorable working hours. Also, lorry driving is mentally demanding because it requires long periods of alertness and sustained attention. Finally, lorry drivers often complain of an authoritative and punitive attitude from front line supervisors which suggests that not only the absence of positive relations (social support), but also the presence of negative relations (conflicts) may effect the health and wellbeing of these workers.

The conceptual criticisms of the JD-C(S) model already described bring about two restrictions. The first restriction relates to the stress buffering hypothesis of job control. The chance of identifying interaction effects between job demands and job control, both measured at a general level, is small. The importance of using distinctive, instead of generic, measures of job control and job demands when examining the stress buffering hypothesis of job control was shown by Sargent and Terry and Van der Doef and Maes. These researchers showed that some aspects of job control—for example, control over work pace and work method—may protect workers from the harmful effects of certain types of job demands—for example, time pressure—whereas others do not. Stated differently, depending on the particular domain of job control under consideration, different job demands may be differentially related to health and wellbeing. Although the importance of using specific and distinctive measures for this is not an unknown topic in the stress literature, most research workers examining the JD-C(S) model have overlooked this topic.

The related issue of practical applicability is the second restriction that accompanies the conceptual comments on the JD-C(S) model. Several investigators argue that research findings based on the JD-C(S) model give a rather abstract picture of the relation between the psychosocial work environment and wellbeing. For this reason, several researchers have recommended incorporating a range of more concrete demands: work features in the JD-C(S) model. This may explain more variance in outcomes of wellbeing of employees and is likely to provide practical points of departure for interventions. In view of the changing nature of work and the increased call upon evidence based practice in occupational health care, concrete information about risk factors in the psychosocial work environment, based on specific occupational stress models, is badly needed.

The restrictions already described that accompany the application of the JD-C(S) model in occupational stress research and practice formed the incentive for this study. The aim of the present study was to evaluate a modified JD-C model in which one focused measure of job control (control over work method and work pace) and quantitative workload, as well as two job demands which are specific for lorry driving (physical demands and supervisor demands) were included. In accordance with the psychological strain hypothesis, it was expected that job control and quantitative workload would have additive effects on wellbeing in lorry drivers. Furthermore, it was expected that the inclusion of physical and supervisor demands would improve the predictive power of the additive JD-C model. Finally, in view of the distinctiveness and greater specificity of these measures, interactive effects were expected to be detected between job control and job demands on wellbeing in lorry drivers.

### Methods

#### Subjects

In August 1998, self completed questionnaires were sent to the home addresses of a random sample (n=2000) of the population of lorry drivers in the Dutch road transport industry. Initially, a total of 1277 questionnaires were returned. Of these, 52 were not completed because the address was wrong resulting in an adjusted response rate of 63% (1225/1948). All lorry drivers with missing values on the key study variables were excluded from the analyses, which reduced the number of participants to 1181. Table 1 shows information on age, sex, and number of working hours of the study sample. Most of the participants (98%) were men. Mean (SD, range) age of the participants was 39 (10.1, 19–68) years. Participants worked a mean (SD, range) of 57 (11.7, 7–90) hours/week.

#### Questionnaire

All independent variables (job control, quantitative workload, physical demands, and supervisor demands) were measured with the validated Dutch questionnaire on the experience and assessment of work (VBBA). This questionnaire has been widely used in The Netherlands in both research on occupational stress and in daily practice as a tool for occupational health services. The psychometric qualities of the VBBA scales are good. During construction of the scales p varied between 0.82 tot 0.95, and the Loevenier’s H varied between 0.42 and 0.75. An external test of the psychometric properties indicated somewhat less favorable, but still convincing psychometric properties.

#### Job control

Job control was measured with an 11 item scale, including items from the focused measure of timing control and method control developed by Jackson et al. Some examples of this scale are: “Can you decide on your own the order in which you work?” and “Do you interrupt your work for a short time if you find it necessary to do so?”. Items were scored on a four point scale (1=never, 2=sometimes, 3=often, 4=always).

#### Quantitative workload

Quantitative workload was assessed by an 11 item scale. Two example items are: “Do you work under pressure of time?” and “Do you have conflicts with your boss?”.

#### Physical demands

Physical demands were assessed by a seven item scale. Typical items of this scale are: “Does your work require physical strength?” and “In your work, are you seriously inconvenienced by having to lift or move loads?”.

#### Supervisor demands

Supervisor demands were measured by the relation with your immediate boss scale of the VBBA comprising nine items. Some example items of this scale are: “Do you have conflicts with your boss?” and “Do you experience aggressiveness from your boss?”.

### Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>39.1</td>
<td>10.1</td>
<td>19–68</td>
</tr>
<tr>
<td>Male %</td>
<td>98.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working hours/week</td>
<td>57.4</td>
<td>11.7</td>
<td>7–90</td>
</tr>
</tbody>
</table>

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**Note:**

These researchers showed some examples of job control—for example, control over work pace and work method—may protect workers from the harmful effects of certain types of job demands—for example, time pressure—whereas others do not. Stated differently, depending on the particular domain of job control under consideration, different job demands may be differentially related to health and wellbeing. Although the importance of using specific and distinctive measures for this is not an unknown topic in the stress literature, most research workers examining the JD-C(S) model have overlooked this topic.

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For this reason, several researchers have recommended incorporating a range of more concrete demands: work features in the JD-C(S) model. This may explain more variance in outcomes of wellbeing of employees and is likely to provide practical points of departure for interventions. In view of the changing nature of work and the increased call upon evidence based practice in occupational health care, concrete information about risk factors in the psychosocial work environment, based on specific occupational stress models, is badly needed.

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Fatigue was measured with the checklist individual strength (CIS). The CIS consists of 20 statements for which the person has to indicate on a seven point scale to what extent the particular statement applies to him or her. The statements refer to four aspects of fatigue experienced during the previous 2 weeks, namely subjective fatigue (eight items—for example, “I feel tired”), reduction in motivation (four items—for example, “I feel no desire to do anything”), reduction in concentration (five items—for example, “I don’t do much during the day”), and reduction in activity (three items—for example, “I don’t do much during the day”), and reduction in concentration (five items—for example, “My thoughts easily wander”). The CIS is well validated in the clinical setting. Recently, the validity of the questionnaire was established also among working people. In this study a composite CIS total score (ranging from 20 to 140) was calculated by adding the person’s scores for the four factors.

Job dissatisfaction

Job dissatisfaction was assessed by the similarly named scale of the VBBA comprising nine dichotomous items. Some examples of the job dissatisfaction scale are; “I have to continually overcome my resistance to do my work” and “I find the thought that I shall have to do this job until I retire very oppressive”.

Data analysis

To test the stated hypotheses, stepwise multiple regression analyses were conducted on both fatigue and job dissatisfaction. In the first step job control and Karasek’s central job demands component, quantitative workload, were entered into the equation. The two occupation specific demands (physical demands, and supervisor demands) were entered into the equation in the second step. To test the hypothesised interaction between job control and job demands, three interaction terms (job control×quantitative workload, job control×physical demands, and job control×supervisor demands), computed as the product of the standard scores of the independent variables, were entered into the equation in the final step three. In all the analyses effects were accepted as significant at p<0.01.

### RESULTS

#### Preliminary analyses

Table 2 presents range, mean, SD, internal consistency (Cronbach’s α), and zero order Pearson correlations of all study variables. Inspection of table 2 shows that, with the exception of age, all the correlations between the study variables were significant (p<0.01). Because the correlation analyses did not show any significant correlation between age and the other variables, there was no need to control for age in further analyses.

The results of the multiple regression analyses examining the main and interaction effects of job demands and job control on fatigue and job dissatisfaction are shown in table 3. The results of the analyses for fatigue indicated that the proportion of variance accounted for in fatigue increased from 0.00 to 0.26 when the addition of job control and quantitative workload (step one). The entry of physical demands and supervisor demands in step two accounted for another 3% of variance in fatigue. Introduction of the interaction terms in step three did not result in a further increase in R². At the final step three, job control (β=−0.14), quantitative workload (β=0.26), physical demands (β=0.09) and supervisor demands (β=0.16) were uniquely related to fatigue.

The stepwise multiple regression analyses of job dissatisfaction showed a significant increase in R² from 0.00 to 0.26 when job control and quantitative workload were entered into the equation (step one). The entry of physical and supervisor demands in step two accounted for 7% of additional variance in job dissatisfaction. Introduction of the interaction terms in step three resulted in a further increment of R² from 0.33 to 0.38.

### Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>α</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>19–68</td>
<td>39.09</td>
<td>10.13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Job control</td>
<td>0–100</td>
<td>53.47</td>
<td>21.22</td>
<td>0.90</td>
<td>0.03</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Quantitative workload</td>
<td>6–97</td>
<td>44.89</td>
<td>16.40</td>
<td>0.88</td>
<td>0.08</td>
<td>-0.43*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Physical demands</td>
<td>0–100</td>
<td>34.94</td>
<td>21.09</td>
<td>0.88</td>
<td>0.00</td>
<td>-0.15*</td>
<td>0.47*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Supervisor demands</td>
<td>0–100</td>
<td>27.68</td>
<td>20.21</td>
<td>0.89</td>
<td>0.02</td>
<td>-0.40*</td>
<td>0.46*</td>
<td>0.37*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fatigue</td>
<td>20–137</td>
<td>50.09</td>
<td>23.12</td>
<td>0.90</td>
<td>0.06</td>
<td>-0.33*</td>
<td>0.44*</td>
<td>0.29*</td>
<td>0.38*</td>
<td>-</td>
</tr>
<tr>
<td>Job dissatisfaction</td>
<td>0–100</td>
<td>15.97</td>
<td>24.79</td>
<td>0.87</td>
<td>-0.01</td>
<td>-0.32*</td>
<td>0.50*</td>
<td>0.38*</td>
<td>0.45*</td>
<td>0.49*</td>
</tr>
</tbody>
</table>

*p<0.01.

### Table 3

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Fatigue</th>
<th>Job dissatisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>R² change</td>
</tr>
<tr>
<td>Step 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job control</td>
<td>-0.14*</td>
<td>0.22*</td>
</tr>
<tr>
<td>Quantitative workload</td>
<td>0.26*</td>
<td>0.27*</td>
</tr>
<tr>
<td>Step 2:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical demands</td>
<td>0.09*</td>
<td>0.03*</td>
</tr>
<tr>
<td>Supervisor demands</td>
<td>0.16*</td>
<td>0.20*</td>
</tr>
<tr>
<td>Step 3:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controls × quantitative workload</td>
<td>-0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>Controls × physical demands</td>
<td>-0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>Controls × supervisor demands</td>
<td>-0.01</td>
<td>-0.06</td>
</tr>
</tbody>
</table>

*p<0.01. Regression values are standardised coefficients obtained at step 3.
sented by the method recommended by Jaccard 
uniquely to the variance in job dissatisfaction. 

However, the failure to find any interaction 
control on job dissatisfaction confirmed the stress buffering 
interaction effects between quantitative workload and job 

defined, instead of globally defined, job demand and job con-

job wellbeing in certain occupations are often overlooked in occu-

researchers and practitioners still focus on only one global 
capture the psychosocial work environment adequately, many 

interaction hypothesis, job control buffered the impact of 
quantitative workload and job dissatisfaction 

In figure 1 the interaction between quantitative workload 
and job control on job dissatisfaction is graphically repre-
sented by the method recommended by Jaccard et al. As 
shown in figure 1, quantitative workload is strongly related to 
job dissatisfaction at low levels of job control, whereas a weak 
relation between quantitative workload and job dissatisfaction 
is found at high levels of job control. 

DISCUSSION 
The aim of the present study was to evaluate a modified JD-C 
model in which a focused measure of job control (control over 
work method and work pace) and two occupation specific job 
demands were included. The study brought about two impor-
tant findings. Firstly, the inclusion of physical and supervisor 
demands into the JD-C model improved the predictive power 
of the additive model. Secondly, in accordance with Karasek's 
interaction hypothesis, job control buffered the impact of 
quantitative workload on job dissatisfaction. 

In accordance with our expectation the inclusion of physi-
cal and supervisor job demands improved the predictive power 
of the additive JD-C model. For fatigue a moderate amount of 
variance was accounted for by the two occupation specific job 
demands over and above that accounted for by quantitative 
workload and job control. A more substantial improvement 
of the model's predictive power was found when job dissatisfac-
tion was regressed on the independent variables. 

These findings confirm other studies that show that a range 
of work features which are specific for a particular occupation 
should be considered for a full comprehension of the relation 
between the psychosocial work environment and health and 
wellbeing. Although Karasek and Theorell themselves 
have suggested that more work dimensions are required to 
capture the psychosocial work environment adequately, many 
researchers and practitioners still focus on only one global 
measure of job demands and job control. As a consequence, 
other demanding work features that may influence health and 
wellbeing in certain occupations are often overlooked in occu-
pational stress research and practice. 

Another aim of this study was to investigate the stress buff-
ering hypothesis of job control. In view of the available 
evidence, it was proposed that the employment of precisely 
defined, instead of globally defined, job demand and job con-

Main Findings 

- The inclusion of job demands which are specific for lorry 
driving improved the predictive power of the model of job 
demands and control for fatigue and job dissatisfaction in 
this occupation. 
- Job control buffered the detrimental effect of quantitative 
workload only, suggesting that the extent to which job 
demands impact on wellbeing depends on the match 
between the type of job control and job demand under 
consideration. 

Policy Implications 

- Improving psychosocial work conditions of lorry drivers 
may strengthen wellbeing of these workers. 
- However, strategies of effective work stress interventions in 
the road transport industry should differ according to the 
wellbeing outcome on target. 
- In general, researchers and practitioners should use 
occupational stress models and instruments including a 
range of job demands which are useful in describing the 
psychosocial work environment which is specific to a 
particular occupation. 

requirements of a certain stressor or demand and the available 
coping resources for buffering to occur. Interpretation of the 

suggestion that control over work method and work pace pro-
vides an effective resource for workers to cope with a high 
quantitative workload only. More specifically, as set forth by 
Sargent and Terry, a worker who has too much work to do 
will handle the stress better if the job has some flexibility in 
allocation of time and energy to tasks. For instance, a lorry 
driver who can decide for himself or herself at what time and 
in what order to accomplish his route can adjust his work 
situation to his psychological needs and preferences and 
reduce stress. By contrast, a lorry driver in conflict with his 
front line supervisor might benefit more from the support of a 
coworker. 

This implies that confirmation of Karasek's interactive JD-C 
model is not only dependent on the inclusion of more specific 
variables, but depends also on the extent to which the specific 
coping resource matches the specific type of job demand. 
Stated differently, depending on the specific demands posed 
byparticular occupation, certain aspects of control or other 
coping resources may bring about a stress buffering effect 
whereas others may not. The inclusion of job demand and job 
control measures in the JD-C model, which are specific to a 
certain occupation, is therefore likely to result in a further 
 improvement of the predictive power of the model. Moreover, 
from a practical point of view, such an approach will give 
practitioners more concrete and therefore more useful 
information upon which to base effective interventions. 

Interestingly, job control buffered the positive effects of 
quantitative workload on job dissatisfaction whereas no buff-
ering effect of job control was detected when fatigue was on 
target. A review of the literature shows that this finding does 
not constitute a solitary case. Many studies that examined the 
stress buffering effect of job control on job (dis)satisfaction 
also confirmed the hypothesis. By contrast, those studies that examined the stress buffering 
effect of job control on fatigue, or on equivalent concepts— 
such as need for recovery, burnout, and emotional 
exhaustion—failed to confirm the hypothesis. The differ-
ential interaction effect between demands and control on the 
outcome measures runs counter to the implicit assumption of 
the JD-C model that the effects of job demands and job control 
on health and wellbeing are non-specific. In fact, they
confirm Warr's proposal that different psychological outcomes may arise from a combination of separate sources. The practical implication of the differential intervention effect found is that interventions aimed exclusively at increasing control over work pace and work method in jobs with high quantitative workload seem insufficient to prevent or reduce fatigue among lorry drivers. Conversely, these types of interventions that increase control, may, in view of the present results, be quite effective when the promotion of job satisfaction in lorry drivers is intended.

Four aspects of the present study require some consideration. Firstly, it should be noted that the proposed modified JD-C model was not intended to incorporate all the variables required to explain the relation between the psychosocial work environment and wellbeing in lorry drivers. The modified model gives a more comprehensive picture of the psychosocial work environment of lorry drivers. However, other psychosocial work factors which were not considered in this study—for example, job insecurity, long and irregular working hours, contacts with fractious customers, and the work home interference—may influence health and wellbeing of these workers as well.

Secondly, the response rate in the present study was fairly high. Almost two thirds of the lorry drivers who were asked to participate in the study returned completed questionnaires. This high response may be due to the publicity given to the research project (distribution of bulletins) as well as the increased value employers and employees in the road transport industry in recent years have started to attach to occupational stress.

Thirdly, in this study self-completed questionnaires were used to assess both independent and dependent variables. As a consequence, unmeasured self report bias—for example, negative affectivity, mood, and social desirability—may have amplified the main effects of job demands and job control. Although Spector et al. recently showed that the inflating effect of self report bias may be not so prominent, we attempted to minimize this potential influence by using descriptive measures of the independent variables. Furthermore, it should be noted that self report bias results in an underestimation rather than an overestimation of interaction effects. As set forth by Wall et al., the influence of self report bias would be to inflate main effects of job demands and job control at the expense of the underlying interaction effects.

Fourthly, both independent and dependent variables were measured at one point in time. As a consequence of the cross sectional design, no firm basis was given for causal ordering. Stated differently, whether the occurrence of negative psychosocial work factors precede lowered psychological wellbeing or whether lowered psychological wellbeing precedes the occurrence of negative psychosocial work factors, or both, is not elucidated in this study.

Evidently, longitudinal research is needed to obtain a clearer picture of possible causal relations among job demands, job control, and health and wellbeing. More importantly, more intervention studies between job demands and control are required as only these studies can tell us whether changing demands or control promote health and wellbeing of the employee. As reported by Jones et al. the few JD-C intervention studies contrast violently with the many studies of the effects of demands or control. The few JD-C intervention studies question the practical validity of this occupational stress model. In our opinion the practical as well as the theoretical validity of the JD-C model may be improved with the inclusion of a more precisely defined job control construct and job demand concepts which are useful in describing the psychosocial work environment which is specific to a particular occupation.

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