Two models at work

A study of interactions and specificity in relation to

the **D**emand-**C**ontrol **M**odel and the **E**ffort-**R**eward **I**mbalance **M**odel

Natasja van Vegchel

Two models at work: A study of interactions and specificity in relation to the Demand-Control Model and the Effort-Reward Imbalance Model.
Natasja van Vegchel
Thesis Utrecht University, Utrecht.
With summary in Dutch.

The research reported in this thesis was funded by the Research Institute for Psychology & Health, an Institute accredited by the Royal Dutch Academy of Arts and Sciences.

The studies presented in this thesis were conducted as part of the Netherlands concerted research action on "Fatigue at work" granted by the Netherlands Organization for Scientific Research (NWO grant no. 580-02.209).

Publishing this thesis was sponsored by DA&A Driessen, Helmond, The Netherlands, a Dutch high-quality P&O service provider for the (semi-) government.

Printing: Drukkerij Van Stiphout, Helmond, The Netherlands.
Cover design: Drukkerij Van Stiphout and Natasja van Vegchel

ISBN: 90-393-4017-x

Subject headings: Demand-Control Model, Effort-Reward Imbalance Model, interaction terms, specificity, emotional demands, human service work, longitudinal study, cross-validation.

Two models at work

A study of interactions and specificity in relation to

the **D**emand-**C**ontrol **M**odel and the **E**ffort-**R**eward **I**mbalance **M**odel

Twee modellen aan het werk

Een studie over interacties en specificiteit in relatie tot

het **D**emand-**C**ontrol **M**odel en het **E**ffort-**R**eward **I**mbalance **M**odel

(Met een samenvatting in het Nederlands)

PROEFSCHRIFT

Ter verkrijging van de graad van doctor aan
de universiteit Utrecht,
op gezag van de Rector Magnificus, Prof. dr. W. H. Gispen
ingevolge het besluit van het College voor Promoties,
in het openbaar te verdedigen op
vrijdag 16 september 2005 des middags te 14.30 uur

door

Natasja van Vegchel

geboren op 29 september 1976, te Venray

Promotor:
Prof. dr. W. B. Schaufeli

Co-promotoren:
Dr. J. de Jonge
Prof. dr. C. Dormann

Beoordelingscommissie:
Prof. dr. N. van Yperen
Prof. dr. J. A. M. Winnubst
Prof. dr. H. de Witte

Contents

1

General introduction

1.1 Work stress: A public enemy?

"A little hard work never killed anyone" is a well-known saying. However, "*Karoshi*" – a Japanese term referring to death due to long hours of demanding work (Shimomitsu & Odagiri, 2000) – presupposes the contrary, and this phenomenon has been acknowledged outside Japan as well (Michie & Cockfort, 1996). Although the effects of work on employee health are (fortunately!) not always so far-reaching, this does show the importance of studying the relation between work and health. The term "work stress" is often used to denote (adverse) health effects resulting from particular job requirements that do not match the capabilities, resources, or needs of the employee (Dollard, 2003). In the literature the term "stressor" is usually used to refer to an antecedent of stress (i.e., environmental situations or events potentially capable of producing a state of stress), whereas the term "strain" denotes the consequences of stress, or reactions to the condition of stress (cf. Dollard, 2003).

Work stress is a major concern in most industrialized countries, affecting not only employees (whose health is at stake) but also organizations and society at large. The prevalence of work stress is high and continues to rise. For instance, in a large-scale European survey of nearly 16,000 employees, 29% indicated that their work activities affected their health; the most commonly mentioned work-related health problems were back pain (33%), stress (28%), muscular pains (23%), and burnout (23%) (European Foundation for the Improvement of Living and Working Conditions [EFILWC], 2002; Houtman, 2005). In 1967 the Disability Insurance Act was introduced in The Netherlands, and at that time 11% of disability claims were based on mental disorders. Since 1993 most claims have been based on mental disorders and musculoskeletal diseases (Houtman, 1997). In 2002, 37% of disability claims were based on mental disorders, whereas the percentage of musculoskeletal diseases had remained nearly stable (i.e., rising from 23% to 26%) (UWV, 2004). Moreover, work stress is related not only to psychological disorders, but also to a number of physical ailments such as cardiovascular diseases (Belkiç, Landsbergis, Schnall, & Baker, 2004) and musculoskeletal diseases (such as RSI, e.g., Ariëns et al., 2001; and chronic low back pain, e.g., Hoogendoorn, van Poppel, Koes, & Bouter, 2000), and to absenteeism from work (Houtman et al., 1999). The potential outcomes of work stress are thus rather diverse, and pertain not only to health but also to actual participation in the workforce (cf. Houtman, 2005, p. 2).

The price that has to be paid for work stress is high, both literally and figuratively. Literally speaking, the costs associated with work stress are huge. The societal costs of absenteeism and disability were calculated for The Netherlands in 2001 by Koningsveld and associates (2004) and estimated at €12 billion. Most of these costs concerned work-related health issues, mainly as a consequence of psychological and musculoskeletal disorders, each of which accounted for about €3 billion. This tremendous rise in work stress and its associated costs has led to stronger legislation with regard to psychosocial work conditions and sickness absence. In The Netherlands, it is mandatory for organizations to assess the health, well-being, and safety of their employees (rather than solely combating ill-health) and to base organizational policies on these assessments (Schaufeli & Kompier, 2001). Furthermore, statutory sickness benefit schemes have been amended, transferring more of the costs directly onto employers, by means of a new Act (termed the *Wet Verbetering Poortwachter* in Dutch) that requires the employer to continue to pay the employee for 2 years instead of 1 year in the case of sickness, after which time a national compensation system takes over. Moreover, as of January 1, 2006, the Disability Insurance Act will be replaced by a new Act (termed Work and Income According to Work Capacity, or *Wet Werk en Inkomen naar Arbeidsvermogen* in Dutch) aimed at stimulating work resumption. Both laws are intended to establish financial incentives for employers and employees to help partly disabled employees remain at and/or return to work. At the level of the European Union (EU), various countries have introduced legislation to improve the health and safety of employees in their work environment. And recently, the EU social partners signed a framework agreement for employers and employees aimed at preventing, identifying, and combating work stress (Houtman, 2005). It should be noted that in addition to the direct costs due to sickness absence and work disability, there are also hidden consequences of work stress for organizations in connection with diminished well-being. These hidden consequences include for instance more problems, conflicts, disturbed relations (both internal and external) and turnover, and losses in the domain of image, corporate values, and productivity/services (cf. Gaillard, 2003; Schabracq, Maassen van den Brink, Groot, Janssen, & Houkes, 2000).

In sum, sickness absenteeism and work disability due to work-related mental health problems are prevalent in The Netherlands, and their associated costs are quite high (e.g., Houtman, Andries, & Hupkens, 2004). This means that employees' health and quality of life is at stake. Therefore, it is important to gather information about which factors contribute to work stress. For instance, high work pressure is a prominent feature of European working life, as shown by a large-scale European survey in which the percentage of employees who reported "working at a very high speed" increased from 48% in 1990 to 56% in 2000, and the percentage working under "tight deadlines" increased from 50% to 60% (EFILWC, 2002); these factors may in turn contribute to serious health problems (Schaufeli & Kompier, 2001). Indeed, it was shown that of the employees who worked at a high speed, 46% reported backache, 40% reported stress, and 35% reported muscular pain in neck and shoulders, whereas those percentages were respectively 25%, 21%, and 15% for employees who never worked at a high speed (EFILWC, 2002). In a Dutch study of over 7,000 disabled employees, 53% of respondents indicated that there was a clear, direct association between their work environment and the health problems that had caused their disability (Gründemann & Nijboer, 1998). Another Dutch study comparing the job characteristics of more than 3,000 disabled employees with those of the total working population revealed five risk factors that were three to four times more prevalent among disabled employees: high work pace, low job autonomy, high physical workload, unfavorable social climate, and low wages (LISV, 1998).

Hence, particular job characteristics seem to be salient determinants of employee health and well-being. For that reason, the present thesis focuses on the relationship between job characteristics and employee well-being (and absenteeism). Moreover, this thesis aims to identify whether particular combinations of job characteristics are of special importance in determining employee well-being.

The relation between work and health: The role of work stress models

In occupational health psychology several work stress models have been developed in an attempt to shed light on the relationship between job characteristics and employee health/well-being (for an overview, e.g., Cooper, Dewe, & O'Driscoll, 2001). Two prominent work stress models in current occupational health research are the Demand-Control (DC) Model (Karasek, 1979; Karasek & Theorell, 1990) and the Effort-Reward Imbalance (ERI) Model (Siegrist, 1996; Siegrist, Siegrist, & Weber, 1986). These models distinguish themselves from other work stress models by virtue of their simplicity and in the extent to which they have attained a paradigmatic status in research on the psychology of work and health (e.g., de Jonge & Kompier, 1997; Kristensen, 1999). Both models have generated a considerable amount of (mainly cross-sectional) empirical research (e.g., de Lange, Taris, Kompier, Houtman, & Bongers, 2003; van Vegchel, de Jonge, Bosma, & Schaufeli, 2005); due to their simplicity these models are easy to implement both in empirical research and in field research emphasizing practical implications (e.g., Theorell, 1999). The main job characteristics included in the models seem to correspond to the key psychosocial risk factors (such as high work load, low autonomy/control, and low occupational rewards) that have been identified in relation to work stress, absenteeism, and disability (e.g., Houtman, 2005). The DC Model mainly focuses on job demands on the one hand and decision latitude (or job control) on the other as determinants of employee well-being, whereas the ERI Model emphasizes the relation between effort and rewards in the prediction of employee well-being. Each model has its own unique elements, and because a similar mechanism plays a core role in both models they can be viewed as complementary to each other. In a nutshell, both models predict that when the employee experiences high job demands (or high effort) but insufficient job resources to handle these demands (in the form of either decision latitude or rewards), strain will be experienced. However, when enough job resources are available, these resources can counteract the negative impact of demands on employee health and can even change a stressful situation into a challenging one. To put it differently, job resources may change high job demands into either the “spice of life” or the “kiss of death” (cf. Levi, 1990).

The assumption that more or fewer job resources can translate (high) job demands into either positive or negative effects on employee well-being has often been operationalized as an *interaction* between job demands and job resources in relation to employee well-being. An interaction means that the total effect of high demands and low resources is larger than the sum of the separate effects of high demands and low resources on employee well-being. To put it differently, an interaction effect can be regarded as a situation of “1 + 1 = 3”, due to the extra influence of the interplay between characteristics that reinforce each other, whereas without this interplay there would simply be an additive effect (“1 + 1 = 2”). For this reason, it is important to identify the particular job demands and job resources that reinforce each other (i.e., show an interaction), resulting in an extra strong effect on employee well-being. As such, the interaction between job demands and job resources can be regarded as a powerful element of both the DC Model and the ERI Model. In addition, for most organizations the potential value of these work stress models is that they indicate how strain may be reduced without altering the level of demands (and in many cases productivity; Karasek & Theorell, 1990). However, altering strain solely by altering job resources is only possible when an interaction is present. Without an interaction, both demands and resources would need to be altered to reduce strain. Despite the theoretical and practical value of interaction effects, research based on the DC Model and the ERI Model has devoted relatively little attention to identifying their specific features (e.g., de Jonge & Dormann, 2003; Schnall, Landsbergis, & Baker, 1994).

Hence, the present thesis will use the DC Model and the ERI Model as theoretical frameworks, devoting special attention to the interaction between job demands and job resources in relation to employee well-being.

Work, health, and human service work

The present thesis will examine the combined effects of job demands and job resources on employee well-being within the human service sector. Over the past few decades, human service has been a steadily growing work sector. For instance, in the Netherlands 4,120,000 persons were employed in the service sector in 1994, but this number steadily increased to 5,168,000 persons in 2002 (CBS, 2005). Currently, almost eight out of ten Dutch employees are employed in the service sector (CBS, 2004), which means that most employees work with clients. Considering that this group comprises a large segment of the working population, it seems important to study the effects of work on employee well-being in this sector.

According to Siegrist (1999), human service employees may be at increased risk of experiencing work stress. Indeed, a recent European report on work-related stress revealed that the health, social services, and education sectors are most at risk of work-related stress (Houtman, 2005). More specifically, in a Dutch overview of working conditions in particular occupational sectors, Andries, Houtman, and Hupkens (2004) reported that work pace is still increasing in those sectors, whereas autonomy at work is decreasing. Moreover, for employees in health service professions, the possibilities for personal development have decreased, whereas complex and physically heavy work has increased (Andries et al., 2004). Therefore, the risk of work stress consequences is unfavorable in these sectors, more so than in other sectors (Andries et al., 2004, p. 64). It has already been demonstrated that sickness absence rates are highest in human service professions (Gaillard, 2003). A possible reason for this is that such work is increasingly client-driven, which in turn may have led to more stress-related problems (EFILWC, 2002). Another reason may be that working with and for people is more complex than working with inanimate objects, as argued in Hasenfeld's (1983; 1992) Human Service Organization theory. According to Dollard and collaborators (2003), employees who perform human service work experience the same stressors as employees in other occupations (such as high workload, lack of autonomy, low occupational rewards), but may also experience customer-related social stressors. Customer-related social stressors refer to direct interactions with individual customers, and the behavior of customers during such interactions, which may lead to strain (cf. Dormann & Zapf, 2004). Examples of such emotionally demanding tasks include dealing with the aggressive behavior, suffering, or traumatic experiences of clients. In short, different types of job demands seem to be present in the human service sector: work pace/time pressure, physical demands (Andries et al., 2004), and emotional demands due to interactions with clients (Dormann & Zapf, 2004). On the other hand, research on specific resources that could be of particular importance in human service work is still in an early stage (Dollard et al., 2003). In general, occupational stress research shows that job control (Karasek & Theorell, 1990), social support (Johnson & Hall, 1988), and occupational rewards (Siegrist, 1996) represent the major resources available in almost every occupation. Dollard and colleagues (2003) note that this is certainly plausible for human service professions as well, but this still has to be tested.

As was mentioned earlier, relatively little is known about the *combined effects* of job demands and job resources in relation to employee well-being. Because different types of demands and resources are present in the human service sector, studying work and health in this sector provides an opportunity to study several specific combinations of job demands and job resources. Moreover, considering that a growing segment of the working population is employed in human service professions, it seems important to gain more insight into the combined effects of particular demands and resources that are most salient in the prediction of employee well-being.

In sum, work stress seems to be a common phenomenon in The Netherlands and in other industrialized countries, one which is largely dependent on job characteristics. To investigate the relation between work and health, several work stress models, such as the DC Model and the ERI Model, have been developed. Although these two models focus on job demands and job resources, relatively little attention has been devoted to the combined interactive effects of demands and resources that may be especially important in predicting employee well-being. For that reason, the interaction between job demands and job resources with respect to employee well-being will be studied more deeply in this thesis. In view of the rapidly growing human service sector, and data that indicate that human service employees are at especially high risk of stress (e.g., Andries et al., 2004; Houtman, 2005), studying work stress in human service occupations seems warranted.

1.2 Research problem and aim of the study

The present thesis aims to provide better insight into the combined effects of job demands and job resources (i.e., their interaction) on the well-being of human service employees. The DC Model and the ERI Model will be used as theoretical frameworks for operationalizing the relation between job demands and job resources. Both of these models – each with its own unique components – have proven to be valuable and respected approaches to the prediction of employee well-being. Despite what is already known about the relation between work and well-being, there are still several important gaps in our knowledge. For instance, interaction effects have scarcely been found, even though the presumed buffering effect of job resources – that is, their attenuation of negative effects of high job demands on employee well-being – may be the most powerful element of both of these work stress models. In the present study respondents working in nursing homes served as an example of human service employees. With a growing human service sector, which may be especially vulnerable to work stress, it seems highly relevant to study the relation between job characteristics and employee well-being within such a sample. To adequately represent job characteristics in human service work, different types of job demands (such as mental, emotional, and physical demands) and job resources (such as job control and occupational rewards) will be considered (cf. Dollard et al., 2003).

The following general research question forms the basis for the present thesis:

> *What is the relationship between (1) particular combinations of job demands and job resources and (2) employee well-being, as predicted by the Demand-Control Model and the Effort-Reward Imbalance Model?*

The aim of this study is to gain more insight into and understanding of the combined effects of job demands and job resources in relation to employee well-being. To determine the current state-of-the-art concerning the combined effects of job demands and job resources on employee well-being as articulated in the DC Model and the ERI Model, a literature review covering both models was conducted. This review indicated that relatively little is known about the statistical operationalization of the combined effects of job demands and job resources on employee well-being, that the specificity with which job demands and job resources are measured may influence whether a combined effect of job demands and job resources is detected in analyses of employee well-being, and that many studies are cross-sectional. Therefore, two more specific research aims of the present thesis were to investigate:

(1) the statistical operationalization of the demand-resource interaction in relation to employee well-being;
(2) the level of specificity at which job demands and job resources should be measured, in order to detect their combined effects on employee well-being over time.

Although the focus is on these two issues, implicitly the main assumptions of the DC Model and the ERI Model will be examined as well, in a cross-sectional as well as a longitudinal time frame. Based on the results, the present thesis aims to contribute to the further theoretical development of research on the combined effects of job demands and job resources in the prediction of well-being in human service employees.

1.3 Overview of the present thesis

This thesis consists of eight chapters. *Chapter 2* introduces a theoretical framework for studying job characteristics in relation to employee well-being. That is, the DC Model and the ERI Model will be further described and a state-of-the-art review will be provided for both models. The choice of outcome variables will be discussed as well. On this basis, the research model, research questions, and hypotheses underlying the present thesis will be formulated. The research method is presented in *Chapter 3*, which describes the research design, respondent population, procedures, measurement instruments, and general methods of data analysis, including cross-validation. Studies employing both a cross-sectional and longitudinal design will be presented. *Chapter 4* contains a theoretical overview as well as an empirical illustration of different statistical operationalizations of demand-resource interactions. The subsequent three chapters deal with a more specific operationalization of job demands and job resources, the components that constitute the interaction term. *Chapter 5* offers a detailed theoretical discussion of the notion of specificity, whereas longitudinal empirical results based on these specific measures are presented in *Chapter 6* for the DC Model and in *Chapter 7* for the ERI Model. Finally, *Chapter 8* presents the main conclusions and a general discussion, including the most important findings of this thesis as well as a critical methodological reflection on the study as a whole. The chapter concludes with a discussion of theoretical and practical implications and recommendations for future research.

2

Theoretical framework

Parts of this chapter have been published under the title:

van Vegchel, N., de Jonge, J., Bosma, H., & Schaufeli, W. (2005). Reviewing the effort-reward imbalance model: Drawing up the balance of 45 empirical studies. *Social Science & Medicine*, *60*, 1117-1131.

The theoretical framework for this thesis will be clarified in the present chapter. Over the past few decades, several work stress models have been developed to describe the relationship between job characteristics and employee health. Two leading work stress models that have generated a considerable amount of empirical research are the Demand-Control (DC) Model (Karasek, 1979; Karasek & Theorell, 1990) and the Effort-Reward Imbalance (ERI) Model (Siegrist, 1996; Siegrist, Siegrist, & Weber, 1986). In the first section of this chapter the DC Model and the ERI Model will be described; also, empirical studies will be reviewed to determine the current state of affairs for both models, and to identify remaining issues for discussion. Because many different outcome variables have been examined in DC studies as well as ERI studies, the second section will elaborate on the choice of outcome variables for the present research. In the last section, the research model, research question, and hypotheses will be presented, in relation to the theoretical and empirical issues considered in the preceding sections.

2.1 Work stress models

In this section a description and critical overview of both the DC Model and the ERI Model will be provided. The DC Model dates from the late seventies, but is nevertheless still relevant for today's practice. The ERI Model is a more recent work stress model, which has gained in popularity since the 1990s. For this particular reason, more has been written about the DC Model in comparison with the ERI Model. Therefore, the ERI Model will be discussed more thoroughly to get a complete picture of the model. The DC Model will be described briefly and only the main points relevant for this thesis will be highlighted. More information about the DC Model and critiques of this model can be found for instance in Karasek and Theorell's book (1990) and in several reviews of the DC Model (e.g., de Jonge & Furda, 1997; de Lange, Taris, Kompier, Houtman, & Bongers, 2003; Schnall, Landsbergis, & Baker, 1994; van der Doef & Maes, 1998, 1999). This section will conclude with a comparison of the main characteristics of the DC Model and the ERI Model.

2.1.1 The Demand-Control Model

Model description

In 1979, the Demand-Control (DC) Model was introduced by the sociologist Karasek (1979), who drew upon two research traditions, namely the occupational stress tradition (e.g., Caplan, Cobb, French, van Harrison, & Pineau, 1976; Kahn, 1981) and the job redesign tradition (e.g., Hackman & Oldham, 1980). In both research traditions, attempts were made to relate psychosocial job characteristics to employee health. The occupational stress tradition focused on "stressors" at work, such as high workload, role conflict, and role ambiguity (e.g., French & Kahn, 1962). The job redesign tradition focused mainly on job control, as its primarily aim was to inform the (re)design of jobs in order to increase motivation, satisfaction, and performance at work. According to Karasek (1979), the interaction between job demands placed on the employee and the discretion available to the employee to decide how to meet these demands (i.e., job control) contributes importantly to the prediction of strain and active learning.

Within the DC Model, psychological job demands refer to a task's mental workload and the mental alertness or arousal needed to carry it out (cf. Karasek & Theorell, 1990, p. 63). Job control or decision latitude is a composite of the employee's autonomy to make decisions on the job (decision authority) and the breadth of skills used by the employee on the job (skill discretion: cf. Karasek, 1989). Theoretically, in the DC Model an interaction effect has been described as a joint effect of job demands and decision latitude (Karasek, 1989). It is not always clear what is meant by this "joint effect". Two perspectives, also known as the "strain" and "buffer" hypothesis (van der Doef & Maes, 1998, 1999), can be distinguished. According to the first perspective, the most adverse health effects are expected in a high demand – low control work situation. The second perspective proclaims that (high) control can act as a buffer and thus minimize the potentially negative impact of high demands on employee health. Although these perspectives are not mutually exclusive, they have different statistical implications. Whereas the first perspective implies that the nature of the interaction is additive, the second perspective assumes an interaction over and above the main effects. Originally, Karasek (1979) examined an interactive effect between demand and control. However, a decade later Karasek (1989) stated that: "for the Demand-Control Model, the existence of a multiplications interaction term is *not* the primary issue" (p. 143). Opinions differ on this matter, as can be seen in the diversity of operationalizations of demand-control interactions in empirical research (e.g., Landsbergis & Theorell, 2000). This issue will be further discussed later in this chapter.

Figure 2.1 offers a graphical representation of the DC Model. The various combinations of high and low levels of demands and decision latitude result in four types of work situations: (1) high strain, (2) active, (3) low strain, and (4) passive jobs.

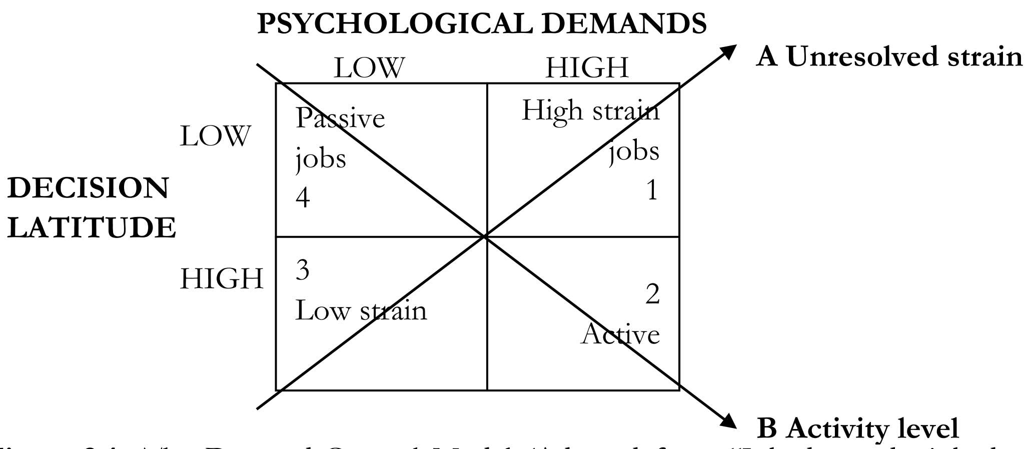


Figure 2.1 The Demand-Control Model (Adapted from "Job demands, job decision latitude, and mental strain: Implications job redesign" by R.A. Karasek, Jr. published in Administrative Science Quarterly, vol. 24 (2) by permission of Administrative Science Quarterly ©)

The model has two hypotheses, represented by the strain diagonal (A) and the active diagonal (B). The first (*strain*) hypothesis maintains that a combination of high job demands and low decision latitude leads to job strain (such as exhaustion and health complaints), represented by Cell 1 in Figure 2.1. High demands initiate a state of arousal, evident in for instance increased heart rate and adrenaline levels. If there is at the same time an environmental constraint (i.e., low decision latitude), the arousal cannot be converted into an effective coping response (e.g., "fight or flight"). Therefore, the arousal is transformed into damaging, unused residual strain (cf. Karasek & Theorell, 1990). The opposite situation, low demands and high decision latitude, is represented by Cell 3 in Figure 2.1. In this situation, Karasek and Theorell (1990) have predicted lower than average levels of residual psychological strain and lower risk of illness, because decision latitude allows the individual to respond to each challenge optimally, and because there are relatively few challenges to begin with.

The second (*active learning*) hypothesis predicts that a combination of both high job demands and high decision latitude will increase work motivation, learning, and personal growth (Cell 2 in Figure 2.1). Although such situations are intensively demanding, employees feel a large measure of control, and are able to use all available skills, enabling a conversion of aroused energy into action through effective problem solving. In the opposite situation, namely low job demands and low decision latitude (Cell 4 in Figure 2.1), a gradual atrophying of skills and abilities may occur. This situation is similar to "learned helplessness" (cf. Seligman, 1992, see Karasek & Theorell, 1990).

In other words, the strain diagonal (A) and the active learning diagonal (B) yield a model that unites the mechanistic stress tradition with the insights of social learning theory and adult education theory (Landsbergis, 1988). Several types of outcomes may result from the situations represented by the two diagonals, for example exhaustion, psychosomatic complaints, and absenteeism in the case of the strain diagonal, and work motivation, learning, and job satisfaction in the case of the active learning diagonal (cf. de Jonge, 1995).

Job demands and decision latitude are usually measured by means of two methods, namely imputation of job characteristics and self-report questionnaires. In the imputation method, a score on job demands and decision latitude is assigned to employees on the basis of their job title. Normally, these (average) scores for particular job titles are derived from large national studies (Karasek & Theorell, 1990). The imputation method is suitable for large multi-occupational studies where information on an individual's occupation is available, but no details on job characteristics (Landsbergis & Theorell, 2000). However, due to minimal within-occupation variability this method is not suitable for small occupational groups (Landsbergis & Theorell, 2000). In this context, or when more precise information about job characteristic is needed, self-report questionnaires may be more appropriate. The original questionnaire used to operationalize the DC Model is the Job Content Questionnaire (JCQ) (Karasek, 1985). The core questions in the JCQ were taken from the U.S. Quality of Employment Surveys (QES), which were administered to three nationally representative samples in 1969, 1972, and 1977. In 1985, the full JCQ (Version 1.1) was developed by adding newly drafted items. The JCQ has been widely used in North America, Europe, and Japan (Landsbergis & Theorell, 2000).

In reaction to criticism regarding the simplicity of the DC Model, the model was extended to include several job characteristics, for instance job insecurity, physical exertion, hazardous exposure, and social support (Karasek & Theorell, 1990). The most well-known of these variables is workplace social support, yielding the Demand-Control-Support (DCS) Model (Johnson & Hall, 1988). The DCS Model distinguishes collective and isolated work conditions, such that eight work situations can be defined, namely the four work situations identified in the CD Model (see Figure 2.1) in combination with high support, and these four work situations in combination with low support. The most adverse health effects were predicted for a work situation with high demands, low decision latitude, and low social support, also termed iso-strain (cf. Johnson & Hall, 1988).

Critical overview of DC studies

Since its introduction, the DC Model has provided the theoretical framework for many empirical studies. The model has been applied to numerous outcome variables, including physical outcomes (e.g., cardiovascular diseases [CVD]), behavioral outcomes (e.g., sickness absence), and psychological outcomes (e.g., burnout). The theoretical and empirical literature on the DC model has been examined in several reviews aimed at revealing crucial characteristics distinguishing studies which support the model from those which do not. Two notable reviews by Van der Doef and Maes, paying special attention to interactions, addressed physical outcomes (1998) and psychological (1999) outcomes. These reviews drew a distinction between the "strain" hypothesis, testing additive effects, and the "buffer" hypothesis, testing interaction effects in addition to main effects.

Because of this clear distinction between studies that solely examine main effects (i.e., the strain hypothesis) and studies that test true statistical interactions (i.e., the buffer hypothesis), the reviews by Van der Doef and Maes (1998, 1999) will serve as a starting point for evaluating the validity of the DC Model. The results of both reviews are summarized in Table 2.1, displaying the percentage of studies confirming each hypothesis by outcome category. These confirmation rates represent the number of supportive studies relative to the total number of studies examining the hypothesis in question.

As can be seen in Table 2.1, Van der Doef and Maes' reviews of 51 physical health studies (1998) and 63 psychological well-being studies (1999) show that the strain hypothesis has been tested more often than the buffer hypothesis, and that the strain hypothesis has received considerable support, whereas the relatively limited number of studies testing the buffer hypothesis show inconsistent results. More concretely, Van der Doef and Maes (1998, 1999) found that 86 out of 143 studies testing the strain hypothesis (at least partially) supported this hypothesis (success rate of 59%), whereas for the buffer hypothesis 30 out of 78 studies showed (partial) support (success rate of 38%). In other words, there is

Table 2.1 Confirmation rates in DC studies with regard to the strain hypothesis and the buffer hypothesis, by outcome category (based on van der Doef & Maes, 1998, 1999)

Outcome category	Total (*n* = 114)	Strain hypothesis		Buffer hypothesis	
Physical health	*51**				
All cause mortality	2	50%	(1/2)	0%	(0/0)
Cardiovascular disease	(22*)				
Cardiovascular mortality	7	43%	(3/7)	0%	(0/2)
Cardiovascular morbidity	14	62%	(8/13)	33%	(1/3)
Cardiovascular disease symptomatology	8	43%	(3/7)	100%	(1/1)
Specific non-CVD related outcomes	(13*)				
Alcohol-related morbidity/mortality	2	50%	(1/2)	0%	(0/0)
Gastro-intestinal disease	2	50%	(1/2)	0%	(0/0)
Skin disorder	1	0%	(0/1)	0%	(0/0)
Pregnancy outcome	4	100%	(4/4)	0%	(0/0)
Musculoskeletal symptoms	6	33%	(2/6)	0%	(0/0)
General (psycho)somatic complaints	18	44%	(7/16)	17%	(2/12)
Psychological well-being	*63**				
General psychological well-being	43	68%	(28/41)	48%	(15/31)
Job-related well-being	(36*)				
Job satisfaction	31	60%	(18/30)	43%	(10/23)
Burnout	4	75%	(3/4)	0%	(0/4)
Job-related psychological well-being	8	88%	(7/8)	50%	(1/2)

* Note that some studies include several types of outcomes and therefore are counted twice. Hence, the sum of studies in the sub-categories exceeds the number of studies in the main outcome categories (and similarly, the total sum over categories exceeds 114).

considerable empirical evidence for the DC Model's assumption that the combination of (high) demands and (low) decision latitude is associated with (poor) employee health and well-being. However, true statistical interactions between demands and control have not been consistently demonstrated (e.g., Jones & Fletcher, 1996; van der Doef & Maes, 1998).

Some empirical studies based on the DC Model have focused on the strain hypothesis, whereas others have tested the buffer hypothesis, mirroring the controversy in the literature over the exact relationship between demands and control. The fact that more DC studies have examined the strain hypothesis (i.e., only main effects) as opposed to the buffer hypothesis (i.e., interaction effect) could indicate that more researchers believe that an additive effect is sufficient to prove the validity of the DC Model. On the other hand, it could be argued that it is easier to demonstrate an additive effect than an interaction effect (over and above additive effects). This is also reflected in the confirmation rates, as relatively more support is found for the additive effects than for the interactive effects. Therefore, it is important to pay attention to the meaning of each perspective. Besides the above-mentioned difference (i.e., a high demand – low control situation leading to strain, versus the moderating effect of control on the relation between demand and strain and its statistical consequences), the practical implications of each perspective differ as well (van der Doef & Maes, 1998, 1999). Evidence for the moderating effect of control (i.e., the buffer hypothesis) would lead to the recommendation to enlarge control, without repercussions for the level of demands. However, focusing solely on control would be insufficient in the case of the strain hypothesis, as high demands would still have a detrimental effect on employee health. Also, from a theoretical point of view it could be argued that an interaction between demands and control is necessary to validate the DC theory. As Beehr and associates (2001) have stated: "… if main effects are all that constitute the theory, then demands and lack of control are simply a set of independent stressors with no necessary relationship to each other" (p. 117).

Points for consideration

In line with several authors (e.g., Beehr et al., 2001; Ganster & Fusilier, 1989), this chapter takes the point of view that the moderating effect of control (i.e., the interaction) – even though it is not always empirically confirmed – is the main thrust of the DC Model. Therefore, the remaining part of this critical overview will focus on several conceptual and methodological arguments that have been put forward to explain the inconsistent results with regard to demand-control interactions (e.g., de Jonge & Kompier, 1997; Kristensen, 1995, 1996; Wall, Jackson, Mullarkey, & Parker, 1996).

Firstly, the detection of significant interaction effects may be influenced by the mathematical formulation of the interaction term (e.g., de Jonge, van Breukelen, Landeweerd, & Nijhuis, 1999; Landsbergis, Schnall, Warren, Pickering, & Schwartz, 1994). Originally, Karasek (1979) operationalized the interaction between job demands and decision latitude as a "relative excess" interaction (cf. Southwood, 1978). According to this interaction term, job strain is equal to the absolute value of demands minus decision latitude plus a constant. In spite of Karasek's suggestion to use a relative excess interaction (Karasek, 1979), the literature with regard to the DC Model shows a broad range of operationalizations of the interaction between job demands and decision latitude. More specifically, three mathematical interaction terms have characterized DC research thus far (Landsbergis & Theorell, 2000). Firstly, there is the quadrant approach, which classifies job strain as scoring above the median on demands and below the median on decision latitude. Secondly, there is the quotient, namely demands divided by decision latitude. Finally, there is the multiplicative interaction term (with main effects partialled out), which consists of the multiplicative product of demands and decision latitude (for a more detailed description, see Chapter 4).

Although empirical support for various types of interaction terms suggests a robustness of the job strain concept, this might be an artifact of selection processes, whereby positive associations with outcomes are reported and negative associations are ignored. For this reason Landsbergis and colleagues (1994) tested four different interaction terms (i.e., quadrant term, quotient term, multiplicative term, and linear discrepancy term) in relation to blood pressure. All terms revealed significant effects for systolic blood pressure, but not for diastolic blood pressure (for which the multiplicative and linear terms were not significant). A few other studies that tested different interaction terms showed somewhat different results (e.g., Karasek, 1979; Sauter, 1989). Karasek himself (1979) found support for relative excess as well as multiplicative interactions with regard to job and life dissatisfaction. However, Sauter (1989) noted that only the relative excess term (and not the multiplicative term) was significantly associated with dissatisfaction and illness symptoms. As such, these studies do not seem to support a unanimous preference for one type of interaction term.

Secondly, the probability of finding significant DC interaction effects might be affected by the conceptualization and operationalization of the two main concepts of the model (cf. de Jonge & Kompier, 1997; Kasl, 1996; Wall et al., 1996). Several authors have argued that the original measures as formulated in the JCQ are too global to reveal interaction effects (e.g., Terry & Jimmieson, 1999; Wall et al., 1996). Some studies that did show a DC interaction will be briefly considered. For instance, De Jonge and colleagues (2000; 1999) found significant interaction effects by incorporating different conceptualizations of demands (e.g., psychological, emotional, and physical demands) into the DC Model. In a similar vein, Söderfeldt and associates (1997) as well as Van Vegchel and colleagues (2004) demonstrated the importance of including quantitative as well as emotional demands in the DC Model for the detection of effects in a sample of Swedish human service workers. In addition, Wall, Jackson, Mullarkey and Parker (1996) detected interaction effects for a more focused control measure and a measure of job demands in relation to job satisfaction, whereas they could not demonstrate such an effect when a broader control measure (decision latitude) was included in parallel analyses. Results reported by Sargent and Terry (1998) also suggested that job demands were moderated by specific, task-relevant aspects of control (i.e., task, decision, and scheduling control) but not by a general measure of control. An important feature of these studies seems to be the specificity with which demands and/or control was measured. In fact, the reviews by Van der Doef and Maes (1998, 1999) show that supportive studies of DC interactions were more likely to measure specific demands (e.g., time pressure) combined with a corresponding aspect of control (such as decision authority over pace and method), representing a closer match between conceptualizations of demands and control. On the other hand, studies that did not demonstrate a moderating effect of job control (i.e., an interaction) often used a broader conceptualization of demands or control (e.g., decision latitude). So, a disadvantage of the Job Content Questionnaire might be that the measure of demands is too broad (e.g., de Jonge & Kompier, 1997; Jones & Fletcher, 1996). In addition, decision latitude might also be too broadly conceptualized, incorporating different aspects of control (i.e., skill discretion and decision authority) (e.g., Schreurs & Taris, 1998).

Thirdly, most DC studies have used either a cross-sectional or a longitudinal study design. Concerning the limited number of studies that examined interaction effects, Van der Doef and Maes (1998, 1999) noted that almost none of the longitudinal studies supported the DC interaction, especially in the case of psychological well-being outcomes. This result was updated and confirmed by De Lange and colleagues (2003), who reviewed 45 longitudinal DC studies and also noted only modest support for the DC Model in longitudinal studies. Therefore, it seems more difficult to demonstrate interaction effects in longitudinal studies, in comparison with cross-sectional studies. However, it should be noted that the number of longitudinal studies, and especially those that test true interactive effects, is rather limited, which precludes firm conclusions (e.g., de Lange et al., 2003; van der Doef & Maes, 1999). Furthermore, De Lange et al. (2003) mentioned that only a few longitudinal studies examined the DC Model in relation to behavioral outcomes (such as sickness absence). The overview in Table 2.1 based on the reviews of Van der Doef and Maes (1998, 1999) confirms that behavioral outcomes have only rarely been considered, and also shows that only a few studies investigated burnout, an outcome of special importance for human service employees, the population under study in the present research.

Finally, the nature of the population under study can influence the likelihood of finding DC interaction effects. The DC Model generalizes across occupations, assuming that for most employees workload is the central component of job demands (e.g., Sparks & Cooper, 1999; van der Doef & Maes, 1999). However, this may not apply to all occupational groups. For human service employees, stressors related to interactions with clients could constitute equally important or even more important job demands. With an upcoming service sector, specific demands related to service work may become increasingly important. Although empirical research has noted the specific characteristics of human service work, attention has primarily been focused on the outcome side (i.e., studying burnout), and not on the specific demands inherent to service work (cf. Zapf, 2002). Hockey (2000) suggests that three broad types of job demands may be distinguished, namely mental, emotional, and physical demands. Especially in human service organizations, all three job dimensions seem to be essential due to the nature of the job, namely: mental demands (e.g., time pressure), emotional demands (e.g., handling unfriendly clients) and physical demands (e.g., carrying/lifting heavy weights). As the DC Model only examines psychological demands[1], the model may give an oversimplified image of human service work (cf. Söderfeldt et al., 1997). For this reason it might be fruitful to amend the DC Model to include emotional and physical demands, at least with respect to human service occupations. In other words, occupation-specific measurement of demands might improve the explanatory and predictive power of the DC Model (c.f. Sparks & Cooper, 1999; van der Doef & Maes, 1999).

Conclusion

In conclusion, the DC Model has generated many empirical studies as well as many critical review papers. In our opinion, what particularly makes the DC Model a unique and interesting theoretical model is the interactive effect of job demands and job resources (e.g., control) on job-related strain (cf. Beehr et al., 2001; de Jonge & Dormann, 2003). Especially in this respect, however, empirical studies

---

[1] Note that Karasek and Theorell (1990) use the term "psychological" demands, while in the present thesis the term "mental" demands is used in line with the tripartite division of Hockey (2000).

have yielded only inconsistent support for the model. The above-presented critical overview argued that the DC Model might benefit from several refinements, which will be the focus of the present study. Firstly, there is confusion regarding the exact mathematical formulation of the interaction term. Therefore, more information about the exact meanings and interpretations of different types of interactions is needed. Secondly, the conceptualization and operationalization of demand and control seems to influence whether interactions are found: more specific measures are more likely to support the model as opposed to more general measures. Thirdly, a relatively large number of studies are cross-sectional. For that reason, longitudinal studies are highly recommended, especially longitudinal studies that examine the moderating effect of control (i.e., interactions). In addition, the (longitudinal) effect of the DC Model for behavioral outcomes could be further examined, and for human service employees it would be desirable to include burnout as well. And finally, the DC Model is very general, and should be adapted to human service work in order to represent this specific occupational group properly. For the same reason, it would be advisable to use more specific demand measures.

2.1.2 The Effort-Reward Imbalance Model

Model description

The ERI Model has its origins in medical sociology and emphasizes both the effort and the reward structure of work (Marmot, Siegrist, Theorell, & Feeney, 1999). The model is based on the premise that work-related benefits depend on a reciprocal relationship between efforts and rewards at work. Siegrist (1996) defines efforts as job demands and/or obligations that are imposed on the employee. Occupational rewards distributed by the employer (and by society at large) include money, esteem, and job security or career opportunities (Siegrist, 1996). More specifically, the ERI Model claims that work characterized by both high efforts and low rewards represents a reciprocity deficit between "costs" and "gains". This imbalance may cause sustained strain reactions. So, working hard without receiving appreciation is an example of a stressful imbalance. In addition, it is assumed that this process will be intensified by overcommitment (a personality characteristic), such that highly overcommitted employees will respond with more strain reactions to an effort-reward imbalance, in comparison with less overcommitted employees. Because the ERI Model has evolved considerably over time, a more detailed historical overview of the most relevant developments leading to the model in its current form will be provided.

Development of the ERI Model

In 1986 a sociological framework referred to as the ERI Model was introduced by Siegrist and associates (1986) to predict and explain (the onset of) cardiovascular-related outcomes. The ERI Model claims that the work role is crucial to the fulfillment of individual self-regulatory needs. That is, work offers opportunities to acquire self-efficacy (e.g., successful performance), self-esteem (e.g., recognition), and self-integration (e.g., belonging to a significant group). Based on the principle of social exchange (i.e., reciprocity), the employee invests efforts and expects rewards in return. However, when there is an imbalance between high effort and low reward, this taken-for-granted routine is disrupted and the fulfillment of self-regulatory needs is threatened. According to Siegrist et al. (1986) this imbalance may lead to a state of “active distress” by evoking strong negative emotions, which in turn activate two stress axes, namely the sympathetic-adrenomedullary and the pituitary-adrenal-cortical systems (Henry & Stephens, 1977). In the long run, sustained activation of the autonomic nervous system may contribute to the development of physical (e.g., cardiovascular) diseases as well as mental diseases (e.g., depression, see also Weiner, 1992).

In its early years, the ERI Model was primarily used to investigate cardiovascular outcomes. It was not until 1998 that the model was applied to other psychological and behavioral outcomes as well. Appels can be viewed as a pioneer in linking ERI (i.e., high effort and low reward) to psychological outcomes such as vital exhaustion (Appels, Siegrist, & de Vos, 1997). Appels’ work (1991) showed that vital exhaustion may lead to acute myocardial infarction (AMI). In addition, he found strong independent effects of ERI and vital exhaustion on AMI (Appels et al., 1997). These results suggest that ERI could lead to cardiac events, and that this relation might be partially mediated by vital exhaustion. Implicitly, the ERI Model can also be considered as an account of psychological well-being, as ERI evokes strong negative emotions, which are related to impaired well-being (cf. Gaillard & Wientjes, 1994). Furthermore, it has been argued that the model can be applied to addictive behavior as well. According to Blum and colleagues (1996) prolonged stress leads to dysfunction or disruption of the mesolimbic dopamine system, which in turn stimulates addictive behavior. To summarize, effort-reward imbalance seems to evoke adverse health by stimulating neuro-biological, psychological, and behavioral pathways.

In general, it is widely assumed that people will not passively remain in a high effort – low reward imbalance situation, but that they will instead try cognitively and behaviorally to reduce their efforts and/or maximize their rewards (as for example in the cognitive theory of emotion (Lazarus, 1991) and the expectancy theory of motivation (Schönpflug & Batman, 1989)). This suggests that effort-reward imbalance might not influence health over a longer period. However, according to Siegrist (1996) negative affect associated with ERI may not be consciously appraised, as it is a chronically recurrent everyday experience (cf. Gaillard & Wientjes, 1994). Furthermore, Siegrist (1996) identified some specific circumstances under which a high cost/low gain condition may be maintained: (1) when there is no alternative job due to conditions on the labor market, (2) when strategic reasons play a role (e.g., expectation of future gains), and (3) when the employee exhibits a motivational pattern of excessive work-related overcommitment. Overcommitment is seen as a personality characteristic based on the cognitive, emotional, and motivational elements of Type A behavior that reflect an exorbitant ambition in combination with a need for approval and esteem (Hanson, Schaufeli, Vrijkotte, Plomp, & Godaert, 2000; Siegrist, 1998).

Overcommitment can be defined as the person-specific component of the ERI Model, whereas effort and rewards comprise the situation-specific component.

To measure the key concepts of the ERI Model, early researchers gathered information from different sources, namely contextual information (such as administrative data and objective measures) as well as descriptive and evaluative information (through interviews and questionnaires). A combination of these sources was usually used to measure effort and reward. Overcommitment was assessed solely via questionnaires (cf. Matschinger, Siegrist, Siegrist, & Dittmann, 1986). Subsequently, a questionnaire was developed to measure all components of the ERI Model, namely effort, rewards, and overcommitment. The introduction of this ERI Questionnaire (ERI-Q: Siegrist & Peter, 1996) led to a predominant use of questionnaires to test the ERI Model.

Despite developments in their operationalization over time (for more details, see Chapter 3), the concepts effort, reward, and overcommitment have remained the core components of the ERI Model. Graphical representations of the original version and the current version of the ERI Model are given in Figure 2.2 and Figure 2.3, respectively. As can be seen, two concepts have been re-labeled: "intrinsic effort"/"need for control" has become "overcommitment", and "status control" has become "security/career opportunities". Reasons for these changes are not mentioned in the literature.

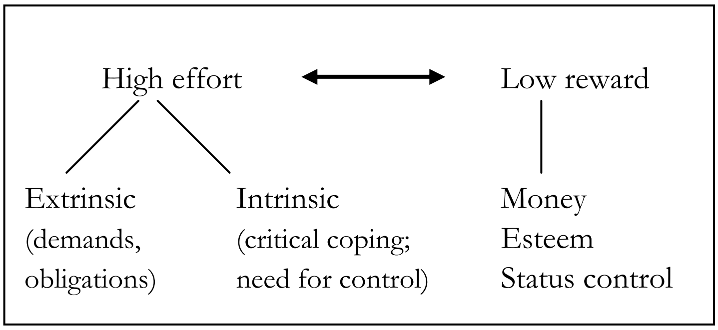


Figure 2.2 The original ERI Model (Siegrist, 1996, p. 30. Copyright © 1996 by the Educational Publishing Foundation. Reprinted with permission.)

The most profound difference between Figures 2.2 and 2.3 is the role of overcommitment. According to Figure 2.2, overcommitment (i.e., "Intrinsic (critical coping; need for control)") is part of effort. Because highly overcommitted employees underestimate challenging situations and overestimate their own capability, they tend to invest (too) much effort. Therefore, the amount of effort invested depends on both extrinsic effort (i.e., demands and obligations from work) and intrinsic effort (i.e., overcommitment). Hence, the main assumption of this version of the ERI Model was that a mismatch between high extrinsic or *intrinsic* effort and low rewards may lead to adverse effects on health. Later, as shown in Figure 2.3, overcommitment is presented as an independent concept. Here, overcommitment influences the perception of both high effort and low rewards, and therefore influences employee health indirectly. In addition, overcommitment is also thought to have a direct effect on employee health, as being highly overcommitted (i.e., involved with work all the time) may be exhausting in the long run.

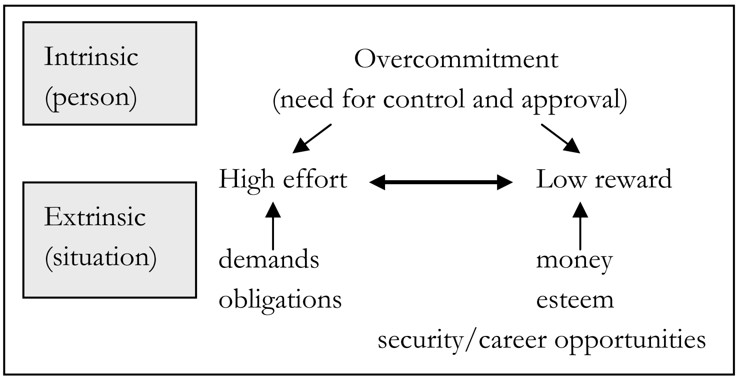


Figure 2.3 The current ERI Model (Siegrist, 1999, p. 40. Copyright © 1999 by Rainer Hampp Verlag. Reprinted with permission. Reprinted with permission.)

Based upon this line of reasoning, Siegrist (2002) has formulated three predictions for the ERI Model. Firstly, according to the *extrinsic ERI hypothesis*, an imbalance between (high) extrinsic effort and (low) rewards increases the risk of poor health, over and above the risks associated with each component by itself (i.e., high effort and low rewards). Secondly, according to the *intrinsic overcommitment (OVC) hypothesis*, a high level of overcommitment, possibly resulting in continued exaggerated efforts combined with disappointing rewards, may also increase the risk of poor health (i.e., a main effect of overcommitment), even in the absence of an extrinsic effort-reward imbalance. And finally, according to the *interaction hypothesis (i.e., ERI * OVC)*, an extrinsic ERI in combination with a high level of overcommitment leads to the highest risk of poor health. Therefore, a complete test of the ERI Model covers all three of these conditions (i.e., effort, rewards, and overcommitment).

Critical overview of ERI studies

As the ERI Model is a more recent work stress model that started to flourish in the 1990s, a full comprehensive review of the model was not yet available at that time. Therefore, relatively little was known about the number of studies that have confirmed its hypotheses and the crucial features distinguishing supportive from nonsupportive studies. In order to address these issues, we decided to review the results of all 45 empirical tests of the ERI Model published in the period 1986 – 2003 (for more details, see van Vegchel, de Jonge, Bosma, & Schaufeli, 2005). Taking the development of the ERI Model into account, the model was evaluated on the basis of evidence for three hypotheses, namely the (extrinsic) ERI hypothesis, the OVC hypothesis, and the interaction (ERI*OVC) hypothesis (cf. Siegrist, 2002). A distinction was made between physical health outcomes (mainly CVD-related outcomes), behavioral outcomes (i.e., sickness absence, smoking and alcohol consumption) and psychological well-being (i.e., (psycho)somatic health symptoms and job-related well-being). Table 2.2 shows the confirmation rates for each hypothesis by outcome category. The confirmation rates are percentages reflecting the proportion of supportive studies relative to the total number of studies that examined each hypothesis.

Table 2.2 Confirmation rates in ERI studies with regard to the ERI hypothesis, the OVC hypothesis, and the interaction (ERI*OVC) hypothesis, by outcome category

Outcome category	**Total (*n* = 45)**	**ERI hypothesis (Effort & Rewards)** [1]		**OVC hypothesis**		**Interaction hypothesis (ERI * OVC)**	
Physical health outcomes	*25**						
CVD incidence	8	100%	(8/8)	80%	(4/5)	0%	(0/1)
CVD symptoms and risk factors	17	87%	(13/15)	45%	(5/11)	0%	(0/3)
Other outcomes	1	0%	(0/1)	0%	(0/1)	0%	(0/1)
Behavioral outcomes	*3*						
Behavioral outcomes	3	67%	(2/3)	0%	(0/1)	0%	(0/0)
Psychological well-being	*19**						
(Psycho)somatic symptoms	16	87%	(13/15)	86%	(6/7)	33%	(1/3)
Job-related well-being	7	83%	(5/6)	100%	(2/2)	50%	(2/4)

* Note that some studies include several types of outcomes and therefore are counted twice. Hence, the sum of studies in the sub-categories exceeds the number of studies in the main outcome categories (and similarly, the total sum over categories exceeds 45).

[1] This column includes all studies that tested the ERI hypothesis (i.e., effort & rewards), with effort characterized as either extrinsic or *intrinsic* (i.e., overcommitment).

As can be seen from Table 2.2, the ERI Model seems to be a fruitful model for shedding light on the relation between job characteristics and employee health, although the role of the personality characteristic overcommitment is less well established. In general, the ERI hypothesis has been intensively examined and most studies support the notion that a combination of high effort and low rewards induces impaired employee health. More specifically, Table 2.2 shows that 41 out of 48 studies testing the ERI hypothesis (at least partially) supported this hypothesis (i.e., success rate of 85%). The OVC hypothesis was studied in about half of the studies, of which most yielded evidence that highly overcommitted employees had impaired health compared to their less overcommitted counterparts. That is, 17 out of 27 studies that tested the OVC hypothesis showed (partial) evidence for this hypothesis (i.e., success rate of 63%). However, it should be noted that results varied considerably over the outcome categories. The hypothesized interaction between ERI and OVC has only rarely been tested in empirical research (only 12 times, with 3 studies supporting the hypothesis: success rate of 25%), so there is an insufficient basis for strong conclusions with respect to the overall support for this hypothesis.

Points for consideration

In a way, it is not surprising that the ERI hypothesis has been studied most often. After all, the notion of high effort – low reward imbalance lies at the heart of the ERI Model. Furthermore, from the beginning effort-reward imbalance was assumed to affect employee well-being (i.e., the ERI hypothesis), whereas the role of overcommitment (and the associated hypotheses) evolved over time. Originally, overcommitment was considered to be part of the effort concept (i.e., intrinsic effort), whereas in later versions overcommitment was assumed to be an independent concept. These developments in the ERI Model may have contributed to the greater attention given to the ERI hypothesis, as compared to the role of overcommitment. However, in order to evaluate the full ERI Model, future research should incorporate tests of its predictions concerning effort, rewards, *and* overcommitment. A useful starting point might be to test the specific hypotheses suggested by Siegrist (2002), namely the ERI hypothesis, the OVC hypothesis, and the ERI*OVC hypothesis.

Although the ERI hypothesis has been most extensively studied, there are still many ways to operationalize the co-occurrence of high effort and low rewards. Firstly, depending on the theoretical interpretation of the ERI Model alternative formulations can be postulated. For instance, do high effort and low rewards have independent effects on employee health, or must they occur together if they are to influence employee health? And if they must co-occur, should this be tested as an interaction effect (i.e., an effect over and above the sum of the separate effects of effort and rewards)? In line with the most recent hypotheses, an interaction between effort and rewards has been mentioned by Siegrist (2002). However, as Belkiç and colleagues (2000) have noted, in some studies an interaction seems to exist, in that the relative risk of poor health in the case of the combined status of high effort – low rewards is substantially greater than the sum of the risks due to these two components separately (for example Peter & Siegrist, 1997; Siegrist, 1996). Nevertheless, these interactions were not statistically tested. So, it remains to be seen whether a true multiplicative interaction exists between effort and rewards (Belkiç et al., 2000).

Secondly, the mathematical formulation of the ERI index differs considerably between studies. Even though most studies have used ratios or categories to represent high/low effort and high/low rewards, there are several ways to calculate a ratio (continuous or dichotomized, with or without logarithmic transformation) and to handle the resulting quotient. For instance, the quotient has been used to make a division between two groups (i.e., ratio > 1 forms a risk group, and the ratio ≤ 1 a non-risk group), three groups (i.e., low, intermediate, high), or four groups. In a similar vein, there are internal differences in the composition of categories. For example, results (continuous or dichotomized) have been divided into two categories (e.g., based on cut-off point or median-split), three categories (e.g., neither high effort nor low rewards, either high effort or low rewards, both high effort and low rewards) or four categories (e.g., low effort – high rewards, low effort – low rewards, high effort – high rewards, high effort – low rewards). In earlier publications it was common to use three categories, but lately the use of four categories has increased because research has shown the importance of distinguishing the conditions high effort – high rewards from low effort – low rewards (cf. de Jonge, Bosma, Peter, & Siegrist, 2000). Another definition of ERI, primarily used in earlier ERI studies, is the co-manifestation of at least one high effort and one low reward indicator. Although this definition appears to have been formulated for exploratory reasons, it generates new difficulties as there are many possible compositions of different levels of effort and rewards, enlarging the possibility of capitalization on chance. In general, it should be mentioned that the use of cut-off points for variables forms a rather arbitrary definition of an ERI (or stressful work) situation, as neither natural nor clinically-based thresholds are currently available (de Jonge, Bosma et al., 2000). Moreover, the use of different ERI indices undoubtedly complicates comparisons between studies.

Thirdly, on a more general level of measurement the review showed that approximately one-half of the ERI studies used the original questionnaire, whereas the other half used proxy measures. On the one hand, the use of the original questionnaire simplifies comparison across studies and relates as closely as possible to the original concepts as intended in the model (cf. Beehr et al., 2001; Schnall et al., 1994). On the other hand, studies using original as well as proxy measures have shown support for the ERI Model, indicating an effect of ERI regardless of the type of measure, strengthening the robustness of the model. In addition, the concept of effort in the original questionnaire is composed of a variety of items concerning different types of effort (such as physical load, time pressure, and working overtime). Several dimensions might be captured by effort, for instance physical and psychological demands. Possibly, for some specific occupations it might be desirable to distinguish specific types of demands. In a similar vein, the concept of reward has been operationalized in various ways, mostly as one global reward construct encompassing several specific types of rewards. A disadvantage of using one global reward indicator (and combining different reward types to construct this indicator) is that one can not examine whether specific rewards might have different effects. Hence, a clear definition of which specific rewards should be included and separate analysis of those specific rewards might constitute a useful extension of the ERI Model (Dragano, von dem Knesebeck, Rödel, & Siegrist, 2003; van Vegchel, de Jonge, Bakker, & Schaufeli, 2002). Moreover, the present review showed that support for the ERI Model was found for musculoskeletal disorders when specific rewards were included in the analyses (Dragano et al., 2003), whereas no effect was found when a global reward construct was used (Joksimovic, Starke, von dem Knesebeck, & Siegrist, 2002) (note that both studies used the original questionnaire).

The statistical method often involved logistic regression analyses for both naturally dichotomous and (dichotomized) continuous variables. Although analyzing a dichotomous outcome variable (such as CVD incidence) requires the use of logistic regression analyses, there is a risk in dichotomizing continuous variables. First of all, by dichotomizing continuous variables information is lost and variance might be thrown away. Secondly, the cut-off point determines the division among categories, making this division dependent on the value of the cut-off point, which could yield an incorrect estimation. The same could be argued for the calculation of the ERI index. Most studies have used categories, or ratios with the quotient subsequently divided into categories. Therefore, in the case of continuous variables the use of continuous analyses (e.g., hierarchical regression analyses) as well as a continuous ERI index (e.g., a multiplicative interaction term) might be advisable in future research.

In general, study designs were either prospective (i.e., longitudinal) or cross-sectional, and the relative number of longitudinal versus cross-sectional studies varied over the different types of outcome measures. Studies examining CVD incidence were mainly prospective, strengthening the predictive value of the ERI Model. On the other hand, some studies examining CVD symptoms/risk factors also used cross-sectional designs. Remarkably, all of these cross-sectional studies supported the ERI assumption, but none supported the OVC assumption. This might possibly suggest that ERI and overcommitment have different time-lagged effects, such that ERI has short-term effects at least in terms of CVD symptoms, whereas overcommitment is a long-term determinant of CVD symptoms. In studies of behavioral outcomes and psychological well-being, mainly cross-sectional designs were used. However, it should be noted that ERI studies including behavioral and job-related outcomes are rather scarce.

Conclusion

To draw the balance, in 18 years of empirical research (i.e., from 1986 to 2003 inclusive) the ERI Model has proved to be a valuable contribution to occupational health psychology. However, this critical overview also showed that the ERI model could be further improved by several refinements, which will be addressed in the present study. Firstly, methodologically the model could be further advanced by testing effort-reward imbalance as an interaction effect. Recently Siegrist (2002) has hypothesized an interaction between effort and rewards, but this interaction has often not been statistically tested (Belkiç et al., 2000). Therefore, interactions between effort and rewards should be explicitly tested in order to explore the possibility of effort-reward interactions with regard to employee health. This brings the discussion to a second methodological consideration: the mathematical formulation of the interaction term. As with the DC Model, different formulations (mainly based on ratios and categories) have been used, but it is unknown whether these different formulations have different meanings and interpretations. Finally, in the case of continuous variables it is better to use continuous analyses (such as hierarchical regression analyses) as well as a continuous ERI index (for instance, a multiplicative interaction term).

Secondly, with regard to the conceptualization and operationalization of the key concepts of the ERI Model, two issues stand out. Although effort and rewards can be considered as the main concepts of the model, a complete test of the ERI Model ideally comprises effort, rewards, and overcommitment. Furthermore, a more specific conceptualization and operationalization of both effort and rewards would seem to offer a valuable extension of the ERI Model, especially in the case of specific occupational groups (such as human service workers).

Finally, it would be preferable to use more longitudinal study designs, especially with regard to psychological (job-related) well-being and behavioral outcomes.

2.1.3 DC Model and ERI Model: Similarities and Differences

In the literature, differences as well as similarities between the DC Model and the ERI Model have been noted (e.g., Karasek, Siegrist, & Theorell, 1998; Siegrist, 2001). The most important differences will be briefly enumerated. Firstly, whereas the DC Model puts its explicit focus on situational characteristics of the psychosocial work environment, the ERI Model includes both situational characteristics and personal characteristics (i.e., overcommitment). Secondly, the DC Model provides a broader approach to health outcomes, as the model includes a strain dimension related to health and a learning dimension related to personal growth and development. In this regard, the ERI Model is more narrowly focused on the determinants of health and well-being (e.g., cardiovascular disease). Thirdly, the DC Model's major focus is on task characteristics of the workplace, whereas some components of the ERI Model (such as salary, job security, and career opportunities) link stressful experiences at work with more distant labor market conditions. Finally, in stress-theoretical terms the DC Model is rooted in the stress-theoretical paradigm of personal control; namely, the range of control over one's work situation is the core dimension. The ERI Model fits in better with a stress-theoretical paradigm of social reward that emphasizes threats to or violations of legitimate reward based on social reciprocity. In terms of psychological theory of self, control is more closely related to self-efficacy, whereas reward is closer to self-esteem. From a sociological view, control is associated with power, whereas reward relates to a basic grammar of social exchange (i.e., reciprocity and fairness). These two different stress-theoretical orientations also have different implications for policy: whereas the control paradigm points to the structure of power, division of labor, and democracy at work, the reward paradigm addresses the issue of distributive justice and fairness. The main characteristics of the DC Model and the ERI Model are summarized in Table 2.3.

Table 2.3 Summary of main characteristics of DC Model and ERI Model

Topic	DC Model	ERI Model
Origin	Job redesign and occupational stress research	Medical sociology
Paradigm	Personal control (over work situation)	Social reward (reciprocity)
Job characteristics	Demands, Control	Effort, Rewards
Personal characteristics	-	Overcommitment
Outcomes	Strain and learning	CVD; expanded to employee health/strain
Measure (questionnaire)	JCQ	ERI-Q
Hypotheses	1) High demands – low control: strain 2) High demands – high control: learning	1) High effort – low rewards (= ERI): strain 2) High overcommitment: strain 3) ERI and high overcommitment: most strain
Policy implications	Democracy, influence	Justice, fairness

It is important to keep the differences in Table 2.3 in mind, especially when interpreting data, as they illuminate the different backgrounds from which the models have been developed and could possibly influence the resulting implications. This does not alter the fact that the DC Model and the ERI Model share some common features as well. Actually, some recent studies focus on similarities of the two models (e.g., Calnan, Wainwright, & Almond, 2000; Peter et al., 2002). From a broader work stress perspective, it could be argued that the central tenet of both models is an *interaction* between, on the one hand, job demands that are placed upon the employee (e.g., psychological job demands in Karasek's terms and job-related effort in Siegrist's terms), and on the other hand, job-related resources (such as job control and occupational rewards) to cope with such requirements. In this way, both models can be seen as balance or compensation models, in which job demands are generally defined as those aspects of the job which require additional/sustained physical, mental, or emotional effort (de Jonge & Dormann, 2003). They can be positive in the right circumstances, but can also elicit negative emotional reactions (Warr, 1987). Job resources can be described as those aspects of the job which can lead to (1) buffering of job demands, (2) achievement of personal and/or work goals, and (3) stimulation of personal growth and development (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Karasek, 1979). In the prediction of strain, the role of job resources in the buffering of job demands is of special importance.

2.2 Outcome variables

In occupational health psychology, employee health/well-being has been represented by a large number of health outcome measures. With regard to the DC Model, various outcome measures have been used to represent job strain (such as cardiovascular disease, exhaustion) and/or active learning behavior (such as job satisfaction and work motivation). The DC Model does not provide a clear rationale for determining which specific outcome variables should be used in testing the model. The ERI Model, on the other hand, was initially designed to predict physiological outcomes, or cardiovascular outcomes in particular (through the activation of two neural stress axes). However, beginning in the late nineties, a rapid expansion took place from cardiovascular measures to psychological and behavioral measures. Therefore, both models have been tested with regard to numerous outcome variables. In psychological research**,** a prevailing tripartite division distinguishes a psychological, a physical, and a behavioral component (e.g., Kahn & Byosiere, 1992). In order to provide a general overview of employee well-being, outcome variables from all three categories were included in the present research. More specifically, employee well-being was represented by psychological outcomes (i.e., job satisfaction and exhaustion), physical outcomes (i.e., psychosomatic health complaints), and behavioral outcomes (i.e., sickness absence). Below, these outcome variables will be briefly elucidated.

Psychological outcomes

Job satisfaction is one of the most frequently studied psychological outcome variables in organizational behavior research (e.g., Spector, 1997). Job satisfaction can simply be defined as the extent to which people like their job (satisfaction) or dislike their job (dissatisfaction) (cf. Spector, 1997, p. 2). Reasons for studying job satisfaction originate from humanitarian as well as pragmatic perspectives (Spector, 1997). That is, on the one hand, employees deserve good treatment at work, and job satisfaction is a good indicator of employee well-being or psychological health. On the other hand, job satisfaction can have organizational consequences in terms of behavior that affects organizational functioning (e.g., job performance, withdrawal behavior). In other words, job satisfaction seems to be a valuable outcome measure both for the employee and the organization. Recently, Dollard and colleagues (2003) have argued that job (dis)satisfaction is an outcome of particular importance for human service employees, since job satisfaction is related to customer outcomes, such as customer perceptions of service quality and customer (dis)satisfaction. Two types of effects are possible. Firstly, satisfied employees may provide better service, leading to more satisfied customers. And secondly, dissatisfied customers may exhibit stress-inducing behavior, leading to employee strain in general and low job satisfaction in particular. Hence, job satisfaction is a relevant outcome for human service employees.

Another psychological outcome of special importance for human service employees is exhaustion. Exhaustion, as the core dimension of burnout, has often been referred to as a specific health outcome for human service employees due to “people work” or interactions with clients (see for instance Schaufeli & Enzmann, 1998). However, other variables have also been shown to be related to burnout, such as time pressure, skill discretion, and non-contingent reward (Lee & Ashfort, 1996). Furthermore, Appels (1991; 1997) showed that a high effort – low reward situation could lead to cardiac events, and that this relation might be mediated by vital exhaustion, a concept closely related to (emotional) exhaustion. Therefore, exhaustion seems to be an important variable in relation to both the DC Model and the ERI Model. Although relatively few studies have tested the DC Model and the ERI Model with regard to exhaustion, the studies that have done so are generally supportive (e.g., Bakker, Killmer, Siegrist, & Schaufeli, 2000; de Jonge, Bosma et al., 2000; Rafferty, Friend, & Landsbergis, 2001).

Our critical overview of the ERI Model showed that job-related outcomes such as job satisfaction and exhaustion were not often examined in relation to effort-reward imbalance. For this reason, it might also be interesting to include these outcome variables, to examine the influence of the ERI components on these job-related outcomes.

Physical outcomes

In general, psychosomatic health complaints can be defined as “somatic (physical) complaints that are caused by (vision of causality) or preserved by (vision of circularity) psychosocial factors” (Meijer, 1995, p. 21). Even though the underlying cause may be psychosocial, the complaints themselves are physical. Moreover, in most questionnaires respondents are asked to indicate how often a certain health complaint occurred during a specific period, without considering the underlying cause. Therefore, psychosomatic health complaints will be treated here as physical outcomes. Several explanation models exist for psychosomatic health complaints, with (work) stress being one of the leading models (Meijer, 1995). Often, stressful situations manifest itself by psychosomatic health complaints. Within the DC Model, psychosomatic health complaints have often been denoted as a strain outcome (cf. Karasek & Theorell, 1990). Many DC studies have shown support for the relation between job strain (i.e., high demands and low control) and psychosomatic health complaints (for an overview, see van der Doef & Maes, 1999). In addition, recently the ERI Model has also been tested in relation to psychosomatic health complaints with promising results (for an overview, see van Vegchel et al., 2005).

Behavioral outcome

Sickness absence usually denotes absence from work. Often this type of absence is relatively easy to measure, because sickness absence is registered in many organizations. Sickness absenteeism has been conventionally measured in two different ways, namely with the time-lost index and the frequency index (cf. Warr, 1999). The time-lost index can be computed as the total duration of sickness absence during a specified period. The frequency index consists of the number of separate incidents of sickness absence in a specified period, regardless of the duration. Often, it is assumed that the time-lost index primarily represents involuntary responses to incapacitating sickness, whereas the frequency index is thought to represent more voluntary choices to be absent from work (Warr, 1999).

Although sickness absence is a relatively easily measurable phenomenon, it is relatively complex to explain the origin and duration of sickness absence. According to Kristensen (1991), absence should be regarded as: “a coping behavior that reflects the individual’s perception of his/her health (illness) and is a function of a number of factors at different levels, primarily the combination of job demands and coping possibilities at the job” (p. 15). Absence and presence factors, that is, factors important to the onset and completion of sick leave, complicate the process of sickness absence, as these factors may be present at different levels. These include the individual level (e.g., personality characteristics, demographic variables), the organizational level (e.g., work conditions, job content), and the societal level (e.g., social security system, macro-economic influences). Nevertheless, the core assumption that a discrepancy between work demands and capabilities (which could also be regarded as resources) might lead to sickness absence (cf. Allegro & Veerman, 1998; Kristensen, 1991) is consistent with our view of work stress (see also Chapter 1). As both the DC Model and the ERI Model consider the imbalance between demands/effort and control/rewards as stressful, sickness absence seems to fit this pattern and might form a (long-term) behavioral indicator of job-related strain.

Recently, absenteeism has been studied from a social exchange (Blau, 1964) and equity perspective (Adams, 1965), which assumes that a key feature of the employee-organization relationship is an equitable exchange between what employees invest and what they receive in return, and that absenteeism is an important available means for the employee to restore equity. For instance, Geurts, Schaufeli, and Rutte (1999) found a strong negative relation between perceived inequity and absenteeism, suggesting that sickness absence could indeed be viewed as a direct attempt to restore equitability in the relationship. Almost needless to say, this line of reasoning seems particularly important for the ERI Model, given its basis in a paradigm of social reward and reciprocity.

Furthermore, sickness absence seems an essential outcome variable for several reasons. Firstly, sickness absence is a measure of great economic importance to employers (Marmot et al., 1999). One of the main reasons for employers to take preventive measures in the work environment is to reduce absenteeism and enhance productivity (Houtman et al., 1999). Because sickness absence is a firm outcome, it can be more easily translated into hard economic consequences/policies. Secondly, sickness absence can be regarded as a relatively objective measure of well-being, because it is obtained from company registers. Therefore sickness absence seems to be a useful supplement to self-reported employee well-being (a methodological consideration of self-reported and objective measures can be found in Chapter 3). Thirdly, in studies based on the DC Model and the ERI Model, sickness absence has been scarcely examined (de Lange et al., 2003; van Vegchel et al., 2005). Most research has instead focused on cardiovascular outcomes and psychological well-being. In order to advance research with regard to both models, behavioral outcomes (especially sickness absence) will be included in the present research.

2.3 Research model, research question and research hypothesis

The present study concentrates on the combined effect of job demands and job resources (i.e., the demand-resource interaction) on employee well-being, in a sample of human service employees. The Demand-Control Model (Karasek, 1979; Karasek & Theorell, 1990) focusing on job demands and control, and the Effort-Reward Imbalance (ERI) Model (Siegrist, 1996; Siegrist et al., 1986) emphasizing a reciprocal relationship between effort and rewards at work, together form the theoretical framework. Both models predict that a work situation characterized by high job demands and low job resources (either job control or rewards) will lead to reduced employee well-being; in contrast, when a work situation is characterized by high job resources, the negative impact of demands should be counterbalanced. That is, the combined effect of job demands and job resources determines the state of employee well-being. Therefore, the *interaction* between job demands and job resources can be viewed as the core mechanism in both models (e.g., de Jonge & Dormann, 2003).

Figure 2.3 shows the general research model, which stresses the interaction between job demands (either JCQ demands or effort) and job resources (either job control or reward) in relation to employee well-being. As was argued earlier in this chapter, there is both a theoretical value (i.e., validation of the relationship between demands and resources, cf. Beehr et al., 2001) and a practical value (i.e., possibility of increasing employee well-being solely by altering job resources) in demonstrating that interactions between job demands and job resources form a determinant of employee well-being. However, the present chapter also showed that many studies have not investigated interactions between demands and resources but instead merely report main effects (e.g., Belkiç et al., 2000; van der Doef & Maes, 1999). Moreover, of the studies that do test interactions, only a few have yielded support for the core assumption that it is particularly the interplay of job demands and job resources that contributes to an elevated risk of strain (for an overview: Fox, Dwyer, & Ganster, 1993; van der Doef & Maes, 1999). It has been argued that the mixed evidence for demand-resource interactions may be attributable to the way interactions have been operationalized (e.g., de Jonge & Dormann, 2003; Wall et al., 1996). The present thesis addresses the operationalization of the demand-resource interaction in two respects: (1) the statistical operationalization, or the mathematical formulation, of the interaction term; and (2) the specificity with which the job demands and job resources that constitute the interaction term are operationalized. These issues are represented in Figure 2.3 with the corresponding numbers.

The first of these issues, the statistical operationalization of the interaction term, is represented by the “thunderbolt” in Figure 2.3 (Number 1). Various mathematical formulations have been used to operationalize the interaction between demands and resources, such as a relative excess term, a multiplicative term, and a ratio (cf. Landsbergis & Theorell, 2000). However, it is not clear whether these different interaction terms have different meanings and interpretations, and thus whether it is sensible to view them as interchangeable. This could indicate that, in the case of the DC Model and the ERI Model, the theoretical description of the interaction does not necessarily correspond to its statistical operationalizations. Because relatively little is known about the statistical operationalization of interaction terms within the DC Model and the ERI Model, the first main issue of this thesis is purely exploratory. Hence, the first issue concerns exploration of the “thunderbolt” – that is, of different mathematical formulations of the interaction term – and will be guided by the following research question:

How have interactions been conceptualized in the Demand-Control and Effort-Reward Imbalance literatures, and to what extent do these conceptualizations correspond to the key assumptions of the Demand-Control Model and the Effort-Reward Imbalance Model?

This question will be addressed in Chapter 4. In order to gain more insight into the genesis of the interaction between demands and resources, the three fundamentally different interaction forms distinguished by Edwards and colleagues (1990; 1993) will be discussed. Next, successive overviews of the DC Model and the ERI Model in relation to these interactions will be provided. To examine the impact of different interaction terms in the prediction of employee well-being, an empirical test will then be provided using three fundamentally different interaction terms suggested by the DC Model and the ERI Model.

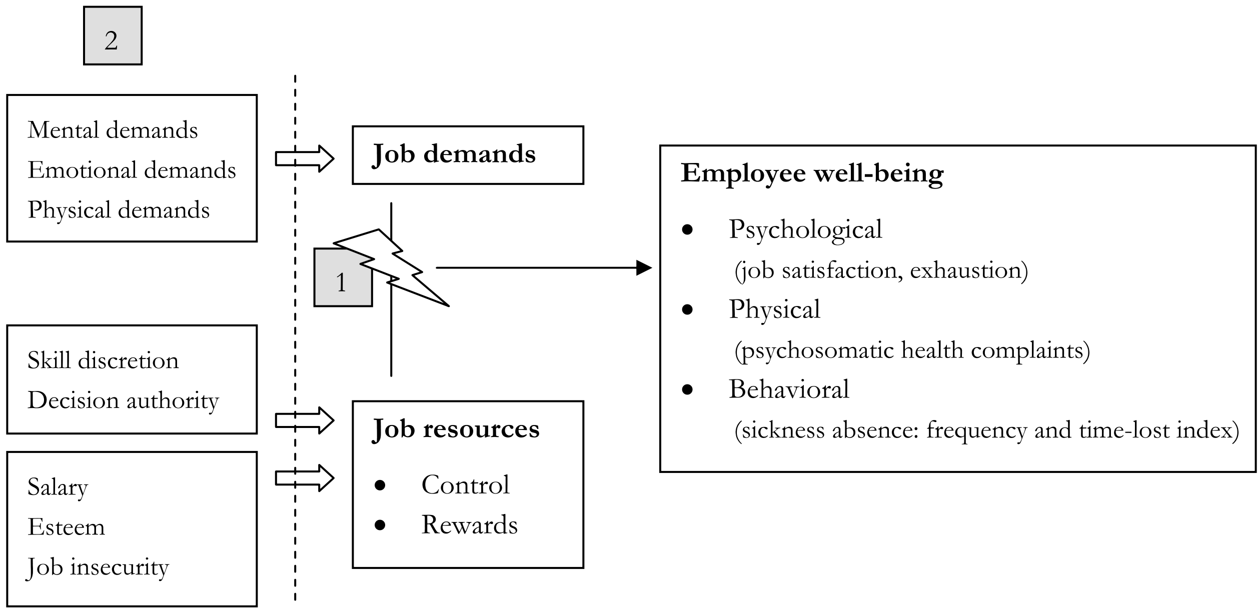


Figure 2.3 General research model.

The second main issue addressed in this thesis, the operationalization of the two components of the interaction term (i.e., job demands and job resources), is represented by Number 2 in Figure 2.3. Both the DC Model and the ERI Model have typically been operationalized with relatively general demand and resource constructs. That is, both models use one ambiguous demand construct, including several demanding aspects at work, without differentiating different types of demands. In addition, although distinct elements can be discriminated within the resource constructs of the DC Model and the ERI Model, these elements are usually combined to form one general resource construct. Nevertheless, critical evaluation of DC studies shows that an important feature that seems to distinguish supportive from non-supportive DC studies with respect to demand-resource interactions seems to be the specificity with which demands and/or resources are measured (e.g., Sargent & Terry, 1998; van der Doef & Maes, 1999). Considering that there has been a similar custom of using general demand and resource measures within the ERI Model, specificity may form a salient issue there as well. Therefore, it will be examined whether the degree of generality or specificity with which job demands and job resources are operationalized influences the likelihood of finding demand-resource interactions. The following hypothesis, labeled the "specificity hypothesis", was formulated to guide the present research:

The likelihood of finding interactions between job demands and job resources in analyses of employee well-being is higher when more specific as compared with more general measures of job demands and job resources are used.

First, the question "Is there a need to be more specific?" will be addressed in Chapter 5. That is, the notion of specificity will be discussed, and the nature of the constructs job demands, job control, and occupational rewards, as used in both models, will be elucidated. This theoretical consideration is followed by longitudinal tests of the specificity hypothesis in relation to the DC Model and the ERI Model, respectively. As can be seen in Figure 2.3 under Number 2, three specific types of demands will be examined (i.e., mental, emotional, and physical demands; cf. Hockey, 2000), together with the specific components of control (i.e., skill discretion and decision authority) and rewards (i.e., salary, esteem, and job security). These specific demands and resources will be compared with the general demand and resource constructs as normally applied within both models. Although the main focus is on the specificity hypothesis, implicitly the two work stress models will be tested as well. More concretely, to examine the specificity hypothesis and the main principles of each model, work hypotheses were formulated with respect to the DC Model and the ERI Model, respectively (see Box 2.1). The work hypotheses for the DC Model will be addressed in Chapter 6, whereas the work hypotheses for the ERI Model will be considered in Chapter 7.

Box 2.1 Work hypotheses for the DC Model and the ERI Model

DC Model:

1) *The likelihood of finding interactions between job demands and job control in analyses of employee well-being outcomes (i.e., job satisfaction, exhaustion, psychosomatic health complaints, and sickness absence) is higher when more specific measures (i.e., mental, emotional, and physical demands; skill discretion and decision authority) as compared with more general measures of job demands and job control (i.e., JCQ demands and decision latitude) are used* (specificity hypothesis applied to the DC Model).
2) *A condition combining high job demands and low job control (Time 1) will lead to the most adverse well-being effects (Time 2) in comparison with high demands – high control, low demands – low control, low demands – high control conditions* (cf. strain hypothesis of the DC Model).

ERI Model:

1) *The likelihood of finding interactions between job demands and occupational rewards in analyses of employee well-being outcomes (i.e., job satisfaction, exhaustion, psychosomatic health complaints, sickness absence) is higher when more specific measures (i.e., mental, emotional, and physical demands; salary and esteem) as compared with more general measures (i.e., effort and composite rewards) of job demands and occupational rewards are used* (specificity hypothesis applied to the ERI Model).
2) *A condition combining high effort and low rewards (Time 1) will lead to the most adverse well-being effects (Time 2) in comparison high effort – high rewards, low effort – low rewards, and low effort – high rewards conditions* (cf. ERI hypothesis).
3) *Overcommitment will have:*
   a) *a direct effect on employee well-being (i.e., overcommitment at Time 1 will lead to reduced employee well-being at Time 2)* (cf. OVC hypothesis); and
   b) *a moderating effect on employee well-being (i.e., adverse well-being effects of an effort-reward imbalance will be stronger in highly overcommitted employees than in less overcommitted employees)* (cf. ERI*OVC hypothesis).

3

Method

This chapter presents an overview of the research method. More specifically, the research design, the research populations, the procedure, and the measurement instruments used in the present research will be discussed. In addition, results of non-response analyses are presented. The chapter closes with a summary.

3.1 Research design

Two types of research designs were applied in the present research: cross-sectional and longitudinal. A cross-sectional design entails data measured at one point in time, whereas a longitudinal design or a panel design includes data measured at several points in time. As each design offers advantages as well as disadvantages, both were used to get the best of both worlds. Two measurement points were used for the longitudinal studies; in other words a two-wave panel design was applied.

Cross-sectional studies can provide valuable information concerning associations between variables (Houkes, 2002; Kessler & Greenberg, 1981; van Veldhoven, de Jonge, Broersen, Kompier, & Meijman, 2002). Compared to longitudinal research, cross-sectional data collection is relatively fast, inexpensive, and easy. In addition, statistical techniques for analyzing cross-sectional data are well developed (Baarda & de Goede, 1995; Houkes, 2002). However, it is impossible to infer causal relationships between job characteristics and employee well-being based on cross-sectional data. According to Cook and Campbell (1979), in order to interpret a relation between two variables X and Y as causal, three requirements should be fulfilled. Firstly, there should be a statistical association between X and Y. Secondly, the independent/causal variable X should precede the dependent/outcome variable Y in time. And thirdly, the influence of third variables must be ruled out. Because a cross-sectional survey can not meet the second requirement (time-lagged measurement of X and Y), longitudinal research is better for investigating causal relationships. Furthermore, longitudinal research offers more statistical possibilities with respect to model building (de Jonge, 1995). In addition, individual changes can be followed, and there are more possible ways to control for third variables (Zapf, Dormann, & Frese, 1996).

However, like cross-sectional research, longitudinal research also has some disadvantages (see for example Taris & Kompier, 2003; Zapf et al., 1996). Firstly, the data collection is more expensive and time-consuming, and there is a risk of losing respondents (e.g., due to "attrition" or "subject mortality"). Selective attrition may lead to a restriction of range in the variables, meaning that the strength of relationships may be underestimated. Secondly, respondents may try to respond consistently across measurements. On the other hand, the initial measurement may sensitize respondent to the issue under investigation, possibly influencing their responses at the second measurement (i.e., "testing effects"). And finally, Zapf and colleagues (1996) have mentioned some other methodological pitfalls of longitudinal research, such as the lack of common standard analytical procedures and the difficulty of determining the time lag needed for stressor-strain effects to develop.

3.2 Study population

The population for the present research consisted of employees of nursing homes. In the Netherlands almost 900,000 employees work in the health care sector, of whom approximately 221,200 work in nursing homes (AZWinfo, 2003). Nursing home employees formed a suitable population for testing our main assumptions for several reasons. First, a nursing home is a human service organization, which is a prerequisite for studying customer-related social stressors (such as emotional demands). In other words, most employees at nursing homes work with clients, and are therefore subject to stressors arising from interactions with clients.

Second, nursing home employees may be subject to other more common stressful working conditions. Several developments in the Netherlands have contributed (and continue to contribute) to increased work stress in nursing homes. On the one hand, due to increasing life expectancies in combination with the proportional increase in the ageing population, more people are getting older (with geriatric health problems). On the other hand, cost containment programs restrict the budgets that are available for the staff (e.g., to enlarge facilities). Hence, increased demand for care in combination with reduced budgets has led to sharpened criteria for admission to nursing homes, and in turn to increasingly severe health problems among those who are admitted for care. Another consequence is that employment in nursing homes has risen steadily. Although nowadays vacant positions are more easily filled due to general conditions on the labor market, for many years it was hard to find good qualified personnel for nursing homes. While this was the case during the research period, it is important to keep in mind that many of the participating nursing homes were facing a shortage of nurses. In practice, this meant that more work had to be done by the same number of employees, which in general led to longer working hours and more stressful working conditions. In fact, in a nationally representative sample of employees, 66% of the employees of nursing homes indicated that their work was physically hard, 57% reported working under time pressure, and 51% described their work as mentally exacting (Bekker et al., 2003). An illustration of how a new employee may experience working in a nursing home can be found in Box 3.1.

Box 3.1 First experiences working in a nursing home as a summer job

From Mo's Diary (2001)

Monday, 2nd of July, 2001

Today was the first day of my summer job. It was fun… being assistant to a nurses' aide. Today my task was to settle into the job, to walk along on the morning rounds (had to get up incredibly early, we started at 7.30), and to wash and dress people.

Some of the elderly people suffered from dementia… that was kind of sad. At first I was a bit shocked by the jokes of the nurses and nurses' aides about those people, but now I think it's all in a day's work, maybe a way of coping with it all. After the people had been washed , we had to make up the beds and clean the rooms, and afterwards bring the food. In the afternoon, we just continued doing the same things… And at four o'clock we were allowed to go home.

Tuesday, 3th of July, 2001

I was allowed to help some people on my own, and I did not drop one of them! At 10 o'clock I got a beeper so I could react to alarm calls. At first I felt really tough: beep, beep, and I was flying. Once someone fell (and I went to get a registered nurse); a few others had difficulties breathing or other medical problems…; others just needed to pee or some attention.

Saturday, 7th of July, 2001

At work it was great, during the weekend they have a different program. Plus, you get paid more! I am curious to see my first pay check. Only I get really crazy from the beeper that keeps on ringing. In the beginning I thought it was kind of cool, but now I find I am still helping one person when the thing goes off again. "Nurse! Nurse! My plant needs some water." And so on. Some of my colleagues who have worked there for years and not just during the summer have little patience… Lucky, I still have some.

A nationally representative survey among the employees of different branches showed that sickness absence (excluding maternity leave) in nursing homes has been rather high in recent years, with a peak in 2000 and 2001 of 8.4% and 8.3%, respectively (Vernet, 2002). For more than half of the employees who were sick for at least two weeks, their sickness absence was work-related (Bekker et al., 2003). The main causes of work-related sickness absence include physical complaints (58%) and workload (15%) (Bekker et al., 2003). In comparison with other employees in the Netherlands, nursing home employees are at greater risk of acquiring disability status as regulated by the Disability Insurance Act (1.4% vs. 2.0% entry: Buijs, Slot-van der Krift, & Velders, 2002). Moreover, the percentage who exit the disability benefits system is slightly lower for nursing home employees (8.5%, 8.0%, and 8.7% vs. 8.8%, 8.9%, and 9.3% for all Dutch employees in 1999, 2000, and 2001, respectively: Buijs et al., 2002; van den Bosch, Bouius, Eikens-Jansen, & Romkes-Heuvelman, 2003).

Finally, another advantage of nursing home employees as a research population is that it is an occupational sector comprised of different occupations. Even though there is a *restriction of sector* as all participants work in nursing homes (including somatic as well as psycho-geriatric units), there is not a *restriction of occupation* as the inclusion of all occupations and specialties enlarges the range of objective work characteristics. Therefore, the sector is likely to have sufficient variance in work characteristics for detecting (main and interaction) effects (cf. Kristensen, 1995, 1996), whereas at the same time variance in demographic characteristics (such as socio-economic status) is restricted (Fox, Dwyer, & Ganster, 1993; Ganster, Fox, & Dwyer, 2001).

With regard to demographic variables it should be noted that in Dutch nursing homes, as in other human service organizations, the percentage of female employees is tremendously large (almost 90%: AZWinfo, 2003). Although the number of men in caring professions is increasing in absolute terms, the percentage of men is decreasing. This is mainly due to the fact that more women are (re-) entering the labor market (Prismant, 2003). Another demographic feature of nursing home employees is their increasing age. During the past eight years the mean age has increased by four years on average. For example, in 1998 the mean age was 36.7 years, whereas in 2002 the mean age rose to 39.5 years (AZWinfo, 2003). Finally, most employees (around 65%) have a medium level of education (versus 21% with a low level and 15% with a high level of education: CBS, 2003).

3.3 Procedure and respondents

Two organizations for residential elderly care participated in the present research. The following data collection procedures were applied separately in each organization. Firstly, a meeting was held with the board of directors. In this meeting arrangements were made concerning the research topic and purpose, the data collection procedures, and ways in which feedback based on the results would be provided to the organization (i.e., research reports and oral presentations). Secondly, a project group comprised of several employees from different departments was formed to get an overview of the practical course of events on the shop floor. The issues discussed with the board were also discussed with the project group. After approval by the board and the project group, a letter announcing the research project was sent to all employees (cf. Kompier & Cooper, 1999). The self-report questionnaires, including an introduction of the aim of the project, were distributed by the researchers at each organizational department. The employees received a sealed envelope with their name on it, including a questionnaire with an identification number (for second round identification) and a blank return envelope. The questionnaires could be posted in locked boxes spread throughout the organizations or by post (free of charge) directly to the researchers. After approximately two weeks a reminder was sent to the employees.

A similar procedure was followed for the second round of data collection. Taris and Kompier (2003) have noted that the time interval between phases of a study is often chosen on pragmatic grounds, rather than on empirical or theoretical grounds. In the present research, the second round data were collected exactly two years after baseline measurement. In this way possible seasonal fluctuations in work were controlled for. Moreover, in a study using different time lags, Dormann (personal communication, 2000) showed that the strongest effects of work characteristics on employee well-being were found over a two year-lag, rather than a shorter or longer interval (see also Dormann & Zapf, 2002).

In mutual agreement with the boards of both organizations for residential elderly care, all employees working at the nursing homes were included in the study (*N* =

554 for Sample 1 and N = 614 for Sample 2). Employees who were on sick leave for a period of three months or more were excluded from participation, as their knowledge concerning common practices at work (especially with regard to more objective work characteristics) might be outdated. The data collection procedure resulted in the following response figures and rates for Sample 1 and Sample 2, as displayed in Table 3.1.

Table 3.1 Number of respondents and response rates for Sample 1 and Sample 2 at Time 1 and Time 2

	Sample 1	**Sample 2**
Time 1	***January 2001***	***April 2000***
• Employees receiving questionnaires	N = 554	N = 614
• Response	n = 405 (73%)	n = 471 (77%)
Time 2	***January 2003***	***April 2002***
• Employees receiving questionnaires	N = 624	N = 918
• Response	n = 420 (67%)	n = 662 (72%)
Panel group		
• Response at both Time 1 and Time 2	n = 267 (48% of initial sample)	n = 280 (59% of initial sample)

Table 3.1 shows that for Sample 1 the data were collected in January 2001, which resulted in a response rate of 73 percent. The second measurement in January 2003 yielded a response of 420 out of 624 (i.e., a response rate of 67%). In total, 267 respondents in Sample 1 filled out the questionnaire on both occasions. For Sample 2, the measurements took place in April. At the first measurement in 2000, 471 out of 614 employees returned the questionnaire (i.e., a 77% response rate). In April 2002, at the second measurement, 662 out of 918 questionnaires were returned (i.e., a 72% response rate). The final panel group consisted of 280 respondents.

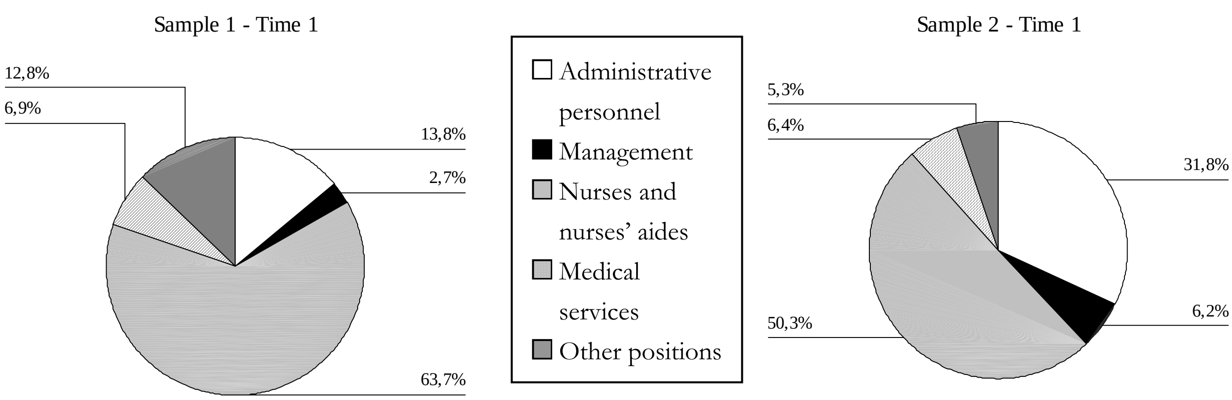
The initial number of employees who were sent questionnaires was higher at Time 2 versus Time 1 (i.e., 624 vs. 554 for Sample 1, and 918 vs. 614 for Sample 2). This was due to organizational changes. For instance, in Sample 1 a department had been moved and extended, and in Sample 2 another nursing home was added to the care foundation. A summary of the highest and lowest response rates for individual institutions at both measurements is shown in Table 3.2.

Table 3.2 Highest, lowest, and mean response rate for individual institutions at both measurements for each sample separately

	Lowest rate	Highest rate	Mean rate
Time 1			
Sample 1 (N = 6 institutions)	69%	82%	77%
Sample 2 (N = 6 institutions)	60%	89%	73%
Time 2			
Sample 1 (N = 7 nursing homes)	46%	93%	72%
Sample 2 (N = 6 nursing homes)	69%	83%	67%

The overall response rates were fairly high with the exception of the response rate of 46% for one nursing home in Sample 1 at Time 2. This might have been due to organizational turmoil (such as, changes in middle management, and movement of one department). The second lowest rate was 65%, which might give a more adequate picture of the response rates.

The occupations included in the samples were classified into five job categories: administrative personnel, management, nurses and nurses' aides, medical services, and other positions. Figures 3.1a and 3.1b show the distribution of employees over these job categories, in percentages.



Figures 3.1a-3.1b Percentage of respondents working in each job category for Sample 1 (a) and Sample 2 (b) at Time 1

Most employees in both samples worked as a nurse or nurses' aide. At Time 2, the distribution of employees over job categories was similar to the distribution at Time 1. The figures for administrative personnel, management, nurses and nurses' aides, medical services, and other positions at Time 2 were respectively 14.8%, 3.8%, 61.6%, 9.1%, and 10.7% in Sample 1, and 28.0%, 6.1%, 54.0%, 6.7%, and 5.3% in Sample 2.

Table 3.3 shows demographic characteristics at Time 1 for the cross-sectional and panel groups in both Sample 1 and Sample 2.

Table 3.3 Description of the cross-sectional group and the panel group in Sample 1 and Sample 2 (standard deviations in parentheses)

	Cross-sectional group sample 1 (n = 405)	Cross-sectional group sample 2 (n = 471)	Panel group sample 1 (n = 267)	Panel group sample 2 (n = 280)
Mean age	38.8 (8.7)	40.6 (9.6)	39.0 (8.7)	40.3 (8.9)
Percentage of women	90.8%	84.0%	91.4%	83.6%
Mean work experience	8.7 (7.1)	11.1 (7.5)	11.3 (7.5)	13.6 (7.5)
Percentage full-time	21.3%	28.3%	19.5%	27.1%

Note. All values measured at Time 1.

In Sample 1, the cross-sectional group appeared not to differ in age and gender from the total working population in the nursing homes (t = 1.19, n.s., and t = 0.61, n.s., respectively). In Sample 2, the cross-sectional group differed in age from the total working population (t = 3.08, p < .01), in that the cross-sectional group was somewhat older (1.70 years older). Concerning gender, the cross-sectional group in Sample 2 did not differ from the total working population (t = 0.53, n.s.).

3.4 Non-response analyses

To check whether non-response due to attrition (or dropout) may have influenced the results, t-tests were calculated to compare the panel group (at Time 1) with the respondents who only responded at Time 1 (i.e., the dropouts). Because such comparisons are used to assess the *absence* of differences, other authors (Daniels & de Jonge, 2001) have suggested setting alpha at .10. As can be seen from Table 3.4, in both samples no significant differences were found for the demographic variables (gender, age, education). For the other research variables, significant differences appeared in Sample 1 between the panel group and the dropouts for JCQ demands, effort, mental demands, rewards (including salary, esteem, and job security), exhaustion, and sickness absence as measured by both the time-lost index and the frequency index. In Sample 2, differences between the groups were observed for emotional demands, decision latitude (including decision authority) and rewards (including salary and esteem). In both samples, the panel groups scored more positively on the variables than the dropouts. That is, the panel group reported lower demands/effort, more rewards, less exhaustion, and less sickness absence. As t-tests might show relatively small differences to be significant when there are over 250 respondents in each group, Cohen's d was calculated to determine the size of the effect. Cohen's d is calculated by taking the difference between the means and dividing by an estimate of the population standard deviation for both groups combined (Goodwin, 2003). According to Cohen (cited in Goodwin, 2003), effect sizes can be classified as small (about .2), medium (about .5) and large (about .8). As displayed in Table 3.4, the significant differences between the means (i.e., t-tests) have effect sizes, as calculated by Cohen's d, that can be characterized in most cases as small. Only the effect size for decision latitude in Sample 2 can be characterized as medium.

Table 3.4 Independent sample *t*-tests evaluating mean differences between dropouts and the panel group at Time 1, separately for Sample 1 and Sample 2

Variables	***Sample 1***				***Sample 2***			
	t	*df*	*p*	*Cohen's d*	*t*	*df*	*p*	*Cohen's d*
1. Gender	-.51	403	.61	0.02	.21	469	.84	0.00
2. Age	.62	401	.54	0.05	-.95	467	.34	0.06
3. Education	-.05	396	.96	0.00	1.20	459	.23	0.08
1. JCQ demands	-2.29	396	*.02*	0.17	-.25	469	.80	0.01
2. Effort	-2.93	385	*.00*	0.22	.19	469	.85	0.01
3. Mental demands	-3.43	399	*.00*	0.26	-.63	469	.53	0.04
4. Emotional demands	-.88	400	.38	0.07	2.71	469	*.01*	0.17
5. Physical demands	-1.13	400	.26	0.08	-1.61	469	.11	0.11
6. Decision latitude	.91	399	.36	0.07	2.28	469	*.02*	0.42
6a. Skill discretion	.39	401	.70	0.03	1.42	469	.16	0.08
6b. Decision authority	1.45	402	.15	0.11	2.79	469	*.01*	0.18
7. Rewards	.351	384	*.00*	0.26	2.82	469	*.01*	0.15
7a. Salary	2.44	372	*.02*	0.18	3.21	469	*.00*	0.21
7b. Esteem	2.33	394	*.02*	0.17	1.99	469	*.05*	0.14
7c. Job security	3.65	399	*.00*	0.32	.87	469	.38	0.06
8. Overcommitment	-.54	403	.59	0.04	-.49	469	.63	0.04
9. Job satisfaction	1.48	401	.14	0.11	1.58	469	.11	0.10
10. Exhaustion	-2.66	397	*.01*	0.19	-1.06	469	.29	0.07
11. Psychosomatic health complaints	-.56	394	.57	0.04	-.29	462	.77	0.02
12. Time-lost index	-3.10	372	*.00*	0.23	-.44	416	.66	0.03
13. Frequency index	-3.27	372	*.00*	0.25	-.68	416	.50	0.05

Note Significant *p*-levels are printed in italics (alpha was set at .10)

Table 3.5 and Table 3.6 show several comparisons testing whether there was bias due to wave non-response (i.e., multiple testing bias [G3 (T2) vs. G2], history effects [G1 vs. G2], regression to the mean [G3 (T) vs. G3 (t2)], and non-response bias at Time 1 [G3 (t1) vs. G2]), for Sample 1 and Sample 2, respectively.

For Sample 1, the results of the comparisons are shown in Table 3.5. In general, employees who only responded at Time 2 (i.e., G2) scored more positively (i.e., lower demands, more rewards, and less sickness absence) in comparison with employees in the panel group (at Time 2). Employees who only responded at Time 2 (i.e., G2) scored more positively than people who only responded at Time 1 (i.e., G1). With the exception of the time-lost index, employees from the panel group reported higher demands, fewer job resources (decision authority and rewards), and lower employee well-being at Time 1 than at Time 2. Finally, employees who responded only at Time 2 (i.e., G2) scored more positively than the panel group (at Time 1).

Table 3.5 Comparison of several respondents groups of participants for Sample 1 to check for biases due to wave non-response

Variables	G3 (T2) vs. G2				G1 vs. G2				G3 (T1) vs. G3 (T2)				G3 (T1) vs. G2			
	t	*df*	*p*	*Cohen's d*	*t*	*df*	*p*	*Cohen's d*	*t*	*df*	*p*	*Cohen's d*	*t*	*df*	*p*	*Cohen's d*
1. Gender	.74	417	.46	0.05	1.10	288	.27	0.08	.01	267	.99	0.00	.74	417	.46	0.05
2. Age	-3.78	412	*.00*	0.27	1.02	285	.31	0.09	-.87	263	.39	0.16	1.80	412	*.07*	0.13
3. Education	2.45	410	*.02*	0.18	1.54	280	.13	0.13	-1.67	261	.10	0.06	1.67	408	.10	0.12
1. JCQ demands	.19	408	.85	0.01	5.04	282	*.00*	0.42	5.25	258	*.00*	0.25	3.63	410	*.00*	0.27
2. Effort	3.29	393	*.00*	0.24	7.36	266	*.00*	0.63	4.10	250	*.00*	0.20	5.56	393	*.00*	0.42
3. Mental demands	2.74	410	*.01*	0.20	8.75	282	*.00*	0.74	6.72	262	*.00*	0.28	6.26	413	*.00*	0.46
4. Emotional demands	3.89	412	*.00*	0.28	4.39	285	*.00*	0.37	1.03	262	.30	0.04	4.31	411	*.00*	0.31
5. Physical demands	1.27	410	.20	0.09	3.29	283	*.00*	0.28	3.60	262	*.00*	0.11	2.69	411	*.01*	0.20
6. Decision latitude	.07	409	.95	0.00	-1.24	282	.22	0.11	-1.13	261	.26	0.04	-.51	411	.61	0.04
6a. Skill discretion	-.23	412	.82	0.02	-.25	284	.81	0.02	.82	264	.41	0.03	.12	413	.90	0.02
6b. Decision authority	1.19	413	.24	0.09	-2.07	285	*.04*	0.17	-3.97	265	*.00*	0.16	-1.07	413	.29	0.07
7. Rewards	-2.91	390	*.00*	0.22	-7.82	267	*.00*	0.67	-4.45	244	*.00*	0.21	-5.92	393	*.00*	0.46
7a. Salary	-2.37	381	*.02*	0.19	-6.49	258	*.00*	0.56	-4.01	235	*.00*	0.20	-4.91	378	*.00*	0.39
7b. Esteem	-1.93	407	*.06*	0.15	-5.66	280	*.00*	0.46	-3.48	257	*.00*	0.17	-4.23	406	*.00*	0.32
7c. Job security	-2.70	411	*.01*	0.21	-7.23	283	*.00*	0.60	-2.88	262	*.00*	0.17	-5.75	412	*.00*	0.44
8. Overcommitment	.85	410	.39	0.05	1.95	284	*.05*	0.15	1.40	263	.16	0.07	1.75	413	*.08*	0.12
9. Job satisfaction	.18	412	.86	0.02	-2.65	285	*.01*	0.22	-2.79	263	*.01*	0.14	-1.60	412	.11	0.11
10. Exhaustion	.64	411	.53	0.05	4.49	284	*.00*	0.37	3.28	259	*.00*	0.15	2.56	409	*.01*	0.19
11.Psychosomatic complaints	-.19	401	.85	0.01	1.60	2.75	.11	0.14	2.69	257	*.01*	0.12	1.39	405	.17	0.10
12. Time-lost index	2.12	391	*.04*	0.16	3.84	256	*.00*	0.33	-1.79	312	*.07*	0.05	1.33	380	.18	0.10
13. Frequency index	1.83	391	*.07*	0.01	4.19	256	*.00*	0.37	.07	312	.95	0.00	1.59	380	.11	0.12

Note G1 = employees who only participated at Time 1; G2 = employees who only responded at Time 2; G3 = panel group; T1 = Time 1; T2 = Time 2. Significant *p*-levels are printed in Italics (alpha was set at .10).

Table 3.6 Comparison of several respondents groups of participants for Sample 2 to check for biases due to wave non-response

Variables	G3 (T2) vs. G2				G1 vs. G2				G3 (T1) vs. G3 (T2)				G3 (T1) vs. G2			
	t	*df*	*p*	*Cohen's d*	*t*	*df*	*p*	*Cohen's d*	*t*	*df*	*p*	*Cohen's d*	*t*	*df*	*p*	*Cohen's d*
1. Gender	-2.90	1	*.09*	0.08	1.30	570	.19	0.08	.01	280	.99	0.00	1.70	659	*.09*	0.08
2. Age	-5.05	648	*.00*	0.29	3.00	563	*.00*	0.12	.51	273	.61	0.16	2.49	652	*.01*	0.07
3. Education	1.55	646	.12	0.09	-.87	554	.38	0.06	-2.17	272	*.03*	0.06	.51	647	.62	0.03
1. JCQ demands	-0.13	648	.89	0.01	1.55	564	.12	0.09	1.88	2.74	*.06*	0.08	1.43	653	.15	0.08
2. Effort	2.19	613	*.03*	0.13	1.24	543	.22	0.08	-.26	260	.79	0.02	1.71	632	*.09*	0.10
3. Mental demands	1.26	648	.21	0.07	.95	563	.34	0.06	-1.05	2.75	.30	0.05	.29	652	.77	0.02
4. Emotional demands	2.44	652	*.02*	0.13	-1.57	567	.12	0.09	.21	275	.84	0.00	2.27	656	*.02*	0.12
5. Physical demands	-2.94	653	*.00*	0.16	-.17	566	.86	0.01	1.01	277	.31	0.03	-2.25	655	*.03*	0.12
6. Decision latitude	.28	646	.78	0.02	-2.37	561	*.02*	0.14	.20	275	.84	0.00	.24	650	.81	0.01
6a. Skill discretion	-.12	650	.91	0.01	-.89	564	.38	0.04	1.34	276	.18	0.05	.90	653	.37	0.05
6b. Decision authority	.65	653	.52	0.04	-4.06	567	*.00*	0.25	-1.76	276	*.08*	0.10	-1.00	656	.32	0.06
7. Rewards	-1.65	605	.10	0.10	-3.25	537	*.00*	0.20	1.70	258	*.09*	0.09	-.09	626	.93	0.00
7a. Salary	-1.31	591	.19	0.07	-1.73	530	*.09*	0.10	3.83	251	*.00*	0.19	2.10	619	*.04*	0.12
7b. Esteem	-1.90	634	*.06*	0.09	-3.44	555	*.00*	0.20	.46	269	.65	0.02	-1.49	644	.14	0.07
7c. Job security	-.63	650	.53	0.04	-3.45	564	*.00*	0.19	-2.06	276	*.04*	0.10	-2.53	653	*.01*	0.14
8. Overcommitment	2.59	653	*.01*	0.14	3.24	566	*.00*	0.20	.94	277	.35	0.03	3.14	655	*.00*	0.17
9. Job satisfaction	-.74	647	.46	0.04	-3.39	563	*.00*	0.20	-1.43	274	.15	0.07	-1.95	652	*.05*	0.10
10. Exhaustion	2.49	651	*.01*	0.14	3.64	566	*.00*	0.22	.96	275	.34	0.04	3.04	655	*.00*	0.17
11.Psychosomatic complaints	2.72	651	*.01*	0.15	2.76	564	*.01*	0.17	.05	272	.96	0.00	2.76	650	*.01*	0.15
12. Time-lost index	2.20	655	*.03*	0.12	4.80	536	*.00*	0.30	2.64	256	*.01*	0.15	4.61	632	*.00*	0.26
13. Frequency index	.77	655	.44	0.04	2.37	536	*.02*	0.16	1.71	256	*.09*	0.08	1.97	632	*.05*	0.11

Note G1 = employees who only participated at Time 1; G2 = employees who only responded at Time 2; G3 = panel group; T1 = Time 1; T2 = Time 2. Significant *p*-levels are printed in Italics (alpha was set at .10).

Table 3.6 shows the results for Sample 2, which shows a similar pattern. That is, in general employees who only responded at Time 2 (i.e., G2) scored more positively than the panel group at Time 2, more positively than employees who only responded at Time 1 (i.e., G1), and more positively than the panel group at Time 1. Also, employees from the panel group responded more positively at Time 1 than at Time 2. Two exceptions should be mentioned: physical demands and rewards (including salary). The panel group reported lower physical demands than either employees who only responded at Time 1 or those who only responded at Time 2. And the panel group scored more positively on rewards (including salary) at Time 1 than at Time 2, and more positively than employees who only responded at Time 2.

Again, Cohen's *d* was calculated to determine the size of these effects. For Sample 1, most effect sizes could be characterized as small. Only the effect sizes for JCQ demands, effort, mental demands, and rewards (including salary, esteem, and job security) could be characterized as medium in the comparison between employees who only responded at Time 1 and employees who only responded at Time 2 (G1 vs. G2), and in the comparison between the panel group at Time 1 and employees who only responded at Time 2 (G3 [T1] vs. G2). For Sample 2, all effect sizes could be characterized as small.

In conclusion, the *t*-tests suggest that some bias due to attrition may have occurred, as well as some other selection effects. Calculation of Cohen's *d* indicated that, with the exception of some history effects and non-response bias at Time 1 in Sample 1, most effects can be characterized as small. Therefore, we believe that these biases did not influence the research results severely.

3.5 Measures

In the present research, mainly self-report measures were used. It is common practice in occupational health psychology to use self-report surveys to measure job characteristics as well as employee well-being. There are at least two important advantages of self-report measures. Firstly, there is a general belief that job characteristics can be adequately tapped with self-report measures (Karasek & Theorell, 1990). This idea is supported by several studies showing mainly moderate to high correlations between objective work conditions and job perceptions (e.g., Griffin, 1983; Kirmeyer & Dougherty, 1988; Spector, 1992). Moreover, it could be argued that, in relation to employee well-being, the impact of the work environment on the employee (i.e., job perception) might be at least as important as the objective work environment (Spector, 1992). Clearly, a job perception can best be measured by asking the opinion of the respondent. Secondly, for practical reasons it is advantageous to use (self-report) questionnaires as they enable one to gather large amounts of data in a relatively fast and inexpensive way.

For the reasons mentioned above, mainly self-report questionnaires were used in the present research. However, it should be mentioned that measuring job characteristics and employee well-being only with self-report questionnaires may lead to common method variance. That is, trivial correlations may be observed due to methodological overlap between independent and dependent measures. To obtain adequate information about job characteristics or employee well-being, more objective measures or information from another source besides the respondent him/herself should be included whenever possible (e.g., de Jonge, Reuvers, Houtman, Bongers, & Kompier, 2000; Frese & Zapf, 1988). Therefore, in the current study company-registered sickness absence was included as an objective outcome measure. This provided a relatively easy and straightforward way to gain more objective information on employee health. Furthermore, it is generally assumed that perceived strain may manifest itself in behavioral outcomes, such as absenteeism. For this reason, sickness absence can be regarded as a (long-term) behavioral outcome of job-related strain (Allegro & Veerman, 1998; de Jonge, Reuvers et al., 2000).

The remainder of this section describes the measurement instruments used in the present research. The measures were selected based on their suitability to represent the DC Model, the ERI Model, and specific extensions from both models as discussed in Chapter 2. To represent as closely as possible the theoretical constructs as intended by the devisers of both work stress models, the original measures for the DC Model and the ERI Model were used (cf. Beehr, Glaser, Canali, & Wallwey, 2001). However, in order to refine and extend the concepts for use in the human service sector, more specific measures were used as well (cf. Dollard, Dormann, Boyd, Winefield, & Winefield, 2003). The measures used in this research can be divided into four categories: (1) job characteristics, (2) personality characteristics, (3) employee well-being, and (4) demographic variables.

3.5.1 Job characteristics

Figure 3.2 gives a graphical overview of the job characteristics that were measured in the present research. More specifically, row 1 represents the type of variable, row 2 represents the questionnaire, row 3 represents the specific variables measured, and row 4 represents the categories into which some variables can be subdivided.

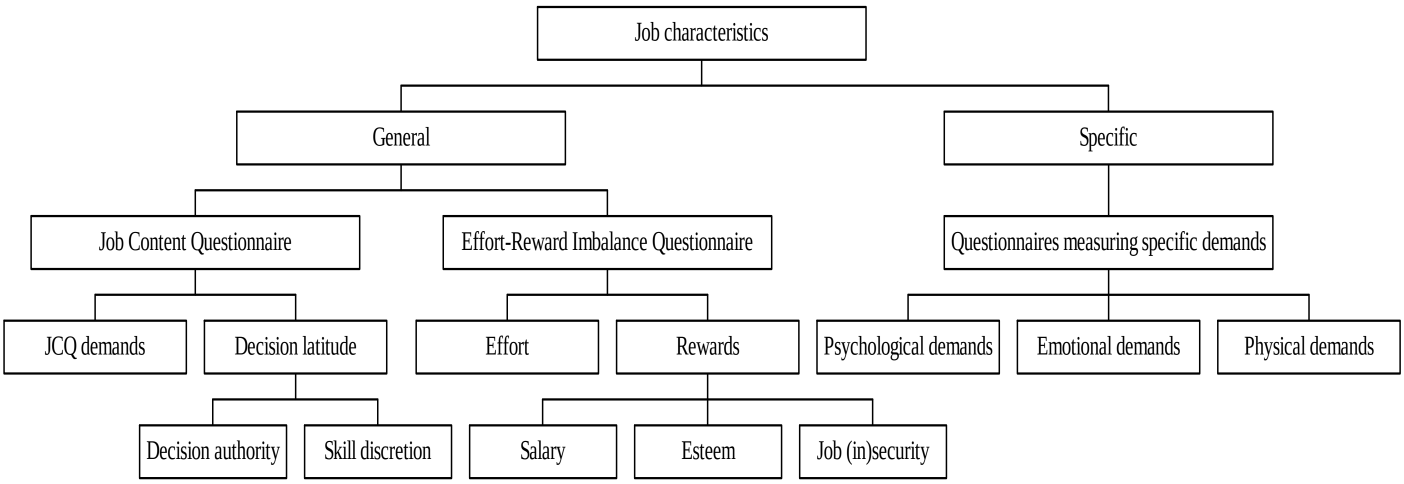


Figure 3.2 Overview of the job characteristics measured

Job Content Questionnaire

The original questionnaire for measuring the key variables of the DC Model is the Job Content Questionnaire (JCQ: Karasek, 1985). A Dutch version of the JCQ was used to measure job demands (to avoid confusion with other types of demands, we refer to these demands as JCQ demands) and decision latitude. The questionnaire came into being by means of translation and back-translation. The validity and reliability have been well established by Karasek and colleagues (1998). The questionnaire uses a response scale ranging from 1 "strongly agree" to 4 "strongly disagree".

JCQ demands

Job demands have been defined as psychological stressors that are present in the work environment (Karasek, 1979). A central feature of job demands is a task's mental workload and the mental alertness or arousal needed to carry out the task (cf. Karasek & Theorell, 1990, p. 63). The construct is measured with items referring to time pressure, job complexity, and role ambiguity. JCQ demands were measured with five items, of which three items require a reversed coding. An example item is: "My job requires working very hard".

Decision latitude

Karasek (1979, p. 289-290) defined decision latitude as "…the working individual's potential control over his tasks and conduct during the working day". Decision latitude is a multidimensional concept, composed of two theoretically distinguishable concepts. Firstly, *decision authority* can be defined as the employee's authority to make decisions on the job. And secondly, *skill discretion* refers to the breadth of skills used by the employee on the job (cf. Karasek, 1989). Decision authority was measured with three items concerning freedom to make decisions on the job that relate to work content and to procedures (one item is reverse coded). An example item is: "My job allows me to make a lot of decisions on my own". Skill discretion was assessed with six items concerning the utilization of skills, the opportunity to learn new things, and task variety (one item is reverse coded). An example item is: "My job requires that I learn new things".

ERI Questionnaire

The original questionnaire for the ERI Model was developed by Siegrist and Peter (1996). A Dutch translation of the ERI Questionnaire (ERI-Q) came into being by means of translation and back-translation, and the Dutch questionnaire is well-validated and reliable (Hanson, Schaufeli, Vrijkotte, Plomp, & Godaert, 2000). The three main concepts of the ERI Model are measured with corresponding scales, namely effort, rewards, and overcommitment. The scales for effort and rewards use a unique answering mechanism. First, the respondent indicates whether a given type of (stressful) condition at work exists, by choosing between two response categories: " agree" vs. "disagree". If the respondent "agrees", he or she is asked to indicate the degree of distressfulness of this condition on a 4-point scale ranging from 1 ("not at all distressed") to 4 ("very distressed"). A negative answer (i.e., "disagree") is also coded as 1. The scale for overcommitment only contains the second part of this answering mechanism (i.e., the 4-point scale ranging from 1 "not at all distressed" to 4 "very distressed").

Effort
The effort scale in the ERI-Q contains six items tapping physical load, time pressure, interruptions, responsibility, working overtime, and increasing demands. An example item is: "I have constant time pressure due to a heavy work load". Siegrist et al. (2004) have recommended including the item on physical load (i.e., "My work is physically demanding") only in those occupational groups where a heavy physical workload is part of the typical task profile.
Rewards
Rewards in the ERI-Q has been operationalized with eleven items, and is generally used as a composite measure. Theoretically, a three-factor structure underlies the concept of rewards, distinguishing salary, esteem, and security/career opportunities. However, Siegrist and associates (2004) have argued that it is empirically almost impossible to disentangle financial from career-related aspects of rewards. Therefore, they have postulated another three-factor structure with one factor defined by financial and career-related aspects of rewards, a second factor defined by esteem rewards, and a third factor defined by rewards in the domain of job security. These three factors are assumed to load on one latent factor (rewards). Recent studies confirm the presence of this three-factor structure (Siegrist et al., 2004), and the importance of distinguishing these three types of rewards (Dragano, von dem Knesebeck, Rödel, & Siegrist, 2003; van Vegchel, de Jonge, Bakker, & Schaufeli, 2002):

Salary (including job promotion) was measured with four items, referring to promotion prospects, the fit between education and occupational position, and adequate salary. An example item is: "My promotion prospects are poor".

Esteem was assessed with five items. The items refer to respect at work (from colleagues and superiors), adequate support in difficult situations, and unfair treatment at work. An example item is: "I receive the respect I deserve from my supervisors".

Job security was assessed with two items, tapping expectations of undesirable change and having poor job security. An example item is: "My job security is poor".

Specific demands

Within the DC Model and the ERI Model it is possible to distinguish several other specific resources. As mentioned above, in the DC Model decision authority and skill discretion can be distinguished within the concept of decision latitude. In the ERI Model, it is possible to distinguish between several rewards (main reward groups: monetary gratification, esteem reward and job security/career opportunities). However, the DC Model and the ERI Model specify global measures of respectively demands and effort with no specific dimensions. Therefore, three specific dimensions of demands were measured in addition to the more global demand constructs, namely mental, emotional, and physical demands (cf. Hockey, 2000). The scales that are used in the present thesis have been extensively tested and have proven to be reliable and valid (e.g., de Jonge, Dollard, Dormann, Le Blanc, & Houtman, 2000; de Jonge, Mulder, & Nijhuis, 1999; van Vegchel, de Jonge, Meijer, & Hamers, 2001).

Mental demands
In general, mental demands refer to (mental) workload. One definition of workload is the extent to which job demands tax the information processing capacity of the person (cf. Zijlstra & Mulder, 1989). Mental demands were measured with an eight-item scale developed by De Jonge, Landeweerd and Nijhuis (1993). The scale measures both qualitatively and quantitatively demanding aspects of the job, such as working under time pressure, working hard, strenuous work, and job complexity. The scale has a five-point response scale ranging from 1 "never" to 5 "always". An example item is: "In the unit where I work, work is carried out under time pressure."
Emotional demands
Emotional demands address the perception that work requires high commitment and burdens the emotional resources of the worker (cf. Ybema & Smulders, 2001). Emotional demands were assessed with a 12-item questionnaire with a five-point response scale ranging from 1 "never" to 5 "always". The scale was adapted from measures used by De Jonge, Mulder and Nijhuis (1999) and Van Veldhoven and associates (2002). The scale contained items about emotionally demanding aspects of work, confrontation with behavioral characteristics of clients (such as aggressiveness and awkwardness) and traumatic events such as death and human suffering. An example item is: "In my work, I am confronted with sickness or other human suffering".
Physical demands
Physical demands were measured with a seven-item questionnaire with a five-point response scale ranging from 1 "never" to 5 "always" (de Jonge et al., 1993). The items refer to carrying heavy loads, working in a constrained position, walking, bending down, and carrying objects at shoulder height. For instance, "At work I have to carry or move heavy objects (over 10 kilogram)".

3.5.2 Personality characteristics

Overcommitment is a personality characteristic, mainly referring to the inability to withdraw from work (Siegrist et al., 2004). Originally, overcommitment was operationalized with a scale called "need for control", as a more work-related reformulation of the Type A concept (cf. Matschinger, Siegrist, Siegrist, & Dittmann, 1986). The need for control scale contains two latent factors: vigor and immersion. Vigor refers to successful coping (by means of perfectionism and hard work). Immersion defines a state of coping with demands reflecting frustrated but sustained efforts and associated negative feelings. Immersion consists of four subscales: (a) need for approval, (b) competitiveness, (c) disproportionate irritability, and (d) inability to withdraw from work (Siegrist, 1996). Although some empirical studies have replicated the factorial structure of immersion (e.g., Peter et al., 1998), other studies could not, and suggested that it is especially the factor "inability to withdraw from work" that is essential for the ERI Model (see Hanson et al., 2000; Niedhammer, Siegrist, Landre, Goldberg, & Leclerc, 2000). Therefore, a shorter version was developed to represent overcommitment, with five items concerning the inability to withdraw from work and one item concerning disproportionate irritability (Siegrist et al., 2004). An example item is: "Work rarely lets me go, it is still on my mind when I go to bed".

Factor analyses of our own databases as well as another Dutch and a Japanese database (de Jonge, van der Linden, Schaufeli, Peter, & Siegrist, 2003; Tsutsumi et al., 2003) showed that the item "I get easily overwhelmed by time pressures at work" loaded on the factor effort, instead of the factor overcommitment. Since this is the only item from the subscale disproportionate irritability, and it is theoretically plausible that employees might interpret this item as a type of effort, it was decided to exclude this item from the analyses. Therefore, the overcommitment scale consisted of five items in the present research.

3.5.3 Employee well-being

Three types of outcome variables were used to represent employee well-being, namely psychological, physical, and behavioral outcomes (e.g., Kahn & Byosiere, 1992). In Figure 3.3 gives a graphical overview of the measures of employee well-being used in the present research.

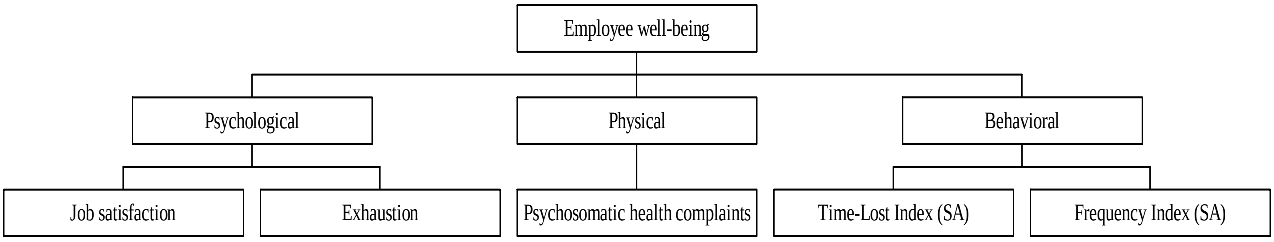


Figure 3.3 Overview of the employee well-being outcome variables measured

Psychological outcomes

Job satisfaction
Job satisfaction was measured with a single item, namely: "I am satisfied with my current job". The response scale ranged from 1 "strongly disagree" to 5 "fully agree". According to Wanous, Reichers and Hudy (1997) a reliability of at least .57 was can be assumed for this single-item measure. In addition, they have shown that this single item correlated highly with multi-item scales. Therefore, this single global item of satisfaction seems to offer a valid and economical measure.

Exhaustion
Exhaustion is a subscale of the general Utrecht Burnout Scale (UBOS: Schaufeli & van Dierendonck, 1999). The UBOS is a Dutch version of the Maslach Burnout Inventory – General Survey (Maslach & Jackson, 1986). The subscale contains 5 items with a 7-point response scale ranging from 0 "never" to 6 "always, daily". For example, "My job makes me feel mentally exhausted".

Physical outcome

Psychosomatic health complaints
Psychosomatic health complaints can be described as somatic or physical complaints that (often) have a psychosocial background (Meijer, 1995).

Psychosomatic health complaints were assessed with a 13-item questionnaire (cf. Dirken, 1969; Jansen & Sikkel, 1981; Joosten & Drop, 1987). The respondents were asked to indicate whether they had been troubled by particular health complaints (such as headache, stomach problems, and dizziness) during the past 6 months (0 = no, 1 = yes).

Behavioral outcome

Sickness absence

Sickness absence was registered by the personnel administration of the health care institutions. Two indices were computed (Warr, 1999). The *Time-Lost Index* was computed as the total duration of sickness absence (in days) in one full calendar year. In other words, how many days was the employee registered as sick during the past year. The *Frequency Index* consisted of the number of separate incidents of sickness absence in one full calendar year, regardless the duration. That is, how many times did the employee call in sick during the past year. (i.e., in Study 1: Time 1 was 1999, and Time 2 was 2001; in Study 2: Time 1 was 2000, and Time 2 was 2002).

3.5.4 Demographic variables

The demographic variables gender, age, and education were included as control variables because they have been identified as possible confounders of the relation between job characteristics and outcome variables (e.g., Schaufeli & Enzmann, 1998). For instance, on balance, women tend to score higher on exhaustion, and older employees tend to score higher on job satisfaction.

3.5.5 Psychometric properties

Factor analyses

To test the factorial structure of the Job Content Questionnaire (JCQ: Karasek, 1985), and the Effort-Reward Imbalance Questionnaire (ERI-Q: Siegrist & Peter, 1996), the specific demand scales, and the self-reported employee well-being scales, confirmatory factor analyses (CFA) in AMOS (Analysis of MOment Structures: Arbuckle & Wothke, 1999) were performed, in both samples at both measurements. The panel groups were used for these analyses. Schumacker and Lomax (1996) recommend using various goodness-of-fit criteria to assess model fit, model comparisons, and model parsimony. Model fit can be assessed with the chi-square statistic (χ^2) and the adjusted goodness-of-fit index (AGFI). Both measures are however sensitive to sample size. The chi-square has a statistical significance value. A small non-significant chi-square indicates good fit. AGFI values close to 1.00 are indicative of good fit (Byrne, 2001). Fit indices that refer to model comparisons include, for instance, the Tucker-Lewis index (TLI; also known as the non-normed fit index) and the comparative fit index (CFI: Bentler, 1990). Both of these indices are not sensitive to sample size, and their values should be over .90 (cf. Bentler, 1990; Schumacker & Lomax, 1996). More recently, a revised cut-off value close to .95 has been recommended (Hu & Bentler, 1999). The Akaike

Information Criteria (AIC: Akaike, 1987) and the root mean square error of approximation (RMSEA) are fit criteria for assessing model parsimony. The lower the AIC, the more parsimonious the model is. An RSMEA value between .05 and .10 indicates an acceptable level of model fit in relation to the degrees of freedom (Bentler, 1990).

Table 3.7 Results of confirmatory factor analyses of the Job Content Questionnaire for the panel groups in Study 1 and Study 2, at both measurements

	Study 1 (n = 206)							Study 2 (n = 233)						
	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC
Time 1														
2 factors	255.40	76	.76	.77	.73	.11	313.40	230.86	76	.82	.69	.63	.09	288.86
3 factors	159.96	74	.85	.89	.87	.08	221.96	198.21	74	.85	.75	.69	.08	260.21
3 factor re.	142.79	68	.86	.90	.87	.07	216.79	117.89	68	.90	.90	.87	.06	191.89
Time 2														
2 factors	182.95	76	.83	.86	.83	.08	240.95	206.90	76	.84	.80	.76	.09	264.90
3 factors	117.63	74	.89	.94	.93	.06	179.63	182.16	74	.87	.83	.79	.08	244.16
3 factor re.	111.22	68	.89	.94	.93	.06	185.22	131.25	68	.89	.90	.87	.06	205.25

Note. * All chi-squares are significant at $p < .001$; re. = respecified

The results of CFAs of the items forming the Job Content Questionnaire (cf. DC Model) are shown in Table 3.7. Two models were specified: a two-factor model with JCQ demands and decision latitude, and a model with three latent factors in which decision latitude was split up into skill discretion and decision authority. These models were compared with the most restrictive model assuming no relations between the variables. Table 3.7 shows that, from a statistical perspective, the models do not fit very well, because all chi-squares were highly significant. However, as was mentioned before, this statistic is highly dependent on sample size, and small model specification errors may yield large χ^2 values if n is large (de Jonge, 1995). In addition, the difference between the chi-squares shows that a three-factor model fitted the data better than a two-factor model in Study 1 at Time 1 ($\Delta\chi^2 = 95.44$; $\Delta df = 2$; $p < .001$) and Time 2 ($\Delta\chi^2 = 65.32$; $\Delta df = 2$; $p < .001$), as well as in Study 2 at Time 1 ($\Delta\chi^2 = 32.65$; $\Delta df = 2$; $p < .001$) and Time 2 ($\Delta\chi^2 = 24.74$; $\Delta df = 2$; $p < .001$). Thus, it seems preferable to test the DC Model by retaining the distinction between decision authority and skill discretion, instead of combining them into a single construct (i.e., decision latitude). The values of the practical indices (i.e., AGFI, CFI, TLI, RMSEA, and AIC) in Study 1 at Time 1 show a good fit for the three-factor model. However, the values of the CFIs and TLIs in Study 1 at Time 1, and in Study 2, are smaller than .90, indicating that the models could be improved. With the help of the Modification Index (MI), AMOS shows how much the model fit will improve if a fixed parameter is freed and estimated from the data (for instance, the correlation between two errors). In this way, AMOS can be used in an exploratory way. However, it should be noted that only theoretically defensible parameter modifications should be made. Inspection of the MIs showed significantly correlated error terms. Stepwise relaxation of the corresponding parameters led to respecified, improved models, which are theoretically defensible. For example, it is plausible that the requirement of learning new things at work (item DL1) might be closely related to the requirement of a high skill level at work (item DL4). With the exception of the TLI (in Study 1 at Time 1, and in Study 2), the respecified models all have acceptable fit indices.

Table 3.8 Results of confirmatory factor analyses of the ERI Questionnaire for the panel groups in Study 1 and Study 2, at both measurements

	Study 1 (n = 154)							Study 2 (n = 95)						
	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC
Time 1														
3 factor	437.44	206	.75	.75	.72	.09	531.44	420.42	206	.66	.68	.64	.11	514.42
5 factors	-	-	-	-	-	-	-	367.70	199	.69	.75	.71	.10	475.69
4 factors	283.64	164	.81	.86	.84	.07	375.64	265.05	164	.74	.81	.78	.08	357.05
4 factor re.	242.98	159	.83	.90	.88	.06	344.98	261.67	159	.73	.80	.77	.08	363.67
Time 2														
3 factor	462.93	206	.74	.74	.71	.09	556.93	367.39	206	.68	.78	.75	.09	461.39
5 factors	375.17	199	.78	.82	.79	.08	483.17	272.39	199	.75	.90	.88	.06	380.39
4 factors	305.86	164	.80	.84	.81	.08	397.86	221.73	164	.78	.91	.90	.06	313.73
4 factor re.	229.47	159	.84	.92	.91	.05	331.47	207.10	159	.78	.93	.91	.06	309.10

Note. * All chi-squares are significant at p < .001; re. = respecified

The factorial structure of the ERI-Q was examined as well. Table 3.8 shows the results of these CFAs. Two models were specified: a three-factor model (i.e., effort, rewards, and overcommitment) was compared to a five-factor model in which reward was split up (i.e., effort, salary, esteem, job security, and overcommitment). Inspection of the fit indices shows that all chi-squares were significant, indicating that the models do not fit very well. The difference between the chi-squares shows that a five-factor model fitted the data better than a three-factor model in three of the four analyses: in Study 1 at Time 2 ($\Delta\chi^2$ = 87.76; Δdf = 7; p < .001), as well as in Study 2 at Time 1 ($\Delta\chi^2$ = 52.72; Δdf = 7; p < .001) and Time 2 ($\Delta\chi^2$ = 95.00; Δdf = 7; p < .001). Closer inspection of the data from Study 1 at Time 1 showed a zero correlation between the two security items[1]. Excluding job security items from the analysis resulted in a model with four related constructs (effort, salary, esteem, and overcommitment), which showed significantly better fit than a three-factor model ($\Delta\chi^2$ = 153.80; Δdf = 42; p < .001). So in general, it seems preferable to operationalize salary and esteem (and security) as distinct constructs, instead of using one general reward construct. Since the two security items were uncorrelated, and hence formed an unreliable and invalid scale, we did not consider job security in subsequent analyses. To reduce complexity and to retain comparability between the studies, a four-factor model (i.e., effort, salary, esteem, and overcommitment)

1 The zero correlation between the security items might be attributable to a reorganization of the departments at Time 1, in which employees did not fear losing their job (item 1: "My job security is poor"), but did fear changes in their position (item 2: "I have experienced or I expect to experience an undesirable change in my work situation").

was specified for all samples. Most of the practical fit indices showed poor fit. The small CFIs, TLIs (< .90), and MIs suggest that the models could be improved. With the exception of Study 2 at Time 1, respecifying the models by relaxing five error covariances resulted in better fit. However, it should be noted that the AGFIs for these respecified models are still rather low, indicating that even though the model comparisons and model parsimony seem acceptable, the practical model fit is not.

Table 3.9 Results of confirmatory factor analyses of the specific demands scales for the panel groups in Study 1 and Study 2, at both measurements

	Study 1 (*n* = 206)							**Study 2 (*n* = 233)**						
	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC
Time 1														
1 factor	1823.03	324	.38	.50	.46	.15	1931.03	2190.28	324	.33	.49	.44	.16	2298.28
3 factors	651.43	321	.77	.89	.88	.07	765.43	903.30	321	.71	.84	.83	.09	1017.30
3 factor re.	498.77	314	.82	.94	.93	.05	626.77	726.23	314	.77	.89	.87	.08	854.23
Time 2														
1 factor	1651.64	324	.43	.50	.46	.14	1759.64	2323.03	324	.33	.43	.38	.16	2431.03
3 factors	723.33	321	.74	.85	.83	.08	837.33	874.44	321	.74	.84	.83	.09	988.44
3 factor re.	579.55	314	.80	.90	.89	.06	707.55	672.54	314	.79	.90	.89	.07	800.54

Note. * All chi-squares are significant at $p < .001$; re. = respecified

The three specific demands scales are assumed to represent different constructs. To examine whether the three scales really represented different constructs, a three-factor model distinguishing the specific types of demands (i.e., mental, emotional, and physical) was tested against a one-factor model representing one global general demands construct. The results in Table 3.9 show that the chi-squares were again highly significant. In addition, the results show that the items of the three specific scales (i.e., mental, emotional, and physical demands) loaded better in a model with three related constructs than in a one-factor model, in Study 1 at Time 1 ($\Delta\chi^2 = 1171.60$; $\Delta df = 3$; $p < .001$) and Time 2 ($\Delta\chi^2 = 928.31$; $\Delta df = 3$; $p < .001$), as well as in Study 2 at Time 1 ($\Delta\chi^2 = 1286.98$; $\Delta df = 3$; $p < .001$) and Time 2 ($\Delta\chi^2 = 1448.59$; $\Delta df = 3$; $p < .001$). Therefore, the specific demands measures will be treated as three separate scales in the subsequent analyses. Most of the practical fit indices showed poor fit. With the help of the MIs the models were modified, such that seven pairs of errors were allowed to correlate. After this procedure, with the exception of the AGFIs, most fit indices of these respecified models were acceptable.

Table 3.10 Results of confirmatory factor analyses of the employee well-being scales for the panel groups in Study 1 and Study 2, at both measurements

	Study 1 (n = 236)							Study 2 (n = 269)						
	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC	χ^{2*}	*df*	AGFI	CFI	TLI	RMSEA	AIC
Time 1														
1 factor	601.31	152	.68	.68	.64	.11	677.31	962.21	152	.55	.62	.57	.14	1038.21
3 factors	410.81	150	.80	.82	.79	.09	490.81	534.22	150	.77	.82	.79	.10	614.42
3 factor re.	266.57	146	.86	.90	.92	.06	354.57	300.73	146	.86	.93	.92	.06	388.73
Time 2														
1 factor	478.92	152	.76	.76	.72	.10	554.92	679.67	152	.69	.70	.67	.11	755.67
3 factors	384.10	150	.81	.83	.80	.08	464.10	465.57	150	.81	.82	.80	.09	545.57
3 factor re.	238.00	146	.87	.93	.92	.05	326.00	269.53	146	.88	.93	.92	.06	357.53

Note. * All chi-squares are significant at $p < .001$; re. = respecified

Finally, the three self-reported employee well-being scales (i.e., job satisfaction, exhaustion, and psychosomatic health complaints) were examined in CFAs to see whether they represented three different constructs or whether a one-factor solution reflecting a general well-being construct would be preferable. The results in Table 3.10 indicate that the items of the three specific scales loaded better in a model with three related constructs than in a one-factor model, in Study 1 at Time 1 ($\Delta\chi^2$ = 190.50; Δdf = 2; $p < .001$) and Time 2 ($\Delta\chi^2$ = 94.82; Δdf = 2; $p < .001$), as well as in Study 2 at Time 1 ($\Delta\chi^2$ = 427.99; Δdf = 2; $p < .001$) and Time 2 ($\Delta\chi^2$ = 214.10; Δdf = 2; $p < .001$). The results justify the use of three distinct scales representing employee well-being. As in the other CFAs, the chi-squares were again highly significant, indicating insufficient fit. The other fit indices and the MIs showed that the model could be improved. Therefore, four error covariances were relaxed in all samples, resulting in better model fit.

Reliability analyses

Table 3.12 shows the internal reliabilities of the measurement instruments used in the present research. In general, a coefficient alpha of > .70 is considered to be adequate (Cortina, 1993). However, alpha is dependent on intercorrelations and on multidimensionality (cf. Cortina, 1993). Therefore, one should be careful in interpreting alphas solely by one standard. In general, the original scales for the DC Model and the ERI Model show relatively low alphas (i.e., JCQ demands, effort, decision latitude, overcommitment). Especially in Sample 2 at Time 1 (both for the total group and the panel group), the alphas are relatively low for these measures. In the case of decision authority and job security, the low alphas could be due to the (small) number of items (n = 3 and 2, respectively). On the other hand, the higher alphas for the more specific measures might be attributable to low multidimensionality or perhaps greater content specificity.

Table 3.12 Reliability coefficients of the measures (Sample 1 and Sample 2)

	Sample 1				Sample 2				Total
	Time 1		Time 2		Time 1		Time 2		
	Total	Panel	Total	Panel	Total	Panel	Total	Panel	Median (range)
1. JCQ demands	.72	.70	.64	.66	.63	.61	.65	.69	.66 (.61 - .72)
2. Effort	.74	.74	.72	.69	.60	.64	.77	.78	.73 (.60 - .78)
3. Mental demands	.90	.90	.89	.89	.88	.87	.87	.88	.89 (.87 - .90)
4. Emotional demands	.86	.86	.87	.85	.92	.90	.87	.90	.87 (.85 - .92)
5. Physical demands	.91	.91	.90	.90	.90	.92	.89	.92	.91 (.89 - .92)
6. Decision latitude	.79	.80	.79	.79	.65	.67	.75	.73	.77 (.65 - .80)
6a. Skill discretion	.73	.77	.72	.73	.58	.62	.68	.69	.71 (.58 - .77)
6b. Decision authority	.74	.70	.68	.68	.48	.52	.60	.51	.64 (.48 - .74)
7. Rewards	.82	.80	.82	.83	.74	.69	.82	.80	.81 (.69 - .83)
7a. Salary	.70	.69	.73	.71	.49	.45	.73	.70	.70 (.49 - .73)
7b. Esteem	.76	.74	.74	.76	.71	.64	.75	.72	.74 (.64 - .76)
7c. Job security	.25	.00	.50	.52	.44	.41	.45	.56	.45 (.00 - .56)
8. Overcommitment	.79	.77	.77	.77	.65	.63	.76	.79	.77 (.63 - .79)
9. Psychosomatic complaints	.88	.85	.79	.78	.84	.86	.86	.85	.85 (.78 - .88)
10. Exhaustion	.87	.86	.85	.85	.91	.89	.88	.88	.88 (.85 - .91)

3.6 Data analyses

This section contains a description of the statistical techniques used in the present research. Both the cross-sectional data and the longitudinal data were analyzed using the following procedure. First, preliminary analyses were conducted to obtain an initial overview of the data (i.e., means, standard deviations, and Pearson correlations). Second, more sophisticated analyses were used to examine the relation between job characteristics (i.e., demands/effort and decision latitude/rewards) and employee well-being. Since the interactions between demands and resources were a central focus, Hierarchical Multiple Regression Analyses (HMRA) were used. Several statistical experts recommend the use of HMRA to test interactions between continuous variables, because in this way main effects are controlled for (Aiken & West, 1991; Stone & Hollenbeck, 1989). The HMRA were conducted using simultaneous entry of variables within each hierarchical step. The structure of the HMRA was similar for most of the analyses. In Step 1 the control variables were entered (i.e., gender, age, and education). Step 2 added two independent variables, that is, a demand variable (either JCQ demands, effort, or a specific demand) and a resource variable (either decision latitude or rewards). Finally, in Step 3 the interaction term representing interaction between the demand variable and the resource variable was entered. In the longitudinal analyses an additional step was carried out: after Step 1 the dependent variable at Time 1 was entered. The other predictor variables entered in all steps of the analyses consisted of the variables measured at Time 1. With the help of an incremental F test (F_{inc}: Jaccard, Turrisi, & Wan, 1990), we tested whether the interaction terms (Step 3) yielded a significant increment in explained variance over and above the variance explained by the additive effects of the independent variables (Step 2). F_{inc} is the indicator of this contribution and has an accompanying *p*-value.

In the analyses including the multiplicative interaction terms (i.e., demands * resources), centered job characteristics were used (i.e., mean subtraction) to reduce the problem of multicollinearity (Jaccard et al., 1990). Accordingly, unstandardized regression coefficients are presented in the tables (Aiken & West, 1991; Jaccard et al., 1990).

Finally, in order to assess reliability, the results were cross-validated in a different, comparable sample. According to Kleinbaum, Kupper and Muller (1988) the most compelling way to assess the reliability of a given model is to conduct a new study and test the fit of the model to the new data. This means that the coefficients obtained from one sample are used to predict the criterion in another sample. In this process, the goal is to obtain an estimate of the cross-validated squared multiple correlation, which is represented by the squared correlation between the predicted and actual criterion values in the second sample (Darlington, 1990). The shrinkage on cross-validation is an indicator of the reliability of the results, and is computed as the difference between the R^2 for Sample 1 and the R^2 for Sample 2. As a rule of the thumb, a reliable model is indicated when the shrinkage value is less than .100 (Kleinbaum et al., 1988). Moreover, the patterns of the regression coefficients from both samples were compared by means of subgroup regression analyses. That is, both samples were placed in one database and it was tested whether the regression coefficients differed significantly between studies. That is, regression analyses were run again, this time including an extra variable ("study") indicating whether the results were from Study 1 (1) or from Study 2 (0). The variable "study" was added in an additional step, and interaction terms were created between (a) demands and study, (b) resources and study, and (c) demands, resources, and study. If the regression coefficient for an interaction term including the variable "study" was significant, this would mean that the samples differed on the associated construct, whereas a nonsignificant coefficient would indicate that samples did not differ significantly.

3.7 Summary

The present chapter has presented an overview of the research method. The research design incorporated both a cross-sectional design (i.e., one measurement) and a longitudinal design (i.e., two-wave panel design with a time interval of two years). Two different samples were included, both consisting of employees of nursing homes.

The data were gathered by mean of self-report questionnaires, yielding response rates of approximately 75% at Time 1 in both samples. These respondents made up the cross-sectional group. Almost 50% of the initial sample responded at both Time 1 and Time 2 in Sample 1, and almost 60% of the initial sample responded at both measurements in Sample 2. The respondents who responded at both Time 1 and Time 2 made up the longitudinal or panel group. A non-response analysis showed that the panel group scored more favorably than the dropouts on demands/effort, rewards, and exhaustion. Additional non-response analyses showed that in general the employees who only responded at Time 2 scored more favorably than both the panel group and employees who only responded at Time 1.

The measures included original questionnaires for the DC Model and the ERI Model as well as additional instruments measuring more specific demands and well-being outcomes. In general, the measures were found to be reliable and valid in the present research and/or in previous research. Finally, the data analysis consisted of preliminary analyses (such as correlations), as well as Hierarchical Multiple Regression Analyses (HMRA) followed by cross-validation procedures.

4

Occupational stress in (inter)action:

The interplay between job demands and job resources

Parts of this chapter have been published under the title:

van Vegchel, N., de Jonge, J., & Landsbergis, P. A. (2005). Occupational stress in (inter)action: The interplay between job demands and job resources. *Journal of Organizational Behavior*, *26*, 535-560.

4.1 Introduction

In Chapter 2, the DC Model and the ERI Model were introduced as two leading work stress models which can be viewed as balance models. In short, both models assume that the balance (or imbalance) between job demands and job resources determines the state of employee well-being. An important assumption is that high job demands do not necessarily lead to impaired well-being. Only in the presence of low job resources will high job demands result in lowered employee well-being. In contrast, when job resources are high, the negative impact of high job demands on employee well-being will be counterbalanced. In statistical terms, the relationship between job demands and job resources as determinants of employee well-being may be operationalized in various ways. In balance models, this relationship has been frequently conceptualized as an *interaction* between demands and resources (e.g., de Jonge & Dormann, 2003). The DC Model defines an interaction as “two separate sets of outcomes (strain and learning) [that] are jointly predicted by two different combinations of demand and control” (Karasek, 1989, p. 143). Statistically, a relative excess term has been suggested as an operationalization of the relationship between demands and control (i.e., | demand - control + constant |, Karasek, 1979). However, empirical studies testing the DC Model have used different mathematical formulations, such as the multiplicative interaction term (i.e., demands * control) and the quotient term (demand / control) (e.g., Landsbergis, Schnall, Warren, Pickering, & Schwartz, 1994; Landsbergis & Theorell, 2000). The opposite holds in the case of the ERI Model, which offers no clear theoretical formulation of the interaction between effort and rewards. Despite this theoretical ambiguity, the statistical operationalization of the relationship between effort and rewards is straightforward. (Siegrist & Peter, 1996) have suggested a ratio term, and although this ratio has been operationalized in various ways, most empirical studies have tested the ERI Model using a ratio term (e.g., van Vegchel, de Jonge, Bosma, & Schaufeli, 2005). Hence, in the case of both the DC Model and the ERI Model, the theoretical description of the interaction does not necessarily correspond to statistical operationalizations of this interaction term. Use of different statistical operationalizations could be a factor contributing to mixed evidence for demand-resource interactions (e.g., de Jonge, van Breukelen, Landeweerd, & Nijhuis, 1999; Landsbergis et al., 1994). Moreover, it is possible that, independent of empirical outcomes, these different statistical operationalizations have different meanings and are therefore not interchangeable.

According to Edwards and Cooper (1990) three fundamentally different interaction terms may represent the relation between job demands and job resources as predictors of strain reactions: (1) the discrepancy term, (2) the multiplicative interaction term, and (3) the ratio term. By displaying these three statistical operationalizations in figures, Edwards and Cooper (1990) showed that they do indeed represent different forms and (statistical) contents of the interaction. The present research assumes that different mathematical formulations of the demand-resource interaction will yield corresponding differences in the meaning of the interaction term.

Use of different interaction terms – that is, different statistical operationalizations of the relation between job demands and job resources as predictors of strain reactions – may have at least two consequences. Firstly, the meaning of the different interaction terms may differ. Secondly (and consequently), empirical findings may differ as well. The mixed evidence for balance models could be a consequence of the use of different mathematical formulations of the interaction term. Hence, an important question is whether the interaction terms as used to test the DC Model and ERI Model adequately represent what they (theoretically) should represent. Therefore, the present chapter concentrates on the following research question, as formulated in Chapter 2:

How have interactions been conceptualized in the Demand-Control and Effort-Reward Imbalance literature, and to what extent do these conceptualizations correspond to the key assumptions of the Demand-Control Model and the Effort-Reward Imbalance Model?

To explore this research question, the present chapter explores the genesis of the interaction between job demands and job resources within the DC Model and the ERI Model. A theoretical statement will be given concerning the kinds of interactions that have been used in the DC Model and in the ERI Model, and these models' exact assumptions about interaction terms. First, the three fundamentally different interaction terms as classified by Edwards and Cooper (1990) will be further explained. In this way, the interactions of the DC Model and the ERI Model can be seen in light of Edwards and Cooper's (1990) classification. Also, to explore the effect of different interaction terms within both models, an empirical test will be provided. To this end the cross-sectional data from Study 1 will be used, and these results will be cross-validated with the cross-sectional data from Study 2.

More concretely, the aim of the present chapter is twofold:

1. to give a theoretical overview of interaction terms, and to relate these interaction terms to both the DC Model and the ERI Model based on the literature (section 4.2);
2. to provide an empirical test, using three fundamentally different interaction terms, of the impact of different interaction terms on the prediction of employee well-being (section 4.3).

4.2 Theoretical consideration

4.2.1 Classification of interactions

The literature on the DC Model and the ERI Model shows that many different interaction terms have been used to represent the relation between job demands and job resources as predictors of strain reactions. To demonstrate that different formulations of interactions do indeed entail differences in the form and (statistical) content of the interaction, Edwards and Cooper (1990) graphically displayed and explained three fundamentally different types of interaction terms – the discrepancy, the interactive, and the proportional form (see Figure 1).

Firstly, the *discrepancy* term (Figure 1a) reflects a positive relation between job demands and strain, and a negative relation between job resources and strain (cf. Edwards & Cooper, 1990). Actually, this term is similar to an additive effect: both

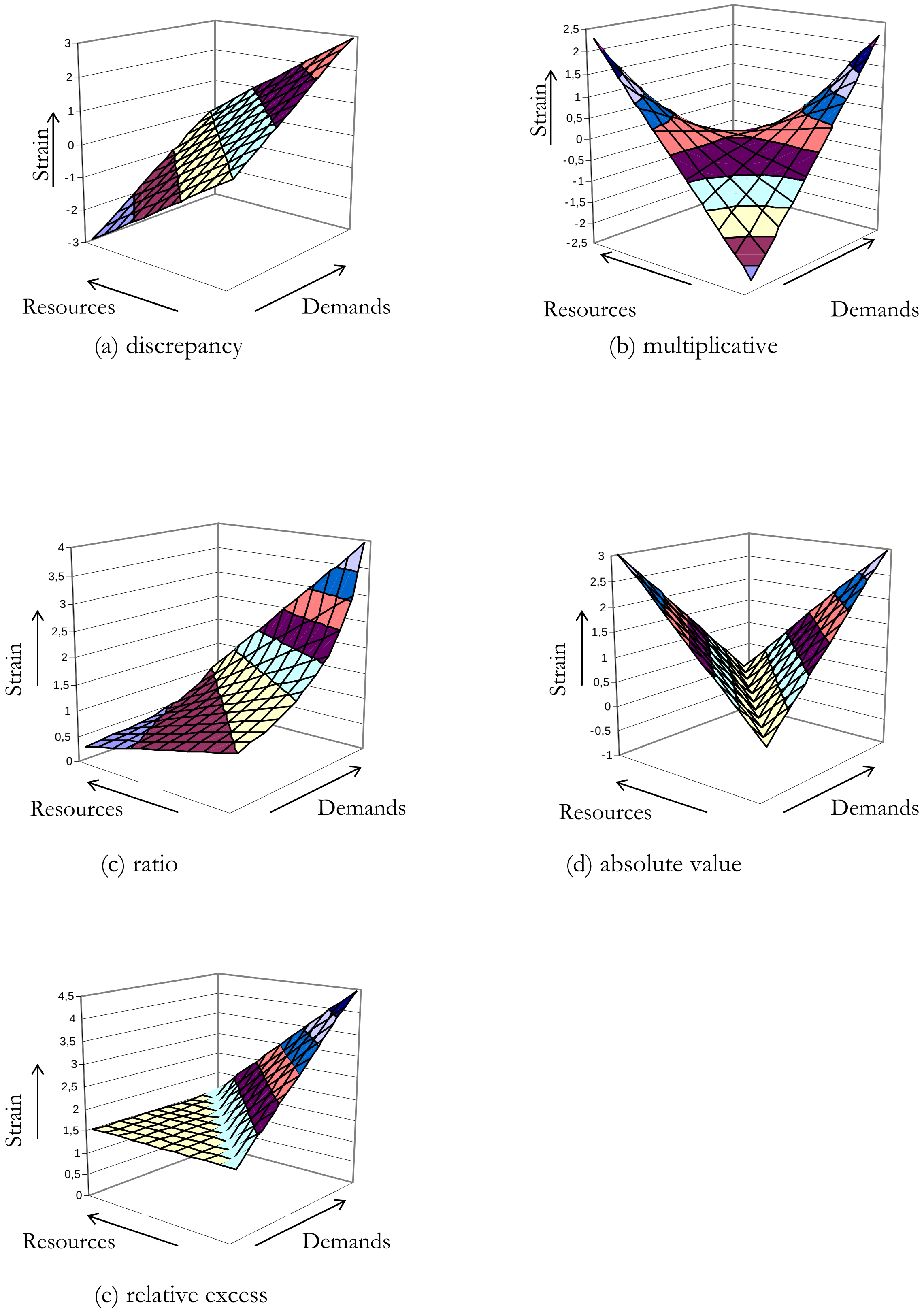


Figure 4.1 Functional forms relating demands, resources and strain (cf. Edwards & Cooper, 1990; Edwards & Van Harrison, 1993)

variables, demands and resources, are assumed to have a linear association with strain. Demands represent a standard by which resources are compared, such that larger deviations of resources from demands are associated with strain. More concretely, this means that most strain is experienced when demands are high, especially when the amount of resources available to the employee is low, but also when resources are high (because demands represent the standard). In the case of low demands, considerably less strain is experienced, especially when resources are high, but also to a slightly lesser extent when resources are low.

The *multiplicative interaction*, also referred to as the "interactive" form by Edwards and Cooper (1990), implies that job resources influence the strength of the association between job demands and strain. In other words, job resources modify the effects of demands on strain (comparable to a buffer effect as described by Cohen and Wills, (1985)). Represented in a three-dimensional figure, this type of interaction appears as a saddle-shaped surface (Figure 1b). In other words, the amount of both demands and resources influences whether or not strain is experienced. If demands are high and resources are low (but also when resources are high and demands are low), much strain will be experienced. If both demands and resources are (very) low, hardly any strain is experienced. However, a combination of high demands and high resources also leads to a low amount of strain (i.e., the point folds back to the same level of strain as in the low demands – low resources combination). This last combination shows the moderating effect of high resources: although demands are high, a large amount of resources prevents the experience of great strain.

Finally, Edwards and Cooper (1990) discuss the *ratio* term, which they call the "proportional" form (Figure 1c). The term proportional refers to the proportion of job demands that is fulfilled by job resources (e.g., demands/resources). Strain increases as the proportion of demands that is fulfilled by resources becomes lower (that is, when there are many demands in proportion to few resources). Actually, the proportional form combines some features of the discrepancy and interactive forms, because demands represent a standard by which resources are compared, and the resources influence the strength of the association between demands and strain. Unique to the proportional form, however, is that the effect of the resources on the relation between demands and strain becomes progressively smaller as the resources increase. To put it differently, when demands equal resources, an average (low) amount of strain will be experienced. When demands are high and resources are low, most strain will be experienced, whereas strain will be lowest in the opposite case (i.e., low demands and high resources). The proportional function of resources can be seen when high resources are compared with low resources. In the case of high resources, the amount of strain will never increase very sharply with increasing demands. However, in case of low resources, when demands increase the level of strain increases sharply.

4.2.2 Demand-control interactions

Theoretically, an interaction effect in the DC Model has been described as a *joint* effect of job demands and decision latitude. Karasek (1989, p. 143) states that true (i.e., multiplicative) interaction effects are often difficult to detect due to lack of statistical power. He then argues that "the exact form of the interaction term is not the main issue, since the 'primary' interaction claimed in the model is that two separate sets of outcomes (strain and activity level) are jointly predicted by two different combinations of demands and control" (Karasek, 1989, p. 143). This definition of an "interaction" implies that the nature of the interaction is primarily additive. According to Kasl (1996, p. 49) this is a "somewhat unusual" operationalization of an interaction term, contrary to the more prevalent view that an interaction consists of a moderator or synergistic effect. By a moderator effect, Kasl (1996) means that high decision latitude prevents variations in demands from increasing the risk of strain; the risk due to demands will be apparent only when decision latitude is low. In contrast, a synergistic effect implies that both high demands and low decision latitude are associated with increased risk but that combining the two increases the risk beyond the mere additive effects.

Originally, Karasek (1979) operationalized the interaction between job demands and decision latitude as a "relative excess" interaction (cf. Southwood, 1978). With this interaction term, job strain is equal to the absolute value of demands minus decision latitude plus a constant (| demands – decision latitude + constant |). Actually, the relative excess term resembles the absolute difference term (see Figure 1d), which is the absolute value of the discrepancy term. Hence, strain is minimized when demands and resources are equivalent (see the V-shaped form). By adding a constant, which serves as a correction factor to emphasize problems of too many job demands and to deemphasize the problem of too little decision latitude, the interaction form becomes the "excess" form (see Figure 1e). That is, strain will only be experienced when demands are greater than (or exceed) decision latitude. Hence, the highest amount of strain will be expected when demands are high and decision latitude is low. For all other conditions (i.e., high demands – high decision latitude, low demands – high decision latitude, and low demands – low decision latitude) strain will be equally low.

In spite of Karasek's suggestion to use a relative excess interaction term (Karasek, 1979), the literature on the DC Model shows a broad range of operationalizations of the interaction between job demands and decision latitude. As a matter of fact, even Karasek's original paper (1979) contains estimations of both relative excess interactions and multiplicative interactions. Hence, different (mathematical) formulations have been used to define this interaction (Landsbergis et al., 1994). More specifically, three interaction terms have dominated DC research thus far (Landsbergis & Theorell, 2000). Firstly, there is the quadrant approach, which classifies job strain as scores above the median on demands and below the median on decision latitude. Secondly, there is the quotient, which is a ratio of demands to decision latitude. Finally, there is the multiplicative interaction term (partialled for main effects), which is composed of the multiplicative product of demands and decision latitude. The quotient interaction term and the multiplicative interaction term fit into Edwards and Cooper's classification (1990), as they are respectively similar to the previously described ratio term (Figure 1c) and multiplicative term (Figure 1b). The quadrant approach, however, uses discrete independent factors. Because most demand and control measures are conceptually closer to continuous than to categorical variables, the use of the quadrant approach is questionable (cf. Viswesvaran, Sanchez, & Fisher, 1999). Therefore, the quadrant approach will not be considered further in this chapter.

In practice, not only has a broad range of interaction terms been used, but many different statistical analyses have been used to test interactions. For example, the relative excess interaction term, the multiplicative interaction term, and the ratio term have often been assessed with hierarchical multiple regression analyses, polynomial regression analyses, and other likelihood regression analyses (such as Poisson, logistic, and Cox regression). Also, covariance structure modeling has been used recently to test the multiplicative interaction term (de Jonge, 2002). On the other hand, the quadrant approach is often evaluated with analysis of variance.

Considering the diversity of operationalizations and analytical methods used in testing the DC Model, a comparison between studies is not easy. Several reviews have attempted to gain more insight into the specific characteristics that distinguish studies that do and do not confirm the model's assumptions (see, for example, de Lange, Taris, Kompier, Houtman, & Bongers, 2003; Schnall, Landsbergis, & Baker, 1994). One source that explicitly focuses on the types of interactions used to test the DC Model is Van der Doef and Maes' (1999) literature review. These authors distinguished between the 'strain' hypothesis, testing additive effects, versus the 'buffer' hypothesis, testing interaction effects in addition to main effects. Their review on psychological well-being shows that the 'strain' hypothesis has been tested more often than the 'buffer' hypothesis, and that the 'strain' hypothesis has received considerable support, whereas the limited number of studies testing the 'buffer' hypothesis show inconsistent results. A review by Schnall et al. (1994; updated by Landsbergis and Theorell in 2000) concerning cardiovascular disease endpoints showed that most studies testing interactions modeled them using a quadrant approach. A newer approach (used in seven studies with positive results) was a quotient term. According to Schnall et al. (1994), both approaches should also examine the main effects of demands and decision latitude to determine whether significant associations are due to joint effects of the variables or primarily to the effects of only one variable. Three of seven other studies (i.e., Hallqvist et al., 1998; Johnson & Hall, 1988; Landsbergis et al., 1994) found a significant interaction using a multiplicative interaction term after controlling for main effects (Landsbergis & Theorell, 2000). So, inconsistent results with regard to the DC Model may have emerged due to the use of different mathematical formulations of the interaction term, as well as different statistical methods (e.g., Schnall et al., 1994; van der Doef & Maes, 1999).

Another disadvantage of the use of different interaction terms is that published data may be the result of a selection process, in which positive associations with outcomes are reported and negative ones are ignored. For this reason Landsbergis and colleagues (1994) tested four different interaction terms (i.e., quadrant term, quotient term, multiplicative term, and linear discrepancy term) in relation to blood pressure in one study. All terms revealed significant effects for systolic blood pressure, but not for diastolic blood pressure (the multiplicative and linear terms were not significant). A few other studies testing different interaction terms simultaneously within the DC Model showed somewhat different results (e.g., Karasek, 1979; Sauter, 1989). Karasek himself (1979) found support for relative excess as well as multiplicative interactions with regard to job and life dissatisfaction. However, Sauter (1989) noted that only the relative excess term (and not the multiplicative term) reached statistical significance for dissatisfaction and illness symptoms. As such, these studies do not seem to support a unanimous preference for one type of interaction term.

Because the literature on the DC Model offers neither a theoretical nor an empirical basis for selecting one specific interaction term, the present chapter will provide an empirical test of the impact of three different interaction terms based on the classification scheme of Edwards and Cooper (1990), applied to the DC Model. That is, the effects of a subtractive term (in the DC Model the most common is the relative excess term), a multiplicative interaction, and a ratio term will be tested using hierarchical multiple regression analyses, to gain more insight into the contributing variables and the impact of the interaction term over and above main effects (Kasl, 1996; Schnall et al., 1994). It should be emphasized that these analyses are *not* meant to determine the best way of statistically operationalizing an interaction term, but simply to explore whether or not different statistical operationalizations lead to different results.

4.2.3 Effort-reward interactions

The ERI Model proclaims that the combination of high effort and low rewards will have the most adverse health effects, especially for employees who are highly overcommitted to their job. To our knowledge, the word "interaction" as such has been mentioned once by Siegrist and colleagues (1990) to describe a mismatch between high effort and low rewards. For a long time, this combined effect was not defined in terms of a specific ERI interaction effect. However, recently Siegrist (2002) has maintained that the effect of the ratio is more than the main effects of effort and rewards, which could be interpreted as a synergistic interaction effect (cf. Kasl, 1996). Therefore the ERI interaction could be labeled as synergistic. With regard to overcommitment the model anticipates the highest risk of reduced health for employees characterized by both effort-reward imbalance and overcommitment. It was not until very recently that the nature of the relation between effort-reward imbalance and overcommitment was clearly specified. For instance, Peter (2002) states that overcommitment can both directly effect employee health, and modify the relation between effort-reward imbalance and employee health (e.g., overcommitment acting as an effect modifier).

Compared to theoretical descriptions of the ERI interaction, its *operationalization* has been more thoroughly developed. In the manual for the effort-reward imbalance questionnaire, Siegrist and Peter (1996) suggested a ratio term to operationalize the interactive relationship between effort and rewards (i.e., effort / rewards). Thus, they assume that most strain will result from a high effort – low rewards condition. Imbalance between effort and rewards will result in strain when rewards are low; when rewards are high (or moderate), the amount of strain is merely determined by effort. As such, it is quite similar to a relative excess term

The empirical literature is very consistent in testing the ERI model, both with regard to the ERI interaction term and analytical methods. Most studies have tested the relation between effort and rewards with a ratio term, perhaps since the ERI questionnaire's manual explicitly proposes this operationalization. The association between effort and rewards has also been tested by creating independent groups based on either tertiles or median splits. Initially, three independent groups were created (e.g., neither high effort nor low rewards, either high effort or low rewards, both high effort and low rewards) (for example, see Bosma et al., 1997). Subsequently, after empirical research showed that it is important to distinguish the conditions high effort – high rewards and low effort – low rewards, four independent groups have been used (e.g., low effort – high rewards, high effort – high rewards, low effort – low rewards, high effort – low rewards) (de Jonge, Bosma, Peter, & Siegrist, 2000), analogous to the four quadrants in Karasek's DC model. In addition, the majority of studies analyze effort-reward imbalance with logistic regression analyses. A few studies have tested general linear models, such as multivariate analyses of variance (Bakker, Killmer, Siegrist, & Schaufeli, 2000; Vrijkotte, van Doornen, & de Geus, 1999) and linear regression analyses (Calnan, Wainwright, & Almond, 2000).

Most ERI studies have reported elevated health risk due to the combination of high effort and low rewards. However, as Belkiç and colleagues (2000) have noted, in some studies a synergistic (or at least moderated) interaction seems to exist: the relative risk of poor health in a combined condition of high effort – low rewards is substantially greater than the sum of the risks due to these two components considered separately (for example Peter & Siegrist, 1997; Siegrist, 1996). However, these interactions were not statistically tested. Since the model was merely tested with a variable representing the combined condition of high effort – low rewards, it is not possible to assess interaction effects. Therefore, ERI studies do show additive effects, but whether interaction effects are present remains to be seen.

Hierarchical multiple regression analyses offer better insight into which variables contribute to an interaction effect (cf. Kasl, 1996). Moreover, by means of regression analyses it is possible to determine whether an interaction effect is significant over and above main effects. And finally, regression analyses allow for a comparison between different interaction terms in terms of explained variance. For these reasons, the present research used hierarchical multiple regression analyses to assess the effects of different interaction terms within the DC Model and the ERI Model.

4.2.4 Summary

To summarize, the first aim of the present chapter was to provide a theoretical overview of interaction terms. In the literature a three-way classification of interaction terms has been offered: discrepancy, multiplicative, and ratio terms (Edwards & Cooper, 1990). The discrepancy term (i.e., demands – resources) represents a linear relation between demands and strain on the one hand, and between resources and strain on the other. The multiplicative interaction term (i.e., demands * resources) resembles a buffer effect in which resources moderate the relation between demands and strain. In the ratio term (i.e., demands / resources) the amount of strain is determined by the proportion of demands that is fulfilled by resources. Because of its proportional nature, the amount of resources is most important in the prediction of strain. In the literature on the DC Model, a relative excess term was originally used to operationalize the relation between demands, resources, and strain. Like the discrepancy term, the relative excess term (i.e., | demands – resources + constant |) is a subtractive term. The main characteristic of the relative excess term is that strain will be experienced only when demands exceed resources. However, the multiplicative term and the ratio term have been used most often to test the DC Model. The literature on the ERI Model articulates no theoretical preference for a particular type of interaction term, but empirically by far most studies have used a ratio term. Although a synergistic interaction between effort and rewards has been predicted (Siegrist, 2002), this interaction effect has not been tested separately from its main effects (Belkiç et al., 2000). The above consideration of the DC and ERI interactions in light of these basic interaction forms (cf. Edwards & Cooper, 1990) shows that different interaction terms do indeed have different meanings and interpretations. This suggests that the choice of an interaction term should be guided by theoretical assumptions. However, neither the DC Model nor the ERI Model offer a clear theoretical rationale for preferring one interaction term over another. In order to explore the effect of operationalizing the relationship between job demands and job resources by means of different interaction terms, an empirical test is given in the next section.

4.3 Empirical test

The second aim of the present chapter is to provide an empirical test using three fundamentally different interaction terms. The main DC and ERI interactions (i.e., a subtractive, an interactive, and a proportional form) will be empirically tested to see whether different interaction terms show congruent results with regard to employee well-being. In order to stay as close as possible to the original concepts as intended by both models (cf. Beehr, Glaser, Canali, & Wallwey, 2001) and to facilitate comparison with other studies (cf. Schnall et al., 1994), the original scales developed for the DC Model and the ERI Model will be used. Because the main issue of the present chapter is the mathematical formulation of the interaction between job demands and job resources, the personal component of the ERI Model (viz, overcommitment) was omitted. That is, to ensure that the (already complex) demand-resource interaction remains the focus, the analyses and three-dimensional graphical representations of the interaction terms will not be further complicated by including this personality characteristic. The reader may recall from Chapter 3 that both self-reported outcome variables (e.g., job satisfaction, exhaustion, and psychosomatic health complaints) and more objective outcome variables (e.g., sickness absence time-lost and frequency indices) will be used to test the interaction terms and the models.

4.3.1 Preliminary analyses

The raw data were examined prior to the hierarchical regression analyses. Initial examination revealed that the distribution of duration of sickness absence was positively skewed in both studies (i.e., skewness = 2.87 in Study 1, and 3.95 in Study 2). This means there were many low scores (i.e., 0), which is usual for sickness absence duration (de Jonge, Reuvers, Houtman, Bongers, & Kompier, 2000). To normalize the data-distribution as much as possible, the scores on sickness absence duration were subjected to a square-root transformation (Tabachnik & Fidell, 1989). After transformation the data were approximately normally distributed (i.e., skewness = 1.51 and 1.60 in Study 1 and Study 2, respectively).

In addition, the means, standard deviations, alpha coefficients, and Pearson correlations for both Study 1 and Study 2 are presented in Table 4.1. Independent *t*-tests showed that the means of the self-reported well-being variables (i.e., job satisfaction, exhaustion, and psychosomatic health complaints) did not differ between studies. On the other hand, registered sickness absence was higher in Study 1 than in Study 2 ($p < .01$). Table 4.1 shows the correlations between the job characteristics and the outcome variables both for Study 1 (lower left corner) and Study 2 (upper right corner). Apart from the nonsignificant correlations between demands and sickness absence frequency (both studies), and between demands and sickness absence duration (Study 1), the correlations were all in the expected directions. That is, demands and effort were positively associated with all outcome variables, whereas decision latitude and reward showed an inverse relationship with the outcome variables. Note that the reverse is true for job satisfaction, the only favorable outcome. Demands and effort were, as expected, highly correlated (.58 in Study 1 and .52 in Study 2), which indicates that the constructs partly overlap.

Table 4.1 Means, Standard Deviations, and Pearson Correlations for Study 1 (n = 405) in lower left corner, and for Study 2 (n = 471) in upper right corner

	M_1	SD_1	M_2	SD_2	1	2	3	4	5	6	7	8	9
1. Job demands	2.62	0.45	2.58	0.56		-.01	.52**	-.35**	-.24**	.34**	.25**	.07	.12*
2. Decision latitude	2.91	0.39	2.94	0.46	-.04		-.07	.07	.20**	-.10*	-.17**	-.03	-.03
3. Effort	2.03	0.59	1.93	0.66	.58**	-.02		-.53**	-.36**	.61**	.43**	.20**	.22**
4. Rewards	3.54	0.47	3.67	0.50	-.29**	.22**	-.42**		-.52**	-.48**	-.34**	-.14**	-.20**
5. Job satisfaction	3.87	0.91	3.87	0.94	-.14**	.32**	-.25**	-.48**		-.39**	-.31**	-.16**	-.16**
6. Exhaustion	1.45	1.01	1.53	1.19	.18**	-.14**	.38**	-.41**	-.36**		.65**	.23**	.23**
7. Psychosom. compl.	4.33	2.95	4.67	3.16	.11*	-.15**	.22**	-.26**	-.24**	.62**		.24**	.21**
8. SA – frequency	1.50	1.69	1.18	1.40	.07	-.13**	.22**	-.24**	-.10	.24**	.23**		.59**
9. SA – duration	3.56	4.52	2.77	3.42	.06	-.19**	.18**	-.26**	-.12*	.30**	.26**	.72**	

Note. M_1 = Mean for Study 1; SD_1 = standard deviation for Study 1; M_2 = Mean for Study 2; SD_2 = standard deviation for Study 2; Psychosom. compl. = psychosomatic complaints; SA = sickness absence
* $p < .05$ ** $p < .01$

4.3.2 Examining three different interaction terms: The multiplicative, relative excess, and ratio term

To test the effects of the different interaction terms (i.e., multiplicative, relative excess, and ratio), multiple hierarchical regression analyses assessed various health outcomes (i.e., job satisfaction, exhaustion, psychosomatic health complaints, sickness absence frequency, and sickness absence duration), separately for the DC

Model and the ERI Model[1]. To examine the interactions visually, three-dimensional plots were drawn. Except in the case of the ratio, the predictor variables were scale-centered prior to computation of the interaction terms, as suggested by Edwards (2002), to avoid multicollinearity (Cronbach, 1987). (That is, the scale midpoint – namely 2.5 – was subtracted, producing scores that could range from –1.5 to +1.5.) For all plots, X represents job demands (i.e., demands or effort), Y represents job resources (i.e., decision latitude or reward), and Z represents strain (i.e., job *dis*satisfaction, exhaustion, psychosomatic health complaints, or sickness absence).

The results of the multiple regression analyses examining the main and interactive effects of the job characteristics on self-reported health (i.e., job satisfaction, exhaustion, and psychosomatic health complaints) are displayed in Table 4.2. The first part of the table shows the results with respect to *job satisfaction*. Concerning the DC Model, Table 4.2 shows that all interaction terms (e.g., multiplicative interaction, relative excess interaction, and ratio) explained additional variance, over and above the main effects of demands and resources. In the case of the ERI Model, the multiplicative interaction and the ratio term explained additional variance in job satisfaction, whereas, the relative excess interaction did not.

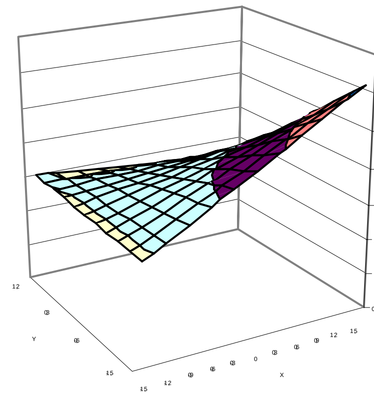


Figure 4.2 Interaction between demands and decision latitude for job satisfaction, using a multiplicative term

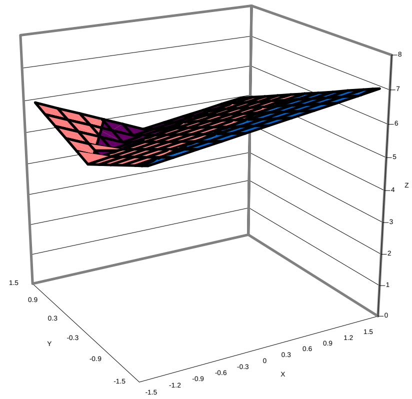


Figure 4.3 Interaction between demands and decision latitude for job satisfaction, using a relative excess term

With the exception of the ratio term for the ERI Model, all significant interaction terms for job satisfaction were drawn as three-dimensional plots (see Figures 4.2 to 4.5). Because the ERI Model's ratio term is not linear, a plot would not be an appropriate way to depict it. Figure 4.2 shows the *multiplicative* interaction between demands and decision latitude for the outcome job satisfaction. For employees with high demands and low decision latitude (i.e., high strain job), job satisfaction was lowest. Employees who reported low demands and low decision latitude reported the highest job satisfaction. Because the saddle-shaped pattern folds back to the same level of job satisfaction, employees in the high demands –

[1] Since associations between variables may be curvilinear (Warr, 1987), additional regression analyses were conducted including quadratic terms. The quadratic terms did not explain additional variance over and above the interaction terms, nor did they alter the results when quadratic terms were entered before the interaction terms.

high decision latitude condition also reported similarly high levels of job satisfaction. That is, even though employees experienced high job demands, a large amount of decision latitude seems to have prevented low job satisfaction. Finally, the employees in the low demands – high decision latitude condition experienced a moderate level of job satisfaction.

The *relative excess term* is shown in Figure 4.3. The figure is not completely in line with the example figure (see Figure 1e), which assumes that only employees whose demands exceed their decision latitude will experience strain (in this case: low job satisfaction). It can be seen from Figure 4.3 that employees in the high strain condition were indeed least satisfied with their jobs. However, employees in the low demands – high decision latitude condition were relatively dissatisfied as well. Employees experiencing both low demands and decision latitude were somewhat more satisfied, and employees experiencing both high demands and decision latitude were most satisfied.

The *ratio* term in Figure 4.4 shows, as expected, that employees with high demand and low decision latitude were least satisfied. For all other conditions, employees were about equally satisfied. Note the proportional form, indicating that in the case of low decision latitude, job satisfaction decreased sharply when demands increased, whereas differences in demands did not influence the level of satisfaction in the case of high decision latitude.

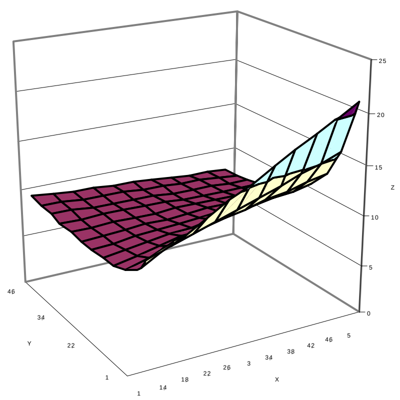


Figure 4.4 Interaction between demands and decision latitude for job satisfaction, using a ratio term

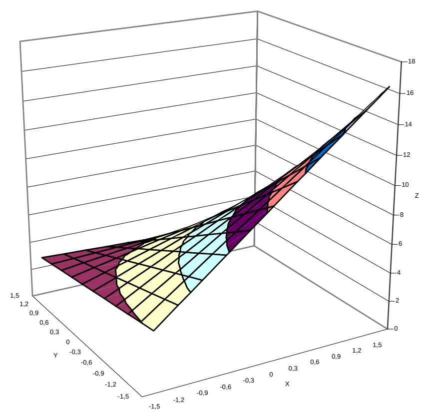


Figure 4.5 Interaction between efforts and reward for job satisfaction, using a multiplicative term

Finally, Figure 4.5 shows the *multiplicative* interaction between effort and rewards for the outcome job satisfaction, which shows a pattern similar to the multiplicative interaction for the DC Model (Figure 4.2). The most strain (i.e., the least job satisfaction) was reported by employees experiencing high effort and low rewards. Employees experiencing either both high effort and high rewards, or both low effort and low rewards, reported most job satisfaction, whereas employees experiencing low effort and high rewards were somewhat less satisfied with their job.

Table 4.2 Hierarchical multiple regression analyses of self-reported health (Study 1; n = 350 due to listwise deletion)

	Job satisfaction						Exhaustion						Psychosomatic health complaints					
	DC Model			ERI Model			DC Model			ERI Model			DC Model			ERI Model		
	MI	RE	R	MI	RE	RS	MI	RE	R	MI	RE	RS	MI	RE	R	MI	RE	RS
1. Gender	-.63**[a]	-.21**[b]	-.21**[b]	-.49**[a]	-.16**[b]	-.19**[b]	-.00[a]	-.00[b]	.00[b]	-.14[a]	-.04[b]	-.02[b]	-.57[a]	-.06[b]	-.06[b]	-.81[a]	-.08[b]	-.06[b]
Age	.00	.04	.04	.00	.03	.01	-.01	-.02	-.02	.00	.01	.02	-.01	-.04	-.04	-.01	-.02	.03
Education	-.08†	-.11†	-.11†	-.04	-.06	-.09†	-.01	-.02	-.02	-.02	-.02	-.04	-.28*	-.12*	-.12*	-.28*	-.12*	-.12*
Contract (full/part time)	.09	.04	.04	.30*	.14*	.14*	.05	.02	.02	-.16	-.07	-.08	-.22	-.03	-.03	-.57	-.08	-.10
2. Demands	-.25*	-.13*	-.13*	-.11	-.07	-.08	.39**	.17**	.17**	.50**	.28**	.26**	.64†	.10†	.10*	.85**	.17**	.15*
Resources	-.78**	-.44**	.34**	.85**	.46**	.45**	-.39*	-.15*	-.15*	-.61**	-.28**	-.30**	-.54	-.07	-.07	-1.12**	-.19**	-.17**
1. Gender	-.63**	-.21**	-.22**	-.53**	-.17**	-.18**	-.00	-.00	.01	-.16	-.04	-.02	-.58	-.06	-.05	-.81	-.08	-.06
Age	.00	.04	.03	.00	.02	.01	-.02	-.02	-.02	.00	.01	.02	-.01	-.04	-.04	-.01	-.02	.03
Education	-.08†	-.11*	-.09	-.04	-.06	-.09†	-.01	-.02	-.03	-.02	-.03	-.04	-.28*	-.12	-.13*	-.28*	-.12*	-.12*
Contract (full/part time)	.10	.05	.06	.31**	.14**	.14*	.04	.02	.01	-.16	-.06	-.08	-.24	-.03	-.04	-.57	-.08	-.10
2. Demands	-.27**	.18	.54*	-.12	-.07	-.13*	.42**	-.01	-.43†	.49**	.28**	.26**	.73*	.11	-.31	.85**	.17**	.15*
Resources	.77**	.06	-.20	.91**	.48**	.53**	-.38*	.01	.34†	-.58**	-.27**	-.29**	-.49	-.08	.26	-1.13**	-.20**	-.18*
3. Interaction (MI/R/Ratio)	.42†	-.44†	.90**	-.25†	.04	.15*	-.65*	.25	.81*	-.12	.03	.01	-1.86*	-.01	.55†	.02	-.02	-.03
R^2 (Step 3)	.168	.169	.183	.279	.273	.303	.069	.057	.072	.223	.223	.223	.062	.047	.055	.118	.119	.100
Incr. F-test	3.24†	3.60†	9.40**	3.38†	0.61	5.00*	5.25*	1.02	6.61*	0.57	0.34	0.03	5.37*	0.00	3.02†	0.00	0.15	0.10
Incr. R^2	.008	.009	.022	.007	.001	.013	.014	.003	.018	.001	.001	.000	.015	.000	.008	.000	.000	.000

Note. For DC Model: Demands = job demands, and Resources = decision latitude. For ERI Model: Demands = effort, and Resources = rewards. MI = multiplicative interaction; RE = relative excess term; R = ratio; RS = Ratio Siegrist

[a] unstandardized regression coefficients (*B*) [b] standardized regression coefficients (*beta*)

† $p < .10$ * $p < .05$ ** $p < .01$

In short, with the exception of the relative excess term for the ERI Model, all demand-resource interactions were significant in analyses of job satisfaction. As was mentioned in Section 4.2.1, a multiplicative interaction term and a ratio term imply that the relationship between job demands and strain is moderated by job resources. In the case of the multiplicative term, the amount of both demands and resources determines whether strain is experienced; in the case of the ratio term, the amount of job resources mainly determines whether strain is experienced. The relative excess term, on the other hand, implies that strain is only experienced when demands exceed resources. Depicting the interactions in three-dimensional figures shows that the most strain (i.e., the least satisfaction) was experienced in the high demands – low resources condition, as would have been expected from the example figures displayed in Figure 1. Considering that the relative excess term was only found to be significant for the DC Model, and that its plot was not entirely as one would expect (i.e., with strain experienced only when demands exceed resources), the present results appear to offer more support for the multiplicative interaction term and the ratio term. This suggests that job resources play a moderating role in the relationship between job demands and job satisfaction.

The columns in the middle of Table 4.2 show the results for *exhaustion*. In the case of the DC Model, Table 4.3 shows that the multiplicative interaction term and the ratio term explained additional variance, over and above the main effects of demands and resources, whereas the relative excess interaction did not. In the case of the ERI Model, none of the interaction terms were significant, even though both effort and rewards showed significant main effects. That is, although both effort and rewards showed significant additive effects in the explanation of exhaustion, their interaction over and above these separate main effects was not significant.

Figure 4.6 shows the graphical representation of the *multiplicative* interaction between demands and decision latitude with regard to the outcome variable exhaustion. Employees perceiving high demands and low decision latitude reported the greatest exhaustion. Although employees perceiving low demands and low decision latitude experienced the lowest levels of exhaustion, the saddle-shaped pattern means that employees perceiving high demand and high decision latitude also experienced very little exhaustion. So, experiencing high decision latitude may prevent high demands from resulting in exhaustion (in line with the notion of a buffer effect). In addition, it should be noted that experiencing low demands and high decision latitude was associated with a moderate level of exhaustion.

Figure 4.7 shows a similar interaction for the *ratio* term. As can be seen, the forms of the multiplicative interaction (Figure 4.6) and the ratio (Figure 4.7) differ considerably. Employees experiencing high demands and low decision latitude reported feeling most exhausted. Relative to this high strain condition, exhaustion declined with decreasing demands *or* increasing decision latitude. It should be noted that increasing decision latitude may be more beneficial, as the effects of demands on strain are less severe in the case of high decision latitude. The least exhaustion was experienced in both the high demands – high decision latitude condition and the low demands – high decision latitude condition. In the low demands – low decision latitude condition, the amount of exhaustion was only slightly higher.

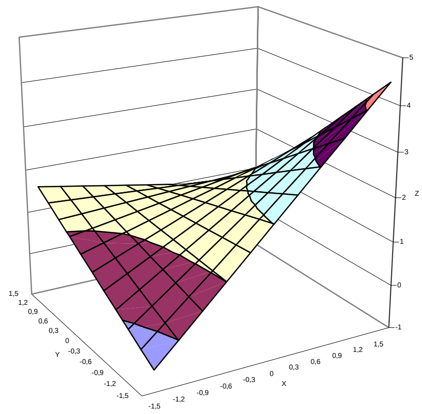


Figure 4.6 Interaction between demands and decision latitude for exhaustion, using a multiplicative term

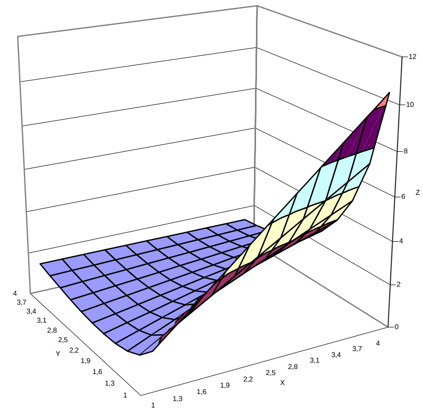


Figure 4.7 Interaction between demands and decision latitude for exhaustion, using a ratio term

To summarize, although both rewards and effort were related to exhaustion, there was no evidence that only the particular combination of (high) effort and (low) rewards was associated with exhaustion. Therefore, the interaction predicted by the ERI Model was not supported for the outcome variable exhaustion. In the case of the DC Model, both the multiplicative interaction term and the ratio term were significant, lending support to the idea that decision latitude moderates the relation between job demands and exhaustion.

The last columns of Table 4.2 show that the results for *psychosomatic health complaints* were similar to those for exhaustion. Again, the multiplicative interaction term and the ratio term were significant in analyses of the DC Model, whereas none of the interaction terms were significant in analyses of the ERI Model. In addition, the graphical representations of the multiplicative and ratio terms representing interaction between demands and decision latitude (Figure 4.8 and 4.9, respectively) show a pattern comparable to the findings for emotional exhaustion (Figures 4.6 and 4.7). However, the effects seem to be somewhat stronger in the case of psychosomatic health complaints. In other words, the ERI Model was not supported in analyses of psychosomatic health complaints, whereas the DC Model was supported in the case of the multiplicative interaction and ratio terms, suggesting a moderating effect of decision latitude in the relation between job demands and psychosomatic health complaints.

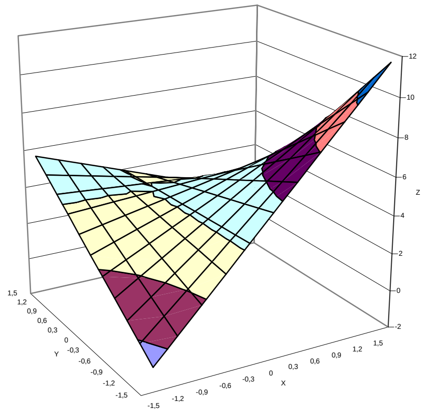


Figure 4.8 Interaction between demands and decision latitude for psychosomatic health complaints, using a multiplicative term

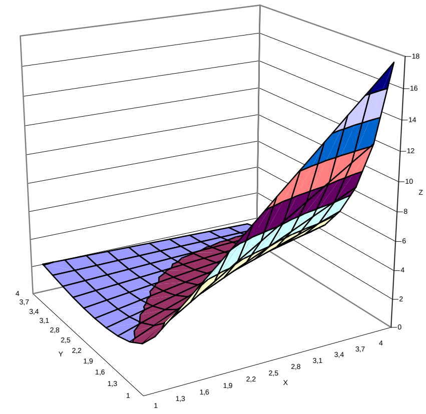


Figure 4.9 Interaction between demands and decision latitude for psychosomatic health complaints, using a ratio term

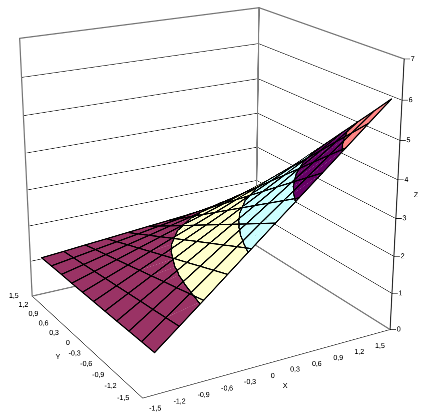


Figure 4.10 Interaction between effort and rewards for sickness absence frequency, using a multiplicative term

In contrast, results with regard to company-registered sickness absence only revealed significant interactions for the ERI Model (see Table 4.3). The interactions for the DC Model were not significant. For the *sickness absence frequency index*, only the multiplicative interaction explained significant additional variance over and above the main effects. This interaction is displayed in Figure 4.10, which shows that employees experiencing high effort and low rewards called in sick most often. In all other conditions (i.e., high effort – high rewards, low effort – high rewards, and low effort – low rewards), sickness absence frequency was low. Even though high effort shows an especially strong association with sickness absence (see steep rise in front on the X-axis, compared to the flat line to the left on the Y-axis), high effort can be compensated by high rewards as sickness absence frequency was about equally as low in this condition.

Table 4.3 Hierarchical multiple regression analyses of sickness absence (Study 1; n = 338 due to listwise deletion)

	Frequency index						Time-lost index					
	DC Model			ERI Model			DC Model			ERI Model		
	MI	RE	R	MI	RE	RS	MI	RE	R	MI	RE	RS
1. Gender	.20[a]	.03[b]	.03[b]	-.07[a]	.01[b]	.00[b]	-.45[a]	-.03[b]	-.03[b]	-.83[a]	-.05[b]	-.04[b]
Age	-.02*	-.14*	-.14*	-.03*	-.13*	-.10†	-.02	-.05	-.05	-.02	-.04	-.01
Education	-.18*	-.14*	-.14*	-.20**	-.15**	-.17**	-.23	-.06	-.06	-.31	-.09†	-.13*
Contract (full/part time)	.31	.07	.07	.10	.02	.05	.27	.02	.02	-.32†	-.03	-.04
2. Demands	.31	.08	.08	.45**	.15**	.14*	.70	.07	.07	.66	.09	.08
Resources	-.54*	-.12*	-.12*	-.56**	-.16**	-.15*	-2.36**	-.20**	-.20**	-2.27**	-.24**	-.25**
1. Gender	.19[a]	.03[b]	.03[b]	-.02[a]	.01[b]	.00[b]	-.45[a]	-.03[b]	-.03[b]	-1.10[a]	-.06[b]	-.04[b]
Age	-.02*	-.14*	-.14*	-.03*	-.13*	-.10†	-.02	-.05	-.05	-.02	-.04	-.01
Education	-.18*	-.14*	-.13*	-.20**	-.15**	-.17**	-.23	-.06	-.07	-.31	-.09*	-.13*
Contract (full/part time)	.30	.08	.08	.11	.03	.05	.25	.03	.02	-.33	-.03	-.04
2. Demands	.34	.19	.19	.44**	.15**	.15*	.75	.12	.00	.65	.09	.07
Resources	-.53*	-.22	-.22	-.45*	-.13*	-.15*	-2.33**	-.25	-.15	-1.91**	-.20**	-.23**
3. Interaction (MI/R/Ratio)	-.45	-.16	-.15	-.53†	.07	-.01	-.71	-.07	.09	-1.63*	.10†	.05
R^2 (Step 3)	.066	.064	.064	.117	.113	.104	.063	.062	.062	.110	.106	.111
Incr. F-test (Step 2 vs. 3)	0.92	0.35	0.24	3.19†	157	0.00	0.33	0.08	0.09	4.32*	2.82†	0.41
Incr. R^2 (Step 2 vs. 3)	.003	.001	.001	.009	.004	.000	.001	.000	.000	.012	.008	.001

Note. For DC Model: Demands = job demands, and Resources = decision latitude. For ERI Model: Demands = effort, and Resources = rewards.
MI = multiplicative interaction; RE = relative excess term; R = ratio; RS = Ratio Siegrist

[a] unstandardized regression coefficients (*B*) [b] standardized regression coefficients (*beta*)

† $p < .10$ * $p < .05$ ** $p < .01$

In analyses of the *sickness absence time-lost index* (i.e., duration), both the multiplicative interaction term and the relative excess interaction term were significant. Figure 4.11 depicts the multiplicative interaction between effort and rewards. In a high effort – low rewards work situation, employees stayed home ill for much longer periods than in any of the other conditions. Remarkably, employees with low effort and low rewards stayed home a little bit longer than employees with high rewards (regardless of the amount of effort). Therefore, rewards seem to be most important in promoting earlier return-to-work after an illness.

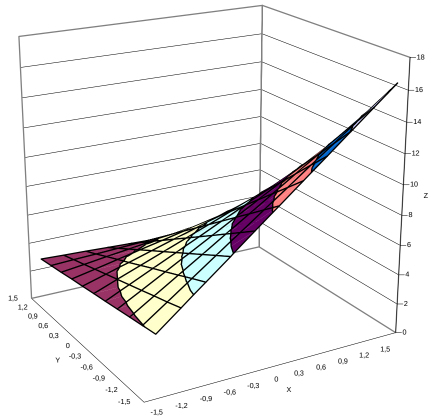


Figure 4.11 Interaction between effort and rewards for sickness absence duration, using a multiplicative term

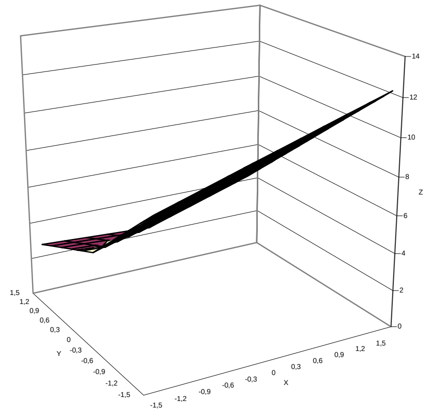


Figure 4.12 Interaction between effort and and rewards for sickness absence duration, using a multiplicative term

Figure 4.12 shows the relative excess interaction for the same variables. Again, employees experiencing high effort and low rewards had the longest sick leave. On the other hand, employees in the opposite condition (low effort and high rewards) stayed home ill for the shortest periods of time. This plateau of relative excess was very small, indicating greater sickness absence duration for both high(er) effort and low(er) rewards. For employees in the high effort – high rewards condition, sickness absence duration was only little bit higher. In sum, sickness absence duration could be reduced by increasing rewards, but to reduce sickness absence duration even further, job effort should be reduced as well.

Summarizing the results with regard to sickness absence, the effort-reward interaction was associated with sickness absence, whereas the demand-decision latitude interaction seemed to be less important. As such, the interaction corresponding to the ERI Model was supported, while that corresponding to the DC Model received no support. For sickness absence frequency, only the multiplicative interaction between effort and rewards was significant. Firstly, this implies that the choice of an interaction term can influence whether significant interaction effects are observed. Secondly (and more importantly), this implies that rewards moderate the relation between effort and sickness absence frequency, as the amounts of both effort and rewards seem to be important. In the case of sickness absence duration, the multiplicative interaction and the relative excess term were significant. The multiplicative interaction term implies a moderating effect of rewards on the effort-absence relation, such that increases in rewards might be sufficient to reduce sickness duration. On the other hand, the relative excess term implies that two conditions are needed – both low effort and high rewards – to promote an early return to work.

All in all, this empirical test showed that the multiplicative interaction term yielded consistent results for both models. Namely, when significant interaction term(s) were observed, one of these terms was the multiplicative interaction. In the case of the DC Model, the ratio term yielded consistent results as well. More concretely, these results support the idea that resources seem to moderate the relation between demands and strain. The amount of resources is especially important (as demonstrated by the ratio term), but the amount of demands may be important as well for retaining a balance between demands and resources (as demonstrated by the multiplicative term). In addition, demand-decision latitude interactions suggested by the DC Model were associated with job satisfaction, exhaustion, and psychosomatic health complaints, but not with either of the sickness absence indices (time-lost or frequency). Effort-reward interactions suggested by the ERI Model, on the other hand, were associated with job satisfaction and sickness absence, but not with exhaustion and psychosomatic health complaints.

4.3.3 Cross-validation of results in a second independent sample

Analytical strategy

The results presented so far in this chapter were cross-validated in a second, comparable sample (labeled Study 2). First, the coefficients obtained in Study 1 were used to predict the criterion variables in Study 2. In this way, cross-validated squared multiple correlations could be estimated. Calculating the difference between the original sample's explained variance (R^2 in Study 1) and the estimated explained variance in the second sample (R^2 in Study 2) yields a "shrinkage value" (Kleinbaum et al., 1988). As was mentioned in Chapter 3, a shrinkage value of less than .100 indicates that the model is reliable.

Since the explained variance does not provide a complete picture of the results of a cross-validation, patterns in the regression coefficients were further examined in multi-sample analyses. The data from both studies were collapsed into one database, and between-study differences in regression coefficients were evaluated. That is, first the main job characteristics (i.e., one job demand and one job resource) and a corresponding interaction term (a relative excess, multiplicative interaction, or ratio term) were entered. Next, a dummy variable ("study") was entered indicating whether the results were from Study 1 (1) or Study 2 (0). When this variable is *not* significant, this means that the regression lines do not differ between the two studies; in this case the analysis was not continued. However, when the variable "study" was significant, three interaction terms were entered in an additional analytical step: (1) demands x study, (2) resources x study, and (3) demand-resource interaction x study[1]. If none of these interaction terms were

[1] Note that interaction terms (1) or (2) are sometimes very similar to interaction term (3), leading to a high tolerance, which may form grounds for excluding the interaction from the analyses.

significant, this indicated that even though the regression lines differed between studies, the slopes did not differ (i.e., the lines had the same direction). However, when a significant interaction was found, this meant that the results of the two studies differed in terms of both regression lines and slopes. For instance, if the interaction “demands x study” was significant, this would mean that the studies differed with regard to their regression coefficients for demands.

Differences in R-squares in the two samples

Table A4.4, included in the Appendix, shows the results of the shrinkage analyses for the DC Model and the ERI Model. With the exception of the ratio term for job satisfaction (with a shrinkage value of .110), all results for the DC Model were validated in Study 2 (i.e., shrinkage values were less than .100). For the ERI Model the results were somewhat less favorable. Specifically, the results with regard to exhaustion were not replicated in Study 2 within the range of allowable shrinkage value (with shrinkage values ranging from .129 to .148). The same was true for psychosomatic health complaints: shrinkage values were just over .100 for all interaction terms (i.e., from .104 to .108). Therefore, the ERI Model appeared to be less valid across samples than the DC Model, at least in the case of the outcome variables exhaustion and psychosomatic health complaints. But in general, the remaining results of Study 1 were successfully cross-validated in Study 2.

Comparing patterns of regression coefficients in the two samples

The results of the multi-sample analyses are displayed in Tables A4.5 and A4.6 (see Appendix) for self-reported health and company-registered sickness absence, respectively. For the DC Model, Table A4.5 shows that the variable “study” was not significant in the analyses of job satisfaction and exhaustion, indicating that the regression lines did not differ across studies. In the analyses of psychosomatic health complaints, the regression lines did differ, but in general the signs of the regression lines showed no differences between studies (although the regression coefficient for the multiplicative interaction term showed a statistical trend, $p < .10$). Note that the demands x study interaction was excluded from the analyses due to a high tolerance level. For the ERI Model, the regression lines for the multiplicative interaction term did not differ between Study 1 and Study 2 in analyses of job satisfaction and exhaustion. In the case of job satisfaction, the remaining results showed the two studies to be largely similar, except for a statistical trend observed for the ratio interaction term ($p < .10$). That is, even though the regression lines differed between studies, generally speaking their signs did not differ. In analyses of exhaustion and psychosomatic health complaints, mainly the coefficient for effort was found to differ between studies.

Table A4.6 shows the multi-sample analyses for sickness absence. For this outcome variable, all regression lines differed between Study 1 and Study 2. For the DC Model, the analysis including a multiplicative term for the time-lost index showed that the direction of regression lines did not differ between studies. However, in the case of the relative excess term and the ratio term, differences between studies are suggested by the differing coefficients for decision latitude (resources) and the interaction. Analyses of the frequency index indicated that it was mainly the regression coefficients for the demand-control interaction that differed between studies. For the ERI Model, three regression coefficients differed between studies given a .10 significance level: in the case of the time-lost index, the interaction coefficient for the multiplicative term and the rewards coefficient for the ratio term; and in the case of the frequency index, the rewards coefficient for the multiplicative term). Overall, however, the signs of most regression lines did not differ across studies. So, the pattern for the ERI Model was similar across studies in analyses of sickness absence.

To summarize, the cross-validation analyses for the DC Model showed that the regression coefficients were generally similar over Study 1 and Study 2 in analyses of job satisfaction, exhaustion, and psychosomatic health complaints. In analyses of both sickness absence indices, the coefficients for decision latitude (time-lost index) and the demand-control interaction differed. For the ERI Model, the regression coefficients generally did not differ between Study 1 and Study 2 in analyses of job satisfaction and sickness absence (both indices), whereas analyses of exhaustion and psychosomatic health complaints showed differences between studies mainly with respect to effort (demands). Hence, both models seem to be valid across samples in the case of the outcome variable job satisfaction. The DC Model seems to be more valid for exhaustion and psychosomatic health complaints, whereas the ERI Model seems to be more valid for sickness absence (both the time-lost and the frequency index). Perhaps, decision latitude and rewards have a different impact on different types of outcomes, which could be a reason for the divergent associations found in the present study.

4.4 Summary

Balance models such as the DC Model and the ERI Model are characterized by the assumption that an imbalance between high job demands and low job resources leads to strain. Moreover, (high amounts of) job resources may moderate the relation between job demands and strain, preventing negative effects of high demands on employee well-being. As such, an interaction between job demands and job resources is the main thrust of these models. Although both models have been empirically supported in the literature, evidence with respect to this moderating effect or interaction is not consistent. One reason for the mixed empirical evidence may the statistical operationalization of the *relationship* between demands and resources (i.e., the mathematical formulation of the interaction term).

The present chapter addressed the mathematical formulation of interaction terms as used in tests of the DC Model and the ERI Model. According to Edwards and Cooper (1990), three basically different interaction terms exist: discrepancy, multiplicative, and ratio terms. Displaying these terms graphically shows that they have different forms, and therefore different meanings. The discrepancy term is essentially an additive form. Each variable, job demands and job resources, has a linear relationship with strain. The multiplicative interaction term is similar to a moderator effect. Job resources can moderate the relation between high job demands and strain. The amounts of both job demands and job resources are important in the prediction of strain. The ratio term emphasizes the role of job resources. If job resources are high, strain will not be very high (independent of the amount of job demands). However, in case of low job resources, strain will increase sharply if job demands increase. In the case of the DC Model, the relationship between job demands and decision latitude was originally operationalized as a relative excess term (a derivative of the discrepancy term). This means that strain is only expected when job demands exceed job resources. For all other conditions no strain is expected. Contrary to this suggestion, DC studies have used many different interaction terms. The multiplicative and ratio terms have been used most often to test the model. In the case of the ERI Model, there appears to be no theoretical preference for one particular interaction term, but most studies have operationalized the interaction between effort and reward with a ratio term. Three (fundamentally different) interactions terms that have been used within the DC Model and the ERI Model to operationalize the relation between job demands and job resources as predictors of employee outcomes are the relative excess term, the multiplicative interaction term, and the ratio term.

To illustrate the impact of different statistical operationalizations of the interaction term (i.e., different relations between demands and resources) in analyses of employee well-being, an empirical test was offered incorporating three important interaction terms corresponding to the DC Model and the ERI Model. This empirical test showed that for both models, the multiplicative interaction term yielded consistent results. Namely, when significant interaction term(s) were observed, one of these terms was the multiplicative interaction. In the case of the DC Model, the ratio term yielded consistent results as well. With respect to the outcome variables, interaction terms corresponding to the DC Model were associated with all self-reported health outcomes (i.e., job satisfaction, exhaustion, and psychosomatic health complaints), but not with sickness absence (time-lost and frequency indices). Interaction terms corresponding to the ERI Model, on the other hand, were associated with job satisfaction and sickness absence, but not with exhaustion and psychosomatic health complaints.

Cross-validation analyses showed that most results of Study 1 could be replicated in Study 2 within the allowed shrinkage value (based on explained variance), and that patterns in the regression coefficients did not differ dramatically. For the DC Model, a few regression coefficients differed between Study 1 and Study 2 in the analyses of sickness absence, showing differences mainly with respect to decision latitude and the interaction. For the ERI Model, the results for exhaustion and psychosomatic health complaints differed, which may be especially attributable to differing regression coefficients for effort. Note that the conditions in which results were less valid across samples are exactly the same conditions in which no interactions were found. This may indicate that the amount of effort experienced in relation to exhaustion and psychosomatic health complaints is sample specific, and that testing these associations in other samples may still be worthwhile.

In conclusion, the present chapter showed, based on analyses of different mathematical operationalizations of the relation between demands and resources, that the form and meaning of these different interaction terms truly differ. The empirical test showed that the multiplicative interaction term was the most consistent interaction term across models (DC and ERI Model) and across outcome variables. Apart from its implication that the combination of high demands and low resources is most detrimental to employee well-being (as suggested by all of the interaction terms), the multiplicative term implies that *either* job resources can be increased (in order to buffer the negative effects of high job demands) *or* job demands can be decreased (so that such buffering effects are not necessary) to preserve employee well-being. In this respect a multiplicative term seems to reflect a balance model in the most literal way of speaking, as both having high demands and resources or having low demands and resources (i.e., balance) is good for employee well-being, whereas imbalance is not. However, it should be noted that these are conclusions based on an empirical test. Ideally, both the DC Model and the ERI Model should be operationalized with the interaction term that best matches the theory. Although the inventors of both models would be the most obvious persons to make this decision, we will discuss these theoretical issues surrounding the models and their interactions in the final chapter.

This chapter has provided an overview of different interaction terms, including an empirical test. That is, the statistical operationalization or mathematical formulation of the interaction term itself was examined. However, as was stated earlier, results may also depend on the operationalization of the constructs themselves. For instance, either general or specific scales may be used to operationalize job demands, effort, decision latitude, and rewards. The next chapter will deal with this particular issue.

5

Two models at work:

Is there a need to be more specific?

Parts of chapter have been submitted as:

van Vegchel, N., de Jonge, J., Dormann, C., & Schaufeli, W. (2004). Karasek's Demand-Control Model: Testing specific demands and specific control. Manuscript submitted for publication.

van Vegchel, N., de Jonge, J., Dormann, C., & Schaufeli, W. (2005). Enhancing the Effort-Reward Imbalance Model by specifying its components: A longitudinal study among human service workers. Manuscript submitted for publication.

In Chapter 2, it was argued that both the DC Model and the ERI Model can be regarded as balance models. One of the most important features of these balance models is the assumption that negative effects of (high) job demands can be counterbalanced by the availability of job resources. To model such counter-balancing effects, interactions between job demands and job resources are frequently used. Therefore, the interaction between demands and resources in relation to employee health can be viewed as the core mechanism in both models.

Although an impressive number of empirical studies including the DC Model and/or the ERI Model have been conducted over the past decades, only a few studies have yielded support for the core assumption that it is particularly the *interaction* of job demands and job resources that contributes to an elevated risk of strain (e.g., Fox, Dwyer, & Ganster, 1993; van der Doef & Maes, 1999, for an overview). It has been argued that the mixed evidence for a demands-resources interaction may be attributable to the way the interaction is operationalized (e.g., de Jonge & Dormann, 2003; van der Doef & Maes, 1999; Wall, Jackson, Mullarkey, & Parker, 1996). In the previous chapter, the mathematical formulation of the interaction between job demands and job resources was investigated in relation to employee well-being.

This chapter deals with the operationalization of the two components (i.e., job demands and job resources) that constitute the interaction term. More specifically, this chapter addresses the question: "Is there a need to be more specific?" That is, would replacing the generally formulated demands and resources, as specified in the DC Model and the ERI Model, with more specifically formulated demands yield more positive and consistent results regarding their interaction? First, the notion of specificity as such is discussed (Section 5.1). Next, the nature of the constructs of job demands, job control and occupational rewards, as used in both models, is elucidated. More specifically, the conceptualization of job demands (DC Model) and effort (ERI Model) is discussed in Section 5.1.1, followed by job control (DC Model) in Section 5.1.2. and occupational rewards (ERI Model) in Section 5.1.3. The chapter closes with a summary, including an answer to its key question (Section 5.2).

5.1 The notion of specificity

The notion of specificity refers to whether a measure assesses a specific aspect or combines a number of aspects into an undifferentiated general index (Cohen & Wills, 1985). Accordingly, in the present thesis a "specific measure" refers to a measure that assesses a single specific aspect; on the other hand, a "general measure" denotes a measure that combines a number of different aspects in one measurement scale. Both the DC Model and the ERI Model use very broad operationalizations of job demands and job resources (e.g., de Jonge & Dormann, 2003; Terry & Jimmieson, 1999; van Vegchel, de Jonge, Bosma, & Schaufeli, 2005). That is, different aspects of demands or resources are amalgamated into one concept, and consequently included in a single measurement scale. Hence, as formulated in the DC and ERI Models, job demands and job resources are general rather than specific measures. This is most obvious in the case of the scales measuring resources. The DC Model assumes that the most important resource for counteracting job demands is decision latitude, which is composed of two subscales: skill discretion and decision authority. Although skill discretion and decision authority are theoretically distinguishable, empirical research usually employs the general concept of decision latitude (e.g., Ganster & Fusilier, 1989; Schreurs & Taris, 1998). In a similar vein, the ERI Model distinguishes salary, esteem, and job security as types of job resources, yet combines these specific constructs in a single general reward construct.

The use of global, nonspecific scales encompassing different constructs, instead of specific measures, has been mentioned as a possible reason for the inconsistent results regarding demands-resources interactions (e.g., de Jonge & Dormann, 2003; Terry & Jimmieson, 1999; Wall et al., 1996). This is not to say that the use of general measures is wrong or should be avoided. In some types of research, in particular large-scale epidemiological studies, general measures may offer a sensible way to represent broad categories and to assess average effects. However, such an epidemiological approach obscures the differential impact of specific components (Cutrona & Russell, 1990), which may be especially important in detecting buffer or moderator effects of job resources on job demands (i.e., demand-resource interactions) in the prediction of employee well-being in specific situations (such as human service work). Analogous to the social support literature, it is reasonable to assume that a broad or generic conceptualization of job resources may not moderate any given demand-strain relationship. Rather, a close conceptual fit between demands and a moderator may be needed to detect a demand-resource interaction (Frone, Russell, & Cooper, 1995, p. 145). To put it differently: specific demands elicit particular salient coping requirements, meaning that buffering effects may only be observed when the resource measure matches the stressors faced by employees (cf. stress-matching hypothesis by Cohen & Wills, 1985). Hence, assessing a single, undifferentiated and nonspecific construct (e.g., job control or occupational rewards), without assessing its specific components, could mask the capacity of specific resources (e.g., skill discretion or esteem) to buffer negative effects of demands (e.g., Sargent & Terry, 1998; Terry & Jimmieson, 1999). In statistical terms this makes sense as well, because the presence of relatively independent subscales may reduce the internal consistency of a composite scale, and thus attenuates its predictive value (Terry & Jimmieson, 1999).

The assumption that only particular job resources may have the capacity to reduce negative effects of particular demands implies that both resources and demands should be measured on a specific level. That is, certain demands may require certain resources to protect employee well-being. Assessing demands and resources on a specific level might be a first step towards identifying what kinds of job resources should ideally be available to counterbalance specific demands. In this respect, Cutrona and Russell (1990) speak of an "optimal match" of demands and resources. They admit that it is still an unanswered question whether certain specific resources are most beneficial in combination with specific kinds of demands, but at the same time they argue that it would be practically as well as theoretically valuable to identify such optimal demand-resource combinations. Practically, better resource-based interventions could be designed to counter specific demands, whereas from a theoretical point of view the discovery of optimal demand-resource combinations could shed new light on how specific demands threaten employee well-being, as well as how particular resources protect or enhance well-being.

Some preliminary evidence suggests that combining specific demands with specific resources could yield better evidence of demand-resource interactions. With respect to the DC Model, Cooper et al. (2001) concluded: "Evidence to date shows some support for the Karasek model, particularly when salient job demands and areas of control are clearly defined and are matched with each other" (p. 140). Two studies illustrate this point. Firstly, Wall et al., (1996) observed a significant interaction effect between demands and a specific measure of control, but an equivalent effect was not found for the interaction between demands and nonspecific decision latitude. Secondly, Sargent and Terry (1998) found some support for their hypothesis that the extent to which job control buffers the effects of job demands depends on the match between the specific demands and the type of buffer. In a similar vein, a review by Van der Doef and Maes (1999) showed that studies showing DC interactions were more likely to measure a specific demand (e.g., time pressure) combined with a specific aspect of control (such as decision authority over pace and method), achieving a closer match in the conceptualization of demands and control (e.g., Kivimäki & Lindström, 1995; Kushnir & Melamed, 1991; Wall et al., 1996). On the other hand, studies that did not demonstrate a moderating effect of job control (i.e., an interaction) often used a broader conceptualization of demands or control (e.g., decision latitude). Hence, it appears that support for the DC Model (i.e., an interaction between demands and control) is more likely to be found when specific rather than general conceptualizations of demands and control are used.

Common sense would lead us to believe that specificity problems play a similar role regarding the constituent elements of the ERI model. That is, stress-buffering effects of rewards may be more pronounced when effort and rewards are operationalized with specific rather than nonspecific measures. Since the ERI-model has hardly been tested using multiplicative interaction terms (see Chapter 4), little is known about the stress-buffering effects of occupational rewards. Two recent reviews of studies using the ERI-model have concluded that this model may also benefit from a more specific operationalization of its constituent constructs. More specifically, Tsutsumi and Kawakami (2004, p. 2352) stated with respect to rewards that: "specific dimensions may work better than others for specific outcomes or for specific occupations". In a similar vein, Van Vegchel and associates (2005) have argued that both effort and rewards encompass several different dimensions, and that splitting up these dimensions might constitute a useful extension of the ERI Model (see also Section 2.2.2).

To recapitulate, specificity seems to be an important issue in successfully demonstrating moderating effects of job resources on the relationship between job demands and strains. It is likely that specific resources may have the potential to buffer negative effects in interaction with specific demands (e.g., Cohen & Wills, 1985; Sargent & Terry, 1998; Terry & Jimmieson, 1999). Use of only global indices for job demands and/or job resources, as in most research to date, may leave important demand-resource interactions undetected. The remaining sections of this chapter will demonstrate how job demands and job control (DC model), and effort and rewards (ERI-model), can be conceptualized from a more specific point of view.

5.1.1 Towards a more specific conceptualization of job demands

Broadly speaking, job demands refer to the degree to which the work environment contains stimuli that require effort (cf. Jones & Fletcher, 1996). In other words, job demands can be seen as the requirements that are placed on the employee by the job. Balance models such as the DC Model and the ERI Model assumed that job demands are not harmful in themselves. Depending on the level and type of job resources, job demands can be experienced as either positive (i.e., stimulating or challenging) or negative (i.e., stressful).

Before turning to a more specific conceptualization of job demands, first the term itself will be explained. We refer to job demands as "demands" as denoted in the DC Model, or as "effort" as denoted in the ERI Model. In the present study, it is acknowledged that perceived effort that is put into a job can be seen as a characteristic of the job (i.e., a job demand) and as a characteristic of the employee (i.e., his or her intrinsic effort). This is consistent with the ERI Model, which divides effort into an extrinsic (i.e., situational) and an intrinsic (i.e., personal) component (Siegrist, 1996). Initially, extrinsic effort referred to the obligations, requirements, and duties of the job, whereas intrinsic effort referred to a personality characteristic, also labeled overcommitment, which resembles the Type A behavioral pattern. However, further development of the model led to a more strict distinction between (extrinsic) effort and overcommitment as two independent concepts (for a more detailed description of the development of the ERI Model, see Section 2.2.2). Hence, nowadays the ERI Model regards effort as a job characteristic, similar to the concept of job demands. For this reason effort will be treated like job demands, and the terms effort and demands will be used interchangeably in the next sections.

Over the past decades, the nature of job demands has changed considerably as a consequence of the changing nature of work. There has been a shift from "hand to head", or from physical demands to mental demands (e.g., Howard, 1995). One can also note that there has been a similar shift from "hand to heart", or from physical demands to emotional demands (e.g., Dormann & Zapf, 2004). That is not to say that physical demands have disappeared, as they still remain important in certain professions. But the increased use of ICT as well as the increase in service jobs with direct client or customer contact has led to more mental (i.e., cognitive) and emotional demands. It is important to distinguish between these three types of job demands (i.e., physical, mental, and emotional) as they influence different aspects of human functioning (Hockey, 2000). Firstly, physical demands affect the musculo-skeletal system because of the execution of physical activities (for instance, carrying and lifting). Secondly, mental demands primarily involve information processing, such as memory and planning. And finally, emotional demands have an impact on emotions and are strongly related to interpersonal relationships (e.g., caring and concern for others). By distinguishing different, more specific demands, it is possible to identify which demands are important in which situations. For example, physical demands are more essential for construction workers (Janssen, Bakker, & de Jong, 2001), whereas emotional demands are more prevalent in human service work (de Jonge, Dollard, Dormann, Le Blanc, & Houtman, 2000; de Jonge, Mulder, & Nijhuis, 1999; Söderfeldt et al., 1997). Even though distinguishing different types of demands seems to be quite sensible, for practical reasons (e.g., parsimonious use of items) it is common to include only general demand measures in (epidemiological) research. However, by generalizing across occupations, one implicitly assumes that individuals will experience the same type of job demands irrespective of the work environment (e.g., Sparks & Cooper, 1999).

Especially in human service organizations, there are mental, physical, and emotional demands due to the nature of particular jobs (e.g., de Jonge, Mulder et al., 1999). For instance, nurses work under time pressure (mental demands), have to lift clients (physical demands), and have to handle unfriendly clients (emotional demands). As the DC Model only examines mental demands, the model appears to oversimplify demands in particular job categories such as human service work (cf. Söderfeldt et al., 1997). Moreover, various authors have argued that the demand measure in the Job Content Questionnaire (Karasek, 1985) does not specifically reflect mental demands, as it also includes other types of job characteristics such as job complexity and lack of control (e.g., de Jonge & Kompier, 1997; Ganster, 1995). As such, the scale seems to encompass more than the construct. For this reason it might be fruitful to amend the DC Model by creating a more specific mental demands measure, and by adding measures of emotional and physical demands. The first studies that operationalized the DC Model with different types of demands showed promising results. For instance, De Jonge and colleagues (2000; 1999) found significant interaction effects when different types of demands (e.g., mental, emotional, and physical demands) were incorporated into the DC Model. In a similar vein, Söderfeldt and associates (1997) as well as Van Vegchel and colleagues (2004) demonstrated the importance of including quantitative as well as emotional demands in the DC Model for explaining outcomes in human service workers.

The ERI Model uses one broad demand measure, encompassing mental demands and one *optional* item tapping physical demands (see Chapter 3). Although we applaud this approach as it recognizes the specific occupation under study, it is unfortunate that the physical demands item is simply added to the other mental demands items, making the demand construct even broader. Empirical studies comparing different types of job demands have shown that an ERI including mental demands accounted for elevated risks in the domains of exhaustion and psychosomatic symptoms, whereas an ERI with physical demands accounted for elevated risk of low job satisfaction (de Jonge, Bosma, Peter, & Siegrist, 2000; van Vegchel, de Jonge, Meijer, & Hamers, 2001). Moreover, in samples containing human service employees, elevated risks on all outcome variables were best accounted for by an ERI including emotional demands (de Jonge & Hamers, 2000; van Vegchel et al., 2001). Empirical evidence suggests that it is useful to distinguish between mental and physical demands (de Jonge, Bosma et al., 2000; van Vegchel et al., 2001), and that extending the model to include emotional demands may be

important in the case of particular occupational groups like human service employees (de Jonge & Hamers, 2000; van Vegchel et al., 2001).
In short, depending on the part of our human system that is influenced by a particular demand, job demands can be classified as mental, physical, or emotional demands (Hockey, 2000). However, both the DC Model and the ERI Model use a general demand measure, encompassing several aspects. If demand-resource interactions are to be detected, a certain amount of specificity may be required (e.g., Cohen & Wills, 1985; van der Doef & Maes, 1999). For instance, depending on the particular occupation under study, some types of job demands may be important, whereas other are not (cf. Terry & Jimmieson, 1999). Therefore, the present study includes the original demand/effort scales as a benchmark, comparing them with more refined demand constructs (i.e., mental, emotional, and physical demands).

5.1.2 Towards a more specific conceptualization of job control

Job control is essential for employee well-being (Sauter, 1989). The idea that job control affects health and productivity is closely linked to the role of control in human motivation. Almost a half a century ago, White (1959) suggested in his seminal article that humans have a basic intrinsic need to control their environment. In a similar vein, it has been argued that the motivation to strive for control results from the belief that control ensures positive outcomes (Rodin, Rennert, & Solomon, 1980), or at least minimizes the maximum danger (i.e., minimax hypothesis: Miller, 1979). Within this line of reasoning, control can be broadly defined as the ability to exert some influence over one's environment so that the environment becomes more rewarding or less threatening (Ganster, 1989, p. 3) (see Box 5.1 for definitions of job control concepts). Moreover, control can be regarded both as a characteristic of the environment and as a personal characteristic (Jones & Fletcher, 2003). Not surprisingly, in models of work stress – such as the DC model – control is usually treated as a characteristic of the work environment. The main hypothesis of the DC model, that job control moderates the potentially negative effects of high job demands, is consistent with the literature on control in two ways (e.g., Terry & Jimmieson, 1999; Wall et al., 1996). Firstly, control has been identified as a factor which mitigates the effects of a wide range of stressors such as a demanding job (e.g., Steptoe & Appels, 1989), analogous to the stress-buffering hypothesis (Cohen & Wills, 1985). And secondly, similar to Miller's (1979) minimax hypothesis, control is seen as a mechanism through which the potentially detrimental effects of increased demands can be avoided, because control enables the person to adjust demands to his or her current needs and circumstances (e.g., Karasek & Theorell, 1990; Terry & Jimmieson, 1999). Job decision latitude in the DC Model has been defined as "the working individual's potential control over his tasks and his conduct during the working day" (Karasek, 1979, p. 289-299). This definition mirrors the construct of job control as commonly used in the job redesign literature, as it is very similar to job autonomy (Ganster & Fusilier, 1989).

Although the theoretical literature on the DC Model equates job decision latitude with job control, the operationalization of decision latitude shows clear differences (e.g., Wall et al., 1996). The measure of decision latitude includes not only items referring to job control, but also items tapping skill level, variety, creativity, and learning new things (e.g., "My job requires me to be creative"; "My job requires a high level of skill"). So it seems that the decision latitude measure taps both job control and job complexity/skill utilization (e.g., Ganster & Fusilier, 1989). Karasek (1989) acknowledged this difference by stating that decision latitude is composed of two more specific, theoretically distinguishable concepts: decision authority and skill discretion (see Box 5.1 for definitions). Whereas decision authority directly influences the employee's sense of control, skill discretion is preceded by the acquisition, over the long term, of skills needed to influence the work process. Although from a broader perspective both decision authority and skill discretion give the employee the opportunity to influence their job (i.e., decision latitude), the two constructs represent different dimensions of control. So, having a say in what happens (i.e., authority) or having skills to influence the work environment are two different methods to control the work environment.

Box 5.1 Definitions of job control concepts

Job control: the ability to exert some influence over one's work environment so that the work environment becomes more rewarding or less threatening (cf. Ganster, 1989, p. 3).

Job autonomy: the employee's opportunities or freedom, inherent in the job, to determine a variety of task elements (de Jonge, 1995, p. 144).

Decision latitude: the working individual's potential control over his tasks and his conduct during the working day (Karasek, 1979, p. 289-299).

Decision authority: the employee's autonomy to make decisions on the job (Karasek, 1989, p. 137).

Skill discretion: the breath of skills used by the worker on the job (Karasek, 1989, p. 137; Wall et al., 1996).

Now that the conceptual meaning of decision latitude, skill discretion, and decision authority has been considered, relevant empirical data on their discriminant and convergent validity will be discussed. Several factor-analytic studies have indicated the importance of differentiating between decision authority and skill discretion. For instance, Smith and colleagues (1997) showed in multiple independent samples that decision latitude loaded on two separate factors, reflecting decision authority and skill discretion. In a similar vein, Schreurs and Taris (1998) demonstrated in two different Dutch samples that a correlated three-factor model (i.e., job demands, decision authority, and skill discretion) fitted the data better than a two-factor model (consisting of job demands and the composite measure of decision latitude, including both skill discretion and decision authority). The three-factor model was also found in Canadian population samples (see Karasek et al., 1998). In addition, today's practice shows that some occupations may have low decision authority but high skill discretion (e.g., symphony musicians), or vice versa (e.g., airport baggage carriers) (Theorell, 1989). This illustrates once more that it does not make sense – at least in these occupations – to collapse both aspects into one measure of decision latitude. Furthermore, studies that separately analyzed decision authority and skill discretion reported different and sometimes even opposite effects of decision authority versus skill discretion on outcome measures (e.g., de Jonge, Reuvers, Houtman, Bongers, & Kompier, 2000; Rafferty, Friend, & Landsbergis, 2001; Schreurs & Taris, 1998). For example, decision authority was negatively associated with psychosomatic health complaints and sickness absence, whereas skill discretion was positively associated with those outcomes (de Jonge, Reuvers et al., 2000). Taken together, empirical evidence supports the proposition that decision authority and skill discretion are related but *separate* concepts.

In summary, within the context of the DC Model, there are ample theoretical and empirical grounds to regard job control as a two-dimensional concept including decision authority as well as skill discretion (see also Terry & Jimmieson, 1999). Nevertheless, it is still common practice in stress research to study decision latitude as an overarching construct, without giving separate attention to decision authority and skill discretion. If stress-buffering effects of job control are to be detected in the relation between job demands and strain, it may be preferable to measure more specific job control constructs, such as decision authority and skill discretion (e.g., Terry & Jimmieson, 1999; Wall et al., 1996). The present study examines these two specific aspects of job control. Moreover, the composite scale decision latitude is also included as a benchmark (cf. Wall et al., 1996)

5.1.3 Towards a more specific conceptualization of occupational rewards

The basic tenet of the ERI Model is that employees should receive (an appropriate amount of) rewards in return for their efforts. According to the ERI Model, three types of rewards can be distinguished: salary, esteem, and job security/promotion prospects (cf. Siegrist et al., 2004). However, ERI theory does not distinguish between the specific rewards on a conceptual level. That is, although three specific rewards are mentioned, they are not further defined or considered separately. Nevertheless, these three types of rewards seem to represent conceptually different levels. For instance, according to Maslow's need hierarchy (1954), salary and job security can be considered as basic safety needs, whereas esteem can be considered as a higher-order social need. In line with the hierarchy, more basic needs have to be fulfilled before higher-order needs can be fulfilled (e.g., Kamalanabhan, Uma, & Vasanthi, 1999). More concretely, if employees are worried about their salary and/or job security, they are less likely to pay attention to the amount of esteem they receive. On the other hand, if these basic needs are satisfied, motivational or social aspects of the job might become more important (cf. van Vegchel, de Jonge, Bakker, & Schaufeli, 2002).

From a practical point of view, it also seems essential to distinguish between different kinds of rewards. Clearly, different rewards have different values and meanings both for employees and for organizations. Needless to say, a pat on the back will be experienced very differently from a raise in salary. Whereas esteem is an immaterial reward, salary and promotions do have financial consequences. Indirectly, job security may have financial consequences for the employee (e.g., the security of having a stable income) and for the employer (e.g., depending on the situation it may be financially attractive to have contracts of fixed/indefinite duration). Thus, different rewards may indeed have different meanings. Moreover, distinguishing between different types of rewards allows researchers to provide more concrete instructions for organizational interventions aimed at creating a more healthy work environment. For instance, if employees have to deal with death and dying, esteem might be an important resource for coping with feelings of guilt and grief, for letting the employee know that he/she did the best he/she could considering the situation, whereas a raise in salary or more job security would be less relevant resources.

Depending on the occupation under study, some types of rewards may be more or less salient than others. For instance, it may be argued that in the human service sector – the subject of our investigations – esteem is an especially important reward. Human service work requires great personal involvement, even though the monetary compensation and social recognition are relatively poor (Cutrona & Russell, 1990). This means that, by implication, recognition by supervisor and/or colleagues could act as the most important 'counterbalancing resource' for high (emotional) effort. Because financial budgets are low in today's health care systems, and salaries are restricted by rules in collective agreements, it may be very difficult to reward employees with a high salary. In addition, job security may be of less importance in this particular occupational group, because most employees in the human service sector are part-time and/or secondary earners in a dual-income household. In general, secondary earners are more concerned with intrinsic satisfaction than with extrinsic rewards at work, such as salary and prestige (e.g., Calnan, Wainwright, & Almond, 2000; Martin & Hanson, 1985). Therefore, for a secondary earner, job security and salary are probably not the main reasons to work in this sector. As such, salary and security can be considered as basic needs that are mostly fulfilled, and social needs (e.g., esteem) become more important.

Although the ERI Model distinguishes three different types of rewards, usually all three are combined to form one general reward indicator. As argued by Van Vegchel et al. (2002), the use of one general reward indicator implies that all rewards are equal, or at least equally distributed. It follows that a distinction can be made between the contribution of each of these three aspects, for instance concerning interactions with efforts. Collapsing all three aspects into one measure also rules out the possibility of studying joint or combined effects of combinations of different rewards (for instance, a low score on esteem may be compensated by a high score on job security).

Recently, the issue of distinguishing different rewards within the ERI Model seems to have become a point of consideration in stress research (i.e., reviews, empirical studies, psychometric analyses; (e.g., Siegrist et al., 2004; Tsutsumi & Kawakami, 2004). According to ERI theory (2004), rewards consists of three factors: financial rewards, esteem, and promotion prospects/job security. A few studies have tested the factor structure of occupational rewards, with somewhat different results. In a Dutch study, Hanson and colleagues (2000) tested the factor structure of rewards using confirmative factor analyses, and found a significantly better fit for a three-factor structure in comparison with a one-factor structure (i.e., a composite measure of rewards, including all previously mentioned aspects). In a Japanese validation study, principal component factor analysis suggested a two-factor structure distinguishing between job insecurity (and one item referring to promotion prospects), on the one hand, and esteem *and* salary, on the other

(Tsutsumi, Ishitake, Peter, Siegrist, & Matoba, 2001). Finally, Siegrist and colleagues (2004) found another factor structure, namely: (1) financial reward *as well as* promotion prospects, (2) esteem, and (3) job security. In summary, the results with regard to the underlying structure of rewards seem to be consistent for the esteem component, but inconsistent for salary and job security/promotion prospects. A possible explanation that "…in empirical terms, it is almost impossible to disentangle financial from career-related aspects." (Siegrist et al., 2004, p. 1487). Therefore, Siegrist suggested that this final factor structure (i.e., salary/promotion prospects, esteem and job security) would be best in empirical terms, and that this structure should be adopted in future empirical research.

Empirical studies testing for effort-reward imbalance separately in relation to specific rewards are rather scarce. Although some studies have included (post hoc) analyses with respect to the main effects of specific rewards (e.g., Hasselhorn, Tackenberg, Peter, & NEXT-StudyGroup, 2004; Niedhammer, Tek, Starke, & Siegrist, 2004), as far as we are aware, only two studies have tested an effort-reward imbalance including specific reward indicators: firstly, a study of 167 health care employees conducted by Van Vegchel and colleagues (2002), and secondly, a study of 316 employees of a bus company by Dragano and associates (2003). Both studies reported the strongest associations with employee health in the case of imbalance between effort and esteem. In addition, when the original ERI (including all rewards) was used, no effects were found for exhaustion, whereas an ERI with specific rewards showed significantly elevated risks (van Vegchel et al., 2002). One explanation offered by the authors was that use of one global reward indicator served to average the effects, leading to a loss of power. As a result, employees at risk were wrongly categorized, ending up in the high effort-high rewards category instead of the high effort-low rewards category. Moreover, a review of the ERI Model (van Vegchel et al., 2005) showed that support for the model was found in relation to musculoskeletal disorders when specific rewards were included in the analyses (Dragano et al., 2003), but not when a general reward construct was used (Joksimovic, Starke, von dem Knesebeck, & Siegrist, 2002). Both studies appear to suggest that effects of effort-reward imbalance are more likely to be observed when specific reward measures are used, resulting in an adequate match between effort and specific rewards. Therefore, investigating different rewards in the context of the ERI Model seems to offer a promising avenue for research.

To recapitulate, there are both theoretical and empirical grounds to view salary, esteem, and job security as separate dimensions of occupational rewards. Most studies, however, still use one global reward index without giving any attention to its separate components. By assessing a single construct, without assessing its specific components, researchers may have missed the opportunity to investigate whether some specific rewards have the potential to buffer negative effects, whereas others do not (cf. Terry & Jimmieson, 1999; Tsutsumi & Kawakami, 2004). Therefore, the present study tested both a general occupational rewards measure, and its separate components, salary (including promotion prospects), esteem, and job security. The specific reward components will be used to test whether different effects arise for specific rewards, and the general occupational rewards measure will be used as a benchmark to examine whether demands-resources interactions are more likely to occur when specific reward measures are used as opposed to a general reward measure.

5.2 Summary and conclusions

To date relatively few studies testing the DC Model and/or ERI Model support the notion that job resources moderate the relationship between job demands and employee well-being (i.e., a demand-resource interaction effect). One reason for the inconsistent results may be the operationalization of the interaction term itself. The primary focus of the present chapter was to consider this operationalization by specifying its constituent components: job demands and job resources. Referring to the interaction between demands and resources in the DC Model and the ERI Model, the question was raised: "Is there a need to be more specific?" This issue of specificity was already raised by Cohen and Wills in 1985, but nevertheless it has not been taken up by the DC Model and the ERI Model. An important assumption of the stress-matching hypothesis is that specific job demands elicit particular salient coping requirements on the part of the employee (Cohen & Wills, 1985). Therefore, it is likely that specific resources have the potential to buffer negative effects of specific demands (e.g., Cohen & Wills, 1985; Sargent & Terry, 1998; Terry & Jimmieson, 1999); that is, it may be that only particular combinations of specific demands and specific resources elicit an interaction effect. Such combinations have been called an "optimal match" of demands and resources (Cutrona & Russell, 1990). In other words, specificity may be needed to identify optimal matches between demands and resources.

In the DC Model and the ERI Model different job aspects (demands as well as resources) are lumped together in composite scales (e.g., de Jonge & Dormann, 2003). That is, both the DC Model and the ERI Model use a general demand measure and a general resource measure, encompassing several more specific aspects. Job demands can be classified as mental, physical, and emotional (Hockey, 2000). Moreover, depending on the particular occupation under study, some types of job demands may be more important than others (cf. Terry & Jimmieson, 1999). In a similar vein, specific job resources can be distinguished, such as the components of decision latitude in the DC model, namely skill discretion and decision authority (Karasek & Theorell, 1990), or the components of occupational rewards in the ERI model, namely salary, esteem, and job security (Siegrist, 1996). Both models use general constructs that should be further specified for an optimal operationalization of job demands and job resources.

In conclusion, both the DC Model and the ERI Model have used general measures to operationalize job demands and job resources. A certain amount of specificity may be needed to detect interaction effects, because more general measures may merge relatively independent aspects, obscuring their potentially significant effects. Moreover, the use of more specific measures may facilitate the discovery of optimal matches between demands and resources. Therefore, the answer to the question "Is there a need to be more specific?" in operationalizing job demands and job resources in the DC Model and the ERI Model can be affirmatively answered. To examine whether a more specific conceptualization of job demands and job resources leads to better detection of demands-resources interactions, the following "specificity hypothesis" was formulated (see also Chapter 2):

The likelihood of finding interactions between job demands and job resources in analyses of employee well-being outcomes is higher when more specific as compared with more general measures of job demands and job resources are used.

It should be noted that this hypothesis does not represent a deterministic law; rather, it proposes a probabilistic principle. This means that demands-resources interactions should not occur exclusively when specific measures are used. Rather, it is hypothesized that the effects should occur in general but should be more pronounced with specific measures of demands and resources than with general measures (cf. Frese, 1999).

The next two chapters will present empirical, longitudinal tests of the specificity hypothesis in relation to the DC Model and the ERI Model, respectively. That is, the DC Model and the ERI Model will be tested using specific measures as well as more general measures, in order to see whether demand-resource interactions are more likely to be observed in relation to employee well-being outcomes when specific measures are used.

6

Karasek's **D**emand-**C**ontrol **M**odel:

Testing specific demands and specific control

Parts of this chapter have been submitted as:

van Vegchel, N., de Jonge, J., Dormann, C., & Schaufeli, W. (2004). Karasek's Demand-Control Model: Testing specific demands and specific control. Manuscript submitted for publication.

6.1 Introduction

In the previous chapters, it was argued that besides the statistical operationalization of the interaction term (Chapter 4), the operationalization of the constructs job demands and job resources (Chapter 5) may influence the likelihood of successfully demonstrating interactions between job demands and job resources. More specifically, it was proposed that if demand-resource interactions are to be detected, a certain amount of specificity may be required, in view of the possibility that only *particular* aspects of job demands and *particular* aspects of job resources interact with each other (e.g., Cohen & Wills, 1985; de Jonge, Dollard, Dormann, Le Blanc, & Houtman, 2000). This was formulated as the specificity hypothesis:

> *The likelihood of finding interactions between job demands and job resources in analyses of employee well-being outcomes is higher when more specific as compared with more general measures of job demands and job resources are used.*

In the present chapter this specificity hypothesis will be tested in relation to the DC Model, one of the most well-known balance models. As discussed in Chapter 5, initial empirical studies testing the DC Model with more specific measures have shown promising results. In general, previous DC studies that did include a more specific operationalization focused *either* on job demands (e.g., Söderfeldt et al., 1997; van Vegchel, de Jonge, Söderfeldt, Dormann, & Schaufeli, 2004) *or* on decision latitude (e.g., Rafferty, Friend, & Landsbergis, 2001; Schreurs & Taris, 1998). The present study considers specific measures for demands and decision latitude *simultaneously*. By using specific measures for both demands and control it is possible to combine different aspects of demands with different aspects of control in demand-control interactions, and to explore if certain combinations represent optimal demand-resource combinations (cf. Cutrona & Russell, 1990). Furthermore, most earlier DC studies that included a specific measure used a cross-sectional design (e.g., de Jonge, Mulder, & Nijhuis, 1999; Rafferty et al., 2001). To gain more insight into possible time-lagged relationships, the present study used a two-wave panel design. Another point of consideration is that most previous studies with more specific measures did not include the original scale. Hence, it was not possible to investigate the concurrent validity of specific measures in comparison with the more general, original measures. A notable exception is a study by Wall et al. (1996), who included a more specific measure of job control as well as the original decision latitude scale. Following Wall et al. (1996), the original scales (i.e., JCQ demands and decision latitude) were included in our study as a benchmark for comparison with scales assessing specific demands (i.e., mental, emotional, and physical demands) and specific types of control (i.e., skill discretion and decision authority). In addition, to test whether the results are applicable only to the present study or can also be replicated in another, comparable sample, the results of Study 1 were cross-validated in a second independent sample (i.e., Study 2).

6.1.1 Specific demand-control hypotheses

In order to study the specificity hypothesis within the context of the DC Model, this hypothesis was further specified:

1) *The likelihood of finding interactions between job demands and job control in analyses of employee well-being outcomes (i.e., job satisfaction, exhaustion, psychosomatic health complaints, and sickness absence) is higher when more specific measures (i.e., mental, emotional, and physical demands; skill discretion and decision authority) as compared with more general measures of job demands and job control (i.e., JCQ demands and decision latitude) are used.*

Moreover, in line with the DC Model it was predicted that the interactions would show the following pattern:

2) *A condition combining high job demands and low job control (Time 1) will lead to the most adverse well-being effects (Time 2) in comparison with high demands – high control, low demands – low control, low demands – high control conditions (cf. strain hypothesis of the DC Model).*

As studies testing specific demands and specific control measures are scarce, it is unclear which specific combinations of demands and control offer an optimal match (cf. Cutrona & Russell, 1990). Therefore, the present research is partly exploratory in that it will investigate which specific demand-control combinations have the largest impact on employee well-being over time.
In the following sections, the empirical outcomes will be presented.

6.2 Different types of job demands and job control in the prediction of employee well-being over time

6.2.1 Preliminary analyses

Prior to testing the hypotheses, the raw data were screened. Preliminary examination revealed that the distribution of the time-lost sickness absence index was positively skewed (i.e., skewness = 3.23 and 2.93 at Time 1 and Time 2, respectively). This means there were many low scores (viz., 0), which is common in the measurement of sickness absence duration (Allegro & Veerman, 1998). To normalize the frequency distribution as much as possible, a square-root transformation was applied to the time-lost index scores (Tabachnik & Fidell, 1989). After this transformation the data were approximately normally distributed (i.e., skewness = 1.65 and 1.34 at Time 1 and Time 2, respectively). In addition, the means, standard deviations, test-retest reliabilities, and Pearson correlations were calculated (see Table 6.1). As can be seen in Table 6.1, displayed at the end of this chapter, the test-retest reliabilities ranged from .15 to .77 in Study 1. Table 6.1 also shows that the different measures of demands (i.e., JCQ, mental, emotional, and physical demands) were moderately correlated, as were the different measures of job control (i.e., decision latitude, skill discretion, and decision authority). In all cases, the measures were correlated at lower levels than their respective scale reliabilities (see Chapter 3, Table 3.12). According to Sargent and Terry (1998) this suggests that empirically distinct, yet related constructs are being assessed.

Although all Pearson correlations between Time 1 job characteristics and Time 2 well-being outcomes were in the expected direction, they were not all significant. For instance, Time 1 JCQ demands were not significantly associated with Time 2 psychosomatic health complaints.

A similar table, displaying the means, standard deviations, test-retest reliabilities, and Pearson correlations for Study 2 can be found in the Appendix 6, Table A6.1. Independent samples *t*-tests and Mann-Whitney *U*-tests were used to compare the panel groups in Study 1 and Study 2 with respect to means on the demographic variables and the dependent variables, at both measurements. The panel groups in Study 1 and Study 2 did not differ with respect to age, but they did differ with regard to gender and education ($p < .01$). That is, Study 1 included more females, and slightly more highly educated employees. At Time 1, there were *no* significant differences on the dependent variables (job satisfaction, psychosomatic health complaints, and exhaustion). Thus the panel groups in Study 1 and Study 2 are comparable with respect to the outcome variables at Time 1. At the second measurement the respondents in Study 2 reported more psychosomatic complaints and exhaustion than the respondents in Study 1 ($p < .01$), whereas levels of job satisfaction were comparable in the two studies. The data from Study 1 will be used to examine the hypotheses, and these results will be cross-validated in Study 2.

6.2.2 Longitudinal relationships between demand-control interactions and employee well-being

To test (1) the specificity hypothesis, which states that more interaction effects will be found when specific instead of general measures are used, and (2) the strain hypothesis of the DC Model, which proposes that job control moderates the effects of job demands on employee well-being over time, a series of hierarchical multiple regression analyses was performed. A multiplicative interaction term was used to represent the moderating effect of job control on the relationship between job demands and strain (see Chapter 4). The results of these analyses are presented separately for each outcome variable (i.e., job satisfaction, exhaustion, psychosomatic health complaints, time-lost sickness-absence index, frequency sickness-absence index) in Table 6.2 to Table 6.6, respectively. In order to examine the specificity hypothesis, general as well as more specific demand and control measures were included. For each outcome variable, separate analyses tested the significance of each set of multiplicative interaction terms. Accordingly, each column in Tables 6.2 to 6.6 shows the results of a different combination of demands (i.e., JCQ demands, mental, emotional, or physical demands) and control (i.e., decision latitude, skill discretion, or decision authority) in the respective multiplicative interaction term. All analyses controlled for gender, age, and education, and for the respective dependent variable at Time 1 (which enables analysis of changes between Time 1 and Time 2). Note that Tables 6.2 to 6.6 have been displayed at the end of this chapter.

Table 6.2 shows results of the analyses of demands and control at Time 1 in relation to *job satisfaction* at Time 2. When demands as originally conceptualized in the DC Model (JCQ demands) were used, two out of three multiplicative interactions turned out to be significant. The combination of JCQ demands and decision latitude yielded a significant interaction effect, as did the combination of JCQ demands and decision authority. This means that additional variance was explained, over and above the main effects, by the interaction terms (as shown by the significant incremental *F*-test). The combination of JCQ demands and skill discretion did not result in a significant interaction. A similar pattern emerged for emotional demands. For mental demands, only the multiplicative interaction term including decision authority was significant, whereas no effects were found for the multiplicative interactions with decision latitude and skill discretion. Finally, physical demands did not yield any significant multiplicative interactions, whether combined with decision latitude, skill discretion, or decision authority.

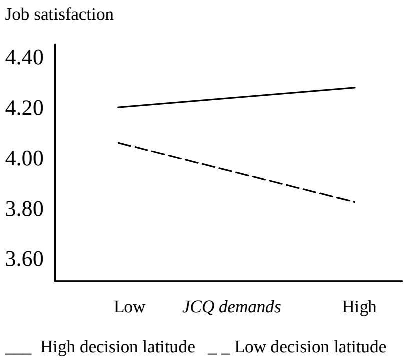


Figure 6.1 Interaction between JCQ demands and decision latitude for job satisfaction

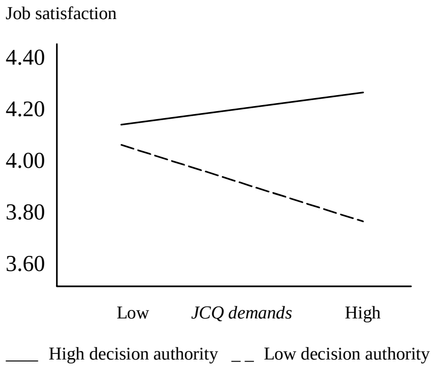


Figure 6.2 Interaction between JCQ demands and decision authority for job satisfaction

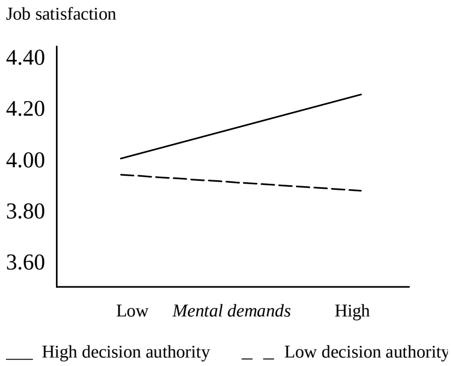


Figure 6.3 Interaction between mental demands and decision authority for job satisfaction

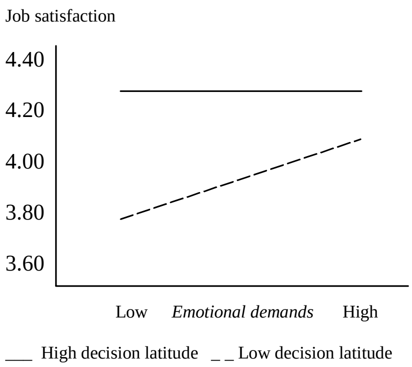


Figure 6.4 Interaction between emotional demands and decision latitude for job satisfaction

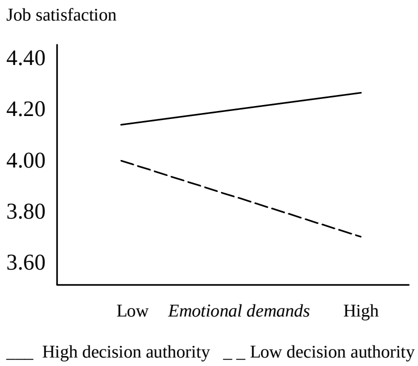


Figure 6.5 Interaction between emotional demands and decision authority for job satisfaction

In order to examine the nature of the significant multiplicative interaction terms, they were graphically displayed according to the method proposed by Aiken and West (1991). This means that the values of the predictor variables were represented at one standard deviation below and one standard deviation above the mean. The regression lines were estimated by entering these values in the regression equation. Figures 6.1 to 6.5 show graphical representations of the interactions between demands and job control at Time 1 observed for job satisfaction at Time 2. These figures show that negative effects of high job demands (+ 1 *SD*) on job satisfaction are dependent on the amount of job control. That is, if the employee experiences a high amount of decision latitude or decision authority (+ 1 *SD*), the employee remains as happy with his/her job or will even be slightly more satisfied with his/her work two years later. On the other hand, for employees who reported a low amount of decision latitude or decision authority (- 1 *SD*), job satisfaction decreases over time (as would be expected). An exception in this latter respect is Figure 6.4, which shows exactly the opposite pattern: an increase in emotional demands accompanied by low decision latitude at Time 1 is followed by *more* job satisfaction over time.

The longitudinal results with regard to *exhaustion* are shown in Table 6.3. Here, one significant multiplicative interaction was found for JCQ demands and decision latitude. Furthermore, two significant multiplicative interactions were found for emotional demands: the first one in combination with decision latitude and the second one in combination with skill discretion. Neither mental demands nor physical demands yielded any significant interaction effects.

The significant multiplicative interactions observed for exhaustion are graphically displayed in Figures 6.6 to 6.8. The figures show that the amount of exhaustion experienced two years later due to high JCQ/emotional demands depends on the amount of decision latitude or skill discretion. On the one hand, employees who initially reported high levels of decision latitude or skill discretion did not report more exhaustion two years later – and some even reported (slightly) less – despite initially high levels of demands. On the other hand, for employees reporting low levels of decision latitude or skill discretion, high JCQ/emotional demands were accompanied by an increase in exhaustion. That is, in order to prevent employees from getting exhausted (even two years later) due to a high level of job demands, a high amount of job control is needed as a buffer. Note that the pattern of the multiplicative interactions for exhaustion is similar to that for job satisfaction.

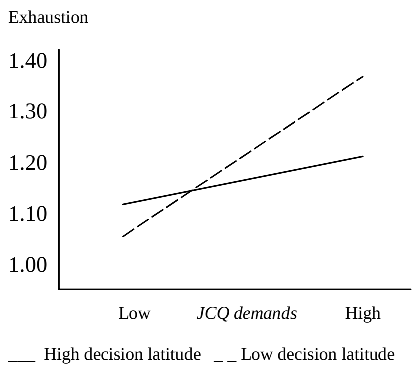


Figure 6.6 Interaction between JCQ demands and decision latitude for exhaustion

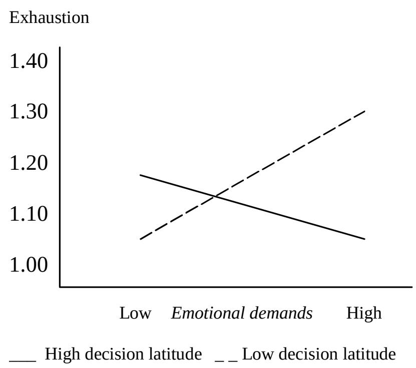


Figure 6.7 Interaction between emotional demands and decision latitude for exhaustion

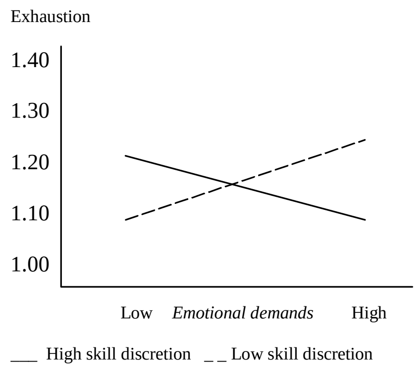


Figure 6.8 Interaction between emotional demands and skill discretion for exhaustion

The hierarchical regression analyses of the relation between demands and control at Time 1 and *psychosomatic health complaints* at Time 2 are presented in Table 6.4. For JCQ demands one significant multiplicative interaction was found, when decision authority was included in the interaction term. Similarly, one significant multiplicative interaction was observed for mental demands in combination with decision authority. For emotional demands, two of the three multiplicative interaction terms were significant. That is, emotional demands in combination with decision latitude, as well as with decision authority, yielded significant effects. As with job satisfaction (Table 6.2), the effects of the multiplicative interaction term including decision authority were stronger than those including decision latitude. For physical demands, no significant interaction effects were found.

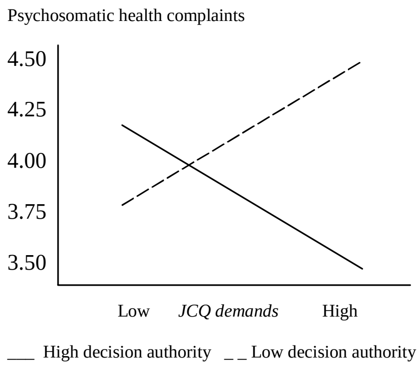


Figure 6.9 Interaction between JCQ demands and decision authority for psychosomatic health complaints

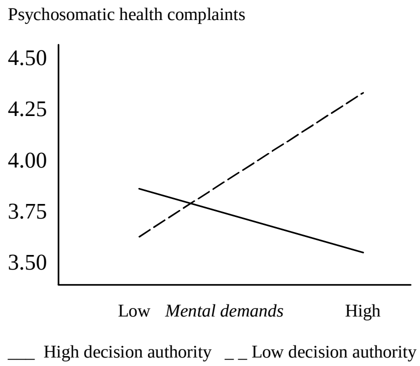


Figure 6.10 Interaction between mental demands and decision authority for psychosomatic health complaints

Figures 6.9 to 6.12 show the multiplicative interactions for psychosomatic health complaints. Most of these figures show that employees who initially reported high job demands accompanied by high levels of decision latitude/authority, experienced fewer psychosomatic health complaints two years later. (An exception is Figure 6.11, where the level of psychosomatic health complaints remains about the same.) However, if employees do not have the latitude or authority to decide what to do, high job demands will lead to more psychosomatic health complaints over time. Nevertheless, in all cases, employees with high demands and low control reported the most psychosomatic health complaints two years later. Thus, the pattern of interactions for psychosomatic health complaints was largely similar to the patterns for job satisfaction and exhaustion.

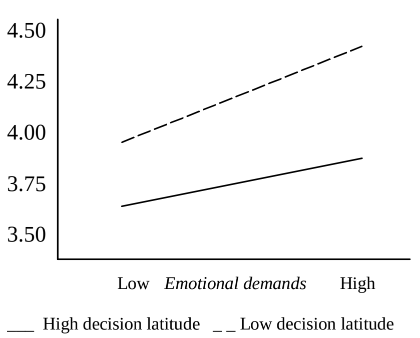


Figure 6.11 Interaction between emotional demands and decision latitude for psychosomatic health complaints

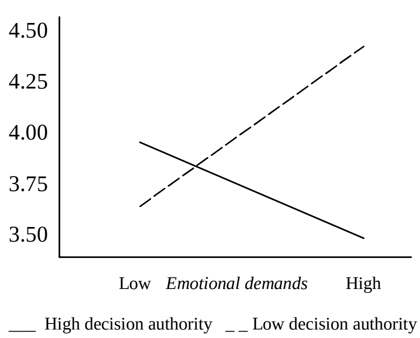


Figure 6.12 Interaction between emotional demands and decision authority for psychosomatic health complaints

Table 6.5 shows the lagged results for the *time-lost index* of sickness absence. *No* significant multiplicative interactions were found, regardless of the demand and control constructs used. Moreover, with the exception of some marginally significant main effects of JCQ demands and decision authority (all *p*s < .10), almost no significant effects were found for an additive model either (i.e., Step 3). To put it differently, almost no evidence was found for the assumption that either job demands or job control (or a combination of the two) at Time 1 influences how long employees are absent from work at Time 2.

The longitudinal results for the *frequency index* of sickness absence are presented in Table 6.6. Significant multiplicative interactions were found, but only when emotional demands were included in the interaction term, regardless the control construct. That is, three significant multiplicative interactions were found for the frequency index, all involving emotional demands: once combined with decision latitude, once with skill discretion, and once with decision authority.

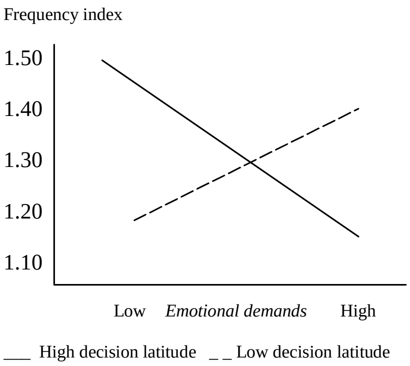


Figure 6.13 Interaction between emotional demands and decision latitude for frequency index

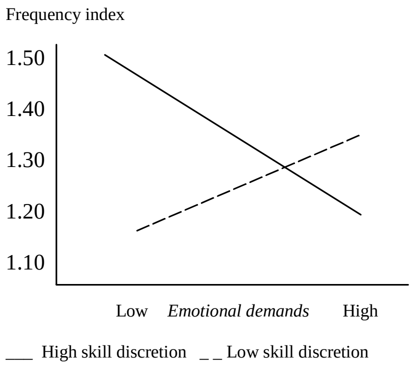


Figure 6.14 Interaction between emotional demands and skill discretion for frequency index

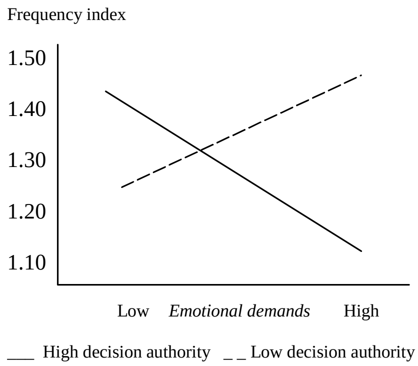


Figure 6.15 Interaction between emotional demands and decision authority for frequency index

The multiplicative interactions for the frequency index are displayed in Figures 6.13 through 6.15. Here the pattern was similar to that found for psychosomatic health complaints. That is, the influence of high emotional demands on sickness absence two years later depended on the amount of job control that was available to the employee. If a high level of control was available, the employee called in sick even less frequently two years later, whereas employees with a low level of control were more often absent from work due to sickness two years later. However, it should be noted that employees who were exposed to a low demands – high control condition were most often absent due to sickness two years later (Figure 6.13 and 6.14), whereas the opposite had been predicted: employees with high demands and low control were expected to report most strain (see Figure 6.15).

Summary

To study the specificity hypothesis applied to the DC Model and the strain hypothesis of the DC Model, the effect of a multiplicative interaction between job demands and job control on employee well-being was examined longitudinally. Table 6.7 shows a summary of the significant multiplicative interactions that were found. Because this table distinguishes between different types of job demands (JCQ, mental, emotional, and physical demands) and between different types job control (decision latitude, skill discretion, and decision authority), it sheds some light on Hypothesis 1 (i.e., the specificity hypothesis with respect to the DC Model). With regard to job demands, it appeared that most of the significant multiplicative interactions included emotional demands (9 out of 15), although interactions including more general JCQ demands (4 times) and mental demands (2 times) were observed as well. With respect to job control, Table 6.7 shows that most of the multiplicative interactions included decision authority (7 times), followed closely by decision latitude (6 times). On the other hand, skill discretion was included in just two multiplicative interactions. To summarize, a specific demand as well as a specific control construct was included most often in the significant multiplicative interaction terms, in a way lending support to the specificity hypothesis.

Table 6.7 Summary of multiplicative interaction effects observed in hierarchical multiple regression analyses

	JCQ demands			Mental demands			Emotional demands			Physical demands		
Outcome variable	DL	SkD	DA	DL	SkD	DA	DL	SkD	DA	DL	SkD	DA
Job satisfaction	†		*			†	†		*			
Exhaustion	†						†	†				
Psychosomatic complaints			**			†	†		†			
Time-lost index												
Frequency index							*	†	*			

Key. DL = decision latitude; SkD = skill discretion; DA = decision authority
Note. Interactions in the shaded cells are significant after sequential Bonferroni procedure
† $p < .10$; * $p < .05$; ** $p < .01$.

A total of 15 interactions were found for the DC Model (i.e., 25%), which is more than would be expected by chance. With the exception of the time-lost index, the multiplicative interaction between demands and control predicted all of the employee well-being outcomes two years later (depending on the type of demands and type of control that were used to construct the interaction term). In general, job control buffered the negative effects of job demands on employee well-being. That is, a positive relation between job demands and strain existed in the case of low job control, whereas a negative (or neutral) relation was found in the case of high job control. To put it differently, high levels of job demands did not necessarily lead to more strain two years later. Only employees with low job control experienced more strain, whereas for employees with high job control the amount of strain either decreased or remained stable. Moreover, most figures showed that the combination of high job demands and low job control led to the most strain over time, thus supporting Hypothesis 2 (strain hypothesis of the DC Model). Exceptions were two multiplicative interactions with respect to sickness absence frequency, which showed that a low demand – high control job led to most strain.

But, in general, the strain hypothesis was supported by the significant interactions in the prediction of (self-reported) employee well-being.

It addition, a sequential Bonferroni procedure was used to control for Type I error across analyses (cf. Daniels & Harris, 2005; Holm, 1979). In line with Daniels and Harris (2005, p. 227-228), tests were placed in ascending order of significance within a group of tests. The smallest probability is then multiplied by the number of tests in the group. The second probability is then multiplied by the remaining number of tests, etceteras. Tests are judged to be significant if the product is less than .10. A group of tests was defined of each control measure for each separate type of demand across a single dependent variable. For example, one group of tests comprised of tests of the three control measures by emotional demands on job satisfaction. Looking at the separate outcome variables, it appeared that the number of significant interactions for job satisfaction and psychosomatic health complaints were far beyond chance, even after the sequential Bonferroni procedure.

6.2.3 Cross-validation of DC results in a second independent sample

As results may be dependent on the particular sample studied, a generally accepted method for assessing the validity of results is to replicate them in another sample by means of cross-validation. Two cross-validation strategies were used. Firstly, as Kleinbaum, Kupper, and Muller (1988) have argued, the most compelling way to assess the reliability of a given model is to conduct a new study and test the fit of the model to the new data, by using the coefficients obtained in one sample (labeled Study 1) to predict the criterion in another sample (labeled Study 2). The difference between the original sample's explained variance (R^2 Study 1) and the estimated explained variance (R^2 Study 2), also know as the "shrinkage value", indicates whether the model is reliable. A shrinkage value of less than .100 is considered to be appropriate and indicates that the variance explained in both models is about equal. Secondly, as the explained variance does not provide a complete picture of the results of a cross-validation, the patterns of regression coefficients were further examined by means of multi-sample analyses. Both studies were placed in one database, and it was tested whether the regression coefficients differed significantly between studies. For a more detailed description, the reader is referred to Chapter 4, Section 4.3.3. The subsequent sections present the results of these two kinds of cross-validation analysis.

Differences in R-squares in the two samples

Table A6.8, in the Appendix, displays the results of the first cross-validation strategy, shrinkage analysis. With the exception of job satisfaction, all results of Study 1 could be replicated in Study 2 within the accepted shrinkage value (i.e., the difference between R^2 for Study 1 and Study 2 was less than .100). For job satisfaction most results could be replicated. Exceptions were the combinations JCQ demands – decision authority and emotional demands – decision latitude, for which the shrinkage values just exceeded the acceptable value (.107 and .105, respectively), and the combination emotional demands – decision authority, which was not replicated in Study 2 (shrinkage value: .140). Nevertheless, the results of nine out of twelve analyses could be replicated within the acceptable shrinkage value for job satisfaction. In short, nearly all results from Study 1 could be replicated in Study 2, indicating that the observed results are generalizable to other human service samples.

Comparing patterns of regression coefficients in the two samples

Tables A6.9 to A6.13, all displayed in the Appendix, show the results of the second cross-validation strategy: the multi-sample analysis. Table A6.9 depicts the results with regard to job satisfaction. Unlike the shrinkage analyses, the multi-sample analyses show that the results for job satisfaction do *not* differ between studies. The nonsignificant variable "study" indicates that the regression lines for Study 1 and Study 2 do not differ. That means that the regression analyses regarding job satisfaction showed a similar pattern in Study 1 and Study 2.

Table A6.10 shows the results for exhaustion. The regression lines differ, but in general the direction of the lines does not differ significantly between Study 1 and Study 2. This means that the sign of the regression coefficients generally did not differ. Five exceptions were observed, where the regression coefficients of the demand-control interaction did differ between Study 1 and Study 2: mental demands – skill discretion and emotional demands – skill discretion (p < .05); and JCQ demands – skill discretion and emotional demands – decision latitude and physical demands – decision authority (p < .10). In other words, the associations between, for instance, emotional demands and skill discretion differ between the two samples. Nevertheless, most results of the regression analyses in the prediction of exhaustion showed a similar pattern in Study 1 and Study 2.

Table A6.11 displays the multi-sample analyses for psychosomatic health complaints. The regression coefficients for skill discretion seemed to differ most across studies (p < .01 and p < .05). Because decision latitude mainly consists of skill discretion (6 out of 9 items), it is possible that the differences across studies observed for skill discretion underlie the differences observed for decision latitude (p < .05 and p < .10). In addition, all demand-control interaction coefficients differed between studies when the multiplicative interaction term included mental and emotional demands. Another interaction term that differed between studies was the JCQ demand – decision authority interaction coefficient. In short, the results of the regression analyses for psychosomatic health complaints differ between Study 1 and Study 2 with respect to skill discretion (and to a lesser extent decision latitude), and with respect to interactions that include mental demands (and to a lesser extent also emotional demands).

Table A6.12 displays the multi-sample analyses for the time-lost index. Although the regression lines differed, in most cases the signs did not differ between studies. That is, although the magnitude of the regression coefficients differed, the sign of the regression coefficients did not differ. (For instance, the association between JCQ demands and the time-lost index is positive in both samples.) Some differences between studies were found for the mental demands coefficients and its interaction with skill discretion (all p-values < .10). In other words, with the exception of mental demands, the results of the regression analyses predicting sickness absence duration showed a similar pattern across samples.

Finally, Table A6.13 displays the results with respect to the frequency index. In general, the regression coefficients did not differ between studies. A few exceptions should be mentioned: the regression coefficients for decision latitude in the analysis with JCQ demands ($p < .10$) and emotional demands ($p < .05$), one regression coefficient for skill discretion ($p < .10$), one JCQ demand regression coefficient ($p < .10$), and the emotional demand – decision authority interaction coefficient ($p < .10$). Nevertheless, all of the (35) other regression coefficients did not differ between the two samples, indicating that the results of the regression analyses of sickness absence frequency showed a similar pattern in Study 1 and Study 2.

In short, the shrinkage values indicate that most results from Sample 1 could be replicated in Sample 2. Although the analyses showed three somewhat large shrinkage values for job satisfaction, the multi-sample analyses indicated that the regression lines did not differ across studies for job satisfaction (i.e., they were very stable across samples). Considering these multi-sample analyses and the fact that the shrinkage values deviated only slightly, the results for job satisfaction may be considered replicable across samples. Furthermore, in general, the multi-sample analyses showed that, with the exception of psychosomatic health complaints, the results did not differ greatly between Study 1 and Study 2. That is, even though regression lines differed (indicating that different values have been found), the signs usually did not differ (indicating that the direction of the regression lines was similar). However, in the analyses of psychosomatic health complaints, the regression coefficients for skill discretion (and subsequently for decision latitude), as well as those for the interaction terms including mental demands, differed across studies. Therefore, the results for job satisfaction, exhaustion, the time-lost index, and the frequency index can be considered to have been replicated across studies, whereas the results for psychosomatic health complaints may be partly specific to the particular sample under study. As such, most results were found to be similar across samples, implying that the use of specific demand measures (especially emotional demands) and specific control measures (especially decision authority) was important in both samples.

6.3 Summary

Based on the theoretical rationale presented in Chapter 5, it was proposed that interactions between job demands and job resources should better account for employee well-being when job demands and job resources are operationalized in a more specific way (i.e., the specificity hypothesis). The present chapter reported on a longitudinal empirical test of this hypothesis, using the Demand-Control Model as a theoretical framework. Namely, more conventional general measures as well as more specific measures were used to operationalize job demands and job control. Two panel groups were used (i.e., Study 1 and Study 2). The panel group in Study 1 was used for the test group analyses ($N = 267$). Hierarchical regression analyses showed that multiplicative interactions were found for *all* of the self-reported measures, namely job satisfaction, exhaustion, and psychosomatic health complaints. With regard to sickness absence, however, no interactions were found for the time-lost index, but three interactions were found for the frequency index.

In all three cases, the multiplicative interaction term included emotional demands. A total of 15 interactions predicted by the Demand-Control Model were found to be significant (i.e., 25%), which is more than would be expected by chance. In general, graphically displaying the significant interactions showed that employees who worked under conditions of high job demands and low job control experienced the most strain two years later, lending (longitudinal) support to the strain hypothesis of the DC Model. With respect to job demands, it should be noted that most interactions included emotional demands (9 out of 15), although interactions including (more general) JCQ demands (four times) and mental demands (two times) were reported as well. In the case of job control, decision authority was the most frequent component in significant interaction terms (7 out of 15), followed closely by decision latitude (six times), whereas skill discretion was included in just two interactions. That is, if an interaction between demands and control was found to predict employee well-being, in most cases a specific demand (i.e., emotional demands) as well as a specific control concept (i.e., decision authority) was included in this demand-control interaction. For that reason, the use of specific demand and control concepts may be important for the detection of interactions effects, as proposed by the specificity hypothesis.

The results were cross-validated in a comparable independent sample (viz., the panel group in Study 2; N = 280) that differed only slightly in terms of demographic characteristics from the sample in Study 1. In general, the cross-validation analyses showed that the results did not differ between the two respective studies. However, in the case of psychosomatic health complaints the results did show differences regarding skill discretion and the interaction terms (including mental demands). Hence, these results may be less generalizable, and therefore more specific to the particular sample under study. For the other outcome variables – namely job satisfaction, exhaustion, the time-lost index, and the frequency index – the results did not differ between Study 1 and Study 2. That is, the results can be considered similar across samples, meaning that the use of specific demand and control measures was useful in both samples.

The present chapter included a longitudinal test of the specificity hypothesis, using Karasek's Demand-Control Model as a theoretical framework. The next chapter offers another longitudinal test of the specificity hypothesis, this time using Siegrist's Effort-Reward Imbalance Model as a theoretical basis.

Table 6.1 Means, standard deviations, test-retest reliabilities (r_t), and correlation matrix for the panel group in Study 1 (N = 267).

	M	SD	r_t	1.	2.	3.	4.	5.	6.	7.	8.	8a.	8b.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. Gender [a] (1)	0.09	0.28	-																			
2. Age (1)	39.0	8.7	-	.16*																		
3. Education (1)	3.90	1.29	-	.22*	-.12*																	
4. JCQ demands (1)	2.59	0.43	.42*	.02	.05	.07																
5. Mental demands (1)	3.16	0.69	.55*	-.06	.04	.02	.66*															
6. Emotional demands (1)	2.97	0.51	.61*	.05	-.16*	.19*	.31*	.42*														
7. Physical demands (1)	3.04	0.91	.77*	-.24*	-.22*	.20*	.27*	.39*	.28*													
8. Decision latitude (1)	3.59	0.42	.67*	.18*	-.04	.44*	-.05	.01	.17*	-.25*												
a) Skill discretion (1)	3.41	0.63	.62*	.19*	-.04	.42*	.08	.09	.27*	-.22*	.93*											
b) Decision authority (1)	3.70	0.45	.53*	.10	-.04	.31*	-.26*	-.14*	-.08	-.22*	.76*	.47*										
9. Job satisfaction (1)	3.92	0.88	.39*	-.05	-.08	.05	-.16*	-.12*	-.08	-.12	.32*	.28*	.26*									
10. Psychosomatic complaints (1)	4.27	2.86	.57*	-.19*	-.01	-.16*	.05	.12*	.11	.16*	-.10	-.09	-.07	-.25*								
11. Exhaustion (1)	1.36	0.96	.50*	-.10	.00	-.05	.11	.26*	.25*	.20*	-.05	-.08	-.01	-.37*	.60*							
12. Sickness absence – FI (1)	1.30	1.55	.42*	-.05	-.08	-.14*	.04	.15*	.15*	.14*	-.15*	-.14*	-.11	-.10	.17*	.24*						
13. Sickness absence – T-LI (1)	3.05	4.06	.15*	-.12	-.04	-.14*	-.01	.05	.08	.10	-.17*	-.17*	-.12	-.09	.20*	.22*	.73*					
14. Job satisfaction (2)	4.08	0.78	.39*	-.06	.07	-.03	-.12*	-.08	-.13*	-.10	.23*	.16*	.27*	.39*	-.13*	-.14*	-.04	.01				
15. Psychosomatic complaints (2)	3.79	2.87	.57*	-.15*	-.11	-.15*	.02	.09	.11	.22*	-.16*	-.15*	-.12	-.05	.57*	.34*	.22*	.23*	-.28*			
16. Exhaustion (2)	1.17	0.85	.50*	-.06	-.17*	-.03	.13	.19*	.12	.18*	-.07	-.05	-.08	-.15*	.40*	.50*	.18*	.14*	-.30*	.61*		
17. Sickness absence – FI (2)	1.30	1.33	.42*	-.02	-.12	-.05	.18*	.14*	.07	.14*	-.04	-.01	-.08	-.09	.04	.04	.42*	.23*	-.13*	.17*	.14*	
18. Sickness absence – T-LI (2)	3.31	3.67	.15*	-.09	-.09	-.03	.10	.10	.09	.11	-.08	-.04	-.13*	-.11	.12	.05	.21*	.15*	.05	.18*	.06	.52*

* $p < .05$, two-tailed

[a] Gender was coded 0 (male) and 1 (female); [b] internal consistency is represented by KR-20 as the scale only comprises two response categories.

Key (1) = Time 1; (2) = Time 2; FI = Frequency Index; T-LI = Time-Lost Index.

Table 6.2 Regression results: effects of job demands and job control (at Time 1) on job satisfaction (at Time 2) in Study 1 (n = 231due to listwise deletion)

	Job satisfaction																							
	JCQ demands						Mental demands						Emotional demands						Physical demands					
	DL		SkD		DA		DL		SkD		DA		DL		SkD		DA		DL		SkD		DA	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Sex	-.29†		-.28		-.24		-.30†		-.28		-.23		-.28		-.27		-.23		-.29		-.28		-.24	
Age	-.01		-.01		-.01		-.01		-.01		-.01		-.01		-.01		-.01		-.01		-.01		-.01	
Education	-.07	.010	-.05	.010	-.06	.010	-.07†	.010	-.05	.010	-.05	.010	-.07	.010	-.05	.010	-.04	.010	-.07	.010	-.05	.010	-.05	.010
2 Dep. T1	.31**	.170	.33**	.170	.29**	.170	.31**	.170	.33**	.170	.31**	.170	.30**	.170	.32**	.170	.30**	.170	.31**	.170	.33**	.170	.32**	.170
3 Demands	-.10		-.15		-.06		-.03		-.05		-.01		-.13		-.14		-.06		-.01		-.01		-.00	
Control	.45**	.042	.32	.025	.34**	.045	.46**	.039	.30*	.019	.35**	.044	.48**	.045	.35**	.025	.35**	.045	.49**	.038	.28*	.037	.37**	.044
4 D x C	.40†	.010	.21	.006	.49*	.020	.12	.001	.07	.001	.28†	.013	.34†	.010	.22	.007	.41*	.021	.09	.001	.02	.000	.07	.002
R^2		.232		.211		.245		.220		.200		.237		.235		.212		.246		.219		.197		.226
Incr. F		2.94†		1.45		5.91*		0.46		0.24		3.56†		2.87†		1.85		6.04*		0.46		0.03		0.43

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. DL = decision latitude; SkD = skill discretion; DA = decision authority; Dep. T1 = dependent variable at Time 1; D x C = Demands x Control.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table 6.3 Regression results: effects of job demands and job control (at Time 1) on exhaustion (at Time 2) in Study 1 (*n* = 231due to listwise deletion)

	Exhaustion																							
	JCQ demands						Mental demands						Emotional demands						Physical demands					
	DL		SkD		DA		DL		SkD		DA		DL		SkD		DA		DL		SkD		DA	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Sex	.07		.07		.07		.08		.08		.09		.07		.06		.08		.10		.09		.09	
Age	.01*		.01*		.01*		.01*		.01†		.01*		.01†		.01†		.01*		.01†		.01†		.01*	
Education	-.01	.016	-.01	.016	.00	.016	.00	.016	-.01	.016	.01	.016	-.00	.016	-.01	.016	.01	.016	.01	.016	-.01	.016	.01	.016
2 Dep. T1	.45**	.298	.46**	.298	.45**	.298	.46**	.298	.46**	.298	.46**	.298	.46**	.298	.46**	.298	.47**	.298	.45**	.298	.45**	.298	.46**	.298
3 Demands	.21*		.22*		.21†		.06		.05		.05		.05		.03		.03		.06		.07		.05	
Control	-.06	.017	-.02	.016	-.10	.021	-.08	.005	-.01	.003	-.17†	.012	-.08	.003	-.02	.001	-.17†	.009	-.08	.005	.03	.004	-.17†	.013
4 D x C	-.39†	.009	-.21	.005	-.27	.006	-.16	.003	-.14	.004	.01	.000	-.37†	.011	-.30†	.011	-.14	.003	-.06	.000	-.03	.000	-.06	.001
R^2		.340		.335		.341		.322		.321		.326		.328		.326		.328		.319		.318		.328
Incr. *F*		3.06†		1.64		2.04		0.89		1.22		0.00		3.76†		3.77†		0.75		0.22		0.05		0.34

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.

Key. DL = decision latitude; SkD = skill discretion; DA = decision authority; Dep. T1 = dependent variable at Time 1; D x C = Demands x Control.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table 6.4 Regression results: effects of job demands and job control (at Time 1) on psychosomatic health complaints (at Time 2) in Study 1 (*n* = 231due to listwise deletion)

	Psychosomatic health complaints																							
	JCQ demands						Mental demands						Emotional demands						Physical demands					
	DL		SkD		DA		DL		SkD		DA		DL		SkD		DA		DL		SkD		DA	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Sex	-.12		-.09		-.29		-.11		-.07		-.25		-.17		-.13		-.27		-.00		.02		-.12	
Age	.02		.03		.03		.03		.03		.03		.02		.02		.03		.02		.02		.02	
Education	-.08	.054	-.09	.054	-.14	.054	-.09	.054	-.09	.054	-.16	.054	-.11	.054	-.09	.054	-.19	.054	-.06	.054	-.05	.054	-.13	.054
2 Dep. T1	.55**	.288	.55**	.288	.54**	.288	.55**	.288	.55**	.288	.55**	.288	.55**	.288	.55**	.288	.56**	.288	.55**	.288	.55**	.288	.54**	.288
3 Demands	-.06		.07		-.02		.13		.18		.17		.22		.30		.21		.26		.25		.31	
Control	-.83†	.011	-.77†	.010	-.32	.005	-.81†	.012	-.80†	.012	-.31	.005	-.82†	.012	-.88*	.013	-.31	.005	-.71	.016	-.62	.016	-.32	.012
4 D x C	-.83	.003	-.20	.000	-1.75**	.020	-.37	.001	-.13	.000	-.88†	.010	-1.13†	.009	-.62	.004	-1.43*	.020	.09	.000	.26	.001	-.16	.000
R^2		.356		.352		.367		.355		.354		.357		.363		.359		.367		.358		.359		.354
Incr. *F*		1.14		0.12		7.04**		0.39		0.08		3.32†		2.88†		1.34		6.84*		0.04		0.41		0.19

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. DL = decision latitude; SkD = skill discretion; DA = decision authority; Dep. T1 = dependent variable at Time 1; D x C = Demands x Control.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table 6.5 Regression results: effects of job demands and job control (at Time 1) on sickness absence - time-lost index (at Time 2) in Study 1 (n = 235 due to listwise deletion)

	Time-lost index																							
	JCQ demands						Mental demands						Emotional demands						Physical demands					
	DL		SkD		DA		DL		SkD		DA		DL		SkD		DA		DL		SkD		DA	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Sex	-.89		-.95		-.92		-.84		-.88		-.93		-.95		-.97		-1.00		-.76		-.78		-.89	
Age	.04		.04		.04		.04		.04		.04		.03		.03		.03		.03		.03		.03	
Education	-.02	.017	-.08	.017	.00	.017	.02	.017	-.04	.017	.02	.017	-.03	.017	-.08	.017	-.02	.017	.02	.017	-.02	.017	.02	.017
2 Dep. T1	.10	.014	.11†	.014	.10†	.014	.09	.014	.10	.014	.10	.014	.10	.014	.10	.014	.10	.014	.10	.014	.10†	.014	.10†	.014
3 Demands	.91		.96†		.73		.52		.56		.43		.50		.51		.35		.28		.29		.26	
Control	-.74	.016	-.29	.013	-.98†	.023	-.92	.014	-.42	.010	-.101†	.013	-.83	.010	-.37	.005	-.96†	.019	-.71	.010	-.13	.006	-.99†	.020
4 D x C	1.67	.006	1.68	.007	.88	.002	.82	.003	.88	.004	.18	.000	-.40	.001	-.16	.000	-.60	.002	-.07	.000	.25	.001	-.41	.002
R^2		.053		.051		.056		.048		.045		.054		.042		.036		.052		.041		.038		.053
Incr. F		1.44		1.74		0.51		0.61		0.84		0.04		0.13		0.02		0.40		0.01		0.16		0.56

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. DL = decision latitude; SkD = skill discretion; DA = decision authority; Dep. T1 = dependent variable at Time 1; D x C = Demands x Control.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table 6.6 Regression results: effects of job demands and job control (at Time 1) on sickness absence – frequency index (at Time 2) in Study 1 (*n* = 235 due to listwise deletion)

	Frequency index																							
	JCQ demands						Mental demands						Emotional demands						Physical demands					
	DL		SkD		DA		DL		SkD		DA		DL		SkD		DA		DL		SkD		DA	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Sex	.15		.14		.16		.18		.17		.18		.17		.16		.18		.23		.21		.22	
Age	.02†		.02†		.02		.01		.01		.01		.01		.01		.01		.01		.01		.01	
Education	-.04	.016	-.04	.016	-.03	.016	-.01	.016	-.02	.016	-.01	.016	-.03	.016	-.03	.016	-.01	.016	-.00	.016	-.01	.016	.01	.016
2 Dep. T1	.35**	.165	.35**	.165	.35**	.165	.34**	.165	.35**	.165	.34**	.165	.36**	.165	.36**	.165	.36**	.165	.35**	.165	.35**	.165	.35**	.165
3 Demands	.59**		.58**		.59**		.24*		.25*		.23†		-.06		-.08		-.06		.13		.12		.13	
Control	.10	.033	.12	.034	.01	.033	-.04	.014	.04	.015	-.11	.016	.06	.000	.13	.001	-.08	.003	.06	.007	.16	.008	-.10	.008
4 D x C	.19	.001	.21	.001	.06	.000	.29	.003	.29	.003	.11	.000	-.75*	.016	-.58†	.011	-.63*	.015	.08	.000	.16	.002	-.06	.000
R^2		.215		.216		.214		.198		.199		.197		.197		.193		.199		.188		.191		.189
Incr. *F*		0.18		0.26		0.02		0.71		0.86		0.16		4.35*		3.06†		4.20*		0.14		0.61		0.12

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. DL = decision latitude; SkD = skill discretion; DA = decision authority; Dep. T1 = dependent variable at Time 1; D x C = Demands x Control.
† $p < .10$; * $p < .05$; ** $p < .01$.

7

The Effort-Reward Imbalance Model: Is specifying its components rewarding?

Parts of this chapter have been submitted as:

van Vegchel, N., de Jonge, J., Dormann, C., & Schaufeli, W. (2005). Enhancing the Effort-Reward Imbalance Model by specifying its components: A longitudinal study among human service workers. Manuscript submitted for publication.

7.1 Introduction

Demonstrating interaction effects between job demands and job resources with respect to employee well-being appears to be a complex issue. It was argued earlier in this thesis that the statistical operationalization of the interaction term (Chapter 4) and the operationalization of the constructs job demands and job resources (Chapter 5) could influence the chance of detecting such interactions. Regarding the latter, it was proposed that a more specific conceptualization of job demands and job resources could enhance the likelihood of finding interactions, in view of the possibility that only *particular* aspects of job demands and *particular* aspects of job resources interact with each other (e.g., Cohen & Wills, 1985; de Jonge, Dollard, Dormann, Le Blanc, & Houtman, 2000). This principle – that the likelihood of detecting demand-resource interactions will be greater when more specific measures of job demands and job resources are used – was labeled the specificity hypothesis.

The present chapter presents an empirical test of the specificity hypothesis, this time using the ERI Model as a theoretical framework. As was argued in Chapter 5, initial empirical studies testing the ERI Model with more specific measures have shown promising results. In short, empirical evidence suggests that it is useful to distinguish mental from physical demands (de Jonge, Bosma, Peter, & Siegrist, 2000; van Vegchel, de Jonge, Meijer, & Hamers, 2001), and that extending the model to include emotional demands seems worthwhile in the case of particular occupational groups such as human service employees (de Jonge & Hamers, 2000; van Vegchel et al., 2001). Moreover, two preliminary studies suggest that it is useful to split up occupational rewards into its specific components: salary, esteem, and job security (e.g., Dragano, von dem Knesebeck, Rödel, & Siegrist, 2003; van Vegchel, de Jonge, Bakker, & Schaufeli, 2002). The present research builds on these previous studies by using a longitudinal design to gain insight into relationships over time. And, more importantly, the present study included specific measures of demands and rewards simultaneously. By using specific measures for both demands and rewards it is possible to see which particular aspects of demands interact with which particular aspects of rewards, as this may contribute to the identification of optimal demand-resource combinations (cf. Cutrona & Russell, 1990). Moreover, in addition to the more specific measures, the original composite demands (i.e., effort) and rewards measures will be included as a benchmark for comparing these general scales with more specific measures of demands (i.e., mental, emotional, and physical demands) and rewards (i.e., salary and esteem)[1]. In addition, previous studies often used logistic regression analyses and an ERI index based on allocation of respondents to categories (see Section 2.2.2). However, dichotomization of *continuous* variables is not advisable due to the attendant loss of information (and variance) and dependence on (possibly inaccurate) cut-off points. Therefore, hierarchical multiple regression analyses were used including multiplicative interaction terms, as recommended by several statistical experts (Aiken & West,

---

[1] Recall from Chapter 3 that the job security items showed near-zero correlations at Time 1 in Study 1, and were therefore excluded from further analyses.

1991; Stone & Hollenbeck, 1989). Finally, to assess whether the observed results apply to the present sample only or could also be replicated in another comparable sample, the results of Study 1 were cross-validated in a second independent sample (i.e., Study 2).

7.1.1 Specific effort-reward imbalance hypotheses

In order to test the specificity hypothesis with regard to the ERI Model, this chapter examines the ERI Model using both conventional and more specific measures of effort/demands and rewards. In addition, the personal characteristic overcommitment will be included in the analyses. Most studies have examined only the situational components of the ERI Model, namely effort and rewards (van Vegchel, de Jonge, Bosma, & Schaufeli, 2005). However, a complete test of the ERI Model should also include overcommitment, the third key variable of the ERI Model. According to Siegrist (2002), overcommitment can directly influence employee health, and it can have a moderating effect in relation to the imbalance between (high) effort and (low) rewards, such that highly overcommitted employees experience more adverse health effects of ERI than their less overcommitted counterparts.

To evaluate the specificity hypothesis and the main principles of the ERI Model, the following hypotheses were formulated:

1) *The likelihood of finding interactions between job demands and occupational rewards in analyses of employee well-being outcomes (i.e., job satisfaction, exhaustion, psychosomatic health complaints, sickness absence) is higher when more specific measures (i.e., mental, emotional, and physical demands; salary and esteem) as compared with more general measures (i.e., effort and composite rewards) of job demands and occupational rewards are used* (specificity hypothesis applied to the ERI Model).
2) *A condition combining high effort and low rewards (Time 1) will lead to the most adverse well-being effects (Time 2) in comparison with high effort – high rewards, low effort – low rewards, and low effort – high rewards conditions*
   (cf. Effort-Reward Imbalance [ERI] hypothesis).
3) *Overcommitment will have:*
   a) *a direct effect on employee well-being (i.e., overcommitment at Time 1 will lead to reduced employee well-being at Time 2)* (cf. overcommitment [OVC] hypothesis); and
   b) *a moderating effect on employee well-being (i.e., adverse well-being effects of an effort-reward imbalance will be stronger in highly overcommitted employees than in less overcommitted employees)* (cf. ERI*OVC hypothesis).

As was noted in relation to the DC Model (Chapter 6), empirical studies testing the ERI Model with specific measures (i.e., effort and rewards) are scarce. Therefore, little is still known about which specific combinations of demands/effort and rewards can best predict employee well-being. As such, the present study is partly exploratory in that it also examines which specific demands/effort and which specific rewards have the largest impact on employee well-being over time.
In the next sections, the results of the analyses will be presented.

7.2 Different effort and reward concepts in the prediction of employee well-being over time

7.2.1 Preliminary analyses

Prior examination of the raw data revealed that the distribution of the time-lost sickness-absence index was positively skewed. To normalize the distribution as much as possible, the scores were subjected to a square-root transformation (Tabachnik & Fidell, 1989) (for more details, see Chapter 6, Section 6.2.1). The means, standard deviations, test-retest correlations, and Pearson correlations are presented in Table 7.1 at the end of this chapter. With the exception of the time-lost index (test-retest correlation of .15), all variables were stable across time. (Test-retest correlations ranged from .29 to .77.) Generally, the Pearson correlations between Time 1 job characteristics and Time 2 well-being outcomes were in the expected direction, although they were not all significant (e.g., Time 1 physical demands were not significantly associated with the Time 2 time-lost index).

A similar table, displaying the means, standard deviations, test-retest reliabilities, and Pearson correlations for Study 2 can be found in Table A7.1, in the Appendix. Independent samples *t*-tests and Mann-Whitney *U*-tests were used to compare the panel groups in Study 1 and Study 2 with respect to means on the demographic variables and the dependent variables. Because the same study samples (i.e., panel groups) were used in Chapter 6 and in the present chapter, the results are similar and have already been displayed in Section 6.2.1. In short, the samples used in Study 1 and Study 2 differed with respect to some demographic characteristics (i.e., gender and education), and with regard to psychosomatic health complaints and exhaustion at Time 2. That is, the sample in Study 1 included more female respondents and slightly more highly educated respondents, and reported fewer psychosomatic health complaints as well as more exhaustion at the second measurement, as compared with the sample in Study 2. In all other respects, the samples were comparable. The data from Study 1 were used to evaluate the hypotheses, and the results were cross-validated in Study 2.

7.2.2 Longitudinal associations between effort-reward interactions and employee well-being

A series of hierarchical multiple regression analyses was conducted to test (1) the specificity hypothesis, which states that more interaction effects will be found when specific rather than general measures are used, and (2) the ERI hypothesis of the ERI Model, which proposes that a combination of high effort (or job demands) and low occupational rewards will lead to the most impaired employee well-being over time. A multiplicative interaction term was used to represent the moderating effect of occupational rewards on the relationship between job demands and strain (see Chapter 4). Table 7.2 to Table 7.6 show the results of the analyses separately for each outcome variable (i.e., job satisfaction, exhaustion, psychosomatic health complaints, sickness absence time-lost index, and sickness absence frequency index), respectively. In order to examine the specificity hypothesis, general as well as more specific demand and reward constructs were used. For each outcome variable, separate analyses were performed testing the significance of each set of multiplicative interaction terms. Accordingly, each column in Table 7.2 – 7.6 shows the results of a different combination of demand constructs (i.e., effort, mental, emotional, or physical demands) and reward constructs (i.e., composite reward, salary, or esteem) used to construct the respective multiplicative interaction term. All analyses controlled for gender, age, education, and the respective dependent variable at Time 1. That is, the results apply to most respondents irrespective of gender, age, and education, and differences in employee well-being at Time 1 versus Time 2 were analyzed. Note that Table 7.2 to 7.6 are displayed at the end of this chapter.

Table 7.2 shows the results for demands and rewards at Time 1 in relation to *job satisfaction* at Time 2. When the effort scale was used, one significant multiplicative interaction was found for job satisfaction. Namely, the combination of effort and salary yielded a significant interaction effect. This means that additional variance was explained by the interaction term, over and above the main effects (as shown by the significant incremental *F*-test). For the other combinations between the various demand and reward indicators, no significant interactions were found.

In order to explore the nature of the significant multiplicative interaction term, it was graphically represented as regression lines produced by entering the values of the predictor variables – at one standard deviation below and one standard deviation above the mean (Cohen & Cohen, 1983) – into the regression equation (Aiken & West, 1991). Figure 7.1 shows the interaction between effort and salary at Time 1 with regard to job satisfaction at Time 2. This figure shows that the negative effects of high effort (+1 *SD*) on job satisfaction are dependent on the amount of salary (benefits). That is, if the employee experienced a high amount of salary benefits (+1 *SD*), the employee was slightly more satisfied with his/her work two years later, despite an initially high level of effort. On the other hand, for employees who reported low salary benefits (-1 *SD*), job satisfaction decreased over time (as would be expected).

Figure 7.1 Interaction between effort and salary for job satisfaction

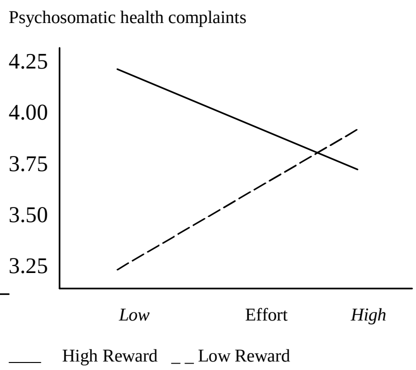


Figure 7.2 Interaction between effort and reward for psychosomatic health complaints

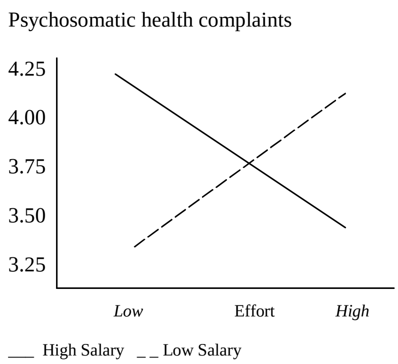


Figure 7.3 Interaction between effort and salary for psychosomatic health complaints

The longitudinal results with regard to *exhaustion* are shown in Table 7.3. No significant multiplicative interaction terms were found for exhaustion, regardless of which demand and reward constructs were used. Moreover, the results for Step 3 (not shown in Table 7.3) showed no significant effects for an additive model either, meaning that no direct effects of demands and rewards on exhaustion were found. That is, neither demands, nor rewards, nor the interaction between demands and rewards seemed to predict the level of exhaustion two years later.

Table 7.4 shows the results of regression analyses of Time 1 demands and rewards as predictors of Time 2 *psychosomatic health complaints*. For the effort construct, two of the three multiplicative interaction terms were significant. That is, effort in combination with composite rewards, and with salary, yielded significant effects for psychosomatic health complaints. For mental, emotional, and physical demands no significant interactions were found, regardless of which reward construct was used.

The significant multiplicative interactions for psychosomatic health complaints are graphically displayed in Figure 7.2 and Figure 7.3. These figures show that a high level of effort did not necessarily lead to more psychosomatic health complaints two years later. Only among employees who received low composite rewards/salary benefits did psychosomatic health complaints increase, whereas among employees with high composite rewards/salary the number of psychosomatic health complaints decreased over time. However, it should be noted that employees in a low effort – high reward condition reported the most psychosomatic health complaints two years later (Figure 7.2 and 7.2), whereas the opposite had been hypothesized: employees with high effort and low rewards were expected to report the most strain.

The lagged hierarchical regression analyses for sickness absence are presented in Table 7.5 for the *time-lost index* and in Table 7.6 for the *frequency index*. Similar multiplicative interactions were found for these two outcomes. For effort as well as for mental demands, none of the multiplicative interaction terms were significant, irrespective of the reward construct with which it was combined. For emotional demands two significant interaction effects were found. That is, the combination of emotional demands and composite rewards yielded a significant interaction, as did the combination of emotional demands and esteem. For physical demands one interaction – namely, its interaction with esteem – was significant.

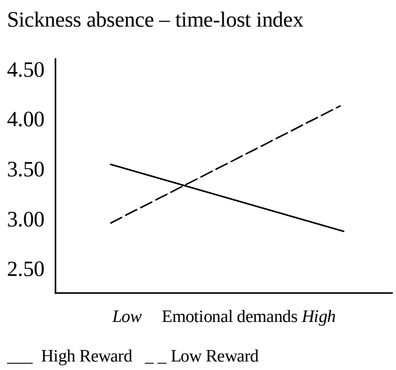


Figure 7.4 Interaction between emotional demands and reward for time-lost index

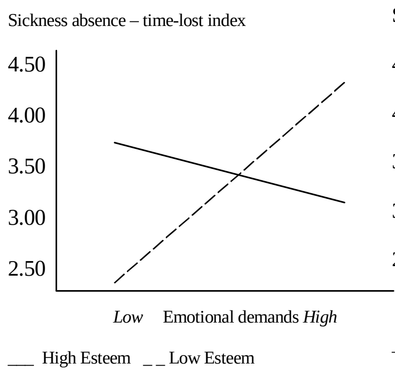


Figure 7.5 Interaction between emotional demands and esteem for time-lost index

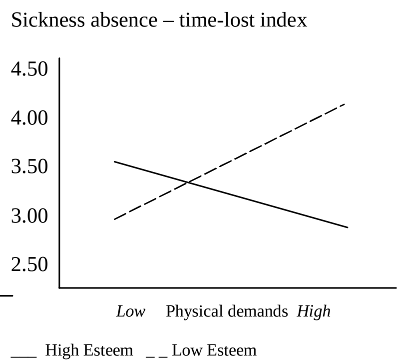


Figure 7.6 Interaction between physical demands and esteem for time-lost index

Figures 7.4 to 7.6 show the multiplicative interactions with respect to the time-lost index, whereas Figures 7.7 to 7.9 show the same interactions for the frequency index. The pattern is similar to that observed for psychosomatic health complaints. That is, whether or not a high level of (emotional/physical) demands resulted in more sickness absence two years later depended on the level of composite rewards/esteem. Employees who felt properly rewarded and appreciated showed less sickness absence two years later. However, employees who reported a lack of rewards and appreciation called in sick more often and stayed home for longer periods. This pattern involving demands, rewards, and sickness absence was observed for both the time-lost index and the frequency index. In most cases, as was expected, employees with high effort and low rewards reported the most strain (Figure 7.4 to 7.6, and Figure 7.9). However, for the frequency index, the opposite was found in two cases: employees who reported low emotional demands and high rewards/esteem showed the most sickness absence two years later (Figure 7.7 and 7.8).

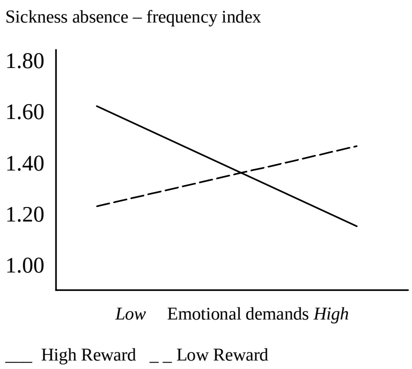


Figure 7.7 Interaction between emotional demands and reward for frequency index

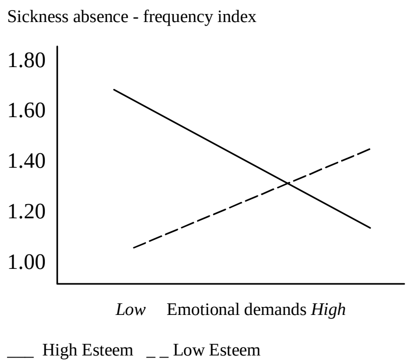


Figure 7.8 Interaction between emotional demands and esteem for frequency index

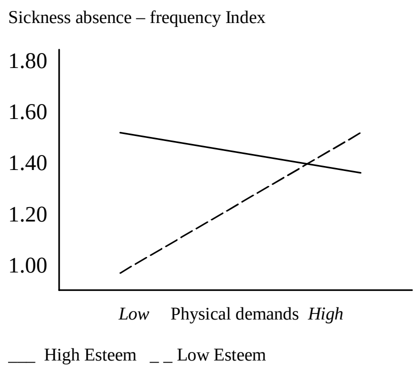


Figure 7.9 Interaction between physical demands and esteem for frequency index

Summary

To study the specificity hypothesis and the moderating effect of rewards, the longitudinal effects of multiplicative interactions between different demand constructs and reward constructs were examined in relation to employee well-being in the context of the ERI Model. Table 7.7 shows a summary of the significant multiplicative interactions that were found. As Table 7.7 distinguishes between different types of job demands (effort; and mental, emotional, and physical demands) and between different types of occupational rewards (composite rewards, salary, and esteem), it sheds light on the specificity hypothesis applied to the ERI Model (Hypothesis 1). With regard to the demand constructs, it can be seen that most of the significant multiplicative interactions included emotional demands (4 out of 9), although interactions including (more general) effort (3 times) and physical demands (2 times) were found as well. With respect to occupational rewards, Table 7.7 shows that most of the significant multiplicative interactions included esteem (4 times), followed closely by reward (3 times) and salary (2 times).

Therefore, a specific demand and a specific reward construct were included most often in the significant interaction terms, in a way lending support to the specificity hypothesis.

Table 7.7 Summary of multiplicative interaction effects found hierarchical multiple regression analyses

	Effort			Mental demands			Emotional demands			Physical demands		
Outcome variable	R	S	E	R	S	E	R	S	E	R	S	E
Job satisfaction		†										
Exhaustion												
Psychosomatic complaints	*	**										
Time-lost index							†		*			†
Frequency index							*		*			†

Key. R = composite rewards; S = salary; E = esteem
Note. Interactions in the shaded cells are significant after sequential Bonferroni procedure
† $p < .10$; * $p < .05$; ** $p < .01$.

Nine significant demand-reward interactions were found for the ERI Model (i.e., 15%). Although this constitutes relatively few interactions (i.e., nine out of 60 possible interaction terms), it just exceeds the level that would be predicted by chance. With the exception of exhaustion, the multiplicative interaction between demands and rewards predicted employee well-being outcomes two years later (depending on the type of demands and the type of rewards used to construct the interaction term). In general, occupational rewards buffered the negative effects of job demands on employee well-being. That is, a positive relation between job demands and strain existed in the case of low occupational rewards, whereas a negative relation was found in the case of high rewards. To put it differently, an increase in job demands did not necessarily lead to more strain two years later. Only employees who felt that they were insufficiently rewarded experienced more strain, whereas for employees with high rewards the amount of strain decreased over time. Moreover, most of the figures showed that the combination of high demands and low occupational rewards led to the most strain over time, supporting Hypothesis 2 (ERI hypothesis of the ERI Model). Exceptions to this pattern were observed in the case of two interactions in the prediction of psychosomatic health complaints, and two interactions in the prediction of sickness absence frequency, all of which indicated that a low demand – high reward condition led to the most strain. In general, however, the ERI hypothesis was supported by (a few) significant interactions in the prediction of employee well-being.

It addition, a sequential Bonferroni procedure was used to control for Type I error across analyses (cf. Daniels & Harris, 2005; Holm, 1979). In line with Daniels and Harris (2005, p. 227-228), tests were placed in ascending order of significance within a group of tests. The smallest probability is then multiplied by the number of tests in the group. The second probability is then multiplied by the remaining number of tests, etceteras. Tests are judged to be significant if the product is less than .10. A group of tests was defined of each reward measure for each separate type of demand across a single dependent variable. For example, one group of tests comprised of tests of the three reward measures by emotional demands on job satisfaction. Looking at the separate outcome variables, it appeared that the number of significant interactions for psychosomatic health complaints and sickness absence frequency still exceeded the level of chance, even after the sequential Bonferroni procedure.

Testing the personal component of the ERI Model: The lagged effects of overcommitment

Because the ERI Model served as a theoretical framework, additional Hierarchical Multiple Regression Analyses (HMRA) were conducted to explore the direct and moderating role of the personality characteristic overcommitment (i.e., Hypothesis 3). HMRAs were conducted using simultaneous entry of variables within each hierarchical step. To explore the direct role of overcommitment in employee well-being at Time 2, first the control variables were entered (i.e., gender, age, education), secondly the dependent variable at Time 1, and finally overcommitment at Time 1. In order to explore the moderating effect of overcommitment, variables were entered in hierarchical steps as follows: (1) control variables; (2) dependent variable at Time 1; (3) demand construct, reward construct, overcommitment; (4) demand construct * reward construct, demand construct * overcommitment, reward construct * overcommitment; and (5) demand construct * reward construct * overcommitment (cf. Aiken & West, 1991). The data in Table 7.8 indicate that overcommitment did not predict employee well-being over time (i.e., direct effect), but that overcommitment did occasionally moderate the effect of ERI on employee well-being. (The complete results of these regression analyses can be found in the Appendix: Tables A7.9, and A7.10a to A7.10e.) More specifically, one three-way interaction was found for job satisfaction (emotional demands * esteem * overcommitment; $F = 3.38$, $p < .10$); two three-way interactions were found for the time-lost index (mental demands * reward * overcommitment; $F = 4.73$, $p < .05$; mental demands * salary * overcommitment; $F = 6.37$, $p < .05$); and the frequency index yielded two three-way interactions (emotional demands * reward * overcommitment; $F = 3.05$, $p < .10$; emotional demands * salary * overcommitment; $F = 3.44$, $p < .10$).

Table 7.8 Summary of direct and moderating effects of overcommitment (R^2 increments)

	Direct effect[1]	Moderating effect[2]											
		Effort			Mental demands			Emotional demands			Physical demands		
Outcome variable	OVC	R	S	E	R	S	E	R	S	E	R	S	E
Job satisfaction	.003	.001	.005	.004	.000	.000	.001	.002	.000	.012†	.000	.001	.000
Exhaustion	.000	.000	.001	.000	.002	.000	.008	.002	.002	.000	.002	.001	.006
Psychosomatic complaints	.002	.004	.004	.004	.004	.000	.005	.001	.000	.000	.000	.001	.002
Time-lost index	.008	.003	.001	.003	.021*	.028**	.009	.010	.012	.002	.002	.000	.005
Frequency index	.002	.000	.000	.000	.002	.005	.002	.011†	.013†	.001	.006	.008	.005

Key. OVC = overcommitment; R = reward; S = salary; E = esteem

[1] R^2 increment in last step = overcommitment; [2] R^2 increment in last step = demand construct * reward construct * overcommitment

† $p < .10$; * $p < .05$; ** $p < .01$.

The significant three-way interactions are displayed in Figures 7.10 to 7.14 at the end of this chapter. Figure 7.10 shows the three-way interaction for job satisfaction. Highly overcommitted employees were generally less satisfied, and satisfaction further decreased if emotional demands increased, regardless of the amount of esteem. For less overcommitted employees an ERI was observed: when emotional demands increased, employees who felt highly appreciated were more satisfied with their job two years later, whereas employees who reported a lack of esteem were less satisfied over time. Figure 7.11 shows the interaction between mental demands, rewards, and overcommitment for the time-lost index. In all cases, the level of the time-lost index increased with an increasing amount of mental demands. So, independent of the level of overcommitment, and regardless of the level of rewards, employees were absent for a longer period when mental demands had been high two years earlier. However, Figure 7.12 shows a different picture when a more specific reward (i.e., salary) was included in this three-way interaction. For highly overcommitted employees, an ERI is observed: high mental demands resulted in longer absence periods two years later, but only for employees with a low salary, whereas employees with a high salary returned to work much sooner. On the other hand, for less overcommitted employees exactly the opposite was the case. Both figures for the frequency index (Figures 7.13 and 7.14) show that among employees who were not extremely committed to work, the frequency of calling in sick decreased when emotional demands increased, independent of the amount of rewards/salary. Among employees who were highly overcommitted, an ERI pattern could be observed, such that the relationship between emotional demands and the frequency index was either positive in the presence of low rewards/salary or negative in the presence of high rewards/salary.

In short, Figures 7.12 to 7.14 show that the effects of an ERI on sickness absence were stronger in highly overcommitted employees, as predicted by the ERI Model. On the other hand, the other figures show either the opposite pattern (Figure 7.10 for job satisfaction) or no clear distinction between high and low overcommitment (Figure 7.11 for the time-lost index), and are as such less supportive of the ERI Model.

7.2.3 Cross-validation of ERI results in a second independent sample

Results may be specific to a particular sample under study. In order to asses the generalizability of the results (of the panel group in Study 1), they were cross-validated in another, comparable sample (i.e., the panel group in Study 2). More specifically, Study 1 was used as the reference group, whereas Study 2 formed the validation group (i.e., the analyses were based on the coefficients from Study 1). Firstly, the “shrinkage value” (cf. Kleinbaum, Kupper, & Muller, 1988) was examined by calculating the difference between the original sample’s explained variance (R^2 Study 1) and the estimated explained variance (R^2 Study 2). A shrinkage value of smaller than .100 is considered to be appropriate and indicates that the variance explained in both models is about equal (Kleinbaum et al., 1988). Secondly, as explained variance does not provide a complete picture of the results of a cross-validation, the patterns of the regression coefficients were further examined in multi-sample analyses. Both studies were placed in one database and it was tested whether the regression coefficients differed significantly between studies. For a more detailed description of the cross-validation procedure, the reader is referred to Chapter 4, Section 4.3.3. In the next sections, the results of cross-validation will be presented for the analyses of the various demand and reward constructs (i.e., the situational component of the ERI Model), as well as for analyses of the direct and moderating effects of overcommitment.

Differences in R-square in the two samples

The results of the first cross-validation strategy, the shrinkage analysis, are displayed in the Appendix in Table A7.11. Most of the results of Study 1 could be replicated in Study 2 within the allowed shrinkage value. More specifically, 54 out of 60 analyses (or 90%) were replicated within the allowed shrinkage value. However, in the case of job satisfaction four analyses could not be replicated: those involving the combinations effort – salary, emotional demands – rewards, emotional demands – salary, and physical demands – salary (shrinkage values were .127, .132, .128, .119, and .119, respectively). Note that most of these combinations included salary as a reward construct. In addition, two analyses with regard to sickness absence frequency could not be replicated in Study 2 within the allowed shrinkage value: both combinations included emotional demands, once combined with composite rewards and once combined with esteem (shrinkage values of .150, and .121, respectively). All other analyses could be replicated within the allowed shrinkage value. As such, with the exception of job satisfaction (and to a lesser extent the frequency index), the results seem to be replicable, and thus valid, across samples, strengthening their generalizability.

Comparing patterns of regression coefficients in the two samples

Since the explained variance does not provide a complete picture of a cross-validation, the patterns of the regression coefficients were further examined using a second cross-validation strategy: multi-sample analyses. That is, even when the explained variance falls within the allowed shrinkage value (i.e., explained variance is similar), the patterns of the regression coefficients may still differ. To examine these patterns multi-sample analyses were conducted separately for each outcome variable (see Appendix Table A7.12 to A7.16). In general, the regression lines differed between studies, but the signs of the regression lines did not differ significantly (meaning that the direction of the regression coefficients was the same). In other words, the strength of the relation between demands, rewards, and employee well-being differed, but the direction was the same (i.e., more demands led to more strain, and more rewards led to less strain). More specifically, for job satisfaction (Table A7.12) the regression coefficients for the interaction terms that included composite rewards and salary differed between studies. On the other hand, the analyses including esteem did not differ at all between studies, as the regression lines did not differ (as shown by the nonsignificant variable "study"). For exhaustion (Table A7.13) as well as psychosomatic health complaints (Table A7.14), the regression coefficients were comparable across studies. For sickness absence, the time-lost index (Table A7.15) did not differ between studies with the exception of the regression coefficients for the following two interactions: emotional demands – rewards, and emotional demands – esteem. Most results for the frequency index (Table A7.16) did not differ between studies. Only the regression coefficients for the interaction terms including emotional demands differed between studies. In short, most results of the multi-sample analyses suggested similar findings in Study 1 and Study 2.

To summarize, the shrinkage analyses as well as the multi-sample analyses showed that the results for job satisfaction differed between studies, due to different findings for rewards and salary. Both cross-validation techniques showed that results for exhaustion and psychosomatic health complaints did not differ between studies. Although shrinkage analyses showed no difference between studies for the time-lost index, further examination in multi-sample analyses showed that the interaction coefficients for the emotional demands – composite rewards combination, and for the emotional demands – esteem combination, did differ between studies. Finally, both methods of cross-validation showed that for the frequency index, results differed when emotional demands was included in the interaction term. However, it should be stressed that despite these differences, most of the results were valid across samples. Therefore, the results of the hierarchical regression analyses in Study 1 seem to be valid across samples, at least within the human service sector, implying that assessment of specific demands as well as specific rewards contributes to the detection of interaction effects.

Cross-validation of the ERI results with regard to overcommitment

In a similar vein, the analyses including the direct and moderating effects of overcommitment were cross-validated. In the following sections, shrinkage analyses and multi-sample analyses will be briefly discussed. Tables displaying these results can be found in the Appendix (Table A7.17 to A7.19e).

Differences in R-square in the two samples (analyses including overcommitment)

Table A7.17, included in the Appendix, shows the shrinkage values for the analyses including the direct and moderating effects of overcommitment. In the first column it can be seen that, with regard to the direct effect of overcommitment, all results in Study 1 could be replicated in Study 2 within the allowed shrinkage value.

The remaining columns show results for the moderating effect of overcommitment. As in the shrinkage analyses without overcommitment (see Appendix Table A7.11), most shrinkage values were acceptable (i.e., below .100); however, for job satisfaction and the frequency index some shrinkage values were too large. For job satisfaction about half of the results could not be replicated within the allowed shrinkage value. For the frequency index, results for mental and emotional demands differed across studies. As such, the results appear to be less valid across studies for the outcomes job satisfaction and sickness absence frequency.

Comparing patterns of regression coefficients in the two samples (analyses including overcommitment)

Results for the multi-sample analysis of the direct effect of overcommitment can be found in the Appendix in Table A7.18. Only the regression coefficients for overcommitment with respect to the frequency index differed somewhat between studies ($p < .10$).

The multi-sample analyses of the moderating effect of overcommitment can also be found in the Appendix, separately for each outcome variable (see Tables A7.19a to A7.19e, respectively). With the exception of three coefficients (i.e., the three-way interaction between effort, salary and overcommitment; a reward-overcommitment interaction; and an emotional demand-salary interaction), the results for job satisfaction did not differ between Study 1 and Study 2 (Table A7.19a). In the case of exhaustion (Table A7.19b) only two coefficients differed marginally between studies (i.e., an emotional demand-overcommitment interaction, and a reward-overcommitment interaction). With regard to psychosomatic health complaints, the demand-reward interaction (i.e., “DxRxStudy”) differed when emotional demand was included in the interaction term (Table A7.19c). For the time-lost index, the coefficients for all three-way interactions including mental and emotional demands differed between studies (Table A7.19d). Finally, analyses of the frequency index showed the most differences between Study 1 and Study 2 (Table A7.19e). These analyses showed differences with respect to overcommitment. Furthermore, three demand coefficients also differed (one for mental demands and two for emotional demands). In addition, not surprisingly considering the different regression coefficients observed for overcommitment, the regression coefficients for some of the two-way interactions including overcommitment, and for six of the three-way interactions, differed between studies. With respect to the three-way interactions, most of the interaction coefficients that differed included emotional or physical demands. Therefore, with the exception of the frequency index (especially in the analyses of overcommitment), the results generally appear to be valid across samples.

In short, both the shrinkage analyses and the multi-sample analyses suggest that most results with regard to *direct effects* of overcommitment are valid across samples. The analyses of the *moderating effect* of overcommitment were also cross-validated. The shrinkage analyses indicated that job satisfaction and the frequency index were somewhat less valid across samples. With the exception of the frequency index, the multi-sample analyses showed only very few differences between Study 1 and Study 2. The results for the frequency index showed the most differences in relation to the coefficient for overcommitment. Therefore, the regression analyses including overcommitment appear to be valid across samples for most of the well-being outcomes. The results for the frequency index should be interpreted cautiously, however, as they may be specific to the particular sample under study.

7.3 Summary

In Chapter 5, theoretical arguments were provided in support of the proposition that interactions between job demands and job resources in the prediction of employee well-being may be more likely when job demands and job resources are operationalized more specifically (i.e., the specificity hypothesis). In Chapter 6, an empirical test of this hypothesis was provided, using the Demand-Control Model as a theoretical framework. The present chapter also included an empirical test of this hypothesis, this time using the Effort-Reward Imbalance Model as a theoretical framework. More specifically, the demand construct and the reward construct were operationalized with conventional general measures as well as with more specific measures. Two panel groups were used (i.e., Study 1 and Study 2). The panel group in Study 1 (N = 267) was used to analyze the hypotheses. Hierarchical regression analyses showed that, with the exception of the outcome variable exhaustion, the multiplicative interaction between a demand construct and a reward construct predicted employee well-being. Although only nine interactions were found (i.e., 15%), this is more than would be expected by chance. In general, these interactions showed that employees who experienced a high effort – low rewards situation at work reported most strain two years later, yielding (longitudinal) support to the situational component of the ERI Model. Emotional demands were most often included in significant interaction terms (4 out of 9), followed closely by (more general) effort (three times) and physical demands (two times). With regard to occupational rewards, esteem was most often a component of significant interaction terms (4 out of 9), although interactions including the general reward construct and salary were found as well (three and two times, respectively). In other words, the interactions between demands and rewards that were found to predict employee well-being were regularly composed of a specific demands construct (i.e., emotional demands) as well as a specific rewards (i.e., esteem) construct. Hence, the use of specific demands and specific rewards may be important for the analysis of relations between job characteristics and employee well-being, as was assumed by the specificity hypothesis.

Additional analyses were conducted to examine direct and moderating effects of the personal component of the ERI Model, namely overcommitment. Although overcommitment did not directly predict employee well-being over time (i.e., direct effects), some moderating effects of overcommitment on the relation between an effort-reward imbalance and employee well-being were observed. All six significant three-way interactions between effort, rewards, and overcommitment included either mental or emotional demands. However, the results were inconsistent: three interactions with respect to sickness absence (frequency and time-lost indices) supported the ERI Model (i.e., with effects of an effort-reward imbalance stronger in highly overcommitted employees), whereas other interactions showed either the opposite pattern (for job satisfaction) or no clear distinction between high and low overcommitment (for the time-lost index). Hence, although specific demands were important in discovering effects of the personality characteristic overcommitment on the relation between effort-reward imbalance and employee well-being, the patterns of these interactions were inconsistent.

The results were cross-validated in another independent sample (panel group in Study 2; *N* = 280), which differed only slightly in terms of demographic characteristics from Study 1. For job satisfaction, the results differed in relation to rewards and salary, whereas for the frequency index the results differed when emotional demands was included in the interaction term. Therefore, the results with respect to rewards/salary for job satisfaction, and the results with regard to emotional demands for the frequency index, may be less generalizable and more specific to the particular sample under study. In general, the cross-validation analyses showed that the results did not differ between the two studies on the outcome variables exhaustion, psychosomatic health complaints, and the time-lost index. That is, the results can be considered valid across samples, meaning that the use of specific demands and rewards measures was useful in both samples.

The results concerning the direct and moderating effects of overcommitment were cross-validated as well. In general, the results of analyses of the direct effect of overcommitment were valid across samples. The results of analyses of the moderating effect of overcommitment were comparable to the results without overcommitment. Again, most results were valid across samples, with the exception of some analyses with regard to job satisfaction and the frequency index. The results for the frequency index showed the most differences across samples. Therefore, caution is advised in interpreting these results, as they may be specific to the particular sample under study. However, in general, the results of Study 1 could be replicated in Study 2, showing that the analyses were reasonably valid.

In conclusion, most interactions between demands and rewards that were found to predict employee well-being over time were composed of specific demands (i.e., emotional demands) as well as specific rewards (i.e., salary or esteem), lending support to the specificity hypothesis. Therefore, the question "Is specifying its components rewarding?", as displayed in the title of this chapter, can be answered affirmatively. Furthermore, the demands-rewards interactions showed that a combination of high demands and low rewards led to most strain two years later, supporting the ERI hypothesis. Almost no support was found for the ERI Model's assumptions about overcommitment. That is, overcommitment did not predict employee well-being over time (overcommitment hypothesis), and (with the exception of sickness absence frequency) adverse well-being effects of an effort-reward imbalance were not more pronounced in highly overcommitted employees (interaction ERI*OVC hypothesis). Cross-validation analyses showed that most of the results can be viewed as robust across human service samples. The only results that appear to be sample-specific are the coefficients for rewards and salary in the prediction of job satisfaction, and the coefficients for the interaction terms including emotional demands. All other results (including the other coefficients observed for job satisfaction and the frequency index) were similar across samples and thus appear to be valid.

The theoretical and practical implications of the results of this chapter will be discussed in the final chapter. In addition, this final chapter will provide an overview of all results of the present and previous chapters.

Table 7.1 Means, standard deviations, test-retest reliability (r_t), and correlation matrix for panel group in Study 1 (N = 267).

	M	*SD*	r_t	1.	2.	3.	4.	5.	6.	7.	8.	8a.	8b.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Gender [a] (1)	0.09	0.28	-																				
2. Age (1)	39.0	8.7	-	.16*																			
3. Education (1)	3.90	1.29	-	.22*	-.12*																		
4. Effort (1)	1.97	0.57	.47*	.01	-04	.07																	
5. Mental demands (1)	3.16	0.69	.55*	-.06	.04	.02	.65*																
6. Emotional demands (1)	2.97	0.51	.61*	.05	-.16*	.19*	.49*	.42*															
7. Physical demands (1)	3.04	0.91	.77*	-.24*	-.22*	.20*	.38*	.39*	.28*														
8. Rewards (1)	3.59	0.42	.38*	-.06	.06	.11	-.37*	-.26*	-.37*	-.26*													
a) Salary (1)	3.41	0.63	.42*	-.09	.10	.05	-.22*	-.10	-.20*	-.22*	.84*												
b) Esteem (1)	3.70	0.45	.29*	-.01	-.03	.12	-.31*	-.25*	-.33*	-.19*	.84*	.47*											
9. Overcommitment (1)	2.05	0.54	.48*	-.01	.17*	-.00	.18*	.17*	.07	-.09	-.16*	-.02	-.26*										
10. Job satisfaction (1)	3.92	0.88	.39*	-.05	-.08	.05	-.20*	-.12*	-.08	-.12	.46*	.44*	.43*	-.21*									
11. Psychosomatic complaints (1)	4.27	2.86	.57*	-.19*	-.01	-.16*	.17*	.12*	.11	.16*	-.27*	-.13*	-.31*	.36*	-.25*								
12. Exhaustion (1)	1.36	0.96	.50*	-.10	.00	-.05	.37*	.26*	.25*	.20*	-.35*	-.18*	-.37*	.37*	-.37*	.60*							
13. Sickness absence – FI (1)	1.30	1.55	.42*	-.05	-.08	-.14*	.11	.15*	.15*	.14*	-.23*	-.15*	-.20*	.05	-.10	.17*	.24*						
14. Sickness absence – T-LI (1)	3.05	4.06	.15*	-.12	-.04	-.14*	.09	.05	.08	.10	-.16*	-.09	-.17*	.05	-.09	.20*	.22*	.73*					
15. Job satisfaction (2)	4.08	0.78	.39*	-.06	.07	-.03	-.13*	-.08	-.13*	-.10	.35*	.41*	.24*	-.10	.39*	-.13*	-.14*	-.04	.01				
16. Psychosomatic complaints (2)	3.79	2.87	.57*	-.15*	-.11	-.15*	.14*	.09	.11	.22*	-.15*	-.12	-.15*	.20*	-.05	.57*	.34*	.22*	.23*	-.28*			
17. Exhaustion (2)	1.17	0.85	.50*	-.06	-.17*	-.03	.17*	.19*	.12	.18*	-.21*	-.12	-.20*	.19*	-.15*	.40*	.50*	.18*	.14*	-.30*	.61*		
18. Sickness absence – FI (2)	1.30	1.33	.42*	-.02	-.12	-.05	.05	.14*	.07	.14*	-.13*	-.12	-.09	-.03	-.09	.04	.04	.42*	.23*	-.13*	.17*	.14*	
19. Sickness absence – T-LI (2)	3.31	3.67	.15*	-.09	-.09	-.03	.05	.10	.09	.11	-.15*	-.14*	-.11	.08	-.11	.12	.05	.21*	.15*	.05	.18*	.06	.52*

* p < .05, two-tailed

[a] Gender was coded 0 (males) and 1 (females); [b] internal consistency is represented by KR-20 as the scale only comprises two answer possibilities.

Key (1) = Time 1; (2) = Time 2; FI = Frequency Index; T-LI = Time-Lost Index

Table 7.2 Regression results: effects of Time 1 job demands and rewards on Time 2 job satisfaction in Study 1 (n = 223 due to listwise deletion)

	Job Satisfaction																							
	Effort						Mental Demands						Emotional Demands						Physical Demands					
	Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Gender	-.12		-.10		-.16		-.14		-.10		-.18		-.13		-.11		-.16		-.14		-.10		-.19	
Age	-.01†		-.01		-.01*		-.01†		-.01		-.01*		-.01†		-.01		-.01*		-.01†		-.01		-.01†	
Education	-.03	.024	-.02	.024	-.02	.024	-.02	.024	-.02	.024	-.02	.024	-.02	.024	-.02	.024	-.01	.024	-.03	.024	-.02	.024	-.02	.024
2 Dep. T1	.29**	.162	.28**	.162	.33**	.162	.28**	.162	.28**	.162	.33**	.162	.29**	.162	.28**	.162	.34**	.162	.29**	.162	.28**	.162	.32**	.162
3 Effort	.02		.01		-.05		-.03		-.05		-.04		-.04		-.05		-.11		-.01		-.01		-.04	
Rewards	.32*	.033	.26**	.049	.12	.012	.38**	.033	.31**	.050	.17	.011	.28†	.033	.26**	.050	.07	.013	.32*	.012	.26**	.049	.18	.012
4 E * R	.22	.006	.23†	.012	.12	.002	-.10	.002	-.08	.002	-.01	.000	.41	.009	.19	.004	.36	.006	.11	.002	.14	.008	-.01	.000
R^2		.225		.247		.200		.221		.238		.197		.228		.240		.205		.221		.243		.198
Incr. F		1.66		3.19†		0.53		0.36		0.64		0.01		2.26		1.08		1.71		0.62		2.22		0.00

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; E * R= Effort * Rewards.
† p < .10; * p < .05; ** p < .01.

Table 7.3 Regression results: effects of Time 1 job demands and rewards on Time 2 exhaustion in Study 1 (*n* = 223 due to listwise deletion)

	Exhaustion																							
	Effort						Mental Demands						Emotional Demands						Physical Demands					
	Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem	
	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²
1 Gender	-.01		-.01		.00		.00		.00		.01		.01		.01		.02		.03		.02		.02	
Age	.02**		.02**		.02**		.02**		.02**		.02**		.02**		.02**		.02**		.01		.02*		.01*	
Education	-.00	.035	-.00	.035	-.00	.035	-.01	.035	-.01	.035	-.01	.035	.00	.035	.00	.035	.01	.035	-.00	.035	-.00	.035	-.00	.035
2 Dep. T1	.48**	.261	.49**	.261	.48**	.261	.47**	.261	.47**	.261	.46**	.261	.49**	.261	.49**	.261	.49**	.261	.47**	.261	.46**	.261	.46**	.261
3 Effort	-.07		-.09		-.05		.05		.03		.06		-.17		-.17		-.17		.05		.05		.05	
Rewards	.00	.001	-.00	.001	-.02	.001	.02	.002	-.00	.002	-.02	.002	-.06	.007	-.05	.007	-.07	.007	.03	.003	.00	.003	-.01	.003
4 E * R	-.14	.002	-.19	.006	-.01	.000	-.07	.000	-.11	.003	.10	.001	-.05	.000	-.02	.000	.06	.000	-.03	.000	-.04	.000	.04	.000
R²		.299		.303		.297		.298		.301		.299		.303		.303		.303		.299		.299		.299
Incr. F		0.57		1.73		0.00		0.14		0.84		0.34		0.03		0.00		0.04		0.03		0.19		0.08

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; E * R = Effort * Rewards.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table 7.4 Regression results: effects of Time 1 job demands and rewards on Time 2 psychosomatic health complaints in Study 1 (*n* = 223 due to listwise deletion)

	Psychosomatic Health Complaints																							
	Effort						Mental Demands						Emotional Demands						Physical Demands					
	Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem	
	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²	B	ΔR²
1 Gender	-.32		-.34		-.32		-.22		-.30		-.21		-.25		-.30		-.26		-.08		-.15		-.12	
Age	.04*		.04*		.04*		.04*		.04*		.04*		.04*		.04†		.04†		.03		.03		.03	
Education	-.18	.072	-.16	.072	-.20	.072	-.18	.072	-.17	.072	-.18	.072	-.18	.072	-.16	.072	-.18	.072	-.14	.072	-.13	.072	-.15	.072
2 Dep. T1	.58**	.291	.57**	.291	.58**	.291	.57**	.291	.56**	.291	.57**	.291	.58**	.291	.57**	.291	.58**	.291	.57**	.291	.56**	.291	.57**	.291
3 Effort	.14		.04		.24		.35		.30		.34		.10		.02		.13		.35†		.33†		.35†	
Rewards	.46	.004	.11	.004	.53	.004	.08	.005	-.11	.005	.14	.006	.20	.000	-.06	.001	.15	.001	.27	.011	-.02	.010	.35	.011
4 E * R	-1.30*	.014	-1.18**	.021	-.87	.008	.38	.002	.11	.000	.27	.001	-.76	.002	-.40	.001	.02	.000	-.20	.000	-.04	.000	-.33	.001
R^2		.381		.388		.375		.370		.368		.370		.365		.365		.364		.374		.373		.375
Incr. F		4.95*		7.41**		2.59		0.46		0.09		0.25		0.69		0.41		0.00		0.19		0.01		0.53

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.

Key. Dep. T1 = dependent variable at Time 1; E * R = Effort * Rewards.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table 7.5 Regression results: effect of Time 1 job demands and rewards on Time 2 sickness absence – time-lost index in Study 1 (*n* = 217 due to listwise deletion)

	Time-Lost Index																							
	Effort						Mental Demands						Emotional Demands						Physical Demands					
	Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Gender	-.88		-.94		-.81		-.83		-.92		-.75		-.94		-1.00		-.88		-.78		-.85		-.71	
Age	.04		.03		.04		.04		.04		.05		.04		.03		.04		.04		.03		.04	
Education	.01	.019	-.00	.019	-.01	.019	-.01	.019	-.01	.019	-.02	.019	-.01	.019	-.01	.019	-.05	.019	.05	.019	.04	.019	.06	.019
2 Dep. T1	.09	.014	.09	.014	.09	.014	.09	.014	.09	.014	.09	.014	.09	.014	.09	.014	.10	.014	.10	.014	.09	.014	.11†	.014
3 Effort	.07		.18		.15		.51		.53		.53		.32		.31		.56		.27		.25		.31	
Rewards	-.91	.011	-.83†	.017	-.34	.006	-.75	.019	-.73†	.025	-.35	.014	-.38	.013	-.58	.008	.14	.008	-.42	.015	-.60	.020	.02	.011
4 E * R	.19	.000	.53	.002	-.36	.000	.40	.001	.46	.002	.06	.000	-2.37†	.013	-.66	.002	-2.88*	.020	-.93	.008	-.21	.001	-1.19†	.014
R^2		.044		.052		.039		.053		.060		.047		.059		.054		.061		.056		.054		.058
Incr. F		0.04		0.61		0.18		0.22		0.64		0.01		2.83†		0.50		4.42*		1.79		0.18		3.14†

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; E * R = Effort * Rewards.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table 7.6 Regression results: effects of Time 1 job demands and rewards on Time 2 sickness absence – frequency index in Study 1 (n = 217 due to listwise deletion)

	Frequency Index																							
	Effort						Mental Demands						Emotional Demands						Physical Demands					
	Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem		Reward		Salary		Esteem	
	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1 Gender	.21		.21		.24		.25		.23		.26		.23		.23		.23		.29		.28		.26	
Age	.01		.01		.01		.01		.01		.01		.01		.01		.01		.01		.01		.01	
Education	-.04	.017	-.04	.017	-.04	.017	-.05	.017	-.04	.017	-05	.017	-.03	.017	-03	.017	-.04	.017	-02	.017	-.02	.017	-.02	.017
2 Dep. T1	.35**	.162	.35**	.162	.36**	.162	.34**	.162	.34**	.162	.35**	.162	.35**	.162	.36**	.162	.36**	.162	.35**	.162	.35**	.162	.35**	.162
3 Effort	-.02		-.03		.01		.31*		.29*		.33*		-.15		-.15		-.08		.15		.14		.14	
Rewards	-.03	.000	-.03	.001	-.02	.000	.07	.02	.00	.021	.05	.022	.05	.002	-.04	.002	.16	.001	.15	.008	.02	.008	.20	.008
4 E * R	-.12	.001	-.14	.001	.01	.000	.07	.001	-.05	.000	.23	.002	-1.01*	.015	-.30	.004	-1.15*	.022	-.37	.008	-.11	.001	-.43†	.013
R^2		.180		.181		.179		.201		.200		.203		.197		.185		.202		.195		.188		.200
Incr. F		0.14		0.35		0.00		0.05		0.06		0.62		4.00*		0.80		5.53*		2.17		0.37		3.33†

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; E * R = Effort * Rewards.
† $p < .10$; * $p < .05$; ** $p < .01$.

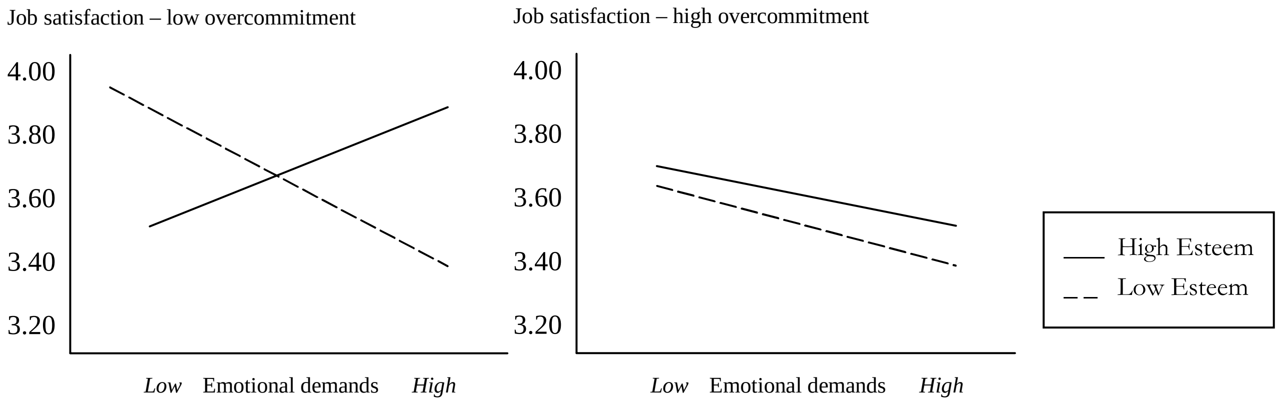


Figure 7.10 Three-way interaction between emotional demands, esteem and overcommitment for job satisfaction

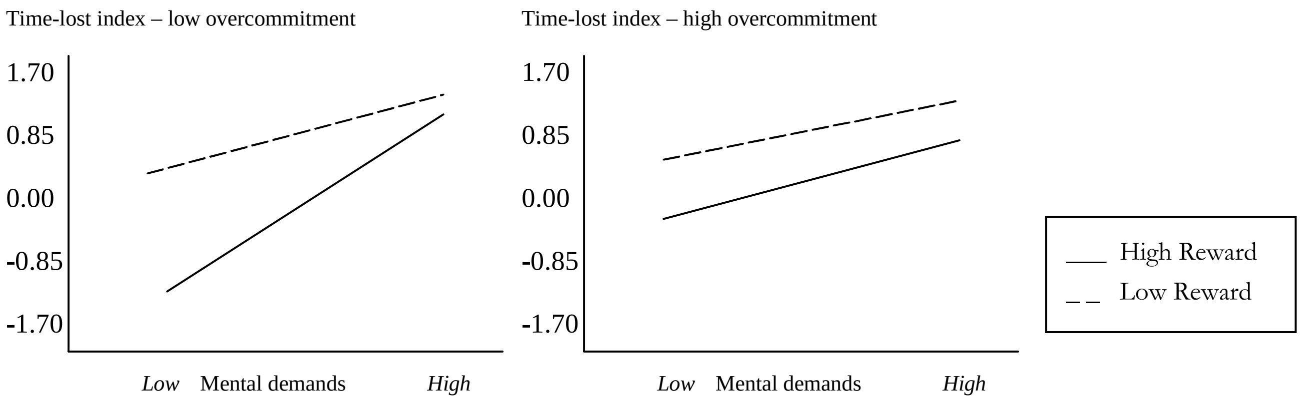


Figure 7.11 Three-way interaction between mental demands, reward and overcommitment for the (sickness absence) time-lost index

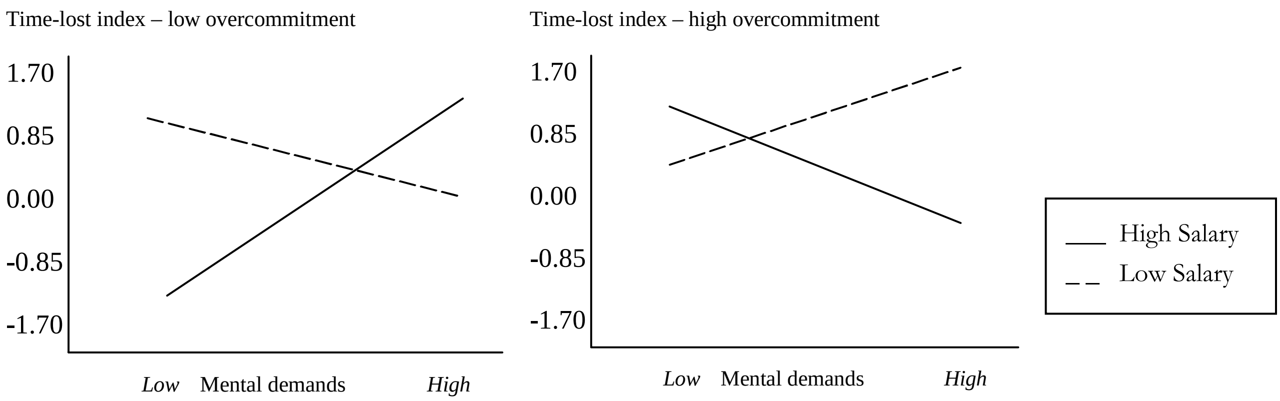


Figure 7.12 Three-way interaction between mental demands, salary and overcommitment for the (sickness absence) time-lost index

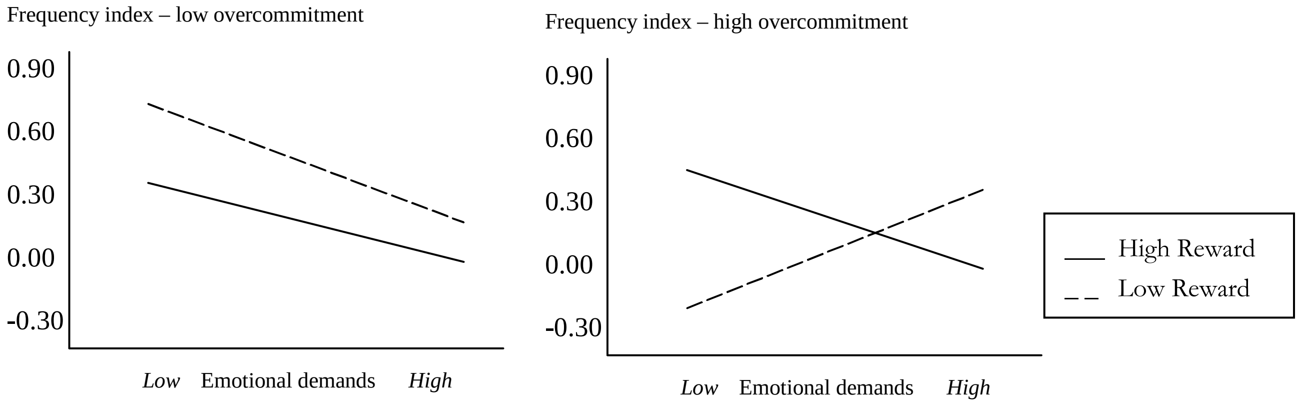


Figure 7.13 Three-way interaction between emotional demands, reward and overcommitment for the (sickness absence) frequency index

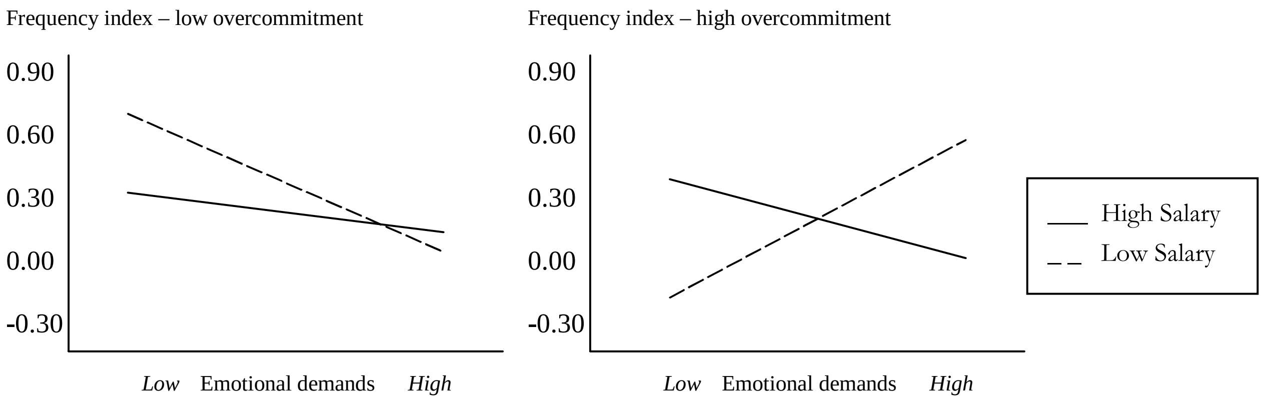


Figure 7.14 Three-way interaction between emotional demands, salary and overcommitment for the (sickness absence) frequency index

8

Main conclusions and general discussion

The previous chapters dealt with several theoretical and empirical issues regarding the combined effects of job demands and job resources in the prediction of employee well-being. Two leading work stress models, the Demand-Control (DC) Model and the Effort-Reward Imbalance (ERI) Model, served as a theoretical framework for studying the association between job characteristics and employee well-being in two samples of human service employees. Based on a critical overview of these models, the present thesis focused on two issues regarding demand-resource interactions, namely (1) the statistical operationalization of the relation between job demands, job resources, and employee well-being, and (2) the notion of specificity (i.e., a more specific operationalization of job demands and job resources).

In this final chapter, the general conclusions that can be drawn from the research findings are discussed. First, Section 8.1 provides an overview of the main findings. In Section 8.2, some methodological considerations will be discussed that should be taken into account when interpreting the results of this study. In Sections 8.3 and 8.4, respectively theoretical and practical implications will be considered. Finally, Section 8.5 offers recommendations for future research.

8.1 Summary of main findings

In the present section, the main findings of this thesis will be presented in the same sequence as in the previous chapters. As the main focus of this thesis is on the combined effects of job demands and job resources (i.e., the demand-resource interaction) in relation to well-being in human service employees, this section will discuss the general findings with special reference to this demand-resource interaction. First, the main findings concerning the various statistical operationalizations of the interaction term will be presented. Second, the main findings concerning general and more specific operationalization of the main components of the interaction (job demands and job resources) will be discussed, with special reference to the notion of specificity. And finally, the main findings with respect to the key hypotheses of the DC Model and the ERI Model will be discussed.

Before presenting the main findings with respect to the above-mentioned issues (i.e., statistical operationalization and specificity), the main conclusions of the critical overview of the DC Model and the ERI Model (Chapter 2) will be presented, as these conclusions formed the impetus for researching these key issues. As such, the discussion of the main conclusions of the reviews can be seen as a kind of prologue. In Chapter 2, it was concluded that the DC Model and the ERI Model can be regarded as balance models; that is, in both models the absence or presence of a state of balance between demands and resources determines the state of employee well-being. Therefore, most comments relate to the DC Model as well as the ERI Model, and for this reason these comments will be discussed for the two models at the same time.

Both the DC Model and the ERI Model have proven to be valuable models for studying the relationship between job characteristics and employee well-being. A large number of empirical studies support the notion that the combination of high job demands (either demands or effort) and low job resources (either control or rewards) has a negative effect on employee well-being (for an overview, see for instance Tsutsumi & Kawakami, 2004; van der Doef & Maes, 1999; van Vegchel, de Jonge, Bosma, & Schaufeli, 2005). However, it is less clear whether this combination indeed represents an interaction between demands and resources. An interaction can be defined as a combined effect of high job demands and low job resources that exceeds the sum of the separate effects of high demands and low resources on employee well-being. Due to an interplay between demands and resources whereby they reinforce each other, there is an extra strong effect on employee well-being (over and above the main effects). With respect to the DC Model, Van der Doef and Maes (1998; 1999) distinguished the strain hypothesis (based on main effects) from the buffer hypothesis (based on true statistical interactions). They concluded that, in comparison with the strain hypothesis, the buffer hypothesis has been examined in a relatively limited number of studies, and that these studies have shown inconsistent results with respect to demand-control interactions. For the ERI Model, on the other hand, a true statistical interaction between effort and rewards (over and above main effects) has not often been examined (Belkiç et al., 2000), and therefore the effects of effort-reward interactions on employee well-being are largely unknown.

Furthermore, there is some confusion regarding the exact mathematical formulation and/or statistical operationalization of the interaction term. That is, for the DC Model and the ERI Model various mathematical formulations have been used to operationalize the relation between job demands, job resources, and employee well-being. In addition, many ERI studies have used dichotomized variables and logistic regression analyses, both for naturally dichotomous and (dichotomized) continuous variables. However, in the case of continuous variables it is advisable to use continuous analyses (e.g., hierarchical regression analyses) including a continuous effort-reward interaction (e.g., multiplicative term). Several authors have argued that the detection of significant interaction effects may be influenced by the mathematical formulation of the interaction term (e.g., de Jonge, van Breukelen, Landeweerd, & Nijhuis, 1999; Landsbergis, Schnall, Warren, Pickering, & Schwartz, 1994). More importantly, however, it is unknown whether these different formulations and operationalizations have different meanings and interpretations. Therefore, more information about the exact meanings and interpretations of different types of interactions is needed.

Also, the probability of finding significant interactions may be affected by the conceptualization and operationalization of the two main concepts in the models, namely demands and control in the case of the DC Model, and effort and rewards in the case of the ERI Model (e.g., de Jonge & Dormann, 2003; Kasl, 1996; Wall, Jackson, Mullarkey, & Parker, 1996). An important feature that seems to distinguish supportive from non-supportive DC studies seems to be the *specificity* with which demands and/or resources are measured (e.g., Sargent & Terry, 1998; van der Doef & Maes, 1999). Needless to say, specificity may also be an important issue in the case of the ERI Model, which includes general demand and resource measures. In addition, the use of more specific measures may also enhance the applicability of the models to specific occupations, such as human service work. Hence, a theoretical and empirical enquiry into specificity appears be warranted.

Finally, most empirical studies testing the DC Model and/or the ERI Model have used a cross-sectional design. Only a limited number of longitudinal studies have tested demand-resource interactions, so there is no basis for firm conclusions. Moreover, in the case of the DC Model only a few longitudinal studies have tested behavioral outcomes such as sickness absence (de Lange, Taris, Kompier, Houtman, & Bongers, 2003), and in the case of the ERI Model only a few longitudinal studies have investigated behavioral outcomes and psychological well-being (van Vegchel et al., 2005). For this very reason, there is a need for longitudinal research, especially longitudinal studies examining the interactive effect of demands and resources in relation to behavioral outcomes and psychological well-being over time.

In conclusion, based on a review of the DC Model and the ERI Model, priority was given to the following issues surrounding demand-resource interactions, which concern whether or not the combined effect of job demands and job resources is adequately represented:

(1) the statistical operationalization of the relation between job demands, job resources, and employee well-being;
(2) the notion of specificity, that is, whether general versus specific measures of demands and job resources should be used to predict well-being over time.

Although the focus is on these two issues, the DC Model and the ERI Model were implicitly tested as well. So, an additional third issue will be discussed:

(3) whether cross-sectional and longitudinal data analyses support the main assumptions of the DC Model and the ERI Model.

The main findings in relation to these issues will be discussed in the following sections.

8.1.1 The statistical operationalization of demand-resource interactions

The first part of this thesis focused on the statistical operationalization of the relation between job demands and job resources. In other words, the mathematical formulation of the interaction term was investigated. The research question was formulated as follows:

How have interactions been conceptualized in the Demand-Control and Effort-Reward Imbalance literature, and to what extent do these conceptualizations correspond to the key assumptions of the Demand-Control Model and the Effort-Reward Imbalance Model?

The literature on the DC Model shows that a relative excess term was originally suggested by Karasek (1979) to operationalize the relation between demands, resources, and strain (i.e., | demands – resources + constant |). Nevertheless, most researchers have used the multiplicative term (i.e., demands * resources) or the ratio term (i.e., demands / resources) to test the DC Model (e.g., Landsbergis et al., 1994; Landsbergis & Theorell, 2000). The literature on the ERI Model articulates no theoretical preference for one particular interaction term, but by far most empirical studies have used a ratio term (i.e., resources divided by demands). So within the DC Model and the ERI Model the relation between demands, resources, and strain is usually operationalized statistically with the relative excess term, the multiplicative term, or the ratio term. However, thus far the authors of neither the DC Model nor the ERI Model have offered a clear theoretical rationale for preferring one interaction term over another.

A thorough empirical test was conducted to explore the impact of operationalizing the relation between job demands and job resources by means of different interaction terms. The main DC and ERI interactions (i.e., the relative excess term, the multiplicative interaction, and the ratio term) were empirically tested. In short, results showed that the multiplicative term yielded the most consistent results for the DC Model as well as the ERI Model. Namely, whenever significant interaction term(s) were observed, one of these terms was the multiplicative term. For the DC Model, the ratio term also yielded consistent results. These results were successfully cross-validated in a second independent sample (i.e., Study 2), indicating that the results are not artifacts of a particular sample but can be observed in other comparable human service samples as well.

Nevertheless, according to Edwards and colleagues' (1994; 1990; 1993) three-way classification of interaction terms, the relative excess, multiplicative, and ratio terms can be classified as descriptive, multiplicative, and ratio terms, respectively. These interaction terms are fundamentally different with respect to form and content (Edwards & Cooper, 1990). Therefore, it remains to be seen whether these interaction terms correspond to the key assumptions of the DC Model and the ERI Model. In the section on theoretical implications, the meaning and interpretation of the different interaction terms will be further discussed, together with the support observed for the main hypotheses of both models.

8.1.2 General versus specific job demands and job resources

The second part of this thesis focused on the use of more specific measures as opposed to general measures when investigating interactions between job demands and job resources in relation to employee well-being. The following hypothesis was formulated for this purpose, termed the "specificity hypothesis":

> *The likelihood of finding interactions between job demands and job resources in analyses of employee well-being outcomes is higher when more specific as compared with more general measures of job demands and job resources are used.*

In investigating the specificity hypothesis, it is possible to look at general versus specific job demands, as well as general versus specific job resources (see Table 8.1), and to look at combinations of job demands and job resources that range from completely general (both demands and resources measured generally) to completely specific (both demands and resources measured specifically, see Table 8.2). As can be seen in Table 8.1, the demand construct that yielded the most significant (multiplicative) interactions was emotional demands, in the case of both the DC Model and the ERI Model (i.e., nine out of fifteen interactions [or 60%] and four out of nine interactions [or 27%], respectively). Furthermore, interactions including a general demand construct were observed: JCQ demands for the DC Model (27%) and effort for the ERI Model (20%). Finally, two interactions including mental demands were observed for the DC Model (13%), whereas two interactions including physical demands were observed for the ERI Model (13%). In sum, emotional demands seem to be as important as, or even more important than, the original demand constructs (i.e., JCQ demands and effort). Therefore, it seems important to include emotional demands if interaction effects are to be detected, lending support to the specificity hypothesis.

Table 8.1 Number of interactions observed for each demand and resource construct from the DC Model and the ERI Model

		Maximum expected	Observed - DC Model	= %		Maximum expected	Observed - ERI Model	= %
General demands:	JCQ-D	15	4	27%	Effort	15	3	20%
Specific demands:	- MD	15	2	13%	- MD	15	0	0%
	- ED	15	9	60%	- ED	15	4	27%
	- PhD	15	0	0%	- PhD	15	2	13%
Total		*60*	*15*	*25%*		*60*	*9*	*15%*
General resources:	DL	20	6	30%	CR	20	3	15%
Specific resources:	- SkD	20	2	10%	- Sal	20	2	10%
	- DA	20	7	35%	- Est	20	4	20%
Total		*60*	*15*	*25%*		*60*	*9*	*15%*

Key. JCQ-D = JCQ demands; MD = mental demands; ED = emotional demands; PhD = physical demands; DL = decision latitude; SkD = skill discretion; DA = decision authority; CR = composite rewards; Sal = salary; Est = esteem.

With regard to job resources in the DC Model, Table 8.1 shows that most of the significant demand-control interactions included decision authority (35%), followed closely by the general decision latitude construct (30%). For the ERI Model, esteem was most often a component of the significant effort-reward interactions (20%), followed closely by composite rewards (15%) and salary (10%). In other words, for both models the inclusion of a specific resource construct (i.e., decision authority or esteem) in the interaction term yielded the most significant interactions, in terms of both absolute numbers and percentages. As such, the examination of more specific resource constructs, such as decision authority and esteem, seems to be important for the detection of demand-resource interactions, supporting the specificity hypothesis.

Table 8.2 displays different combinations of demands and resources, varying from completely general measures (general demands and general resources) to mixed measures (general demands and specific resources, or specific demands and general resources) and finally to completely specific measures (specific demands and specific resources). As can be seen in Table 8.2 for both the DC Model and the ERI Model, the more specific the measures used to construct the interaction term, the more significant interactions were found. For both models, the most interactions were found when both specific demands and specific resources were included (i.e., seven for DC Model and four for ERI Model). For this reason the specificity hypothesis seems to be supported in *absolute numbers*.

Table 8.2 Number of interactions observed for different demand-resource combinations in the DC Model and the ERI Model

	Maximum expected	Observed - DC Model	= %	Maximum expected	Observed - ERI Model	= %
General demands – general resources	5	2	40%	5	1	20%
General demands – specific resources	10	2	20%	10	2	20%
Specific demands – general resources	15	4	27%	15	2	13%
Specific demands – specific resources	30	7	23%	30	4	13%
Total	*60*	*15*	*25%*	*60*	*9*	*15%*

However, in *relative* numbers (i.e., the percentage of significant interactions relative to possible interactions) a quite different picture emerges: the more general measures that were included in the interaction term, the more significant interactions were found. The probability of observing interactions including specific variables was *not* higher in our study. Nevertheless, it should be considered that only five "general interactions" were tested as opposed to 30 "specific interactions" and 25 "mixed interactions". This means that when a significant "general interaction" was found, the percentage of significant interactions increased immediately by 20% (as compared to an increase of 4% in the case of one mixed interaction, and 3.3% in the case of one specific interaction). However, it should be mentioned that most of the (more specific) interactions that were found represent theoretically sound combinations of particular demands and corresponding resources (for a more detailed discussion, see Section 8.3.2).

In conclusion, although the relative number of specific demand-resource combinations is not in line with the specificity hypothesis, the absolute number is. Moreover, in the case of job demands both the absolute and the relative number of significant interactions including specific job demands (i.e., emotional demands) exceeded the number including general demand constructs. In a similar vein, there were more significant interactions involving specific job resources (i.e., decision authority for DC Model and esteem for ERI Model) as opposed to general job resources, in absolute and relative terms. All in all, the measurement of specific demands, specific resources, and specific demand-resource combinations seemed to lead to better detection of interaction effects in human service workers. In this sense, the specificity hypothesis seems to be confirmed. Hence, including more specific measures would improve both DC theory and ERI theory.

8.1.3 Two models at work in relation to employee well-being

The DC Model and the ERI Model served as the theoretical framework for investigating the interaction between job demands and job resources in relation to employee well-being. Both models were tested cross-sectionally (Chapter 4) as well as longitudinally (Chapter 6 and 7). First, the main findings regarding the core assumption of the DC Model will be discussed, followed by a similar discussion for the ERI Model.

The core assumption from the DC Model, known as the *strain hypothesis* (cf. Karasek & Theorell, 1990), can be formulated as follows:

> *A condition combining high job demands and low job control will lead to the most adverse well-being effects in comparison with high demands – high control, low demands – low control, and low demands – high control conditions.*

The cross-sectional examination of the DC Model, which was mainly focused on a comparison of different interaction terms (Chapter 4), indicated that the demand-control interaction was significantly associated with all of the self-reported well-being outcomes (e.g., job satisfaction, exhaustion, and psychosomatic health complaints). The form of the interaction differed (depending on the type of interaction: multiplicative, relative excess, or ratio), but *all* interactions showed that the most strain was experienced by employees reporting both high job demands and low job control (i.e., decision latitude). Therefore, the DC Model was supported by these cross-sectional analyses for self-reported well-being. However, *none* of the demand-control interaction terms turned out to be significant for company-registered sickness absence (both the time-lost and frequency indices). In sum, the DC Model was cross-sectionally supported with regard to self-reported health (i.e., job satisfaction, exhaustion, and psychosomatic health complaints), but *not* with regard to sickness absence (frequency and duration). In other words, job control appeared to buffer the negative effects of (high) job demands on self-reported well-being, but not on sickness absence. To put it differently, high job demands were not necessarily associated with poor employee well-being. Only human service employees with low job control experienced lower well-being, whereas employees with high job control experienced either higher or equivalent levels of well-being.

The longitudinal study examining specificity (Chapter 6) showed that, depending on the type of demand and control constructs used, different interactions were significant. Based on this research it is more difficult to conclude whether or not the DC Model was supported, as twelve different demand-control combinations were tested for each outcome variable. Looking at the original formulation (i.e., JCQ demands and decision latitude), the DC Model was only supported in relation to the outcomes job satisfaction and exhaustion, although it should be noted that an interaction between JCQ demands and decision authority was also found for job satisfaction and psychosomatic health complaints. Hence, support was only found with respect to self-reported well-being. However, including more specific demands (especially emotional demands) and specific control measures (mainly decision authority) yielded some additional interactions for the self-reported health variables as well as for sickness absence frequency. A total of 15 significant demand-control interactions (25% of the total number of interactions that was tested) were found over time. This exceeds chance levels (i.e., 10%), and the sequential Bonferroni procedure (cf. Daniels & Harris, 2005; Holm, 1979) indicated that capitalization on chance was hardly of any importance for the outcomes job satisfaction and psychosomatic health complaints. Two interactions (i.e., emotional demands * decision latitude, and emotional demands * skill discretion, both for sickness absence frequency) showed that the most adverse health effects were found for employees experiencing low demands and high control; however, all other interactions showed that the most adverse health effects were found when demands were high and job control was low, supporting the strain hypothesis in the prediction of (self-reported) employee well-being. That is, human service employees who experienced high job demands and low job control reported more strain two years later.

The main hypothesis of the ERI Model, known as the effort-reward imbalance (ERI) hypothesis, states that (cf. Siegrist, 2002):

> *A condition combining high effort and low rewards will lead to the most adverse well-being effects in comparison with high effort – high rewards, low effort – low rewards, and low effort – high rewards conditions.*

The cross-sectional research, mainly aimed at testing different interaction terms (Chapter 4), showed that the interaction between effort and rewards was associated with job satisfaction, sickness absence duration, and sickness absence frequency. *No* such associations were found for the outcomes exhaustion and psychosomatic health complaints. Depending on the type of interaction (multiplicative, relative excess, or ratio) the form of the interaction differed, but for *all* interactions the most strain was experienced by employees who reported high effort and low rewards. Therefore, the ERI hypothesis was supported with respect to job satisfaction and sickness absence (both duration and frequency), but *not* for exhaustion and psychosomatic health complaints.

The longitudinal analyses with respect to the ERI Model (Chapter 7), which were originally designed to study specificity, showed that the significance of the various demand-reward interactions depended on the type of demands and rewards that were included in the interaction term. Including the original constructs, effort and (composite) rewards, yielded just one significant interaction in relation to psychosomatic health complaints. Including specific demands and the specific components of rewards showed additional interaction effects for job satisfaction and sickness absence (time-lost and frequency index). In total, nine interactions (i.e., 15% of all tested interactions) were found, which exceeds the level that would be expected by chance (i.e., 10%). Moreover, a sequential Bonferroni procedure (cf. Daniels & Harris, 2005; Holm, 1979) showed that capitalization on chance was particularly unlikely with respect to the findings for psychosomatic health complaints and sickness absence frequency. All interactions were in the expected direction: demands were positively associated with strain over time, and rewards were negatively associated with strain two years later. However, four interactions suggested that the combination of low demands and high rewards led to the most adverse effects on well-being (i.e., psychosomatic health complaints and sickness absence frequency) two years later. The other interactions showed the most adverse health effects for employees who had previously reported high effort and low rewards, as is assumed by the ERI hypothesis. Therefore, only modest support was found for the ERI hypothesis in the prediction of employee well-being (i.e., with support observed mainly in relation to job satisfaction and the sickness absence time-lost index).

In the longitudinal analyses, the effect of the personality characteristic overcommitment was tested as well (see Chapter 7). The ERI Model formulates two hypotheses for overcommitment, known as the overcommitment (OVC) hypothesis and the ERI*OVC hypothesis, respectively (cf. Siegrist, 2002):

Overcommitment will have:

a) a direct impact on employee well-being (i.e., overcommitment at Time 1 will lead to reduced employee well-being at Time 2);

b) a moderating effect on employee well-being (i.e., adverse well-being effects of an effort-reward imbalance will be stronger in highly overcommitted employees than in less overcommitted employees).

Overcommitment by itself did *not* predict employee well-being over time, meaning that overcommitment did not have a direct impact on employee well-being over time (i.e., OVC hypothesis rejected). Some longitudinal moderating effects of overcommitment on the relation between an effort-reward imbalance and employee well-being were found, with respect to job satisfaction and sickness absence (time-lost and frequency indices). All of the significant three-way interactions between effort, rewards, and overcommitment included either mental or emotional demands. However, the results were inconsistent: some interactions supported the ERI Model (i.e., effects of an effort-reward imbalance were stronger in highly overcommitted employees), whereas others either showed the opposite or no clear distinction between high and low overcommitment. More specifically, effects of an effort-reward imbalance were stronger in highly overcommitted employees in relation to sickness absence (mainly the frequency index), but not in relation to job satisfaction or the time-lost index, and no such moderating effects were found for psychosomatic health complaints and exhaustion. That is, strong overcommitment seemed to aggravate the negative effects of a high effort-low reward work situation on the frequency of sickness absence, but not on the other employee well-being outcomes. Therefore, in general the ERI*OVC hypothesis was not supported in this study (except in relation to the frequency index).

8.2 Methodological considerations

In the preceding sections, the main findings of this thesis were presented. Though this study has many strong points (such as cross-validation of results in a second independent sample, and longitudinal examination of the relation between work and health), it also suffers from some methodological limitations that should be considered when interpreting the findings. The following methodological considerations will be addressed: the study design, the study population, the measurement instruments, and the statistical analyses.

Study design

The present study consisted of two parts: an exploration of different interaction terms and a test of more specific measures within both models. The first part used a cross-sectional design, whereas the second part used a longitudinal design. Therefore, it is not possible to draw firm conclusions about the causal relations underlying observed results for the different interaction terms. Even though the DC Model and the ERI Model guided our assumptions about these causal relations, these results should be interpreted cautiously. Nevertheless, it should be noted that even longitudinal designs can not *prove* causality and have their own methodological limitations (Zapf, Dormann, & Frese, 1996).

A first limitation is that it is hard to determine the right time lag between two measurement moments. Basically, the measurement interval between the phases of a study should correspond to the time that a causal variable needs to affect an outcome variable (the underlying causal interval) (Frese & Zapf, 1988; Taris & Kompier, 2003). In addition, the length of this causal lag is often unknown. Based on empirical grounds, namely a multiphase study by Dormann and Zapf (2002), and on common sense (controlling for seasonal fluctuations), a time interval of exactly two years was selected. In addition, several different relationships were tested simultaneously and it is possible that different relationships have different causal lags. For instance, no effects were found for any of the combinations of effort/demands – rewards in relation to exhaustion. Perhaps the time lag of two years was not suitable for testing this association. Zapf and colleagues (1996) mentioned that overly short time lags may lead to the conclusion that no causal effects exist, whereas overly long time lags may lead to an underestimation of the true causal impact. More multiphase studies are needed to determine the appropriate causal lags for studying effects of particular job characteristics on particular outcome variables.

A second methodological pitfall of longitudinal studies is bias due to attrition (or panel loss). If non-response occurs completely at random, only the statistical conclusion validity is threatened (e.g., due to reduced sample size and statistical power). In the case of non-response that is not random, conclusions based on the study may not be valid for the total population, threatening the external validity (Hagenaars, 1990). Before examining the data in this study, non-response analyses were conducted (see Section 3.5). In general, the non-response analyses showed that the panel group scored more positively on demands/effort, rewards, and exhaustion than the dropouts. Additional non-response analyses showed that the employees who only responded at Time 2 scored somewhat more favorably than both the panel group and employees who only responded at Time 1. Calculation of Cohen's *d* indicated that these effects can be characterized as small. This suggests that the non-response may not have biased the main findings systematically.

Study population

The fact that our samples consisted of employees in a single occupational domain (i.e., nursing homes) conferred both strengths and weaknesses. An advantage is that this mostly eliminated the major socio-economic status factors that are confounded with both health status and occupational differences (cf. Ganster et al., 2001). A limitation of sampling from a single occupational domain, however, is that the variation in job characteristics might be restricted in comparison with larger multi-industry studies (e.g., Kristensen, 1995). Therefore, the power to detect interaction effects might be limited. Fortunately, health care occupations are likely to have some natural variation in job characteristics due to different specialties and different occupations within the nursing homes (Fox, Dwyer, & Ganster, 1993; Ganster, Fox, & Dwyer, 2001). Research into nursing professions is important because the quality of work and well-being in this domain has implications for the future well-being of rather large segments of industrialized working populations. Nevertheless, in order to generalize the results to other occupations (especially male populations), more research in multi-occupational groups is needed. Further investigation of gender effects may be particularly warranted, as some studies indicate that results may depend on employee gender (e.g., Peter et al., in press; Peter, Siegrist et al., 2002).

An additional point that could be made with regard to our study population is that the measurements were not completely independent of each other, as respondents were nested within departments and within nursing homes. Violation of the assumption of independence may cause overly small estimates of standard errors in standard regression models, which in turn may lead to spurious "significant" findings (cf. de Jonge, van Breukelen et al., 1999). On the other hand, empirical research shows that the additional variance that can be explained at a higher level (i.e., above the individual level) is usually no more than 10% of the variance in employee well-being and strain (van Veldhoven, de Jonge, Broersen, Kompier, & Meijman, 2002).

As with all samples from the active working population, a "healthy worker effect" may have influenced the results (cf. Zapf et al., 1996). That is, employees with adverse health reactions may be absent from work more frequently, or may have adjusted their work situation (e.g., working fewer hours, or even leaving the work force), leading to underrepresentation of these employees in our samples. So there may be a restriction of range in health and well-being outcomes.

Measurement instruments

To adhere as closely as possible to the DC Model and the ERI Model, the original questionnaires (i.e., the JCQ and the ERI-Q) were used in the present study. Several authors have criticized the conceptualization and operationalization of the main concepts within the original questionnaires (e.g., Kasl, 1996; Tsutsumi & Kawakami, 2004; Wall et al., 1996). For example, some authors have argued that the measures are too global to reveal interaction effects and that both demands and resources might have a multifaceted nature (e.g., Söderfeldt et al., 1996; Terry & Jimmieson, 1999). Although we extended the DC Model and the ERI Model by measuring several types of specific demands, we only used the original scales to represent the job-related resources (i.e., control and rewards). It would be advisable to include more (occupation-)specific variables for job resources as well. For example, instead of general measures of job control, particular forms of control such as emotional control may better reflect the occupational peculiarities of human service work (e.g., Zapf, Vogt, Seifert, Mertini, & Isic, 1999).

Another point of consideration is that the present study relied mostly on self-report questionnaires to measure the variables under investigation (i.e., job characteristics, personality characteristic, and well-being). Some authors have argued that this procedure may artificially inflate the correlations between job characteristics and employee well-being, also known as common method variance (Conway, 2002). Other authors have found little evidence for the effects of common method variance in self-report studies, and have argued that the problems with self-reported data are less serious than initially believed (Semmer, Zapf, & Greif, 1996; Spector, 1999). Moreover, in the present study several precautions were taken to reduce the problem of common method variance, for instance: classifying job characteristics in different terms from the outcome variables as much as possible; measuring the indicators with different response formats; and positioning measures of the indicators in different locations throughout the questionnaire (cf. de Jonge, 1995).

Despite these precautions, the fact that the original scales were used means that it was not possible to classify all job characteristics in different terms from the outcome variables, which may be especially questionable in the case of the response options in the ERI-Q[1]. It may be argued that whether one feels consciously "distressed" or "not distressed" about a certain work condition is not a real characteristic of the job. Frese and Zapf (1988) have argued that asking the respondent to rate the stressfulness of a situation might increase the cognitive and/or emotional processing that the item requires, elevating the risk of common method variance. However, using the original questionnaires has also advantages in terms of comparability and proximity to the original concepts as intended by the devisers of both models (cf. Beehr, Glaser, Canali, & Wallwey, 2001; Schnall, Landsbergis, & Baker, 1994). In addition, this study also included company-registered sickness absence indices to represent employee well-being. Associations were found between effort, rewards, and self-reported job satisfaction, as well as between effort, rewards, and company-registered sickness absence. Therefore, it is unlikely that the associations between effort, rewards, and employee well-being were caused solely by common method variance. Moreover, although the literature shows that associations (i.e., main effects) may be inflated by common method variance, there is no evidence that interactions, the main focus of the present study, are spuriously created by common method variance. Indeed, Wall et al. (1996) argued that spurious main effects can restrict opportunities to demonstrate any underlying interactions.

Statistical analyses

Most statistical analyses in this thesis took the form of hierarchical multiple regression analyses. Some considerations on these analyses can be mentioned. Firstly, to compare different interaction terms (as in Chapter 4) as well as different conceptualizations of job demands and job resources (as in Chapters 6 and 7) many regression analyses were conducted for each outcome variable (i.e., 12 interactions per outcome variable). Although the percentage of significant interactions was more than what would have been expected based on chance, there might still have been a capitalization on chance. Moreover, the amount of variance explained by the interaction terms was rather small (ranging from .007 to .022). However, in our opinion this does not negate the theoretical importance or mean that the interaction effects have little substantive significance (see also Frese & Zapf, 1988;

[1] In order to prevent misclassification and unanswered items, Tsutsumi (2004) has suggested using a response format with one step instead of two steps. Researchers have adopted this suggestion, and the most recent version of the ERI-Q was changed accordingly (Siegrist et al., 2004).

Wall et al., 1996). The results are nevertheless important because the size of the interaction effect is attenuated by measurement error when interaction terms are formed by multiplying variables to form cross-product terms as is required in regression analyses (Aiken & West, 1991). Also, Semmer and colleagues (1996) indicated there is an upper limit of 10% of the variance which can be explained by a stressor-strain relationship, due to methodological considerations as well as the multi-causal aetiology of (reduced) well-being. In this respect, Champoux and Peters (1987) have argued that interaction research in field investigations usually show less than 2% variance explained, similar to our findings. Moreover, the vast majority of observed interactions showed the predicted pattern. Therefore, we think that the results do have some theoretical value, distinguishing between different statistical interaction terms and between specific and general measures of job demands and job resources.

Furthermore, to examine effects on change in employee well-being over time (i.e., the longitudinal analyses in Chapter 6 and 7), we adjusted for baseline employee well-being (i.e., at the first measurement). On the one hand, this might have reduced the apparent influence of job characteristics (and overcommitment) and their interactions, in that relatively few interactions and main effects of rather small magnitude may have been observed. On the other hand, it strengthens our results, because it shows that work (and overcommitment) are predictors of employee well-being two years later independent of the state of employee well-being at the first measurement, which is normally one of the most important confounding variables (Stansfeld, Bosma, Hemingway, & Marmot, 1998).

Another point of consideration is that job security was not included as a separate specific reward in the statistical analyses, because of inconsistent results in Study 1 at Time 1. That is, the two job security items showed a near-zero correlation in the panel group in Study 1 at the first measurement. It was argued in Chapter 3 that this near-zero correlation might be attributable to a reorganization of the departments at that time, whereby employees did not fear losing their job (as is stated in item 1), but did fear changes in their position (as stated in item 2). Previous cross-sectional research has shown relationships between job security and several health outcomes, such as musculoskeletal disorders and psychosomatic complaints (Dragano, von dem Knesebeck, Rödel, & Siegrist, 2003; van Vegchel, de Jonge, Bakker, & Schaufeli, 2002). Therefore, more longitudinal research is needed that includes all three specific rewards of the ERI Model: salary, esteem *and* job security.

Finally, the results of all analyses were cross-validated in another comparable sample. However, it should be noted that the reliabilities in Study 2 were slightly lower than the reliabilities in Study 1. Because of lower reliabilities, associations between variables might be underestimated (i.e., attenuation), and so too the amount of explained variance (e.g., Dooley, 1984). These factors may have influenced the cross-validation. Nevertheless, most results could still be successfully cross-validated, providing evidence that the results are not an artifact of the specific sample under study, but were instead valid and applicable to other comparable human service professions as well.

Given the strengths and weaknesses of this study, it is possible to consider its theoretical and practical implications. In the next two sections, theoretical and practical implications will be discussed, taking into account the considerations addressed in the present section.

8.3 Theoretical implications

This section contains an overview of the theoretical implications of this thesis. Firstly, this section discusses the theoretical implications of different statistical operationalizations of interaction terms, and how they fit in with the DC Model and the ERI Model. Secondly, theoretical implications for the notion of specificity will be discussed, considering specific demand-resource combinations as well as specific job demands and job resources separately. Finally, because the DC Model and the ERI Model served as the theoretical framework for all studies, this section includes a theoretical consideration of both models and their implications for the association between job characteristics and employee well-being.

8.3.1 Statistically different interaction terms and demand-control and effort-reward imbalance theory

On the whole, the classification of interactions from Edwards and Cooper (1990) fits in with the interaction terms that have been used in empirical research to operationalize the interaction between job demands and job resources in relation to employee well-being (i.e., subtractive term, interactive term, ratio term). Because Edwards and Cooper (1990) have argued that these interaction terms are fundamentally different from each other with respect to form, meaning and interpretation, the interaction terms that have been used in empirical research may be fundamentally different as well. To consider these interaction terms in greater depth, a description of each interaction term will be given (see also Chapter 4, Figure 4.1, for a graphical representation of the interaction terms). Firstly, the *relative excess* term defines job strain as the absolute value of demands minus resources plus a constant. Strain will only be experienced when demands are greater than (or exceed) resources. More concretely, the highest amount of strain is to be expected in the high demands – low resources condition, whereas for the other conditions strain is equally low. Secondly, the *multiplicative interaction* is similar to a buffer or moderator effect (cf. Cohen & Wills, 1985): job resources modify the relation between job demands and strain. Strain is experienced both in the high demands – low resources condition and in the low demands – high resources condition. Hardly any strain is experienced in the low demands – low resources condition or in the high demands – high resources condition. Especially this last combination shows the moderating effect of high resources. That is, even though demands are high, a large amount of resources prevents the experience of strain. Thirdly, the proportional or *ratio term* implies that the amount of job resources in proportion to the amount of job demands (demands/resources) influences the amount of strain that is experienced. Most strain will be experienced in the high demands – low resources condition, whereas strain will be lowest in the opposite case. For the other conditions, an average (low) amount of strain will be experienced. Job resources contribute to the proportional part. When a large amount of resources is available strain will never increase very sharply; however, in the absence of resources strain will increase very sharply when demands increase.

The interaction terms have several similarities and differences. One similarity between the relative excess, the multiplicative, and the ratio term is that in all three cases the most strain is expected in the high demands – low resources condition. Of course, this is an important assumption of both the DC Model and the ERI Model. A second similarity can be easily seen when the values of the extreme conditions are depicted in a diagram, as in Figure 8.1. It should be noted that the hypothetical values of the extreme conditions are based on the extreme values as displayed in Chapter 4, Figure 4.1.

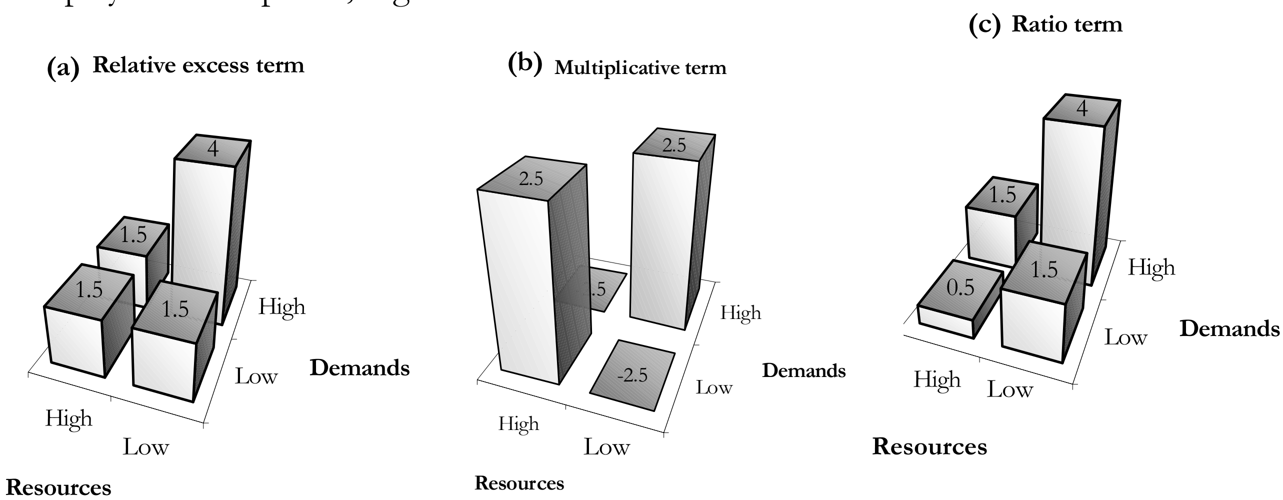


Figure 8.1 Diagrams showing strain levels in conditions of low demands or high demands in combination with high resources or low resources, for three different interaction terms (a = relative excess term; b = multiplicative term; c = ratio term)

Figure 8.1 shows that the low demands – low resources condition and the high demands – high resources condition have equal strain values. Therefore an equal amount of low to average strain is experienced in these conditions. It is especially the low demands – high resources (or non-strain) condition that seems to differ. But what differs even more, and is also important for interpreting the interaction terms, is the transition from one condition to another. Recall the three-dimensional figures from Chapter 4 (Figure 4.1). Whereas the multiplicative term and the ratio show a *gradual* transition, the relative excess term shows a more *abrupt* transition from one condition to another. The relative excess term implies that only the high demands – low resources condition is important for experiencing strain. All other conditions are equally low. The multiplicative term implies that not only the high demands – low resources condition is stressful, but also the low demands – high resources condition. Finally, the figure depicting the ratio term implies that the amount of resources is most important. If the amount of resources is high, strain can only vary from almost none (with low demands) to low (with high demands). On the other hand, if there are few resources available the amount of strain ranges from low (with low demands) to very high (with high demands).

So apart from the "high strain" condition, one's selection of an interaction term should depend on one's assumptions about the *course* of strain. If it assumed that only the high strain condition leads to strain, and that the other conditions are about equal, the relative excess or ratio term would seem to fit this pattern. However, if it is assumed that not only overload is stressful, but also *under*load (cf. Warr, 1994), a multiplicative term would be preferable.

Another difference between the interaction terms is that only the multiplicative term is "reversible". That is, the product of "demands * resources" is mathematically speaking identical to the product of "resources * demands". This is not the case for the relative excess term and the ratio term: a totally different picture would emerge with respect to employee well-being if demands and resources were reversed in the formula used for computing the interaction term. However, there is no psychological reason to calculate "| demands – resources + constant |" instead of "| resources – demands + constant |", or to calculate "demands / resources" instead of "resources / demands". As such, the multiplicative term seems to be the most robust term. The ratio term differs in another important respect as well, which may actually constitute a serious problem. Namely, the ratio term is not scale-invariant. This implies that if a constant is added to both demands and resources, the results may differ. So depending on the coding of the items, results may become significant. Therefore, theory testing may be more adequately carried out by means of a multiplicative term.

By means of an empirical test, the impact the various interaction terms on employee well-being was examined within both models. The empirical findings for the DC Model and the ERI Model show that the multiplicative interaction term was the only interaction term that yielded consistent results for both models. The ratio term was also an important type of interaction, but only for the DC Model. This is remarkable, since it could have been assumed based on strong empirical preferences that the ratio term is an important term for the ERI Model as well. The relative excess term received almost no support. Thus, the empirical results suggest it is plausible to regard the interaction between demands and resources in relation to strain as multiplicative. This means that both demands and resources have an impact on the amount of strain. More specifically, when demands do not equal resources (i.e., especially high demands – low resources, but to a lesser extent also low demands – high resources) strain will be experienced. On the other hand, when demands equal resources almost no strain will be experienced. So it may be possible to experience high demands without suffering strain as long as resources are also high.

In other words, the multiplicative interaction implies that either job resources can be increased (to buffer the negative effects of high job demands) or job demands can be decreased (so that such buffering effects are not necessary) to preserve employee well-being. In this respect a multiplicative interaction seems to reflect a balance model in the most literal sense, as having either high demands and high resources or low demands and low resources (i.e., balance) is good for employee well-being, whereas an imbalance is not.

Although an empirical test provides some insight into how the interaction between job demands and job resources in relation to employee well-being may be regarded, theoretical grounds for choosing one interaction term over another should guide research. Therefore, an attempt will be made here to embed the choice of an interaction, as well as its statistical operationalization, within the theories of the DC Model and the ERI Model.

In terms of the stress-theoretical models, a relative excess term was originally proposed for the DC Model. However, the DC Model holds that the four work situations have different implications (cf. Karasek, 1979; Karasek & Theorell, 1990). Firstly, high strain is expected in a high demands – low resources condition, because employees have insufficient control to respond optimally to the high job demands. Secondly, low strain is expected in a low demands – high resources condition, because job control allows the individual to respond to each challenge optimally, and because there are few challenges to begin with. The other conditions represent the active learning diagonal, in which having high demands as well as high resources is assumed to lead to active learning behavior, because the employee is able to cope with the job demands effectively, possibly resulting in feelings of mastery. On the other hand, having both low demands and low resources would lead to a passive situation characterized by a gradual atrophying of skills and abilities, similar to “learned helplessness” (Seligman, 1992). The question is what the level of strain would be in the active learning conditions to determine which interaction term fits DC theory most adequately. According to Karasek and Theorell (1990) “strain inhibits learning” (p. 100) because feelings of anxiety inhibit new learning attempts, and “learning inhibits strain” (p. 101) due to feelings of mastery which inhibit perceptions of strain. Only a few studies have investigated the interrelation between strain and learning (e.g., Holman & Wall, 2002; Parker & Sprigg, 1999; Taris & Feij, 2005; for an overview see Taris & Kompier, 2004), and these studies show that strain and learning may mutually influence each other. Moreover, a three-wave study among new employees by Taris and Feij (2005) showed that strain tended to *decrease* for employees in the high demands – high control condition over time, whereas strain *increased* slightly for the employees in the low demands – low control condition over time. In short, it is unlikely that the amount of strain experienced in the active and passive work situations is as low as in the “no strain” condition (low demands – high control), as is assumed by the relative excess term. Therefore, a relative excess term is probably not the right interaction term to display the relationship between job demands and job control in terms of DC theory. The multiplicative term assumes that the most strain is experienced when there is an imbalance between demands and resources (either high demands – low resources or low demands – high resources). This would contradict the assumption of the DC Model that “no strain” is experienced in a low demands – high control job, and may therefore be a less adequate representation. The ratio term might best fit the theoretical line of the DC Model. It is also in line with the findings of Taris and Feij (2005), who argued as follows in their discussion: “our results suggest that it is more important for workers to have high control than to have low demands. Positive outcomes in terms of learning and strain occurred in high control jobs, irrespective of the amount of job demands; in contrast, low demands were associated with low levels of strain, but low demands did not always results in high levels of learning" (p. 561). As the ratio term (defined as demands / resources) also emphasizes the resource side, the ratio term might fit the theory of the DC Model most adequately.

In early research the ERI Model was most often operationalized in terms of three conditions: (1) high effort and low rewards, (2) either high effort or low rewards, (3) neither high effort nor low rewards (e.g., Siegrist & Peter, 1994; Siegrist, Peter, Junge, Cremer, & Seidel, 1990). As such, it was assumed that most strain would be experienced in the high demands – low resources condition, that some strain would be experienced in the high demands – high resources and low demands – low resources conditions, and that no strain would be experienced in the low demands – high resources condition. This pattern seems to come closest to a *ratio term*. However, later empirical research showed that four categories might be more appropriate, because the conditions in which demands and resources are either both high or both low are not similar with regard to employee well-being (cf. de Jonge, Bosma, Peter, & Siegrist, 2000). Considering that the ERI Model is based on the principle of social exchange (i.e., reciprocity), it may be that that experiencing an imbalance is particularly stressful. The perception of fairness or correspondence between effort spent and rewards received plays an especially important role (e.g., Janssen, 2000). This fairness perception can be represented as a trade-off or ratio computed by the researcher (i.e., "objective discrepancy"), or can be estimated directly by the respondent (i.e., "subjective expectancy disconfirmation"). It appears that subjective disconfirmation is a much better predictor of outcomes than objective discrepancies (e.g., Oliver, 1976, 1977; Schaufeli, in press; Weaver & Brickman, 1974). Several items in the Effort-Reward Imbalance Questionnaire (ERI-Q: Siegrist & Peter, 1996) already refer to subjective disconfirmation (for instance, "Considering all my efforts and achievements, my salary/income is adequate"). Therefore, entering subjective disconfirmation into a ratio (calculated by the researcher) would not be entirely sensible. Moreover, the principle of equity theory (Adams, 1965) suggests that an employee would try to restore imbalances not only between high effort and low reward, but also between low effort and high reward. So, *if* one regards the ERI Model literally as an (im)balance model, a multiplicative term would be more appropriate.

In the present thesis, both the DC Model and the ERI Model are regarded as balance models, in which it is especially the combination of (or imbalance between) high job demands and low job resources that leads to lower well-being. Apart from its implication that the combination of high demands and low resources is most detrimental to employee well-being (as suggested by all of the interaction terms), the multiplicative term implies that *either* job resources can be increased (in order to buffer the negative effects of high job demands) *or* job demands can be decreased (so that such buffering effects are not necessary) to preserve employee well-being. In this respect, a multiplicative term seems to reflect a balance model in the most literal sense, as having either high demands and resources or low demands and resources (i.e., balance) is good for employee well-being, whereas imbalance is not. In addition, the empirical test in Chapter 4 showed that the multiplicative term yielded the most consistent results as compared to the relative excess and ratio terms. Moreover, the longitudinal results showed that high strain was experienced not only by employees with high demands and low resources, but also by employees with *low* demands and *high* resources (or work underload). Therefore, a multiplicative term may fit the DC Model and the ERI Model best, if both models are viewed as balance models. Another consideration is that the multiplicative term is the most robust interaction term, as it does not suffer from the serious mathematical drawbacks of the other interaction terms (i.e., changing content when parameters are changed, and lack of scale invariance).

To conclude, the following psychological meanings underlie the use of different statistical operationalizations of the demand-resource interaction. A multiplicative term emphasizes the value of a balanced work situation in terms of demands and resources for employee well-being. The ratio term (defined as demands/resources) focuses on the resource side as an important determinant of employee well-being. And the relative excess term implies that it is especially work in which demands exceed the amount of resources that is stressful. So the choice of the interaction term should be based on the psychological/theoretical meaning the researcher is interested in capturing. Hopefully, the present research will provide an impetus for more careful choices regarding the statistical operationalization of the interaction term. The DC Model and the ERI Model could be further advanced if future research were to provide a clear(er) description of the amount of strain that is experienced in all conditions, and of the course of strain (or transitions from one condition to another), which could in turn stimulate better and more comparable studies.

8.3.2 Demand-resource interactions and the notion of specificity

Several authors have argued that the inconsistent evidence for demand-resource interactions may be attributable to the use of (overly) general scales, encompassing different aspects, instead of specific measures (e.g., de Jonge & Dormann, 2003; Terry & Jimmieson, 1999; Wall et al., 1996). That is, general scales may obscure the differential impact of specific components (Cutrona & Russell, 1990), whereas the latter may be especially important for detecting buffer or moderator effects of job resources on job demands (i.e., demand-resource interactions) in relation to employee well-being. Moreover, particular types of job resources may be required to counteract the negative effects of specific demands (i.e., a certain fit between demands and resources may be needed: cf. Cohen & Wills, 1985; Frone, Russell, & Cooper, 1995). Therefore, the job demands in the DC Model and the ERI Model were extended to include specific demands (i.e., mental, emotional, and physical demands; cf. Hockey, 2000), and job resources were further specified to include their single components (i.e., decision latitude was broken down into skill discretion and decision authority, and rewards into salary and esteem). Assessing job demands and job resources in a more specific way may be a first step in identifying what kind of job resources should ideally be available to counterbalance specific demands (referred to as an "optimal match"; cf. Cutrona & Russell, 1990).

In general, the main findings showed that most of the significant demand-resource interactions included specific demands, specific resources, and to a certain extent specific demand-resource combinations (see discussion of the absolute versus relative number of interactions on p. 148-149). Therefore, the specificity hypothesis – that is, the assumption that more interactions between job demands and job resources in analyses of employee well-being outcomes can be detected when more specific as compared with more general measures of job demands and job resources are used – was supported in our sample of human service employees. To identify theoretical (as well as practical) implications, it is necessary to look more in detail at the content of the particular variables that constituted the significant interactions between job demands, job resources, and employee well-being. In this way, one can also try to identify optimal matches between specific demands and particular resources in the prediction of (specific) well-being outcomes (Cutrona & Russell, 1990; de Jonge & Dormann, 2003).

With respect to the DC Model, the combination of emotional demands and decision authority seemed to be most effective in the prediction of job satisfaction, psychosomatic health complaints, and sickness absence frequency two years later. Remarkably, no interactions including decision authority were found for the outcome exhaustion; instead, the interaction between emotional demands and skill discretion appeared to be most predictive of exhaustion. This result is in line with Rafferty, Friend and Landsbergis' (2001) finding that skill discretion was associated with each burnout dimension (exhaustion, depersonalization and personal accomplishment), whereas decision authority was not. The more general control measure, decision latitude, also appeared to counterbalance the negative effects of (emotional) demands on job satisfaction, psychosomatic health complaints, sickness absence frequency, and exhaustion. However, parallel analyses – including the same type of demands and the same outcome variable, where both interactions were found for decision latitude and one of its specific components (either decision authority or skill discretion) – showed that the interactions including only the specific components were stronger. This could indicate that decision authority is the dominant factor within the construct of decision latitude in the case of job satisfaction, psychosomatic health complaints, and sickness absence frequency, whereas skill discretion may be the dominant factor for exhaustion. This finding also lends support to the notion that skill discretion and decision authority have differential effects on employee well-being (cf. de Jonge, Reuvers, Houtman, Bongers, & Kompier, 2000; Theorell, 1989).

For the ERI Model, or the interactions including rewards, the following pattern emerged. Whereas the combination of effort and salary was essential for the prediction of self-reported health (i.e., job satisfaction and psychosomatic health complaints) two years later, the combination of emotional or physical demands and esteem was most important in the prediction of company-registered sickness absence (both time-lost and frequency indices). As with the DC Model, if a significant interaction was found for the general reward indicator, parallel analyses (i.e., for the same demand construct and same outcome) also showed a significant interaction including a specific reward indictor (salary or esteem), the latter explaining slightly more variance. This indicates that the specific reward component is the dominant factor within the composite reward construct. It also indicates that assessing a general, composite construct, without assessing its specific components, may indeed mask the capacity of specific resources to buffer negative effects of demands (e.g., Sargent & Terry, 1998; Terry & Jimmieson, 1999), and that different aspects of rewards (salary and esteem) influence different types of outcomes. Besides the differential influence of the specific resource constructs on particular employee well-being outcomes, some implications with regard to the demand constructs will be discussed as well.

For both models, the demand construct that was included most often in the significant demand-resource interactions was emotional demands. This is remarkable because mental demands (such as time pressure) have dominated occupational stress research to date, even in human service professions (e.g., Zapf, 2002). However, our specific mental demand concept yielded only two significant interactions, both in combination with decision authority. That is, for the ERI Model no interactions were found with respect to mental demands; such interactions were only observed for the DC Model. An explanation for this might be that both mental demands and decision authority can be regarded as job characteristics that involve cognitive processes (e.g., de Jonge & Dormann, 2003). Therefore, from a self-regulation perspective, decision authority could be viewed as more functional for mental demands than occupational rewards (Frone et al., 1995; Lekander, 2002), and job resources are more likely to buffer the negative effects of job demands if they are measured on the same level (cf. matching principle, Cohen & Wills, 1985; de Jonge & Dormann, 2003; Frese, 1999).

The prevalence of emotional demands over mental demands in interaction effects might be explained by the hierarchical principle of the Demand-Induced Strain Compensation Model (DISC Model: de Jonge & Dormann, 2003). The authors of this model maintain that job stress is all about emotions; many demands, resources, and strain reactions have an emotional component or elicit emotional processes (see also Gaillard & Wientjes, 1994; Lazarus, 1999). If no emotions were experienced, the person would not feel anything, including being distressed. Thus, "the DISC Model suggests that most measures of subjective health and well-being are more strongly affected by emotions than by cognitions and by behaviour because more pathways exist along which emotions may exert their effects" (de Jonge & Dormann, 2003, p. 62). Therefore, it is assumed that demands (and resources) that are assessed on an emotional level will show the strongest interaction effects, as they are not mediated by emotions, as compared to job characteristics that are measured on a mental or physical level. This may explain why interactions including emotional demands were most frequently reported in the prediction of employee well-being.

Of course, the occupation under study, in our case human service employees, also determines which particular demands are important or frequently experienced. Although many researchers agree that excessive emotional demands are responsible for the development of burnout and other strain reactions, most studies have not directly measured this kind of demands (e.g., Zapf, 2002; Zapf et al., 1999). It is only since a couple of years ago that researchers have started measuring emotional demands. Similar to our studies, such research suggests that emotional demands are at least as important as, or more important than, mental demands in relation to employee well-being in human service occupations (e.g., de Jonge, Mulder, & Nijhuis, 1999; Elovainio & Sinervo, 1997; Gonge, Jensen, & Bonde, 2002; Söderfeldt et al., 1997; van Vegchel, de Jonge, Meijer, & Hamers, 2001). By measuring emotional demands one can capture more (demanding) aspects of the work environment that are inherent to human service occupations, enhancing the possibly of demonstrating interaction effects.

Another point of consideration is that if buffering effects of resources on job demands are to be detected, these resources should have the potential to be available (e.g., Hobfoll, 1998; Westman, Hobfoll, Chen, Davidson, & Laski, 2005). For instance, support from colleagues is a resource that is easily accessible in human service work: employees are used to working with clients and are often prepared to help their colleagues as well. On the other hand, other types of resources are not easily accessible. For instance, due to budgetary problems, rewards in terms of salary and promotion prospects are more difficult to realize, and may therefore be less available resources for buffering the negative effects of job demands on employee well-being. Therefore, esteem and decision authority may also be more important resources in human service organizations, as they are not only functional, but also potentially available to many employees. In fact, emotional demands were mainly buffered by esteem and decision authority. The potential of esteem/social support and decision authority to counterbalance the negative effects of emotional demands was also predicted by Zapf (2002) in his extensive review of emotion work and psychological well-being. That is, social support may reduce emotional demands, for instance by allowing the employee to vent true feelings to colleagues after a difficult conversation with a client. In a similar vein, control may provide opportunities for deciding how to handle emotional situations. For instance, employees with high job control may decide to postpone an emotional situation and handle it when they feel ready to cope with it (for example, after consulting another colleague), whereas this may not be possible for employees with low control.

Although we assumed that physical demands should be important for human service workers due to the many physical activities that have to be performed (such as carrying, lifting), no interactions were found for the DC Model. Although this assumption also characterizes other studies testing physical demands in human service occupations, a closer inspection of these studies shows that the particular interaction between physical demands and control in relation to employee well-being (i.e., job satisfaction, exhaustion and health symptoms) failed to reach statistical significance (de Jonge, Dollard, Dormann, Le Blanc, & Houtman, 2000; de Jonge, Mulder et al., 1999). In addition, Hollman et al. (2001) only found a positive effect of control under conditions of low physical work load, but not for physically very demanding activities. An explanation for this might be that decision latitude, skill discretion, and decision authority are not appropriate resources to compensate for the negative effects of physical demands. For instance, if a health care worker has to wash many bedridden clients, having more knowledge (e.g., skill discretion) may be a less functional means of mitigating high physical demands than more concrete physical resources, such as a lifting device or support from a colleague in lifting clients. Indeed, a study among construction workers only showed a significant interaction between physical demands and control when social support was added (Janssen, Bakker, & de Jong, 2001). In a similar vein, Hoogendoorn and colleagues (2002) showed that high physical load at work and low social support are risk factors for sickness absence (due to lower back pain). This result is exactly in line with our study, in which two interactions including physical demands were found for the ERI Model. Both interactions were found for sickness absence when physical demands were combined with esteem, a concept that comes close to social support.

Esteem or social support was effective in counterbalancing the negative effects of both emotional and physical demands. In a way, esteem seems to fit both emotional demands and physical demands, because social support can be divided into an emotional component and an instrumental component (cf. House, 1981). As such, it seems that emotional demands may fit with esteem due to the emotional component of esteem (e.g., receiving understanding from colleagues), whereas physical demands may fit the instrumental component of esteem (e.g., getting help with lifting patients). In this way, esteem seems to be a matching and functional resource for counterbalancing the negative effects of emotional and physical demands (Cohen & Wills, 1985; de Jonge & Dormann, 2003).

This section will close with some concluding remarks concerning the operationalization of job demands and job resources when investigating the demand-resource interaction in relation to employee well-being. Firstly, emotional demands seem to offer a useful extension of both the DC Model and the ERI Model. Including emotional demands enhances the likelihood of detecting interactions within human service occupations. Moreover, at the beginning of this thesis we argued that emotional demands may become increasingly important as more and more occupations become service-oriented and based on client interactions (e.g., Dormann & Zapf, 2004; EFILWC, 2002). This notion has been taken up by the DC Model very recently (Karasek, 2005). Even though both the DC Model and the ERI Model were developed from a broad socio-epidemiological point of view, they have inspired more specific psychological research into work stress, such as our research investigating more specific demands and resources in relation to well-being. Cross-fertilization seems to be taking place, as emotional demands, developed from a more psychological perspective, have been included in the new version of the Job Content Questionnaire (JCQ) as "core psychological demands" (see possible design example for the JCQ 2.0 by Karasek, 2005). The rapid expansion of the service sector seems to underscore the importance of emotional demands, also for larger epidemiological research.

Secondly, within both the DC Model and the ERI Model, it was demonstrated in parallel analyses (i.e., same demand construct and same outcome variable) that interaction terms including only a specific component of the resource construct yielded stronger effects than interaction terms including the general composite resource construct. Therefore, it is possible that the assessment of a general construct, without assessment of its specific components, may indeed mask the capacity of specific resources to buffer negative effects of demands (e.g., Sargent & Terry, 1998; Terry & Jimmieson, 1999). Moreover, the distinction between the specific components seems to be important, as they had differential effects on employee well-being. Therefore, it seems important that future research should discriminate between the specific components of decision latitude (i.e., skill discretion and decision authority) in the DC Model and/or rewards (i.e., salary, esteem, and job security) in the ERI Model when examining interaction effects in relation to employee well-being.

Finally, if demand-resource interactions are to be detected, the type of resources should match the type of demands imposed on the employee (e.g., Cohen & Wills, 1985; de Jonge & Dormann, 2003; Frone et al., 1995). Implicitly, this also means that the resource should be relevant and functional (e.g., Daniels & Harris, 2005; Lekander, 2002). For instance, comforting words will not be considered helpful in lifting a patient, whereas (literally) getting a helping hand will help. The unique demand-resource interactions that were found in the present study demonstrate the importance of useful, matching resources for buffering the negative effects of job demands. For instance, the negative effects of mental demands were only buffered by decision authority (both mental/cognitive components). Moreover, the demand-resource interactions demonstrated that interactions are more likely to be found when job resources have the potential to be easily accessible and available to employees, as is the case with decision authority and esteem (Hobfoll, 1998; Westman et al., 2005). In short, job resources measured on a specific level that (1) fit the type of demands, (2) are functional, and (3) are available seem to be most beneficial for counterbalancing the negative effects of (specific) demands on employee well-being.

8.3.3 Two models at work: Demand-control and effort-reward interactions in analyses of employee well-being

The DC Model and the ERI Model served as a theoretical framework for testing the interaction between job demands and job resources in relation to employee well-being. Both models were examined cross-sectionally and longitudinally in the present study. First, the theoretical implications of the DC Model will be discussed, followed by a similar discussion for the ERI Model. Afterwards, the results of both models will be compared, and some concluding remarks will be made.

Demand-Control Model

Most DC studies have examined the main effects of demands and control, without examining the demand-control interaction (e.g., de Lange et al., 2003; van der Doef & Maes, 1999). The present study focused on the demand-control interaction (see Chapters 4 and 6). In line with previous studies, the results were checked for main effects prior to inclusion of the interaction term. The cross-sectional study showed main effects of demands and control on job satisfaction and exhaustion, a main effect of demands on psychosomatic health complaints, and a main effect of control on sickness absence (time-lost and frequency index). Our longitudinal study showed main effects of the control measures (decision latitude, decision authority, and to a lesser extent skill discretion) on job satisfaction, of JCQ demands on exhaustion, and of JCQ/mental demands on sickness absence frequency. No noticeable main effects were found on psychosomatic health complaints and sickness absence duration (time-lost index). As such, it seems that main effects are more easily detected in cross-sectional research than in longitudinal research, and that the demand-control interaction may include other types of demands and control than the main effects. That is, combined effects whereby demands and control reinforce each other may consist of other types demands and control than those displaying separate or main effects on employee well-being. On the other hand, it could be argued that due to common method variance, main effects are likely to be overestimated and the chance of finding interactions is reduced (e.g., Wall et al., 1996; Zapf et al., 1996).

The main findings (Section 8.1.3) showed that demand-control interactions were generally found in relation to self-reported well-being and to a lesser extent (only in the longitudinal analyses with emotional demands) in relation to sickness absence. In addition, most interactions were in line with the strain hypothesis of the DC Model: high demands and low control were associated with the most strain. However, longitudinally two demand-control interactions also showed that the most strain (i.e., sickness absence frequency) was experienced in the opposite condition, that is, among employees reporting low demands and high control. This could indicate that the low demand – high control condition is also stressful over time (as is theoretically assumed by the multiplicative interaction term and by the concept of work underload, see for instance Warr, 1994). Although the condition in which most strain was experienced differed, the *pattern* of the interactions was the same. That is, with the exception of one interaction, *all* interactions showed a positive relation between demands and strain, whereas a negative (or neutral) relation was found in the case of high control. To put it differently, an increase in job demands did not necessarily lead to more strain two years later. Only employees with low job control experienced more strain, whereas for employees with high job control the amount of strain either decreased or remained stable. So in general, job control buffered the negative effects of job demands on employee well-being.

The only interaction with a deviant pattern was the interaction between emotional demands and decision latitude in relation to job satisfaction. Although Figure 6.4 showed that job satisfaction was higher and stable for employees with high decision latitude, it also showed a *positive* relation between emotional demands and job satisfaction for employees with low decision latitude. That is, employees who reported low decision latitude and high emotional demands were more satisfied two years later, as compared with employees who reported low decision latitude and low emotional demands. A possible explanation for this is that a work situation characterized by low decision latitude as well as low emotional demands is a job with few opportunities to learn and no challenges regarding client interactions, resulting in an easy but less satisfying job (comparable to a "passive" job, cf. Karasek & Theorell, 1990). Experiencing high emotional demands may result in more challenging interactions with clients. Although this may be more stressful (see similar interactions for exhaustion and psychosomatic symptoms), it may also be more satisfying because for most employees one of the main reasons for working in the human service sector is working with (and the opportunity to help) people. Nevertheless, employees with high decision latitude are more satisfied, independent of the level of emotional demands, and therefore increasing decision latitude may be more efficient than increasing emotional demands.

In short, the longitudinal results partly support the interaction hypothesis of the DC Model in that there were 14 significant interaction effects in the hypothesized direction. These interaction terms represent 23 percent of the interactions tested, which means there was *no* strong support for the DC Model. Nevertheless, the support for the model is quite meaningful, as previous empirical studies have shown that it is very difficult to demonstrate true (multiplicative) interaction effects (e.g., Kasl, 1996; Theorell & Karasek, 1996), especially with longitudinal designs (de Lange et al., 2003; van der Doef & Maes, 1999). As noted earlier, the fact that some interaction effects were still found after controlling for baseline employee well-being, together with the fact that the results could be successfully cross-validated in a second comparable sample, strengthens our results with respect to human service employees in particular. Therefore, we believe that the results do have theoretical value, as they showed interaction effects in relation to self-reported well-being when specific measures were used to represent demands (i.e., emotional demands) and control (mainly decision authority).

In conclusion, the DC Model was mainly supported with regard to self-reported well-being (i.e., job satisfaction, exhaustion, and psychosomatic health complaints). Extending the DC Model to include emotional demands also yielded some support for sickness absence frequency. However, the demand-control interaction (regardless of which demand and control constructs were used) did not predict sickness absence duration (i.e., the time-lost index).

Effort-Reward Imbalance Model

Many studies examining the ERI Model have focused on the main effects of effort and rewards, without testing the effort-reward interaction in addition to these main effects (cf. Belkiç et al., 2000). In contrast, the present study highlighted effort-reward interactions. With respect to the main effects of effort/demands and rewards (prior to entry of the interaction), the cross-sectional analyses (Chapter 4) showed that main effects of effort and rewards were found for the outcomes exhaustion, psychosomatic health complaints, and sickness absence frequency, whereas only a main effect of rewards was found for job satisfaction and sickness absence duration (time-lost index). In the longitudinal analyses (Chapter 7), however, almost no main effects were found. Main effects were only found for (composite) rewards and salary on job satisfaction, and for mental demands on sickness absence frequency. The absence of main effects in the longitudinal analyses suggests that the combined effect of effort and rewards (ERI) is particularly important for predicting employee well-being in the long run, whereas its separate components, high effort or low rewards, may be less harmful. In this sense, the core idea of the ERI Model was supported, namely that it is especially an *imbalance* between effort and rewards that is harmful.

As was mentioned in Section 8.2.4, imbalance between effort and rewards led to the most adverse well-being effects, not only in the case of high effort and low rewards (cf. ERI hypothesis), but also in the case of low effort and high rewards.

This seems to support the idea that *under*load harms employee well-being (Warr, 1994), and/or that employees prefer a situation where investments (i.e., effort) and gains (i.e., rewards) are about equal, as suggested by equity theory (Adams, 1965). Whereas the condition showing the most unfavorable effects on employee well-being differed, the *pattern* of effort-reward interaction was the same. As was observed for the DC Model, the level of the job resource (in this case rewards) seems to determine whether (high) effort/demands have a positive or negative impact on employee well-being (two years later). That is, an increase in job demands did *not* necessarily lead to more strain. Only employees who felt that they were insufficiently rewarded experienced more strain, whereas for employees with high rewards the amount of strain decreased over time. To put it differently, occupational rewards appeared to counterbalance the negative effects of effort on employee well-being outcomes, with the exception of exhaustion.

The results of our study corroborate previous findings that ERI predicts psychosomatic health complaints (Stansfeld et al., 1998), and that ERI is related to reduced job satisfaction (de Jonge, Bosma et al., 2000) and increased sickness absence (Peter & Siegrist, 1997; van der Linden, de Jonge, & Schaufeli, 2002). However, contrary to what was found in previous studies (de Jonge, Bosma et al., 2000; van Vegchel et al., 2005), ERI was *not* associated with exhaustion in our study. (Possible reasons for this finding, such as an inefficient time lag, were discussed in the methodological considerations, see Section 8.2.) However, as Belkiç and colleagues (2000) noted, most prior studies did not separately test for an interaction effect, so little is known about the interaction effect (in addition to main effects).

The number of significant effort/demand-reward interactions was not very large. To be precise, in the longitudinal analyses just nine interactions (or 15 percent of the tested interactions) provided support for an interaction between effort/demands and rewards in relation to employee well-being, which means there was *no* strong support for the ERI hypothesis of the ERI Model. As was mentioned above, in view of several important strengths of this study (i.e., controlling baseline employee well-being and cross-validation) we think these results may have theoretical implications – more so because interactions between effort and reward were observed, yet almost no main effects. Moreover, the interaction effects seemed to display a consistent pattern such that effort and salary were most important in the prediction of job satisfaction and psychosomatic complaints, whereas emotional/physical demands and esteem predicted sickness absence.

Overcommitment, the personality characteristic included the ERI Model, was also investigated in additional analyses in our longitudinal study (Chapter 7). In general, overcommitment did *not* influence well-being over time, either directly (OVC hypothesis) or by moderating the relationship between ERI and employee well-being (ERI * OVC hypothesis). The moderating effect of overcommitment has scarcely been examined, and results are not consistent (cf. Chapter 2). Our study showed that moderating effects of overcommitment were only found when mental or emotional demands were included in the interaction term, which may explain why other studies have not detected such an effect. However, the present results were also inconsistent. So even though specific demands were important for the detection of effects of the personality characteristic overcommitment on the relation between effort-reward imbalance and employee well-being, the results of these interactions were inconsistent.

In conclusion, the ERI Model was supported – mainly with regard to sickness absence, but also with regard to job satisfaction and psychosomatic health complaints. Over time, the interaction between effort and salary seemed especially useful for predicting self-reported well-being, whereas an interaction between emotional/physical demands and esteem determined the rate of sickness absence. Nevertheless, the effort-reward interaction (independent of the demand and reward concepts that were used) did not predict exhaustion over time.

Comparing demand-control and effort-reward interactions

Comparing different models is a complex undertaking, as there may be several reasons why such comparisons would be inappropriate or even unfair (cf. Cooper & Richardson, 1986). A comparison between the DC Model and the ERI Model can be justified for the present research on the grounds of procedural equivalence, as we used well-validated translations of the original questionnaires to operationalize both models. In addition, we examined the models from the same perspective, namely as balance models. Therefore, we will focus on demands and resources only (leaving out the personal component overcommitment, which might make the comparison less appropriate). However, as mentioned earlier, the response categories for the scale items differ, which may yield a distorted comparison. Furthermore, we assume that both decision latitude and rewards characterize the work environment of our study population to a similar degree (i.e., distributional equivalence). However, it is nearly impossible to take into account all relevant factors, and thus caution should be taken in interpreting comparisons between two models.

Comparing the interactions that were found for the DC Model with those found for the ERI Model shows that the DC interactions were mainly related to self-reported well-being variables, whereas the ERI interactions often showed a relation with company-registered sickness absence. There may be several explanations for this finding. First, the result that most significant DC interactions were found for self-reported well-being, but not (or to a lesser extent) for sickness absence, is consistent with the literature regarding DC studies. Many DC studies have supported the DC Model with regard to self-reported well-being (for an overview, see van der Doef & Maes, 1999), whereas the few studies of sickness absence generally did not find a significant interaction (e.g., de Jonge, Reuvers et al., 2000; Godin & Kittel, 2004; Vahtera, Pentti, & Uutela, 1996). In general, DC studies of sickness absence usually show a main effect for decision latitude, but not always for demands (e.g., de Jonge, Reuvers et al., 2000; e.g., Godin & Kittel, 2004), which is similar to most of our findings. Having more decision latitude may allow employees to adapt the work situation to their health condition (for example, by taking more breaks), which may be necessary, regardless of the level of demands, for coping with work when one is not feeling well. However, as for the full model (i.e. the interaction between demands and decision latitude), the current study seems to lend more support on self-reported, more psychological/emotional outcomes as compared to more behavioral outcomes.

Second, sickness absence is considered a behavioral outcome which can be interpreted in different ways. It can be seen as a result of physical health (i.e., being sick) or as a result of a motivational process (i.e., being motivated for whatever reason to stay at home for a shorter or longer period). As the ERI Model is based on the principle of social exchange, it can be seen as an equity process (cf. Siegrist, 1996). For that reason it is possible that employees stay ill at home longer to compensate for occupational rewards (i.e., salary, status, respect) that they feel they should – but do not – receive. Actually, Geurts and colleagues (1999) showed a strong negative relation between perceived inequity and absenteeism, suggesting that sickness absence may be used to restore equitability. In this way, sickness absence could be dependent on motivational factors as well as actual illness. This may be one reason why the effects of sickness absence were more pronounced in the ERI interactions as opposed to the DC interactions (see also van der Linden et al., 2002).

Another, methodological reason may be that the ERI questionnaire poses questions about the amount of distress experienced in relation to effort and reward, reflecting how stressful the job is *perceived* to be. Wall and associates (1996) have argued that by including affective elements in the independent as well as the dependent variables, a spurious main effect is built into the observed relationship. This common method variance increases the main effects of effort and rewards on psychological strain, thereby restricting the opportunity to demonstrate an underlying interaction between effort and rewards. Since this problem does not occur when a more objective outcome is used, this might explain why more interaction effects were found for sickness absence than for self-reported well-being. On the other hand, it might also be the case that effort and reward are less important components for predicting psychological well-being, as opposed to more objective outcomes like sickness absence. This is in line with the ERI review, which showed that ERI tends to be longitudinally associated with more objective outcomes (such as cardiovascular diseases).

Finally, it is very well possible that job resources such as occupational rewards and job control have different psychological functions depending on their primary source (de Jonge & Dormann, 2003). This primary source could be split up into two factors, namely: (1) job content resources like decision latitude and (2) job context resources such as occupational rewards. So decision latitude is a key characteristic of the work itself, whereas rewards can be seen as a key characteristic of the labor market or labor conditions. De Jonge and Dormann (2003) argued that job content and job context variables have a different impact depending on the type of outcomes, which could be a reason for the divergent associations found in the present study.

Whereas the present study confirms the positioning of the DC Model and the ERI Model as anchoring points in occupational stress and health research, one could also argue that the findings demonstrate a need for the development of a more comprehensive single model. Recently, researchers are increasingly examining the impact of both work stress models in the same population (e.g., Bosma, Peter, Siegrist, & Marmot, 1998; de Jonge, Bosma et al., 2000; Godin & Kittel, 2004; Kivimäki et al., 2002; Pikhart et al., 2004), and most of these studies suggest that a combination of the two work stress models would be fruitful. There have already been attempts to integrate the two models (and the risk factors they specify), and these studies generally show that a combined model offers improved estimation of risks for poor health/well-being (Calnan, Wainwright, & Almond, 2000; Ostry, Kelly, Demers, Mustard, & Hertzman, 2003; Peter, Alfredsson et al., 2002; Peter, Siegrist et al., 2002). However, as Calnan and colleagues (2000) have noted, "Arguably, the combined analyses is the stronger because it directly explores the relationship between all of the JCQ and ERI variables. However, combined analysis lacks a theoretical basis and may be vulnerable to differences in the way in which the two models are compiled and coded." (p. 310). In addition, when combining models it is important to consider how much complexity we *really* need to display the relationship between job characteristics and employee well-being. This issue was recently raised and examined in depth by Van Veldhoven and associates (2005) in a study of 37,291 Dutch employees.

Three factors that may determine the complexity of work stress models (van Veldhoven et al., 2005) will be discussed and evaluated with respect to our own findings. First, the number of job characteristics should be considered. One of the reasons for the popularity of the DC Model and the ERI Model is that they include just a few relevant job characteristics, which makes them easy-to-grasp, manageable, yet still practically and theoretically valuable models. Combining the DC Model and the ERI Model into one balance model that only distinguishes demands and resources would not be advisable, as this would diminish opportunities to discover demand-resource interactions (see also Chapter 5), and offer less concrete recommendations for intervention. Moreover, Van Veldhoven et al. (2005) found that a model drawing a general distinction between demand and resource dimensions fit the data only minimally better than a single-factor model containing all job characteristics. To maintain the parsimony of the models, they should not include too many variables either. However, the models may be improved by a few refinements. For instance, it may be advantageous to distinguish between different types of demands (e.g., time/mental and physical demands, de Jonge, Bosma et al., 2000; van Veldhoven et al., 2005; emotional and quantitative demands; Söderfeldt et al., 1997; van Vegchel, de Jonge, Söderfeldt, Dormann, & Schaufeli, 2004; or mental, emotional, and physical demands, de Jonge, Dollard et al., 2000; de Jonge, Mulder et al., 1999; van Vegchel et al., 2001), between skill discretion and decision authority (e.g., Rafferty et al., 2001; Schreurs & Taris, 1998; van Veldhoven et al., 2005), and between different occupational rewards (Dragano et al., 2003; van Vegchel et al., 2002), as was also demonstrated in the present thesis. For this reason, it seems preferable to use a demand-control-reward model in which it possible to discriminate between different types of demands, different types of control, and different types of rewards.

Second, a model's complexity can be increased by proposing that particular job characteristics predict some outcomes but not others. In this respect, our research seems to indicate that specific types of demand-resource interactions are predictive of specific types of outcomes. In general, our research showed that combining demands and control enhanced the prediction of self-reported well-being, whereas combining demands and rewards was more useful for predicting sickness absence. However, this distinction is only very general, and does not exclude other possibilities. For instance, the combination of emotional demands and decision authority also predicted sickness absence frequency, and the combination of effort and salary predicted self-reported well-being to some extent (i.e., job satisfaction and psychosomatic health complaints). Moreover, these findings are only based on the present research, which has its own limitations (see Section 8.3). Therefore, perhaps a better suggestion is not to apply the models differentially to self-reported well-being and sickness absence, but instead to combine the models, making it possible to apply them to a large array of outcomes.

Finally, work stress models may apply either to a wide range of occupations (occupation-generic) or only to certain occupations or occupational groups (occupation-specific). There are both advantages and disadvantages of occupation-specific models. On the one hand, incorporating occupation-specific variables may lead to better prediction and improved interventions within that occupation (Sparks & Cooper, 1999), but on the other hand, there is a risk that the resulting models will diverge from general stress models, losing their applicability for a wide range of professions (van Veldhoven et al., 2005). One consideration may be the sample under study, whether it is heterogeneous or homogeneous in terms of occupations. Nonetheless, a general research model would form a good starting point, also in a particular context. The DC Model and the ERI Model have proven to be valid in specific occupational samples as well. As such, retaining key variables from these models, but splitting up their key components, could offer new possibilities in more specific samples. As a first step the general models could be examined, and subsequently their more specific components. On the other hand, the models should keep up with developments in the work environment. A good example is the growing importance of emotional demands due to a growing human service sector. The DC Model responded to this development by including emotional demands in a new version of the JCQ that is currently under construction (Karasek, 2005).

In conclusion, the DC Model and the ERI Model are valid models for examining the relation between job characteristics and employee well-being. Not adding too many job characteristics, yet refining their key concepts may be beneficial (i.e., distinguishing between different types of demands, control, and rewards). The two models overlap to some extent (for a more comprehensive overview of their similarities and differences, the reader is referred to Chapter 2), especially with regard to the demand component. Also, the DC Model has been extended to include social support (which was unfortunately not used in the present research), a concept closely related to esteem rewards. From this perspective, it might be advisable to use a demand-control-reward model that allows for the possibility of distinguishing between different types of demands, control, and rewards. The advantages of such a combined model are that one instead of two models is used (and as such overlapping variables are avoided), and that it may be possible to predict a wider range of outcomes. However, it is also important to realize that both models were derived from a clear theoretical background (viz., the stress-theoretical paradigm of personal control and the stress-theoretical paradigm of social rewards), and that simply combining these models may be theoretically less defensible.

8.4 Practical implications

Although the primary aim of the present research was to contribute to the (theoretical) discussion of demand-resource interactions within the DC Model and the ERI Model, some practical implications can be derived from the findings as well. Recently, Kristensen (2004) commented critically on many papers testing the DC Model and the ERI Model for only using the workplace to supply data for testing the model, without discussing how to use research results for improving working conditions. Also, Kristensen (2004) questioned with good reason the value of a theory that is not applicable in the field. Therefore, we will discuss the implications of our findings for practice, in an attempt to suggest measures for a more healthy work environment.

First, the results indicted that there is a relation between job demands and job resources on the one hand and employee well-being on the other. Moreover, it was shown that these job characteristics influenced the state of employee well-being two years later. So work-related interventions aimed at decreasing job demands and increasing job control and/or occupational rewards may indeed improve employee well-being. In addition, more specific operationalizations (i.e., of job demands in terms of mental, emotional, and physical demands; of decision latitude in terms of skill discretion and decision authority; and of occupational rewards in terms of salary and esteem) provided insight into the specific types of demands and resources that may be particularly important for employee well-being. More specifically, the present study demonstrated that emotional demands, decision authority, and esteem are especially important predictors of employee well-being. Changing these job characteristics through *job redesign* would seem to be an effective tool for enhancing employee well-being (and decreasing absenteeism). This is in line with the Dutch Working Conditions Act (and European guidelines), which is aimed (among others things) at improving and/or maintaining a healthy psychosocial work environment (cf. Schaufeli & Kompier, 2001).

Second, the demand-resource interactions observed in the present thesis indicate that although job demands and job resources may also have separate effects on employee well-being, in some cases their effects reinforce each other, resulting in extra strong (i.e., "synergistic") effects on employee well-being. Employees working in a high demand – low resource job are at especially high risk of impaired well-being, but employees working in low demand – high resource job may also be at risk. In other words, a "balanced" work situation in terms of job demands and job resources is important, because it influences employee well-being (including absenteeism) in the long run. More specifically, the results regarding specificity indicate that emotional demands are especially important in the prediction of employee well-being. Although it is not easy to reduce emotional demands, as they are inherent to the nature of human service work, the demand-resource interactions indicate that it may be possible to enhance/maintain employee well-being by means of job resources such as job control (especially decision authority) and esteem. This is in line with the predictions of Dollard and colleagues (2003) about human service work.

Finally, although the use of different statistical operationalizations to represent demand-resource interactions in analyses of employee well-being is primarily a theoretical matter, it should be noted that their practical implications differ as well. The ratio form implies that intervening only on the resource side would be sufficient (that is, if one considers the ratio to be defined as demand/resources, and not vice versa). Once the employee experiences a high level of resources, the level of demands will not alter the (low) level of strain. However, the multiplicative term implies that the amount of both demands and resources should be considered. In a high demand – low resource condition, increasing resources would be beneficial, whereas in a low demand – low resource situation this would not be beneficial. If strain is to be reduced, the amount of demands and the amount of resources should be more or less equal (preferably both high or both low). Similarly, the relative excess term implies that both demands and resources should be considered. Ideally, demands should be decreased and resources should be increased. Nevertheless, as long as the amount of demands does not exceed the amount of resources, no strain will be experienced. However, it should be noted that the empirical illustration showed that the plateau on which no strain is experienced can be very small (i.e., Chapter 4, Figure 4.12), suggesting that from a certain level strain may be experienced very easily either due to an increase in demands or a decrease in resources. So to improve or retain employee well-being, a manager should either increase resources (ratio), balance demands and resources (multiplicative term), or make sure that demands do not exceed resources (relative excess term). Therefore, the (theoretical) choice of a statistical operationalization of the demand-resource interaction has implications for which measures (i.e., changing the level of demands and/or resources) might ideally improve the work environment.

8.5 Recommendations for future research

The results of the present study reveal several avenues for future research. Several suggestions were already given in the discussion of methodological considerations. These suggestions included: more multiphase studies to determine the specific causal lags over which particular job characteristics influence particular outcome variables, research in other occupational groups to determine whether the results are generalizable to other (especially male) occupations, the inclusion of specific job resources such emotional control in human service samples, and further examination of job security as a specific reward. Based on the results, some additional recommendations can be made for future research.

First, our theoretical and empirical consideration of statistically different interactions terms demonstrated the importance of choosing an interaction term on theoretical grounds, as the different interaction terms differ in their form and, therefore, their implications. Granted, all of the terms predict the highest amount of strain in the high demand – low resource condition. However, the terms differ in their predictions regarding the amount of strain in the other conditions and the differences in strain from one condition to another. Viewing the DC Model and the ERI Model as balance models (as was done in the present study) means that balance between demands and resources should be beneficial for employee well-being, whereas imbalance should have negative effects. Imbalance may be detrimental for employee well-being both in the case of high demands – low resources and in the case of low demands – high resources (a pattern that is often found when displaying interactions in figures). This pattern is adequately represented by a multiplicative term, the term which can also be considered as most robust, and which showed the most consistent findings. Also, both the DC Model and the ERI Model could be further developed to provide a more detailed description of the amount of strain that is experienced in all conditions, and of the course of changes in strain (or transitions from one condition to another), which could stimulate better and more comparable studies.

Second, to gain more insight into specific demands, resources, and their interactions, the present study awaits further validation by other studies using the same design. Studies using the original scale(s) could easily examine whether the specific components of decision latitude (i.e., skill discretion and decision authority) and/or rewards (i.e., salary, esteem, and job security) are better able to buffer the negative effects of job demands on employee well-being. In addition, with respect to the ERI Model, future studies could also include a multiplicative interaction term to determine whether a statistical interaction between effort and rewards is present, *in addition to* the separate main effects of effort and rewards.

Third, emotional demands seem to be an important job characteristic for predicting employee well-being, especially when combined with certain job resources (e.g., esteem, authority). The increasing size of the human service sector implies that these kinds of demands should be of increasing importance in future research. As such, extending the DC Model and/or the ERI Model to include emotional demands may improve their applicability to a growing segment of the working population, namely (human) service professionals. The inclusion of emotional demands in the newest version of the JCQ shows that the DC Model has taken notice of these changes (Karasek, 2005). However, this version of the JCQ is still under construction and awaits testing in larger samples, including different types of occupations. In this respect, it might also be worthwhile to further investigate the role of emotional resources, such as emotion control (e.g., Zapf et al., 1999).

Fourth, future research could test an integrated model, for instance (as was mentioned above) a demand-control-reward model including the possibility of splitting up demands, control, and rewards. However, the theoretical rationale for such a model should be carefully considered. A notable example is the recently proposed DISC Model (de Jonge & Dormann, 2003), which attempts to integrate the DC Model and the ERI Model into a single framework, building on common principles with respect to psychological compensation mechanisms and the balancing of challenging demands. In short, the DISC Model proposes that the strongest interactive relationships between job demands and job resources should be observed when all constructs are based on qualitatively identical dimensions, and thus assumes specific relationships between particular types of demands, resources, and outcomes. That is, emotional demands are most likely to be compensated by emotional resources, cognitive demands by cognitive resources, and physical demands by physical resources. In addition, it is proposed that a particular combination of demands and resources will produce qualitatively similar outcomes. (For instance, emotional demands and emotional resources are most likely to produce emotional outcomes.) Future research might consider this model, especially in relation to human service work.

Fifth, future research may also benefit by taking into account the role of individual characteristics. A good example is a study by Daniels and Harris (2005), who tested different coping styles in the context of the DC Model. Different coping styles may also be important in the context of the ERI Model. On the other hand, the ERI Model already includes the personality characteristic overcommitment, which may also be relevant for job strain (i.e., high demands and low job control, or a stressful work situation as defined by the DC Model). Indeed, Peter and colleagues (2002) tested the DC Model, the ERI Model, and combined the models, and found that a combination of job strain and overcommitment led to increased risk of acute myocardial infarction in women, whereas these results were not found for job strain by itself. Therefore, studying individual/personal characteristics may provide new insights into the relation between work, health, and the employee.

Finally, several job characteristics have been found to show a relation over time with employee well-being. The next step would be to evaluate the effects of changing these job characteristics in (quasi)experimental studies of employee well-being. In other words, work stress intervention research may offer a valuable additional step towards a better understanding of the influence of stressful working conditions on employee well-being in practice. After all, a good theory should be applicable to practice, and this should be tested as well.

Summaries

Summary

The present thesis addresses the relationship between job characteristics and employee well-being. Work stress is a major concern in most industrialized countries, including The Netherlands, and its consequences affect not only employees (whose health and well-being are at stake), but also organizations and society at large (in view of costs related to sickness absence and work disability). Occupational health research shows that work stress is largely dependent on job characteristics, such as job demands and job resources. To investigate the relation between work and employee health, several work stress models, such as the Demand-Control (DC) Model and the Effort-Reward Imbalance (ERI) Model, have been developed. Although these two models focus on job demands and job resources, relatively little attention has been devoted to the *combined* effects of demands and resources on employee well-being. The *interaction* between job demands and job resources – referring to a combined effect of high job demands and low job resources that is larger than the sum of their separate effects – may be an especially powerful tool for predicting employee well-being, as there may be particular demands and resources that reinforce each other, resulting in an extra strong effect on employee well-being. For this reason, the interaction between job demands and job resources in relation to employee well-being is considered in depth in this thesis. In view of the rapidly growing human service sector, and data that indicate that human service employees are at especially high risk of stress, studying the relation between job characteristics and employee well-being within such a sample seems warranted. To adequately represent job characteristics in human service work, different types of job demands (such as mental, emotional, and physical demands) and job resources (such as job control and occupational rewards) will be considered

In this thesis the DC Model and the ERI Model were used as theoretical frameworks for studying the interaction between job demands and job resources in relation to employee well-being. Job demands and decision latitude (or job control) are the major job characteristics constituting the DC Model, whereas the ERI Model emphasizes the reciprocal relationship between effort and rewards at work. Both models predict that a work situation characterized by high job demands and low job resources may adversely influence employee well-being. In contrast, when job resources are plentiful, the negative effects of job demands will be counterbalanced. So it is especially the combination of job demands and job resources (i.e., the demand-resource interaction) that determines the state of employee well-being. A literature review of both models with respect to the combined effects of job demands and job resources on employee well-being (Chapter 2) showed that most studies support the hypothesis that high job demands (either demands or effort) and low job resources (either control or rewards) have a negative effect on employee well-being. However, it is less clear whether this co-occurrence of high demands and low resources represents an interaction. Many studies do not examine the interaction between demands and control/rewards, and the few (mainly DC) studies that do show inconsistent results. The review showed that the mixed evidence for demand-resource

interactions may be attributable to way the interaction is operationalized. Hence, the present thesis addresses the operationalization of the demand-resource interaction in two respects: (1) the statistical operationalization, or the mathematical formulation of the interaction term, and (2) the specificity with which the job demands and job resources that constitute the interaction term are operationalized.

The research design included a cross-sectional design as well as a longitudinal design (i.e., two measurement points, over a two-year time interval). Two different samples were included, both consisting of employees at nursing homes. Data were gathered by means of self-report questionnaires, yielding response rates of approximately 75% at Time 1 in both samples (N = 405 in Sample 1 and N = 614 in Sample 2). Almost 50% of the initial sample responded at both Time 1 and Time 2 in Study 1, and almost 60% of the initial sample responded at both measurements in Study 2. To put it differently, 267 employees made up the longitudinal or panel group in Study 1, and the panel group in Study 2 consisted of 280 employees. The data were examined in preliminary analyses (such as correlations) as well as Hierarchical Multiple Regression Analyses, followed by cross-validation of the results of Study 1 in Study 2.

First, the *statistical operationalization* of the interaction term was examined theoretically as well as empirically (Chapter 4). The literature on the DC Model shows that a relative excess term (i.e., | demands – resources + constant |) was originally suggested by Karasek to operationalize the relation between demands, resources, and strain. Despite this suggestion, the multiplicative term (i.e., demands * resources) and the ratio term (i.e., demands / resources) have been used most often to test the DC Model. The literature on the ERI Model articulates no theoretical preference for one particular interaction term, but empirically by far most studies have used a ratio term. In sum, within the DC Model and the ERI Model the relation between demands, resources, and strain is usually operationalized statistically by means of the relative excess term, the multiplicative term, or the ratio term. Edwards and Cooper's (1990) classification shows that these interaction terms can be classified as fundamentally different interaction terms (i.e., discrepancy, multiplicative, and ratio, respectively) with different forms, meanings, and interpretations. Because this theoretical overview of interaction terms did not reveal a clear theoretical preference for one particular interaction term, an empirical test was performed to explore the impact of operationalizing the relation between job demands and job resources by means of different interaction terms. The main DC and ERI interactions (i.e., relative excess term, multiplicative interaction, and ratio term) were empirically tested. In short, results showed that the multiplicative term yielded the most consistent results for the DC Model and the ERI Model. Namely, when significant interaction term(s) were observed, one of these terms was the multiplicative term. These results were successfully cross-validated in Study 2. Moreover, regarding the DC Model and the ERI Model as balance models implies that the multiplicative term fits the key assumptions of these models most adequately: having both high demands and high resources or having both low demands and low resources (i.e., balance) enhances employee well-being, whereas imbalance does not. In addition, the longitudinal results (in Chapters 6 and 7) showed that high strain was experienced not only by employees with high demands and low resources, but also by employees with low demands and high resources (or work underload).

Second, the *specificity* with which job demands and job resources are operationalized was addressed. The issue of specificity was raised by Cohen and Wills in 1985, but nevertheless it has not been taken up by the DC Model and the ERI Model. An important assumption is that specific job demands require particular job resources to handle them. Therefore, only specific resources may have the potential to buffer negative effects of specific demands, meaning that only particular (optimal) combinations of specific demands and resources elicit an interaction effect. To test this "specificity hypothesis" the job demands of the DC Model and the ERI Model were extended to include the following specific demands: mental, emotional, and physical demands; and job resources were further subdivided into their single components (decision latitude into skill discretion and decision authority, and rewards into salary and esteem). In general, the findings showed the importance of including specific demands (mainly emotional demands) and specific resources (decision authority for the DC Model and esteem for the ERI Model) in the interaction term if demand-resource interactions are to be demonstrated in the prediction of employee well-being over time (Chapters 6 and 7). Generally, these results were successfully cross-validated in a second independent sample (i.e., Study 2).

By testing interactions, the main assumptions of the DC Model and the ERI Model could be tested as well. In general, most of the significant demand-resource interactions showed that job resources buffered the negative effects of job demands. That is, a positive relation between job demands and strain existed in the case of low job resources, whereas a negative (or neutral) relation was found in the case of high job resources. The DC Model was mainly supported for self-reported well-being (i.e., job satisfaction, exhaustion, and psychosomatic health complaints). Extending the DC Model to include emotional demands yielded some additional support for sickness absence frequency. However, the demand-control interaction did not predict sickness absence duration. The ERI Model was mainly supported with respect to sickness absence, but also with regard to job satisfaction and psychosomatic health complaints. Over time, the interaction between effort and salary seemed especially useful for predicting self-reported health, whereas the interaction between emotional/physical demands and esteem determined the rate of sickness absence. Nevertheless, the effort-reward interaction did not predict exhaustion. In conclusion, the DC Model and the ERI Model were shown to be valid models for examining the relation between job characteristics and employee well-being. It appears that rather than adding new job characteristics, refining known concepts may be worthwhile (that is, discriminating between different types of demands, control, and rewards).

This thesis concludes with a discussion of practical implications. The observed demand-resource interactions indicate that, in addition to their separate effects, job demands and job resources may reinforce each other, resulting in extra strong (i.e., "synergistic") effects on employee well-being. Employees working in a high demand – low resource job are at especially high risk of impaired well-being, but employees working in a low demand – high resource job may also be at risk. In other words, a "balanced" work situation in terms of job demands and job resources is important because it influences employee well-being (including absenteeism), also in the long run. More specifically, the results regarding specificity indicate that emotional demands are especially important for the prediction of employee well-being, as least as far as the human services are concerned. Although it is difficult to reduce emotional demands as such, as they are inherent to the nature of human service work, the observed demand-resource interactions indicate that it is possible to enhance/maintain employee well-being by increasing job resources such as decision authority and esteem. As such, the longitudinal results point to job redesign aimed at promoting a balance between job demands and job resources as an effective tool for enhancing employee well-being.

Samenvatting (Summary in Dutch)

In dit proefschrift wordt de relatie tussen werkgerelateerde kenmerken en welbevinden onderzocht binnen de dienstverlenende sector. In het bijzonder wordt gekeken naar het gecombineerde effect van taakeisen (zoals werkdruk en fysieke inspanningen) en werkbronnen (zoals de mogelijkheid om beslissingen te nemen en beloningen) op het welbevinden van werknemers in de gezondheidszorg.

In **hoofdstuk 1** wordt een algemene inleiding gegeven op het onderzoek, en wordt de achtergrond van het onderzoek geschetst. Het blijkt dat de ervaren werkstress hoog is, en blijft toenemen, in geïndustrialiseerde landen. Dit gaat gepaard met allerlei gezondheidsklachten, een hoog ziekteverzuim en een hoge arbeidsongeschiktheid. Bepaalde werkkenmerken (zoals werkdruk, autonomie, en beloningen in het werk) blijken van invloed te zijn op de gezondheid en het welbevinden van werknemers. Er zijn werkstressmodellen ontwikkeld om de relatie tussen werk en gezondheid te weerspiegelen, zoals het Demand-Control (DC) Model en het Effort-Reward Imbalance (ERI) Model. Beide modellen focussen op taakeisen enerzijds en werkbronnen anderzijds. Echter, er is weinig aandacht besteed aan gecombineerde effecten van taakeisen en werkbronnen als voorspeller van het welbevinden van de werknemers. Met name, een *interactie* tussen taakeisen en werkbronnen kan beschouwd worden als een krachtige determinant in het bepalen van welbevinden. Dit omdat bepaalde taakeisen en werkbronnen elkaars effect op welbevinden kunnen versterken. Een interactie betekent dan ook dat het gecombineerde effect van taakeisen en werkbronnen groter is dan de som van de afzonderlijke effecten van (hoge) taakeisen en (lage) werkbronnen (het "1+1=3 principe"). Daarom zal in dit proefschrift deze interactie tussen taakeisen en werkbronnen met betrekking tot welbevinden centraal staan. Aangezien de dienstverlenende sector gestaag groeit, en de werknemers van deze sector worden blootgesteld aan diverse vormen van werkstress, lijkt het van belang om de relatie tussen werkkenmerken en welbevinden juist binnen deze groep te bestuderen. Om de werkkenmerken adequaat te representeren binnen deze groep, zullen verschillende typen taakeisen (mentaal, emotioneel en fysiek) en werkbronnen (controle en beloningen) bestudeerd worden. De volgende algemene onderzoeksvraag dient als basis voor het huidige proefschrift:
Wat is de relatie tussen (1) bepaalde combinaties van taakeisen en werkbronnen en (2) welbevinden, zoals voorspeld door het Demand-Control Model en het Effort-Reward Imbalance Model?

Hoofdstuk 2 schetst het theoretisch kader dat gebruikt is om de interactie tussen taakeisen en werkbronnen te bestuderen. Het DC Model alsmede het ERI Model vormen de theoretische basis voor dit proefschrift. Het DC Model veronderstelt dat taakeisen en controle (of beslissingsruimte) in of over het werk de belangrijkste werkkenmerken zijn die welbevinden beïnvloeden, terwijl het ERI Model de wisselwerking tussen inspanningen (cf. taakeisen) en beloningen benadrukt in relatie tot welbevinden. Beide modellen kunnen gezien worden als balansmodellen, die voorspellen dat werk waarin veel taakeisen en weinig werkbronnen (controle of beloningen) aanwezig zijn, zal resulteren in een slecht welbevinden voor de werknemer (oftewel stressreacties). Anderzijds, wanneer er een balans bestaat tussen veel taakeisen en veel werkbronnen, zullen hoge taakeisen niet noodzakelijkerwijs resulteren in een verminderd welbevinden, omdat de werknemer dankzij de aanwezige werkbronnen beter om kan gaan met de eisen die aan hem/haar gesteld worden. Dat wil zeggen dat met name de *combinatie* van taakeisen en werkbronnen bepalend is voor de gemoedstoestand van het welbevinden. Het literatuuroverzicht in hoofdstuk 2 met betrekking tot de gecombineerde effecten van taakeisen en werkbronnen laat zien dat veel taakeisen en weinig werkbronnen het welbevinden doorgaans negatief beïnvloeden. Echter, of dit gecombineerde effect daadwerkelijk een interactie betreft is minder evident. Immers, de meeste studies testen de daadwerkelijke aanwezigheid van de interactie niet, en van de weinige studies die het interactie-effect testen zijn de resultaten inconsistent. Uit het literatuuroverzicht blijkt dat een mogelijke oorzaak voor het inconsistente bewijs voor de interactie tussen taakeisen en werkbronnen gelegen zou kunnen zijn in de manier waarop de interactie wordt geoperationaliseerd. Vandaar dat het huidige proefschrift zich richt op de operationalisatie van de interactieterm, en wel in twee opzichten: (1) de statistische operationalisatie, oftewel de wiskundige formulering van de interactieterm, en (2) de specificiteit waarmee de taakeisen en de werkbronnen, die samen de interactieterm vormen, worden geoperationaliseerd. Overeenkomstig met psychologisch werkgerelateerd onderzoek is gekozen voor de volgende maten voor welbevinden: arbeidstevredenheid en uitputting (psychologische maten), psychosomatische klachten (fysieke maat) en ziekteverzuim (duur en frequentie, beide gedragsmaten).

In **hoofdstuk 3** wordt de methode van het onderzoek beschreven. De dienstverlenende sector wordt gerepresenteerd door twee steekproeven, afkomstig uit twee verschillende stichtingen. De eerste steekproef bestaat uit zes verzorgings- en verpleeghuizen, en de tweede steekproef uit zeven verzorgings- en verpleeghuizen. De onderzoeksgegevens zijn verzameld met behulp van schriftelijke vragenlijsten op twee tijdstippen. Allereerst zijn er gegevens verzameld van de werknemers op tijdstip 1 (cross-sectioneel onderzoek), vervolgens zijn bij een deel van diezelfde werknemers ook op tijdstip 2 gegevens verzameld (longitudinaal of panelonderzoek). Op tijdstip 1 was de respons in beide steekproeven ongeveer 75% (N = 405 in steekproef 1, en N = 614 in steekproef 2). Na twee jaar heeft ongeveer 50% van de groep die ook op tijdstip 1 deelnam de vragenlijst wederom ingevuld; zij vormen de panelgroep, bestaande uit 267 respondenten in steekproef 1, en 280 respondenten in steekproef 2. De onderzoeksgegevens zijn geanalyseerd met behulp van hiërarchische multipele regressieanalyse, en de validiteit van de data van steekproef 1 is getoetst door de data te kruisvalideren in steekproef 2.

Hoofdstuk 4 handelt over de statistische operationalisatie van de interactieterm, die de relatie tussen taakeisen, werkbronnen en welbevinden weergeeft. Het hoofdstuk bestaat uit een theoretisch deel en een empirisch deel. Volgens Edwards en Cooper bestaan er drie fundamenteel verschillende interactietermen:

descriptieve, multiplicatieve, en ratio termen. Het uitzetten van deze termen in grafieken laat zien dat zij verschillende vormen, en dus verschillende betekenissen hebben. De descriptieve term (taakeisen – werkbronnen) is in essentie een additieve vorm. Iedere variabele (zowel taakeisen als werkbronnen) heeft een lineaire relatie met stressreacties: des te meer taakeisen des te meer stressreacties, en des te meer werkbronnen des te minder stressreacties. De multiplicatieve interactieterm (taakeisen * werkbronnen) is vergelijkbaar met een moderatoreffect. Dat wil zeggen dat de relatie tussen hoge taakeisen en stressreacties beïnvloed (en gematigd) kan worden door de aanwezigheid van werkbronnen. De hoeveelheid taakeisen én werkbronnen is belangrijk in de voorspelling van stressreacties. De ratio term (taakeisen / werkbronnen) benadrukt de rol van werkbronnen. Als er veel werkbronnen voorhanden zijn, dan zullen de stressreacties nooit erg hoog zijn (onafhankelijk van hoeveelheid taakeisen). Echter, wanneer weinig werkbronnen voorhanden zijn zullen de stressreacties sterk toenemen wanneer de taakeisen toenemen. Voor het DC Model werd de relatie tussen taakeisen, werkbronnen en welbevinden oorspronkelijk geoperationaliseerd als een relatieve overstijging (| taakeisen – werkbronnen + constante | , hetgeen een afgeleide van de descriptieve term is). Dit betekent dat er alleen stressreacties worden verwacht wanneer de hoeveelheid taakeisen groter is ("overstijgend") dan de hoeveelheid werkbronnen. Ondanks dit voorstel wordt het DC model meestal getoetst met de multiplicatieve en de ratio term. De literatuur aangaande het ERI Model lijkt geen theoretische voorkeur voor een bepaalde interactieterm aan te geven, maar empirisch blijkt dat veruit de meeste studies een ratio term gebruiken. Kortom, met betrekking tot het DC Model en het ERI Model wordt de relatie tussen taakeisen, werkbronnen en welbevinden meestal statistisch geoperationaliseerd door middel van drie (fundamenteel verschillende) interactietermen: een relatieve overstijging, multiplicatieve, of ratio term.

Om de invloed van het gebruik van verschillende statistische operationalisaties van de interactieterm (d.w.z. verschillende relaties tussen taakeisen en werkbronnen) in relatie tot welbevinden te illustreren, werd een empirische test toegevoegd met daarin de drie belangrijkste interactietermen overeenkomstig met het DC Model en het ERI Model. De cross-sectionele groep op tijdstip 1 van steekproef 1 werd gebruikt voor de analyses. De resultaten laten zien dat een multiplicatieve term de meest consistente resultaten oplevert, zowel voor het DC Model als voor het ERI Model. Dat wil zeggen, wanneer een significante interactieterm gevonden werd dan was (één van) de significante interactieterm(en) een multiplicatieve term. Voor het DC Model leverde de ratio term ook consistente resultaten op. Verder waren alle interacties op basis van het DC Model gerelateerd aan zelfgerapporteerd welbevinden (arbeidstevredenheid, uitputting en psychosomatische klachten), maar niet aan ziekteverzuim (duur en frequentie). Met andere woorden, bepaalde combinatie van taakeisen en controle in het werk beïnvloeden het welbevinden van de werknemers (maar niet het ziekteverzuim). De interacties op basis van het ERI Model waren geassocieerd met arbeidstevredenheid en ziekteverzuim, maar niet met uitputting en psychosomatische klachten. Dus, bepaalde combinaties van inspanningen en beloningen waren met name belangrijk voor arbeidstevredenheid en ziekteverzuim. De resultaten werden met goed gevolg gekruisvalideerd in steekproef 2, hetgeen impliceert dat de resultaten geen artefact zijn van de eerste steekproef, maar dat de resultaten generaliseerbaar zijn naar andere vergelijkbare dienstverlenende groepen.

Hoofdstuk 5 betreft een theoretische inleiding op de behoefte aan het specificeren of verfijnen van de concepten taakeisen en werkbronnen. De titel van het hoofdstuk omvat dan ook de vraag: "Is er een behoefte aan specificiteit?". Al in 1985 hebben Cohen en Wills het issue betreffende specificiteit aangehaald, desalniettemin is dit issue nog niet opgenomen in het onderzoek naar het DC Model en het ERI Model. Een belangrijke veronderstelling is dat specifieke taakeisen bepaalde werkbronnen vereisen om met deze taakeisen om te gaan. Daarom is waarschijnlijk dat alleen specifieke werkbronnen de potentie hebben om de negatieve effecten van specieke taakeisen tegen te gaan, en dat alleen bepaalde (optimale) combinaties van specifieke taakeisen en specifieke werkbronnen tot een interactie-effect zullen leiden. Het DC Model en het ERI Model gebruiken voornamelijk algemene maten voor zowel taakeisen als werkbronnen. Taakeisen kunnen geclassificeerd worden als mentaal, emotioneel en fysiek. Afhankelijk van het type werk zijn deze taakeisen meer of minder belangrijk. Anderzijds kunnen specifieke werkbronnen onderscheiden worden binnen beide modellen. Zo bestaat beslissingsruimte (of controle) in het DC Model uit vaardigheidsdiscretie en beslissingsautoriteit, terwijl de beloningen in het ERI Model bestaan uit salaris, erkenning en baanzekerheid. Beide modellen gebruiken dus algemene constructen die verder gespecificeerd zouden kunnen worden om een optimale operationalisatie van taakeisen en werkbronnen te bewerkstelligen. De vraag "Is er behoefte aan specificiteit?" kan hierdoor bevestigend beantwoord worden met betrekking tot de operationalisatie van taakeisen en werkbronnen binnen het DC Model en het ERI Model. Om te onderzoeken of een specifiekere conceptualisatie van taakeisen en werkbronnen leidt tot een betere detectie van interactie-effecten is de "specificiteithypothese" opgesteld:
De kans op het vinden van interacties tussen taakeisen en werkbronnen in relatie tot welbevinden is groter wanneer specifiekere maten, in vergelijking met algemenere maten, gebruikt worden voor taakeisen en werkbronnen.
In de volgende twee hoofdstukken worden de resultaten weergegeven voor achtereenvolgens het DC Model en het ERI Model.

In **hoofdstuk 6** worden de longitudinale resultaten weergegeven van de specificiteithypothese waarin het DC Model als theoretisch raamwerk dient. De meer gangbare (taakeisen uit DC Model en beslissingsruimte) alsmede de meer specifieke maten werden gebruikt om taakeisen en controle te operationaliseren. De panelgroep van steekproef 1 werd gebruikt voor de analyses. De hiërarchische regressie analyses lieten zien dat multiplicatieve interacties werden gevonden voor *alle* zelfgerapporteerde uitkomstmaten, zijnde arbeidstevredenheid, uitputting en psychosomatische klachten. Met betrekking tot ziekteverzuim werden geen interacties gevonden voor de duur van het verzuim, maar wel drie interacties voor de frequentie van het verzuim. In totaal werden 15 interacties (oftewel 25%) gevonden, hetgeen meer is dan op basis van toeval verwacht mag worden (namelijk

10%). In het algemeen laten de interacties zien dat wanneer werknemers hoge taakeisen rapporteren, maar weinig controle in het werk, dit zal resulteren in de meeste stressreacties twee jaar later, hetgeen de stresshypothese van het DC Model ondersteunt. Met betrekking tot taakeisen kan vermeld worden dat de meeste interacties emotionele taakeisen omvatten (9 van de 15 keer), alhoewel taakeisen uit DC Model (4 keer), en mentale taakeisen (2 keer) ook voorkwamen. In het geval van controle in het werk was beslissingsautoriteit de meest voorkomende component in de significante interactietermen (7 van de 15 keer), gevolgd door beslissingsruimte (6 keer), terwijl vaardigheidsdiscretie slechts twee keer voorkwam. Dus, een interactie tussen taakeisen en controle in voorspelling tot welbevinden omvatte meestal een specifieke taakeis (emotioneel) en een specifiek controleconcept (beslissingsautoriteit). Het gebruik van specifieke taakeis- en controleconcepten lijkt belangrijk in het detecteren van interactie-effecten, zoals ook voorgesteld wordt door de specificiteithypothese. De resultaten werden gekruisvalideerd in een vergelijkbare onafhankelijke steekproef (namelijk de panelgroep van steekproef 2), en lieten zien dat in het algemeen de resultaten niet verschillen tussen steekproef 1 en steekproef 2: het gebruik van specifieke maten was nuttig in beide steekproeven.

Hoofdstuk 7 omvat wederom een empirische test van de specificiteithypothese, ditmaal gebruik makende van het ERI Model als theoretisch kader. De taakeis- en beloningsconstructen werden geoperationaliseerd met behulp van conventionele (inspanning en beloningen) en meer specifieke maten. De panelgroep van steekproef 1 werd gebruikt voor de longitudinale analyses. De regressieanalyses laten zien dat, met uitzondering van uitputting, welbevinden voorspeld wordt door de multiplicatieve interactie tussen taakeis- en beloningsconstructen. Alhoewel slechts negen interacties werden gevonden (oftewel 15%), is dat wederom meer dan verwacht mag worden op basis van toeval. In het algemeen laten de interacties zien dat werknemers die hun werk ervaren als veel(taak)eisend maar weinig belonend de meeste stressreacties rapporteren twee jaar later, hetgeen (longitudinale) ondersteuning levert voor de situationele component van het ERI Model. Emotionele taakeisen kwamen het meest voor in de significante interactietermen (4 van de 9), gevolgd door (meer algemene) inspanning (3 keer) en fysieke taakeisen (2 keer). De interactietermen omvatten het meest vaak erkenning als beloningscomponent (4 van de 9), alhoewel interacties met het algemene beloningsconstruct en salaris ook voorkwamen (respectievelijk 3 en 2 keer). Met andere woorden, de interacties tussen taakeisen en beloningen die welbevinden voorspelden, bestonden meestal uit een specifieke taakeis (voornamelijk emotioneel) en een specifieke beloning (voornamelijk erkenning). Het gebruik van specifieke taakeisen en specifieke beloningen lijkt van belang bij het vinden van interacties in de voorspelling van welbevinden, zoals verondersteld wordt door de specificiteithypothese. Extra analyses lieten over het algemeen zien dat de persoonlijkheidscomponent van het ERI Model, "overbetrokkenheid" ("overcommitment" in het Engels) geen (directe of modererende) invloed had op welbevinden twee jaar later. Alle bovenstaande resultaten (van de panelgroep van steekproef 1) werden gekruisvalideerd in de panelgroep van steekproef 2. Enkele verschillen werden gevonden voor ziekteverzuimfrequentie, maar het merendeel van de kruisvalidaties laat zien dat de resultaten gerepliceerd kunnen worden in andere dienstverlenende groepen, en dus valide zijn.

In **hoofdstuk 8** worden tenslotte de belangrijkste bevindingen gepresenteerd. Tevens worden enkele methodologische kanttekeningen geplaatst met betrekking tot het onderzoeksdesign, de steekproeven, de meetinstrumenten en statistische analysemethoden. Ook worden de theoretische implicaties van deze studie besproken met betrekking tot de statistische operationalisatie van de interactieterm, de specificiteit van taakeisen en werkbronnen, en de werkstressmodellen (DC Model en ERI Model). De eerste bevinding laat zien dat de drie meest gebruikte statistische operationalisaties van de interactieterm in het DC Model en het ERI Model (relatieve overstijging, multiplicatieve en ratio term) verschillen qua inhoud en vorm. Idealiter zou die interactieterm gekozen moeten worden die het beste aansluit bij de theoretische gedachten die men heeft over de relatie tussen taakeisen en werkbronnen in voorspelling van stressreacties. Alle interactietermen veronderstellen dat de meeste stressreacties zullen optreden in de conditie met veel taakeisen en weinig werkbronnen. Als men veronderstelt dat alleen de conditie met veel taakeisen en weinig werkbronnen leidt tot stressreacties, dan passen de relatieve overstijging en de ratio term het beste. Maar, als men veronderstelt dat naast overbelasting ook *onder*belasting stressreacties kan oproepen dan is een multiplicatieve term te prefereren. Vanuit het oogpunt dat het DC Model en het ERI Model balansmodellen zijn past de multiplicatieve term het beste: een balans is goed voor welbevinden, terwijl een disbalans stressreacties oproept. Daarnaast leverde de multiplicatieve term de meest consistente bevindingen in de empirische test, ongeacht model of uitkomstmaat (hoofdstuk 4) en laten de resultaten van longitudinaal onderzoek (hoofdstuk 6 en 7) zien dat niet alleen veel taakeisen en weinig werkbronnen gepaard gaan met stressreacties, maar ook weinig taakeisen en veel werkbronnen. Een andere overweging is dat de multiplicatieve term de meest robuuste term is, dat wil zeggen dat de inhoud niet veranderd als de parameters veranderd zouden worden (zoals wel het geval is bij relatieve overstijging en ratio term) en dat de resultaten onafhankelijk zijn van de schaal die gebruikt wordt.

De tweede bevinding komt uit het specificiteitgedeelte (hoofdstuk 5, 6, 7) naar voren. Emotionele taakeisen zijn een belangrijke toevoeging voor het DC Model en het ERI Model. Het opnemen van emotionele taakeisen bevordert de detectie van interacties in de dienstverlenende sector. Dit type taakeis neemt aan belangrijkheid toe, gezien de groei van deze sector. Ook laat het specificiteitsgedeelte zien dat in parallelle analyses (waarin dezelfde taakeisen en dezelfde uitkomstmaat is gebruikt) de interacties met alléén het specifieke component van de werkbron (bijvoorbeeld erkenning) sterkere effecten laat zien dan de interactie met de algehele samengestelde werkbron (bijvoorbeeld beloningen). Het is dus best mogelijk dat de meting van een algemeen werkbronconstruct, zonder beoordeling van zijn afzonderlijke componenten, de beschermende werking van specifieke werkbron-componenten tegen taakeisen heeft gemaskeerd. Daarnaast hadden verschillende componenten een verschillende werking op welbevinden. Het lijkt dus belangrijk om de specifieke componenten te onderscheiden van beslissingsruimte (zijnde beslissingsautoriteit en vaardigheidsdiscretie) in het DC Model, en/of van beloningen (zijnde salaris, erkenning en baanzekerheid) in het ERI Model. Tot slot lijken werkbronnen gemeten op een specifiek niveau, die passen bij het type taakeis, functioneel zijn, en beschikbaar zijn, het meest geschikt te zijn in het tegengaan van de negatieve effecten van (specifieke) taakeisen op welbevinden.

Ten slotte zijn impliciet de twee werkstressmodellen getoetst. Het DC Model werd voornamelijk ondersteund voor zelfgerapporteerde uitkomstmaten (arbeidstevredenheid, uitputting en psychosomatische klachten). Uitbreiding van het DC Model met emotionele taakeisen liet enige ondersteuning zien voor ziekteverzuimfrequentie, maar niet voor ziekteverzuimduur. Het ERI Model werd voornamelijk ondersteund in relatie tot ziekteverzuim, maar ook met betrekking tot arbeidstevredenheid en psychosomatische klachten. Over de tijd, leek met name de interactie tussen inspanning en salaris belangrijk voor zelfgerapporteerde gezondheid, terwijl een interactie tussen emotionele/fysieke taakeisen en erkenning de mate van ziekteverzuim bepaalden. Echter, het ERI Model was niet in staat uitputting te voorspellen in het huidige onderzoek. Beide werkstressmodellen zijn valide modellen om de relatie tussen werkkenmerken en welbevinden weer te geven. Met name het verfijnen van hun concepten (taakeisen, controle en beloningen) lijkt van belang in het ontdekken van interactie-effecten met betrekking tot welbevinden.

Het proefschrift wordt afgesloten met enkele praktische implicaties en aanbevelingen voor toekomstig onderzoek. De taakeis-werkbron interacties impliceren dat, alhoewel taakeisen en werkbronnen ook afzonderlijk welbevinden kunnen beïnvloeden, in bepaalde situaties taakeisen en werkbronnen elkaars effect kunnen versterken resulterend in een extra sterk effect op welbevinden. Met name, werknemers die werken in een situatie waar sprake is van veel taakeisen en weinig werkbronnen lopen het risico dat hun welbevinden wordt aangetast, maar ook werknemers met weinig taakeisen en veel werkbronnen kunnen dit risico lopen. Met andere woorden, een "uitgebalanceerde" werksituatie in termen van taakeisen en werkbronnen is belangrijk, omdat dit het welbevinden (inclusief ziekteverzuim) van de werknemers op de langere termijn beïnvloedt. Daarnaast blijkt dat emotionele taakeisen een belangrijke rol spelen in de voorspelling van welbevinden, in ieder geval in de dienstverlenende sector. Alhoewel het moeilijk is om emotionele taakeisen te reduceren, immers zij zijn inherent aan het dienstverlenende werk, laten de interacties zien dat het mogelijk is door middel van het verhogen van werkbronnen (zoals beslissingsautoriteit en erkenning) het welbevinden te handhaven/verbeteren. In zoverre pleiten de longitudinale resultaten voor werk (her-)ontwerp interventies, waarin aandacht wordt gespendeerd aan de balans tussen taakeisen en werkbronnen, als een effectieve methode om het welbevinden van werknemers te verbeteren.

References

Adams, J. S. (1965). Inequity in social exchange. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 2, pp. 267-299). New York: Academic Press.
Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.
Akaike, H. (1987). Factor analysis and AIC. *Psychometrika, 52*, 317-332.
Allegro, J. T., & Veerman, T. J. (1998). Sickness absence. In P. J. D. Drenth & H. Thierry & C. J. d. Wolff (Eds.), *Handbook of organizational psychology* (2nd ed., Vol. 2, pp. 121-144). Hove, England: Psychology Press.
Andries, F., Houtman, I., & Hupkens, C. (2004). Kerncijfers arbeid. In I. L. D. Houtman & P. G. W. Smulders & D. J. Klein Hesselink (Eds.), *Trends in arbeid 2004 [Trends in work 2004]* (pp. 45-65). Hoofddorp, The Netherlands: TNO Arbeid.
Appels, A., & Schouten, E. (1991). Burnout as a risk factor for coronary heart disease. *Behavioral Medicine, 17*, 53-59.
Appels, A., Siegrist, J., & de Vos, J. (1997). 'Chronic workload', 'need for control' and 'vital exhaustion' in patients with myocardial infarction and control: A comparative test of cardiovascular risk profiles. *Stress Medicine, 13*, 117-121.
Arbuckle, J. L., & Wothke, W. (1999). *Amos 4.0: User's guide*. Chicago: SmallWaters Corporation.
Ariëns, G. A. M., Bongers, P. M., Hoogendoorn, W. E., Houtman, I. L. D., van der Wal, G., & van Mechelen, W. (2001). High quantitative job demands and low co-worker support as risk factors for neck pain: Results of a prospective cohort study. *Spine, 26*, 1896-1903.
AZWinfo. (2003). *Arbeidsmarktinformatie Zorg en Welzijn: Verplegende en verzorgende beroepen [Labour market information Care and Well-being: Nursing and caring professions]* [On-line]. Retrieved, from the World Wide Web: http://www.azwinfo.nl/beschrijvingen/verplegende-en-verzorgende-beroepen.php
Baarda, D. B., & de Goede, M. P. M. (1995). *Methoden en technieken. Basisboek: Praktische handleiding voor het opzetten en uitvoeren van onderzoek [Research methods and techniques. Manual for the design and implementation of scientific research]* (2nd ed.). Houten, The Netherlands: Stenfert Kroese.
Bakker, A. B., Killmer, C. H., Siegrist, J., & Schaufeli, W. B. (2000). Effort-reward imbalance and burnout among nurses. *Journal of Advanced Nursing, 31*, 884-891.
Beehr, T. A., Glaser, K. M., Canali, K. G., & Wallwey, D. A. (2001). Back to basis: Re-examination of Demand-Control Theory of occupational stress. *Work and Stress, 15*, 115-130.
Bekker, S., van Essen, G., Josten, E., Meihuizen, H., Allaart, P., Kunnen, R., & Peters, F. (2003). *Arbeid in zorg en welzijn. Integrerend OSA-rapport 2003 [Work in care and well-being. Integrated OSA-report 2003]* (OSA-publicatie ZW47). Tilburg: OSA.
Belkiç, K., Landsbergis, P., Schnall, P., Baker, D., Theorell, T., Siegrist, J., Peter, R., & Karasek, R. (2000). Psychosocial factors: Review of empirical data among

men. In P. L. Schnall & K. Belkiç & P. Landsbergis & D. Baker (Eds.), *The workplace and cardiovascular disease* (pp. 24-26). Philadelphia: Hanley & Belfus.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*, 238-246.

Blau, P. M. (1964). *Exchange and power in social life*. New York: Willey.

Blum, K., Cull, J. G., Braverman, E. R., & Comings, D. E. (1996). Reward deficiency syndrome: addictive, impulsive and compulsive disorders - including alcoholism, attention-deficit disorders, drug abuse and food bingeing - may have a common genetic basis. *American Scientist, 84*, 132-145.

Bosma, H., Marmot, M. G., Hemingway, H., Nicholson, A. C., Brunner, E., & Stansfeld, S. A. (1997). Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. *British Medical Journal, 314*, 558-565.

Bosma, H., Peter, R., Siegrist, J., & Marmot, M. (1998). Two alternative job stress models and the risk of coronary heart disease. *American Journal of Public Health, 88*, 68-74.

Buijs, C., Slot-van der Krift, A. J., & Velders, S. (2002). *WAO en reïntegratie in de zorg- en welzijnssector: Bestands- en stroomcijfers 1999 [Work disability and reintegration in the care and well-being sector: Data and flow numbers 1999]* (OSA-publicatie ZW27). Tilburg: OSA.

Byrne, B. M. (2001). *Structural equation modeling with AMOS: Basic concepts, applications and programming*. Mahwah, NJ: Erlbaum.

Calnan, M., Wainwright, D., & Almond, S. (2000). Job strain, effort-reward imbalance and mental distress: A study of occupations in general medical practice. *Work and Stress, 14*, 297-311.

Caplan, R. D., Cobb, S., French, J. R. P., van Harrison, R., & Pineau, S. R. J. (1976). *Job demands and worker health: Main effects and occupational differences* (U.S.G.P.O. Stock no. 1733-00083). Washington: U.S. Department of Health, Education and Welfare.

CBS (2003). *Statistisch jaarboek 2003 [Statistical yearbook 2003]*. Voorburg/Heerlen: Centraal Bureau voor de Statistiek.

CBS (2004). *Statistisch jaarboek 2004 [Statistical yearbook 2004]*. Voorburg/Heerlen: Centraal Bureau voor de Statistiek.

CBS (2005). *Statline* [On-line]. Centraal Bureau voor de Statistiek. Retrieved March 22, 2005, from the World Wide Web: http://statline.cbs.nl/StatWeb/

Champoux, J. E., & Peters, W. (1987). Form, effect size and power in moderated regression analysis. *Journal of Occupational Psychology, 60*, 243-255.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*, 310-357.

Cohen, Y., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.

Conway, J. M. (2002). Method variance and method bias in industrial and organizational psychology. In S. G. Rogelberg (Ed.), *Handbook of research methods in industrial and organizational psychology* (pp. 344-365). Malden, The Netherlands: Blackwell Publishers.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis for field settings*. Boston: Houghton Mifflin.
Cooper, C. L., Dewe, P. J., & O'Driscoll, M. P. (2001). *Organizational stress: A review and critique of theory, research, and applications*. Thousand Oaks, CA: Sage.
Cooper, W. H., & Richardson, A. J. (1986). Unfair comparisons. *Journal of Applied Psychology, 71*, 179-184.
Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology, 78*, 98-104.
Cronbach, L. J. (1987). Statistical test for moderator variables: Flaws in analyses recently proposed. *Psychological Bulletin, 102*, 414-417.
Cutrona, C. E., & Russell, D. W. (1990). Type of social support and specific stress: Toward a theory of optimal matching. In B. R. Sarason & I. G. Sarason & G. R. Pierce (Eds.), *Social support: An interactional view* (pp. 319-366). New York: John Wiley & Sons.
Daniels, K., & de Jonge, J. (2001). *Longitudinal designs in work stress research and the question of validity.* Paper presented at the Tenth European Congress on Work and Organizational Psychology, Prague, Czech Republic.
Daniels, K., & Harris, C. (2005). A daily study of coping in the context of the job demands-control-support model. *Journal of Vocational Behavior, 66*, 219-237.
Darlington, R. B. (1990). *Regression and linear models*. New York: McGraw-Hill.
de Jonge, J. (1995). *Job autonomy, well-being, and health: A study among Dutch health care workers* (Ph.D. thesis). Maastricht: Datawyse.
de Jonge, J. (2002). *Demand-Control interactions: State of the art and unresolved questions.* Paper presented at the JCQ Workshop, Düsseldorf, Germany.
de Jonge, J., Bosma, H., Peter, R., & Siegrist, J. (2000). Job strain, effort-reward imbalance and employee well-being: A large-scale cross-sectional study. *Social Science and Medicine, 50*, 1317-1327.
de Jonge, J., Dollard, M. F., Dormann, C., Le Blanc, P. M., & Houtman, I. L. D. (2000). The Job Demand-Control Model: Specific demands, specific control, and well-defined groups. *International Journal of Stress Management, 7*, 269-287.
de Jonge, J., & Dormann, C. (2003). The DISC Model: Demand-Induced Strain Compensation mechanisms in job stress. In M. F. Dollard & H. R. Winefield & A. H. Winefield (Eds.), *Occupational stress in the service professions* (pp. 43-74). London: Taylor & Francis.
de Jonge, J., & Furda, J. (1997). Het Job Demand-Control Model: Een tussentijdse balans. In K. v. Dam & W. Bloemers (Eds.), *Individu, arbeid en organisatie: Ontwikkelingen in de arbeids- en organisatiepsychologie* (pp. 219-230). Utrecht: De Tijdstroom.
de Jonge, J., & Hamers, J. P. H. (2000). Inspanningen en beloningen in het werk van verplegenden en verzorgenden: Een kwestie van balans of disbalans? [Efforts and rewards in nursing jobs: A matter of balance or imbalance?]. *Verpleegkunde, 15*, 64-73.

de Jonge, J., & Kompier, M. A. J. (1997). A critical examination of the Demand-Control-Support Model from a work psychological perspective. *International Journal of Stress Management, 4*, 253-258.

de Jonge, J., Landeweerd, J. A., & Nijhuis, F. J. N. (1993). Constructie en validering van de vragenlijst ten behoeve van het project 'Autonomie in het werk' [Construction and validation of questionnaire for project 'Autonomy at work']. *Studies bedrijfsgezondheidszorg nummer 9*.

de Jonge, J., Mulder, M. J. G. P., & Nijhuis, F. J. N. (1999). The incorporation of different demand concepts in the Demand-Control Model: Effects on health care professionals. *Social Science and Medicine, 48*, 1149-1160.

de Jonge, J., Reuvers, M. M. E. N., Houtman, I. L. D., Bongers, P. M., & Kompier, M. A. J. (2000). Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes, and sickness absence: Baseline results from SMASH. *Journal of Occupational Health Psychology, 5*, 256-268.

de Jonge, J., van Breukelen, G. J. P., Landeweerd, J. A., & Nijhuis, F. J. N. (1999). Comparing group and individual level assessments of job characteristics in testing the Job Demand-Control Model: A multilevel approach. *Human Relations, 52*, 95-122.

de Jonge, J., van der Linden, S., Schaufeli, W., Peter, R., & Siegrist, J. (2003). *Validity and reliability of the Dutch ERI scales: Preliminary findings.* Paper presented at the ESF meeting, Düsseldorf.

de Lange, A. H., Taris, T. W., Kompier, M. A. J., Houtman, I. L. D., & Bongers, P. M. (2003). "The very best of the millennium": Longitdinal research and the Demand-Control-(Support) Model. *Journal of Occupational Health Psychology, 8*, 282-305.

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology, 86*, 499-512.

Dirken, J. M. (1969). *Arbeid en stress [Work and stress]*. Groningen: Wolters-Noordhof.

Dollard, M. F., Dormann, C., Boyd, C. M., Winefield, H. R., & Winefield, A. H. (2003). Unique aspects of stress in human service work. *Australian Psychologist, 38*, 84-91.

Dooley, D. (1984). *Social research methods*. Englewood Cliffs, NJ: Prentice-Hall.

Dormann, C., & Zapf, D. (2002). Social stressors at work, irritation, and depressive symptoms: Accounting for unmeasured third variables in a multi-wave study. *Journal of Occupational and Organizational Psychology, 75*, 33-58.

Dormann, C., & Zapf, D. (2004). Customer-related social stressors and burnout. *Journal of Occupational Health Psychology, 9*, 61-82.

Dragano, N., von dem Knesebeck, O., Rödel, A., & Siegrist, J. (2003). Psychosoziale Arbeitsbelastungen und muskulo-skeletale Beschwerden: Bedeutung für die Prävention [Psychosocial work stress and musculoskeletal diseases: Significance for prevention]. *Zeitschrift für Gesundheitswissenschaften, 11*, 196-207.

Edwards, J. R. (1994). The study of congruence in organizational behavior research: Critique and a proposed alternative. *Organizational behavior and human decision processess, 58*, 51-100.

Edwards, J. R. (2002). Alternatives to difference scores: Polynomial regression analyses and response surface methodology. In F. Drasgow & N. W. Schmitt (Eds.), *Advances in measurement and data analysis* (pp. 350-400). San Francisco: Jossey-Bass.

Edwards, J. R., & Cooper, C. L. (1990). The person-environment fit approach to stress: Recurring problems and some suggested solutions. *Journal of Organizational Behavior, 11*, 293-307.

Edwards, J. R., & van Harrison, R. (1993). Job demands and worker health: Three-dimensional reexamination the relationship between person-environment fit and strain. *Journal of Applied Psychology, 78*, 628-648.

European Foundation for the Improvement of Living and Working Conditions. (2002). *Quality of work and employment in Europe: Issues and challenges* (EF0212). Dublin: European Foundation for the Improvement of Living and Working Conditions.

Elovainio, M., & Sinervo, T. (1997). Psychological stressors at work, psychological stress and musculoskeletal symptoms in the care for the elderly. *Work and Stress, 11*, 351-361.

Fox, M. L., Dwyer, D. J., & Ganster, D. C. (1993). Effects of stressful job demands and control on physiological and attitudinal outcomes in a hospital setting. *Academy of Management Journal, 36*, 289-318.

Frese, M. (1999). Social support as a moderator of the relationship between work stressors and psychological dysfunctioning: A longitudinal study with objective measures. *Journal of Occupational Health Psychology, 4*, 179-192.

Frese, M., & Zapf, D. (1988). Methodological issues in the study of work stress: Objective versus subjective measurement of work stress and the question of longitudinal studies. In C. L. Cooper & R. Pain (Eds.), *Causes, coping and consequences of stress at work* (pp. 375-411). Chichester: Wiley and Sons.

Frone, M. R., Russell, M., & Cooper, M. L. (1995). Relationship of work and family stressors to psychological distress: The independent moderating influence of social support, mastery, active coping, and self-focused attention. In R. Crandall & P. L. Perrewé (Eds.), *Occupational stress: A handbook* (pp. 129-150). Washington, DC: Taylor & Francis.

Gaillard, A. W. K. (2003). *Stress, productiviteit en gezondheid [Stress, productivity and health]* (2nd ed.). Amsterdam: Nieuwezijds.

Gaillard, A. W. K., & Wientjes, C. J. E. (1994). Mental load and work stress as two types of energy mobilization. *Work and Stress, 8*, 141-152.

Ganster, D. C. (1989). Worker control and well-being: A review of research in the workplace. In S. L. Sauter & J. J. Hurrell Jr. & C. L. Cooper (Eds.), *Job control and worker health*. Chichester: John Wiley & Sons.

Ganster, D. C. (1995). Interventions for building healthy organizations: Suggestions from the stress research literature. In L. R. Murphy & J. J. Hurrell Jr. & S. L.

Sauter & G. R. Keita (Eds.), *Job stress interventions* (pp. 323-336). Washington: APA.

Ganster, D. C., Fox, M. L., & Dwyer, D. J. (2001). Explaining employees' health care costs: A prospective examination of stressful job demands, personal control, and physiological reactivity. *Journal of Applied Psychology, 86*, 954-964.

Ganster, D. C., & Fusilier, M. R. (1989). Control in the workplace. In C. L. Cooper & I. T. Robertson (Eds.), *International review of industrial and organizational psychology* (pp. 235-280). Chichester: Wiley and Sons.

Geurts, S. A., Schaufeli, W. B., & Rutte, C. G. (1999). Absenteeism, turnover intention and inequity in the employment relationships. *Work and Stress, 13*, 253-267.

Godin, I., & Kittel, F. (2004). Differential economic stability and psychosocial stress at work: Associations with psychosomatic complaints and absenteeism. *Social Science and Medicine, 58*, 1543-1553.

Gonge, H., Jensen, L. D., & Bonde, J. P. (2002). Are psychosocial factors associated with low-back pain among nursing personnel? *Work and Stress, 16*, 79-87.

Goodwin, C. J. (2003). *Research in psychology: Methods and design* (3rd ed.). New York: John Wiley & Sons.

Griffin, R. W. (1983). Objective and social sources of information in task redesign: A field experiment. *Administrative Science Quarterly, 28*, 184-200.

Gründemann, R. W. M., & Nijboer, I. D. (1998). *WAO-intrede en werkhervatting [Work disability and work resumption]*. Amsterdam: NIA-TNO.

Hackman, J. R., & Oldham, G. R. (1980). *Work redesign*. Reading, Massachutes: Addison-Wesley.

Hagenaars, J. A. (1990). *Categorical longitudinal data: Log-linear panel, trend and cohort analysis*. Newbury Park, CA: Sage.

Hallqvist, J., Diderichsen, F., Theorell, T., Reuterwall, C., Ahlbom, A., & SHEEP-study-group. (1998). Is the effect of job strain on myocardial infarction due to interaction between high psychological demands and low decision latitude? Results from Stockholm Heart Epidemiology Program (SHEEP). *Social Science and Medicine, 46*, 1405-1415.

Hanson, E. K. S., Schaufeli, W., Vrijkotte, T., Plomp, N. H., & Godaert, G. L. R. (2000). The validity and reliability of the Dutch effort-reward imbalance questionnaire. *Journal of Occupational Health Psychology, 5*, 142-155.

Hasenfeld, Y. (1983). *Human service organizations*. Englewood Cliffs, NJ: Prentice Hall.

Hasenfeld, Y. (1992). *Human services as complex organizations*. Newbury Park: Sage.

Hasselhorn, H.-M., Tackenberg, P., Peter, R., & NEXT-StudyGroup. (2004). Effort-reward imbalance among nurses in stable countries and in countries in transition. *International Journal on Occupational and Environmental Health, 10*, 401-408.

Henry, J. P., & Stephens, P. M. (1977). *Stress, health, and the social environment*. Berlin, Germany: Springer.

Hobfoll, S. E. (1998). *Stress, culture, and community: The psychology and philosophy of stress.* New York: Plenum Press.

Hockey, G. R. J. (2000). Work environments and performance. In N. Chmiel (Ed.), *Introduction to work and organizational psychology: A European perspective* (pp. 206-230). Malden, MA, US: Blackwell Publishers Inc.

Hollmann, S., Heuer, H., & Schmidt, K.-H. (2001). Control at work: A generalized resource factor for the prevention of musculoskeletal symptoms? *Work and Stress, 15*, 29-39.

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics, 6*, 65-70.

Holman, D. J., & Wall, T. D. (2002). Work characteristics, learning-related outcomes, and strain: A test of competing direct effects, mediated, and moderated models. *Journal of Occupational Health Psychology, 7*, 283-301.

Hoogendoorn, W. E., Bongers, P. M., de Vet, H. C., Ariëns, G. A., van Mechelen, W., & Bouter, L. M. (2002). High physical work load and low job satisfaction increase the risk of sickness absence due to low back pain: Results of a prospective cohort study. *Occupational Environment Medicine, 59*, 323-328.

Hoogendoorn, W. E., van Poppel, M. N. M., Koes, B. W., & Bouter, L. M. (2000). Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine, 25*, 2114-2125.

Houkes, I. (2002). *Work and individual determinants of intrinsic work motivation, emotional exhaustion and turnoverintention: A study among bank employees and teachers* (Ph.D. thesis). Maastricht: Datawyse.

House, J. S. (1981). *Work stress and soial support.* London: Addison-Wesley.

Houtman, I., Kornitzer, M., de Smets, P., Koyungu, R., de Backer, G., Pelfrene, E., Romon, M., Boulenguez, C., Ferrario, M., Origgi, G., Sans, S., Perez, I., Wilhelmsen, L., Rosengren, A., Isacsson, S.-O., & Östergren, P.-O. (1999). Job stress, absenteeism and coronary heart disease European study (the JACE study). *European Journal of Public Health, 9*, 52-57.

Houtman, I. L. D. (1997). *Trends in en rondom arbeid en gezondheid [Trends in work and health]*. Amsterdam: NIA-TNO.

Houtman, I. L. D. (2005). *Work-related stress* (EF05127). Dublin: European Foundation for the Improvement of Living and Working Conditions.

Houtman, I. L. D., Andries, F., & Hupkens, C. (2004). Kerncijfers gezondheid, productivitieit en sociale zekerheid [Core figures on health, productivity and social security]. In I. L. D. Houtman & P. G. W. Smulders & D. J. Klein Hesselink (Eds.), *Trends in arbeid 2004* (pp. 67-94). Hoofddorp, The Netherlands: TNO Arbeid.

Howard, A. (1995). A framework for work change. In A. Howard (Ed.), *The changing nature of work* (pp. 3-44). San Francisco: Jossey-Bass.

Jaccard, J., Turrisi, R., & Wan, C. K. (1990). *Interaction effects in multiple regression.* Newbury Park, CA: Sage Series on Quantitative Applications in the Social Sciences.

Jansen, M. E., & Sikkel, D. (1981). Verkorte versie van de VOEG-schaal [Short version of the VOEG-scale]. *Gedrag & Samenleving, 2*, 78-82.

Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behaviour. *Journal of Occupational and Organizational Psychology, 73*, 287-302.

Janssen, P. P. M., Bakker, A. B., & de Jong, A. (2001). A test and refinement of the Demand-Control-Support Model in the construction industry. *International Journal of Stress Management, 8*, 315-332.

Johnson, J. V., & Hall, E. M. (1988). Job strain, work place social support, and cardiovascular disease: A cross-sectional study of a random sample of the Swedish working population. *American Journal of Public Health, 7*, 1336-1342.

Joksimovic, L., Starke, D., von dem Knesebeck, O., & Siegrist, J. (2002). Perceived work stress, overcommitment, and self-reported musculoskeletal pain: A cross-sectional investigation. *International Journal of Behavioral Medicine, 9*, 122-138.

Jones, F., & Fletcher, B. C. (1996). Job control and health. In M. J. Schabracq & J. A. M. Winnubst & C. L. Cooper (Eds.), *Handbook of work and organizational psychology* (pp. 33-50). Chichester: John Wiley & Sons.

Jones, F., & Fletcher, B. C. (2003). Job control, physical health and psychological well-being. In M. J. Schabracq & J. A. M. Winnubst & C. L. Cooper (Eds.), *The handbook of work and health psychology* (pp. 121-142). Chichester: John Wiley & Sons.

Joosten, J., & Drop, M. J. (1987). De betrouwbaarheid en vergelijkbaarheid van de drie versies van de VOEG [The reliability and comparability of three versions of the VOEG]. *Gedrag & Samenleving, 8*, 251-265.

Kahn, R. (1981). Work and health: Some psychological effects and advanced technology. In B. Gardell & G. Johansson (Eds.), *Man and working life* (pp. 17-37). Chichester: Wiley & Sons.

Kahn, R. L., & Byosiere, P. (1992). Stress in organizations. In L. M. Hough (Ed.), *Handbook of industrial and organizational psychology* (2nd ed., Vol. 3, pp. 571-650). Palo Alto, CA: Consulting Psychologists Press.

Kamalanabhan, T. J., Uma, J., & Vasanthi, M. (1999). A delphi study of motivational profile of scientists in research and development organisations. *Psychological Reports, 85*, 743-749.

Karasek, R. (1989). Control in the workplace and its health-related aspects. In S. L. Sauter & J. J. Hurrell & C. L. Cooper (Eds.), *Job control and worker health* (pp. 129-159). Chichester, England: Wiley.

Karasek, R. (2005). *JCQ Version 2.0* [on-line]. Retrieved April 4, 2005, from the World Wide Web: http://www.jcqcenter.org/JCQ%202RationPropPartFour.html.

Karasek, R., Siegrist, J., & Theorell, T. (1998). *Joint statement on the relationship between the two theoretical models measuring stress at work: The Demand-Control model (DC) and the Effort-Reward Imbalance model (ERI)* [On-line]. Retrieved, from the World Wide Web: http://www.uni-duesseldorf.de/WWW/WorkStress/jointstatement.html.

Karasek, R. A. (1985). *Job Content Instrument: Questionnaire and user's guide. Revision 1.1.* Los Angeles: University of Southern California.

Karasek, R. A., Brisson, C., Kawakami, N., Houtman, I., Bongers, P., & Amick, B. (1998). The Job Content Questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *Journal of Occupational Health Psychology, 3*, 322-355.

Karasek, R. A., Jr. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24*, 285-308.

Karasek, R. A., & Theorell, T. (1990). *Healthy work: Stress, productivity and the reconstruction of working life*. New York: Basic Books.

Kasl, S. V. (1996). The influence of the work environment on cardiovascular health: A historical, conceptual, and methodological perspective. *Journal of Occupational Health Psychology, 1*, 42-56.

Kessler, R. C., & Greenberg, D. F. (1981). *Linear panel analysis: Models of quantitative change*. New York: Academic Press.

Kirmeyer, S. L., & Dougherty, T. W. (1988). Work load, tension and coping: Moderating effects of supervisor support. *Personnel Psychology, 41*, 125-139.

Kivimäki, M., Leino-Arjas, P., Luukkonen, R., Riihimäki, H., Vahtera, J., & Kirjonen, J. (2002). Work stress and risk of cardiovascular mortality: Prospective cohort study of industrial employees. *British Medical Journal, 325*, 857-861.

Kivimäki, M., & Lindström, K. (1995). Effects of private self-consciousness and control on the occupational stress-strain relationship. *Stress Medicine, 11*, 7-16.

Kleinbaum, D. G., Kupper, L. L., & Muller, K. E. (1988). *Applied regression analysis and other multivariable methods* (2nd ed.). Boston: PWS-KENT.

Kompier, M. A. J., & Cooper, C. L. (1999). *Preventing stress, improving productivity: European case studies in the workplace*. London: Routledge.

Koningsveld, E. A. P., Zwinkels, W., Mossink, J. C. M., Thie, X., & Abspoel, M. (2004). *Maatschappelijke kosten van arbeidsomstandigheden van werknemers in 2001 [National costs of working conditions for workers in the Netherlands 2001]* (Technical report). The Hague, The Netherlands: Ministry of Social Affairs and Employment.

Kristensen, T. S. (1991). Sickness absence and work strain among Danish slaughterhouse workers: An analysis of absence from work regarded as coping behaviour. *Social Science and Medicine, 32*, 15-27.

Kristensen, T. S. (1995). The Demand-Control-Support Model: Methodological challenges for future research. *Stress Medicine, 11*, 17-26.

Kristensen, T. S. (1996). Job stress and cardiovascular disease: A theoretical critical review. *Journal of Occupational Health Psychology, 1*, 246-260.

Kristensen, T. S. (1999). Challenges for research and prevention in relation to work and cardiovascular diseases. *Scandinavian Journal of Work, Environment and Health, 25*, 550-557.

Kristensen, T. S. (2004). *The Copenhagen stress model: The "six golden nuggets"*. Paper presented at the Eight International Congress of Behavioral Medicine, Mainz, Germany.

Kushnir, T., & Melamed, S. (1991). Work-load, perceived control and psychological distress in Type A/B industrial workers. *Journal of Organizational Behavior, 12*, 155-168.

Landsbergis, P. A., Schnall, P. L., Warren, K., Pickering, T. G., & Schwartz, J. E. (1994). Association between ambulatory blood pressure and alternative formulations of job strain. *Scandinavian Journal of Work, Environment and Health, 20*, 349-363.

Landsbergis, P. A., & Theorell, T. (2000). Measurement of psychosocial workplace exposure variables. *Occupational Medicine: State of the art reviews, 15*, 163-188.

Lazarus, R. S. (1999). *Stress and emotion: A new synthesis*. London: Free Association Books.

Lee, R. T., & Ashfort, B. E. (1996). A meta-analytic examination of the correlates of the three dimensions of job burnout. *Journal of Applied Psychology, 81*, 123-133.

Lekander, M. (2002). Ecological immunology: The role of the immune system in psychology and neuroscience. *European Psychologist, 7*, 98-115.

Levi, L. (1990). Occupational stress: Spice of life or kiss of death? *American Psychologist, 45*, 1142-1145.

LISV (1998). *Psychische klachten en de WAO [Mental problems and the work incapacitation act]*. Amsterdam: LISV (Landelijk Instituut Sociale Verzekeringen).

Marmot, M., Siegrist, J., Theorell, T., & Feeney, A. (1999). Health and the psychosocial environment at work. In M. Marmot & R. G. Wilkinson (Eds.), *Social determinants of health* (pp. 105-131). Oxford: Oxford University Press.

Martin, P. Y., & Hanson, S. (1985). Sex, family wage earning status and satisfaction with work. *Work and Occupations, 2*, 91-109.

Maslach, C., & Jackson, S. E. (1986). *Manual Maslach Burnout Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Maslow, A. (1954). *Motivation and personality*. New York: Harper & Row.

Matschinger, H., Siegrist, J., Siegrist, K., & Dittmann, K. H. (1986). Type A as a coping carreer - Toward a conceptual and methodological redefinition. In T. H. Schmidt & T. M. Dembroski & G. Blümchen (Eds.), *Biological and psychological factors in cardiovascular disease* (pp. 104-126). Berlin: Springer-Verlag.

Meijer, K. (1995). *Handboek psychosomatiek: Theorie - diagnostiek - methode voor hulpverlening bij psychosomatische klachten [Handbook psychosomatics: Theory - diagnostics - method for assistance by psychosomatic complaints]* (2nd ed.). Baarn, The Netherlands: Intro.

Michie, S., & Cockfort, A. (1996). Overwork can kill: Especially if combined with high demand, low control, and poor social support. *British Medical Journal, 312*, 921-922.

Miller, S. M. (1979). Coping with impeding stress: Psychophysiological and cognitive correlates of choice. *Psychophysiology, 16*, 572-581.

Mo. (2001). *Dagboek Mo [Mo's Diary]* [On-line]. Stichting Daphne. Retrieved March 2, 2004, from the World Wide Web: http://www.daphnefoundation.nl/nl/nldagboekmo01.html#top.

Niedhammer, I., Siegrist, J., Landre, M. F., Goldberg, M., & Leclerc, A. (2000). Etude des qualites psychometriques de la version francaise du modele du Desequilibre Efforts/Recompenses [Psychometric properties of the French version of the Effort-Reward Imbalance model]. *Revue d'epidemiol et de sante publique, 48*, 419-437.

Niedhammer, I., Tek, M.-L., Starke, D., & Siegrist, J. (2004). Effort-reward imbalance model and self-reported health: Cross-sectional and prospective findings from the GAZEL cohort. *Social Science and Medicine, 58*, 1531-1541.

Oliver, R. L. (1976). Hedonic reactions to the disconfirmation of product performance expectations: Some moderating conditions. *Journal of Applied Psychology, 61*, 246-250.

Oliver, R. L. (1977). Effect of expectation and disconfirmation on postexposure product evaluations: An alternative explanation. *Journal of Applied Psychology, 61*, 480-486.

Ostry, A. S., Kelly, S., Demers, P. A., Mustard, C., & Hertzman, C. (2003). *A comparison between the effort-reward imbalance and demand-control models* [on-line]. BMC Public Health. Retrieved, from the World Wide Web: http://www.biomedcentral.com/1471-2458/10.

Parker, S. K., & Sprigg, C. A. (1999). Minimizing strain and maximizing learning: The role of job demands, job control, and proactive personality. *Journal of Applied Psychology, 84*, 925-939.

Peter, R. (2002). Berufliche Gratifikationskrisen und Gesundheit [Effort-reward imbalance and ill health]. *Psychotherapeut, 47*, 386-398.

Peter, R., Alfredsson, L., Hammar, N., Siegrist, J., Theorell, T., & Westerholm, P. (1998). High effort, low reward, and cardiovascular risk factors in employed Swedish men and women: Baseline results from the WOLF Study. *Journal of Epidemiology and Community Health, 52*, 540-547.

Peter, R., Alfredsson, L., Hammar, N., Siegrist, J., Theorell, T., & Westerholm, P. (2002). Job strain, effort-reward imbalance, and coronary risk factors - complementary job stress models in risk estimation? *International Congress Series, 1241*, 165-171.

Peter, R., Hammarström, A., Hallqvist, J., Siegrist, J., Theorell, T., & SHEEP-study-group. (in press). Does occupational gender segregation influence the association of effort-reward imbalance with myocardial infarction in the SHEEP Study? *International Journal of Behavioral Medicine.*

Peter, R., & Siegrist, J. (1997). Chronic work stress, sickness absence, and hypertension in middle managers: General of specific sociological explanations? *Social Science and Medicine, 45*, 1111-1120.

Peter, R., Siegrist, J., Hallqvist, J., Reuterwall, C., Theorell, T., & Group, S. S. (2002). Psychosocial work environment and myocardial infarction: Improving risk estimation by combining two complementary job stress models in the SHEEP Study. *Journal of Epidemiology and Community Health, 56*, 294-300.

Pikhart, H., Bobak, M., Pajak, A., Malyutina, S., Kubinova, R., Topor, R., Sebakova, H., Nikitin, Y., & Marmot, M. (2004). Psychosocial factors at work and depression in three countries of Central and Eastern Europe. *Social Science and Medicine, 58*, 1475-1482.

Prismant. (2003). *Mannen in de verpleging: toestroom of uitstroom? [Men in nursing: onrush or outflow?]*. Utrecht: Prismant.

Rafferty, Y., Friend, R., & Landsbergis, P. A. (2001). The association between job skill discretion, decision latitude and burnout. *Work and Stress, 15*, 73-85.

Rodin, J., Rennert, K., & Solomon, S. K. (1980). Intrinsic motivation for control: Fact or fiction. In J. E. Singer (Ed.), *Advances in environmental psychology* (Vol. 2, Applications of personal control, pp. 131-148). Hillsdale, NJ: Lawrence Erlbaum.

Sargent, L. D., & Terry, D. J. (1998). The effects of work control and job demands on employee adjustment and work performance. *Journal of Occupational and Organizational Psychology, 71*, 219-236.

Sauter, S. L. (1989). Moderating effects of job control on health complaints in office work. In C. L. Cooper (Ed.), *Job control and worker health*. Chichester: Wiley & Sons.

Schabracq, M. J., Maassen van den Brink, H., Groot, W., Janssen, P., & Houkes, I. (2000). *De prijs van stress [The price of stress]*. Amsterdam: Welboom-Elsevier Reed.

Schaufeli, W., & Enzmann, D. (1998). *The burnout companion to study and practice: A critical analysis*. London: Taylor & Francis.

Schaufeli, W., & van Dierendonck, D. (1999). *UBOS: Utrechtse Burnout Schaal* (Manual). Amsterdam: Swets & Zeitlinger.

Schaufeli, W. B. (in press). The balance of give and take: Toward a social exchange model of burnout. *International Review of Social Psychology*.

Schaufeli, W. B., & Kompier, M. A. J. (2001). Managing job stress in the Netherlands. *International Journal of Stress Management, 8*, 15-34.

Schnall, P. L., Landsbergis, P. A., & Baker, D. (1994). Job strain and cardiovascular disease. *Annual Review of Public Health, 15*, 381-411.

Schönpflug, W., & Batman, W. (1989). The costs and benefits of coping. In S. Fisher & J. Reason (Eds.), *Handbook of stress, cognition and health* (pp. 699-714). Chichester: John Wiley and Sons.

Schreurs, P. J. G., & Taris, T. W. (1998). Construct validity of the demand-control model: A double cross-validation approach. *Work and Stress, 12*, 66-84.

Schumacker, R. E., & Lomax, R. G. (1996). *A beginner's guide to structural equation modeling*. Mahwah, NJ: Erlbaum.

Seligman, M. E. P. (1992). *Helplessness: On depression, development, and death* (Repr. ed.). New York: Freeman.

Semmer, N., Zapf, D., & Greif, S. (1996). 'Shared job strain': A new approach for assessing the validity of job stress measurements. *Journal of Occupational and Organizational Psychology, 69*, 293-310.

Shimomitsu, T., & Odagiri, Y. (2000). Working life in Japan. *Occupational Medicine: State of the art reviews, 15*, 280-281.
Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of Occupational Health Psychology, 1*, 27-41.
Siegrist, J. (1998). Adverse health effects of effort-reward imbalance at work: Theory, empirical support, and implications for prevention. In C. L. Cooper (Ed.), *Theories of organizational stress* (pp. 190-204). Oxford: Oxford University Press.
Siegrist, J. (1999). Occupational health and public health in Germany. In P. M. Le Blanc & M. C. W. Peeters & A. Büssing & W. B. Schaufeli (Eds.), *Organizational psychology and health care: European contributions* (pp. 35-44). München: Rainer Hampp Verlag.
Siegrist, J. (2001). A theory of occupational stress. In J. Dunham (Ed.), *Stress in the workplace: Past, present and future* (pp. 52-66). London: Whurr Publishers.
Siegrist, J. (2002a). Effort-reward imbalance at work and health. In P. L. Perrewé & D. C. Ganster (Eds.), *Historical and current perspectives on stress and health* (pp. 261-291). Amsterdam: JAI Elsevier.
Siegrist, J. (2002b). *The Model of Effort-Reward Imbalance*. Paper presented at the Third International Conference on Work Environment and Cardiovascular Diseases, Duesseldorf, Germany.
Siegrist, J., & Peter, R. (1994). Job stressors and coping characteristics in work-related disease: Issues of validity. *Work and Stress, 8*, 130-140.
Siegrist, J., & Peter, R. (1996). *Measuring effort-reward imbalance at work: Guidelines*. Düsseldorf: Heinrich Heine University.
Siegrist, J., Peter, R., Junge, A., Cremer, P., & Seidel, D. (1990). Low status control, high effort at work and ischemic heart disease: Prospective evidence from blue-collar men. *Social Science and Medicine, 31*, 1127-1134.
Siegrist, J., Siegrist, K., & Weber, I. (1986). Sociological concepts in the etiology of chronic disease: The case of ischemic heart disease. *Social Science and Medicine, 22*, 247-253.
Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I., & Peter, R. (2004). The measurement of effort-reward imbalance at work: European comparisons. *Social Science and Medicine, 58*, 1483-1499.
Smith, C. S., Tisak, J., Hahn, S. E., & Schmieder, R. A. (1997). The measurement of job control. *Journal of Organizational Behavior, 18*, 225-237.
Söderfeldt, B., Söderfeldt, M., Jones, K., O'Campo, P., Muntaner, C., Ohlson, C.-G., & Warg, L.-E. (1997). Does organization matter? A multilevel analysis of the Demand-Control Model applied to human services. *Social Science and Medicine, 44*, 527-534.
Söderfeldt, B., Söderfeldt, M., Muntaner, C., O'Campo, P., Warg, L.-E., & Ohlson, C.-G. (1996). Psychosocial work environment in human service organizations: A conceptual analysis and development of the Demand-Control Model. *Social Science and Medicine, 42*, 1217-1226.

Southwood, K. E. (1978). Substantive theory and statistical interaction: Five models. *American Journal of Sociology, 83*, 1154-1203.

Sparks, K., & Cooper, C. L. (1999). Occupational differences in the work-strain relationship: Towards the use of situation-specific models. *Journal of Occupational and Organizational Psychology, 72*, 219-229.

Spector, P. E. (1992). A consideration of the validity and meaning of self-report measures of job conditions. In C. L. Cooper & I. T. Robertson (Eds.), *International Review of Industrial and Organizational Psychology 1992* (Vol. 7, pp. 153-200). Chichester: John Wiley & Sons.

Spector, P. E. (1997). *Job satisfaction: Application, assessment, causes, and consequences.* Thousand Oaks, CA: Sage.

Spector, P. E. (1999). Objective versus subjective approaches to the study of job stress. *Journal of Organizational Behavior, 20*, 737.

Stansfeld, S., Bosma, H., Hemingway, H., & Marmot, M. (1998). Psychosocial work characteristics and social support as predictors of SF-36 health functioning: the Whitehall II study. *Psychosomatic Medicine, 60*, 247-255.

Steptoe, A., & Appels, A. (1989). *Stress, personal control and health.* Chichester: Wiley.

Stone, E. F., & Hollenbeck, J. R. (1989). Clarifying some controversial issues surrounding statistical procedures for detecting moderator variables: Emperical evidence and related matters. *Journal of Applied Psychology, 74*, 3-10.

Tabachnik, B. G., & Fidell, L. S. (1989). *Using multivariate statistics* (2nd ed.). New York: Harper Collins.

Taris, T. W., & Feij, J. A. (2005). Learning and strain among newcomers: A three-wave study on the effects of job demands and job control. *Journal of Psychology, 138*, 543-563.

Taris, T. W., & Kompier, M. (2003). Challenges in longitudinal designs in occupational health psychology. *Scandinavian Journal of Work, Environment and Health, 29*, 1-4.

Taris, T. W., & Kompier, M. A. J. (2004). Job characteristics and learning behavior: Review and psychological mechanisms. In P. L. Perrewé & D. C. Ganster (Eds.), *Research in occupational stress and well-being: Exploring interpersonal dynamics* (Vol. 4, pp. 127-166). Amsterdam: JAI Press.

Terry, D. J., & Jimmieson, N. L. (1999). Work control and employee well-being: A decade review. In C. L. Cooper & I. T. Robertson (Eds.), *International review of industrial and organizational psychology* (Vol. 14, pp. 95-148). Chichester: John Wiley & Sons.

Theorell, T. (1989). Personal control at work and health: A review of epidemiological studies in Sweden. In A. Steptoe & A. Appels (Eds.), *Stress, personal control and health* (pp. 49-64). Chichester, England: Wiley.

Theorell, T. (1999). How to deal with stress in organizations? - A health perspective on theory and practice. *Scandinavian Journal of Work, Environment and Health, 25*, 616-624.

Theorell, T., & Karasek, R. A. (1996). Current issues relating to pscyhosocial job strain and cardiovascular disease research. *Journal of Occupational Health Psychology, 1*, 9-26.

Tsutsumi, A. (2004). *Development and application of the Japanese version of effort-reward imbalance questionnaire*. Okayama, Japan: Okayama University School of Medicine and Dentistry.

Tsutsumi, A., de Jonge, J., Pikhart, H., Fernandez-Lopez, J. A., Xu, L., Peter, R., Knutsson, A., Iwata, N., Watanabe, N., & Kawakami, N. (2003). *Differential item functioning of the Effort-Reward Imbalance (ERI) questionnaire among several countries.* Paper presented at the Fifth Interdisciplinary Conference on Occupational Stress & Health, Toronto, Canada.

Tsutsumi, A., Ishitake, T., Peter, R., Siegrist, J., & Matoba, T. (2001). The Japanese version of the Effort-Reward Imbalance Questionnaire: A study in dental technicians. *Work and Stress, 15*, 86-96.

Tsutsumi, A., & Kawakami, N. (2004). A review of empirical studies on the model of effort-reward imbalance at work: Reducing occupational stress by implementing a new theory. *Social Science and Medicine, 59*, 2335-2359.

UWV. (2004). *Ziektediagnosen bij uitkeringen voor arbeidsongeschiktheid, 2002 [Diagnoses for disability claims, 2002]* (ISSN: 1569 - 1470). Amsterdam: UWV.

Vahtera, J., Pentti, J., & Uutela, A. (1996). The effect of objective job demands on registered sickness absence spells; do personal, social and job-related resources act as moderators? *Work and Stress, 10*, 286-308.

van den Bosch, C. J., Bouius, C., Eikens-Jansen, M. P., & Romkes-Heuvelman, M. J. D. (2003). *Werknemersverzekeringen in de sector zorg en welzijn in 2000 en 2001 [Employee assurances in the sector care and well-being in 2000 and 2001]* (OSA-publicatie ZW50). Tilburg: OSA.

van der Doef, M., & Maes, S. (1998). The Job Demand-Control(-Support) Model and physical health outcomes: A review of the strain and buffer hypotheses. *Psychology and Health, 13*, 909-936.

van der Doef, M., & Maes, S. (1999). The job demand-control(-support) model and psychological well-being: A review of 20 years of empirical research. *Work and Stress, 13*, 87-114.

van der Linden, S., de Jonge, J., & Schaufeli, W. B. (2002). *Testing the Effort-Reward Imbalance Model in a longitudinal perspective.* Paper presented at the Fourth Dutch Conference on Psychology and Health, Kerkrade, The Netherlands.

van Vegchel, N., de Jonge, J., Bakker, A. B., & Schaufeli, W. B. (2002). Testing global and specific indicators of rewards in the Effort-Reward Imbalance Model: Does it make any difference? *European Journal of Work and Organizational Psychology, 11*, 403-421.

van Vegchel, N., de Jonge, J., Bosma, H., & Schaufeli, W. (2005). Reviewing the effort-reward imbalance model: drawing up the balance of 45 empirical studies. *Social Science & Medicine, 60*, 1117-1131.

van Vegchel, N., de Jonge, J., Meijer, T., & Hamers, J. P. H. (2001). Different effort constructs and effort-reward imbalance: Effects on employee well-being in ancillary health care workers. *Journal of Advanced Nursing, 34*, 128-136.

van Vegchel, N., de Jonge, J., Söderfeldt, M., Dormann, C., & Schaufeli, W. (2004). Quantitative versus emotional demands among Swedish human service employees: Moderating effects of job control and social support. *International Journal of Stress Management, 11*, 21-40.

van Veldhoven, M., de Jonge, J., Broersen, S., Kompier, M., & Meijman, T. (2002). Specific relationships between psychosocial job conditions and job-related stress: A three-level analytic approach. *Work and Stress, 16*, 207-228.

van Veldhoven, M., Taris, T., de Jonge, J., & Broersen, S. (2005). The relationship between work characteristics and employee health and well-being: How much complexity do we really need? *International Journal of Stress Management, 12*, 3-28.

Vernet. (2002). *Verzuimmonitor 2001 [Absenteeism monitor 2001]*. Amsterdam: Diverse branches.

Viswesvaran, C., Sanchez, J. I., & Fisher, J. (1999). The role of social support in the process of work stress: A meta-analysis. *Journal of Vocational Behavior, 54*, 314-334.

Vrijkotte, T. G. M., van Doornen, L. J. P., & de Geus, E. J. C. (1999). Work stress and metabolic and hemostatic risk factors. *Psychosomatic Medicine, 61*, 796-805.

Wall, T. B., Jackson, P. R., Mullarkey, S., & Parker, S. K. (1996). The demands-control model of job strain: A more specific test. *Journal of Occupational and Organizational Psychology, 69*, 153-166.

Wanous, J. P., Reichers, A. E., & Hudy, M. J. (1997). Overall job satisfaction: How good are single-item measures? *Journal of Applied Psychology, 82*, 247-252.

Warr, P. (1987). *Work, unemployment and mental health*. Oxford: Clarendon Press.

Warr, P. (1994). A conceptual framework for the study of work and health. *Work and Stress, 8*, 84-97.

Warr, P. (1999). Well-being and the workplace. In N. Schwarz (Ed.), *Well-being: The foundations of hedonic psychology* (pp. 392-412). New York: Russell Sage Foundation.

Weaver, D., & Brickman. (1974). Expectancy, feedback, and disconfirmation as independent factors in outcome satisfaction. *Journal of Personality and Social Psychology, 30*, 420-428.

Weiner, H. (1992). *Perturbing the organism: The biology of stressful experience*. Chicago: University of Chicago Press.

Westman, M., Hobfoll, S. E., Chen, S., Davidson, O. B., & Laski, S. (2005). Organizational stress through the lens of conservation of resources (COR) theory. In P. L. Perrewé & D. C. Ganster (Eds.), *Exploring interpersonal dynamics: Research in occupational stress and well being* (Vol. 4, pp. 171-224). Amsterdam: JAI Press.

Ybema, J. F., & Smulders, P. (2001). *Adverse effects of emotional work: Does social support help?* Paper presented at the EAHOP Conference, Barcelona.

Zapf, D. (2002). Emotion work and psychological well-being: A review of the literature and some conceptual considerations. *Human Resource Management Review, 12*, 237-268.
Zapf, D., Dormann, C., & Frese, M. (1996). Longitudinal studies in organizational stress research: A review of the literature with reference to methodological issues. *Journal of Occupational Health Psychology, 1*, 145-169.
Zapf, D., Vogt, C., Seifert, C., Mertini, H., & Isic, A. (1999). Emotion work as a source of stress: The concept and development of an instrument. *European Journal of Work and Organizational Psychology, 8*, 371-400.
Zijlstra, F. R. H., & Mulder, G. (1989). Mentale belasting: Theoretische gezichtspunten en een overzicht van meetmethoden [Mental workload: Theoretical perspectives and an overview of measurement methods]. In T. F. Meijman (Ed.), *Mentale belasting en werkstress: Een arbeidspsychologische benadering* (pp. 21-41). Assen, The Netherlands: Van Gorcum.

Appendices

Appendices belonging to Chapter 4

Table A4.4 Amount of explained variance in Study 1 and Study 2 (when the latter was used as validation sample), and the resulting shrinkage value

	DC Model			ERI Model		
	MI	RE	R	MI	RE	RS
Job satisfaction						
R^2 Study 1	.168	.169	.183	.279	.273	.303
R^2 Study 2	.078	.084	.073	.234	.251	.238
Shrinkage value (ΔR^2)	.090	.085	***.110***	.045	.022	.065
Exhaustion						
R^2 Study 1	.069	.057	.072	.223	.223	.223
R^2 Study 2	.056	.108	.062	.371	.368	.352
Shrinkage value (ΔR^2)	.013	.051	.010	***.148***	***.145***	***.129***
Psychosomatic health complaints						
R^2 Study 1	.062	.047	.055	.118	.119	.100
R^2 Study 2	.058	.091	.073	.224	.223	.208
Shrinkage value (ΔR^2)	.004	.044	.018	***.106***	***.104***	***.108***
Time-lost index						
R^2 Study 1	.063	.062	.062	.110	.106	.111
R^2 Study 2	.018	.019	.019	.041	.040	.047
Shrinkage value (ΔR^2)	.045	.043	.043	.069	.066	.064
Frequency index						
R^2 Study 1	.066	.064	.064	.117	.113	.104
R^2 Study 2	.058	.025	.022	.046	.040	.030
Shrinkage value (ΔR^2)	.008	.039	.042	.071	.073	.074

Note. Shrinkage values over .100 are printed in Bold Italics. MI = multiplicative interaction; RE = relative excess term; R = ratio; RS = Ratio Siegrist.

Table A4.5 Cross-validation by means of subgroup analyses for job satisfaction, exhaustion and psychosomatic health complaints (self-reported variables)

		Job satisfaction						Exhaustion						Psychosomatic health complaints					
		DC Model			ERI Model			DC Model			ERI Model			DC Model			ERI Model		
		MI	RE	R	MI	RE	RS	MI	RE	R	MI	RE	RS	MI	RE	R	MI	RE	RS
1	Demands[1]	-.35**[a]	-.06[b]	.06[b]	-.14**[a]	-.09*[b]	-.12**[b]	.60**[a]	.13[b]	.12[b]	.70**[a]	.41**[b]	.40**[b]	1.08**[a]	.11[b]	.08[b]	1.22**[a]	.25**[b]	.25**[b]
	Resources[1]	.50**	.12	.03	.87**	.47**	.50**	-.29**	.01	.01	-.44**	-.21**	-.23**	-1.06**	-.10	-.08	-1.11**	-.18**	-.16**
	DxR[1]	.05	-.19	-.33†	-.03	.02	.07	-.08	.19	.20	-.31**	.09**	.04	-.47	.09	.12	.03	-.01	.02
2	Study	-.01	.01	.01	-.00	.08*	.08*	-.04	-.03	-.03	-.03	-.08*	-.08*	-.36†	-.07*	-.07*	-.37†	-.11**	-.09*
1	Demands[1]					-.10*	-.10*					.52**	.47**	1.30**	.11	.11	1.57**	.32**	.30**
	Resources[1]					.47**	.47**					-.18**	-.19**	-1.08**	-.08	-.07	-1.07**	-.17**	-.15**
	DxR[1]					.02	-.00					.14**	.09†	-.10	.15	.15	.10	.01	.07
2	Study					.03	-.16					.69*	.59†	1.46	.21	.27	1.73	.32	.29
3	D x Study					.05	-.05					-.45**	-.39**	#	#	#	-.88*	-.31*	-.29†
	R x Study					.00	.25					-.29	-.29	-.70	-.21	-.34	-.09	-.12	-.10
	DxR x Study					.00	.11†					-.09	-.06	-1.73†	-.09	-.02	-.00	-.03	-.06
	R^2 (total)	.093	.095	.096	.261	.261	.270	.089	.091	.090	.325	.337	.336	.068	.063	.063	.147	.147	.146
	Incr. F					0.08	1.01					6.03**	4.86**	3.46*	2.07	1.71	2.18†	2.20†	2.91*
	Incr. R^2					.000	.003					.015	.013	.008	.005	.004	.007	.007	.010

[1] For DC Model: Demands = job demands, and Resources = decision latitude. For ERI Model: Demands = effort, and Resources = rewards.

[a] unstandardized regression coefficients (*B*) [b] standardized regression coefficients (*beta*).

Note. DxR = interaction between Demands and Resources; D = Demands; R = Resources. Incremental F and R^2 are displayed from Step 2 vs. 3.

Tolerance = .000 limits reached; value excluded from analyses.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A4.6 Cross-validation by means of subgroup analyses for sickness absence time-lost index and frequency index (personnel registered variables)

		Time-lost index						Frequency index					
		DC Model			ERI Model			DC Model			ERI Model		
		MI	RE	R	MI	RE	RS	MI	RE	R	MI	RE	RS
1	Demands[1]	.63*[a]	.10[b]	.16[b]	.56*[a]	.10*[b]	.07[b]	.18[a]	.15[b]	.20[b]	.33**[a]	.15**[b]	.14**[b]
	Resources[1]	-1.18**	-.14	-.19	-1.43**	-.18**	-.16**	-.35**	-.17†	-.21	-.29*	-.10*	-.13**
	DxR[1]	-.11	-.03	-.10	-.42	.05	.08	.06	-.12	-.18	-.36*	.10*	-.02
2	Study	.87**	.10**	.10**	.88**	.08*	.07†	.36**	.11**	.11**	.37**	.09*	.09*
1	Demands[1]	.55	.19†	.25	.68*	.11*	.09	.10	.20†	.25	.29*	.14**	.15**
	Resources[1]	-1.18**	-.14	-.17	-.90†	-.11†	-.09	-.35**	-.17†	-.20	-.07	-.04	-.09
	DxR[1]	.20	-.16	-.23	-.02	.01	.07	.31	-.22	-.27	-.36†	.09*	-.08
2	Study	.36	.41†	.06	4.91	.55	.75	-.20	.21	-.01	1.75	.57	.43
3	D x Study	#	#	#	-.17	-.05	-.05	#	#	#	.12	.04	.03
	Rs x Study	.19	-.68*	-.80*	-1.10	-.50	-.63†	.21	-.35	-.39	-.47†	-.50	-.38
	DxR x Study	-1.18	.42**	.85**	-1.43†	.09	-.01	-.91†	.29*	.51*	-.14	-.02	.06
	R^2 (Step 3)	.035	.048	.050	.085	.083	.085	.031	.034	.033	.081	.079	.071
	Incr. *F*)	.045	5.22**	5.80**	2.96*	2.12†	1.52	1.85	2.63†	2.24	2.35†	1.38	1.64
	Incr. R^2	.001	.014	.015	.007	.008	.006	.005	.007	.006	.009	.005	.007

[1] For DC Model: Demands = job demands, and Resources = decision latitude. For ERI Model: Demands = effort, and Resources = rewards.

[a] unstandardized regression coefficients (*B*) [b] standardized regression coefficients (*beta*).

Note. DxR = interaction between Demands and Resources; D = Demands; R = Resources. Incremental *F* and R^2 are displayed from Step 2 vs. 3.

Tolerance = .000 limits reached; value excluded from analyses.

† $p < .10$; * $p < .05$; ** $p < .01$.

Appendices belonging to Chapter 6

Table A6.1 Means, standard deviations, test-retest reliabilities (r_t), and correlation matrix for the panel group in Study 2 (N = 280).

	M	*SD*	r_t	1.	2.	3.	4.	5.	6.	7.	8.	8a.	8b.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. Gender [a] (1)	0.16	0.37	-																			
2. Age (1)	40.3	8.96	-	.11																		
3. Education (1)	3.40	1.47	-	.11	-.20*																	
4. JCQ demands (1)	2.58	0.54	.35*	-.08	-.08	.09																
5. Mental demands (1)	2.92	0.72	.46*	-.08	-.14*	.14*	.54*															
6. Emotional demands (1)	2.99	0.66	.68*	-.02	-.23*	.19*	.24*	.47*														
7. Physical demands (1)	2.95	0.96	.71*	-.17*	-.15*	-.25*	.31*	.45*	.38*													
8. Decision latitude (1)	2.98	0.43	.43*	.15*	-.03	.32*	-.10	-.14*	.10	-.26*												
a) Skill discretion (1)	3.01	0.48	.44*	.14*	-.04	.36*	.06	-.03	.16*	-.23*	.91*											
b) Decision authority (1)	2.90	0.58	.37*	.09	-.01	.11	-.31*	-.26*	-.05	-.20*	.72*	.37*										
9. Job satisfaction (1)	3.93	0.89	.36*	-.14*	.06	-.08	-.21*	-.33*	-.17*	-.20*	.23*	.13*	.30*									
10. Psychosomatic complaints (1)	4.63	3.14	.67*	-.12*	.02	-.18*	.22*	.31*	.27*	.39*	-.22*	-.19*	-.17*	-.26*								
11. Exhaustion (1)	1.48	1.07	.56*	-.08	-.09	.03	.29*	.50*	.33*	.41*	-.20*	-.10	-.28*	-.36*	.62*							
12. Sickness absence – FI (1)	1.14	1.40	.38*	-.01	-.10	.08	.05	.21*	.25*	.12	-.10	-.09	-.08	-.19*	.22*	.24*						
13. Sickness absence – T-LI (1)	2.71	3.48	.17*	.02	-.02	.01	.06	.20*	.10	.15*	-.08	-.07	-.05	-.18*	.13*	.16*	.60*					
14. Job satisfaction (2)	4.01	0.84	.36*	-.01	.10	-.19*	-.14*	-.21*	-.11	-.15*	.16*	.09	.22*	.36*	-.15*	-.19*	-.17*	-.13*				
15. Psychosomatic complaints (2)	4.62	3.08	.67*	-.13*	.00	-.16*	.15*	.21*	.21*	.30*	-.15*	-.10	-.17*	-.15*	.67*	.44*	.17*	.12*	-.23*			
16. Exhaustion (2)	1.43	0.98	.56*	-.16*	-.10	.01	.19*	.30*	.18*	.22*	-.10	-.03	-.17*	-.27*	.48*	.56*	.17*	.11	-.31*	.64*		
17. Sickness absence – FI (2)	0.99	1.28	.38*	-.10	-.19*	-.05	.06	.14*	.18*	.18*	-.22*	-.17*	-.20*	-.06	.24*	.25*	.38*	.21*	-.12	.23*	.13*	
18. Sickness absence – T-LI (2)	2.06	2.64	.17*	-.11	-.19*	-.00	.02	.04	.09	.12*	-.13*	-.09	-.14*	.03	.18*	.13*	.23*	.17*	-.05	.18*	.05	.70*

* $p < .05$, two-tailed.

[a] Gender was coded 0 (male) and 1 (female); [b] internal consistency is represented by KR-20 as the scale only comprises two response categories.

Key (1) = Time 1; (2) = Time 2; FI = Frequency Index; T-LI = Time-Lost Index.

Table A6.8 Explained variance in Study 1 and Study 2 (validation group) and shrinkage values for the DC Model

	JCQ demands			Mental demands			Emotional demands			Physical demands		
	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority
Job satisfaction												
R^2 Study 1	.232	.211	.245	.220	.200	.237	.235	.212	.246	.219	.197	.226
R^2 Study 2	.135	.130	.138	.142	.135	.144	.130	.130	.106	.142	.141	.146
Shrinkage value (ΔR^2)	.097	.081	*.107*	.078	.065	.093	*.105*	.082	*.140*	.077	.056	.080
Exhaustion												
R^2 Study 1	.340	.335	.341	.322	.321	.326	.328	.326	.328	.319	.318	.328
R^2 Study 2	.287	.288	.295	.294	.295	.294	.285	.288	.295	.297	.306	.286
Shrinkage value (ΔR^2)	.053	.047	.046	.028	.026	.032	.043	.038	.033	.022	.012	.042
Psychosomatic health complaints												
R^2 Study 1	.356	.352	.367	.355	.354	.357	.363	.359	.367	.358	.359	.354
R^2 Study 2	.404	.399	.386	.401	.394	.394	.404	.394	.410	.415	.407	.425
Shrinkage value (ΔR^2)	.048	.047	.019	.046	.040	.037	.041	.035	.043	.057	.048	.071
Time-lost index												
R^2 Study 1	.053	.051	.056	.048	.045	.054	.042	.036	.052	.041	.038	.053
R^2 Study 2	.039	.028	.048	.047	.031	.055	.069	.060	.061	.067	.060	.057
Shrinkage value (ΔR^2)	.014	.023	.008	.001	.014	.001	.027	.024	.009	.026	.022	.004
Frequency index												
R^2 Study 1	.215	.216	.214	.198	.199	.197	.197	.193	.199	.188	.191	.189
R^2 Study 2	.120	.118	.127	.166	.154	.173	.126	.130	.117	.157	.153	.166
Shrinkage value (ΔR^2)	.095	.098	.087	.032	.045	.024	.071	.063	.082	.031	.038	.023

Note. Shrinkage values over .100 are printed in Italics.

Table A6.9 Cross-validation by means of multi-sample analyses for job satisfaction

	Job satisfaction											
	JCQ demands			Mental demands			Emotional demands			Physical demands		
	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority
1 Dep. T1	.32**	.33**	.30**	.32**	.33**	.31**	.31**	.33**	.30**	.32**	.34**	.31**
2 D	-.09	-.10	-.05	-.04	-.06	-.01	-.11†	-.11†	-.09	-.02	-.03	-.02
C	.19*	.10	.21**	.19*	.09	.21**	.22*	.12	.21**	.17†	.07	.20**
DxC	.08	-.01	.17	.07	-.11	.09	.03	.05	-.01	-.03	-.03	-.04
3 Study	-.05	-.05	-.05	-.05	-.06	-.05	-.05	-.05	-.05	-.05	-.05	-.05
1 Dep. T1												
2 D												
C												
DxC												
3 Study												
4 D x Study												
C x Study												
DxC x Study												
R^2 (total)	.150	.145	.160	.149	.145	.158	.154	.147	.160	.148	.143	.157
Incr. F												
Incr. R^2												

Note. Regression coefficients (B) from the third and fourth step of the regression analysis are displayed. The fourth step, including the incremental F and R^2 from Step 3 vs. Step 4, was only displayed if the third step was significant.
Study was coded 1 (Study 1) and 0 (Study 2).
Key. Dep. T1 = dependent variable at Time 1; D = Demands; C = Control; DxC = interaction between Demands and Control.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table A6.10 Cross-validation by means of multi-sample analyses for exhaustion

	Exhaustion											
	JCQ demands			Mental demands			Emotional demands			Physical demands		
	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority
1 Dep. T1	.41**	.48**	.47**	.48**	.48**	.47**	.49**	.49**	.48**	.48**	.48**	.48**
2 D	.07	.06	.06	.03	.03	.03	-.02	-.03	-.01	.04	.05	.03
C	.00	.03	-.05	.01	.04	-.05	.01	.05	-.06	.05	.07	-.03
DxC	-.16	-.06	-.18	.00	-.05	-.04	-.05	-.04	-.03	.07	.01	.11
3 Study	-.21**	-.21**	-.21**	-.21**	-.21**	-.21**	-.21**	-.21**	-.21**	-.21**	-.21**	-.21**
1 Dep. T1	.49**	.49**	.48**	.49**	.48**	.48**	.50**	.49**	.49**	.48**	.48**	.49**
2 D	.12	.13	.11	.03	.02	.01	-.04	-.06	-.05	.08	.09	.07
C	-.08	-.05	-.12	-.08	-.04	-.15	-.08	-.03	-.16	-.07	.01	-.13
DxC	-.42	-.26	-.19	-.23	-.18	.03	-.39	-.33†	-.10	-.07	-.04	-.06
3 Study	-.03	-.16	-.10	.40	.30	.38	.50	.38	.47	.17	-.15	.11
4 D x Study	-.13	-.15	-.10	.02	.03	.02	.04	.04	.05	-.07	-.07	-.06
C x Study	.17	.15	.13	.19	.14	.18	.20	.14	.19	.20	.09	.18
DxC x Study	.50	.47†	.05	.39	.30*	-.09	.55†	.51*	.12	.21	.07	.27†
R^2 (total)	.306	.306	.305	.304	.306	.302	.306	.307	.303	.305	.303	.312
Incr. F	1.19	1.41	0.49	1.18	1.52	0.57	1.59	1.65	0.68	0.87	0.39	1.66
Incr. R^2	.005	.006	.002	.005	.007	.002	.007	.007	.003	.004	.002	.007

Note. Regression coefficients (B) from the final step of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; C = Control; DxC = interaction between Demands and Control.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A6.11 Cross-validation by means of multi-sample analyses for psychosomatic health complaints

	Psychosomatic health complaints											
	JCQ demands			Mental demands			Emotional demands			Physical demands		
	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority
1 Dep. T1	.61**	.62**	.61**	.61**	.61**	.61**	.60**	.60**	.60**	.59**	.59**	.59**
2 D	-.09	-.09	-.19	.06	.06	-.00	.27	.28	.23	.25*	.26*	.24†
C	-.31	-.13	-.40†	-.29	-.14	-.34	-.39	-.22	-.37†			
DxC	-.16	.02	-.33	.36	.01	.10	-.33	-.06	-47†	.38	.30	.31
3 Study	-.52*	-.52*	-.52*	-.54*	-.52*	-.53*	-.53*	-.53*	-.54*	-.54*	-.54*	-.53*
1 Dep. T1	.62**	.62**	.61**	.62**	.61**	.62**	.61**	.61**	.60**	.60**	.60**	.60**
2 D	-.13	-.01	-.15	.09	.13	.11	.19	.28	.14	.28	.27	.35†
C	-.87	-.83*	-.43	-.87*	-.86*	-.41	-.92*	-.96*	-.44	-.70†	-.61	-.35
DxC	-.91	-.33	-1.58*	-.47	-.37	-.80	-1.19†	-.72	-1.31*	.13	.29	-.06
3 Study	2.64	2.69	-.31	2.80	3.09†	-.19	3.05	3.47*	.49	2.51	2.74	-.47
4 D x Study	-.02	-.18	-.06	.01	-.05	-.09	.12	.01	.16	-.06	-.03	-.16
C x Study	1.08*	1.21*	.17	1.11*	1.25**	.24	1.06*	1.29**	.19	1.08†	1.11*	.20
DxC x Study	1.45	.70	1.90*	1.46*	.87*	1.38*	1.48†	1.20†	1.20†	.37	.01	.60
R^2	.407	.406	.410	.411	.411	.408	.411	.412	.411	.413	.413	.412
Incr. F	2.04	2.27†	1.97	2.88*	3.42*	1.99	2.37†	3.04*	1.29	1.41	1.93	0.74
Incr. R^2	.008	.009	.008	.011	.013	.008	.009	.012	.005	.005	.007	.003

Note. Regression coefficients (B) from the final step of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; C = Control; DxC = interaction between Demands and Control.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A6.12 Cross-validation by means of multi-sample analyses for sickness absence – time-lost index

	Time-lost index											
	JCQ demands			Mental demands			Emotional demands			Physical demands		
	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority
1 Dep. T1	.11**	.12**	.12**	.11**	.11**	.11**	.11**	.11**	.12**	.11*	.11*	.11*
2 D	.23	.33	.07	.23	.27	.16	.37	.38	.26	.32†	.34*	.32†
C	-.83*	-.54	-.76*	-.85*	-.54	-.75*	-.94*	-.63†	-.78**	-.68†	-.33	-.68*
DxC	.39	.21	.40	.05	.29	.25	-.32	-.26	-.20	.05	.18	-.07
3 Study	1.46**	1.45**	1.42**	1.45**	1.46**	1.42**	1.45**	1.45**	1.43**	1.46**	1.46**	1.45**
1 Dep. T1	.11**	.12**	.12**	.11*	.11**	.11**	.11*	.11*	.11**	.11*	.11*	.11*
2 D	.65	.72	.53	.65*	.70*	.58†	.48	.51	.34	.54*	.54*	.55*
C	-1.02†	-.73	-.94	-1.09†	-.79	-.84†	-1.09†	-.79	-.92*	-.73	-.34	-.77†
DxC	1.62	1.52	.98	-.68	1.01	-.12	.05	.23	-.35	-.18	.12	-.41
3 Study	.59	.63	.29	-.02	-.07	-.41	1.55	1.45	1.83	.58	.49	.78
4 D x Study	-.65	-.62	-.75	-.80†	-.88†	-.77†	-.18	-.21	-.12	-.37	-.35	-.38
C x Study	.26	.26	.26	.29	.34	.15	.22	.22	.26	.08	.01	.17
DxC x Study	-1.70	-1.85	-.65	-1.06	-1.11†	.43	-.51	-.69	.23	.28	.04	.48
R^2	.087	.083	.090	.091	.091	.094	.085	.080	.088	.090	.086	.096
Incr. F	0.84	.099	0.63	1.37	2.08	1.18	0.10	0.18	0.11	0.41	0.35	0.60
Incr. R^2	.005	.006	.004	.009	.013	.008	.001	.001	.001	.003	.002	.004

Note. Regression coefficients (B) from the final step of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; C = Control; DxC = interaction between Demands and Control.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A6.13 Cross-validation by means of multi-sample analyses for sickness absence – frequency index

	Frequency index											
	JCQ demands			Mental demands			Emotional demands			Physical demands		
	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority	Decision latitude	Skill discretion	Decision authority
1 Dep. T1	.36**	.36**	.36**	.35**	.35**	.36**	.35**	.35**	.36**	.35**	.35**	.35**
2 D	.28*	.31**	.24*	.18*	.19*	.16†	.08	.09	.04	.12†	.13*	.13*
C	-.28*	-.22†	-.19†	-.30*	-.22†	-.22*	-.34*	-.24†	-.26*	-.22	-.11	-.22*
DxC	.15	.07	.16	.21	.16	.25†	-.30	-.28	-.14	.10	.15	.01
3 Study	.32**	.32**	.31**	.32**	.33**	.30*	.32**	.32**	.32**	.33**	.32**	.32**
1 Dep. T1	.36**	.36**	.36**	.35**	.35**	.36**	.36**	.36**	.36**	.36**	.36**	.36**
2 D	.53**	.52**	.54**	.23†	.24*	.23†	-.05	-.06	-.06	.12	.11	.13
C	.03	.03	.02	-.07	-.02	-.07	.04	.07	-.03	.05	.12	-.05
DxC	.21	.20	.11	.26	.23	.08	-.77*	-.59†	-.65*	.06	.15	-.09
3 Study	-2.30*	-1.72†	-2.06†	-1.30	-1.02	-.85	-.87	-.45	-.19	-1.05	-.71	-.44
4 D x Study	-.39	-.32	-.49†	-.12	-.12	-.13	.22	.24	.16	.01	.03	.02
C x Study	-.53†	-.40	-.37	-.42	-.33	-.26	-.62*	-.49†	-.34	-.47	-.38	-.27
DxC x Study	-.16	-.23	.04	-.15	-.18	.18	.58	.39	.63†	.07	-.01	.16
R^2	.223	.219	.221	.217	.212	.217	.219	.211	.215	.215	.212	.215
Incr. F	1.92	1.53	1.67	0.94	0.88	0.60	2.22†	1.61	1.90	1.06	0.78	0.79
Incr. R^2	.011	.008	.009	.005	.005	.003	.012	.009	.011	.006	.004	.004

Note. Regression coefficients (B) from the final step of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; C = Control; DxC = interaction between Demands and Control.

† $p < .10$; * $p < .05$; ** $p < .01$.

Appendices belonging to Chapter 7

Table A7.1 Means, standard deviations, test-retest reliability (r_t), and correlation matrix for panel group in Study 2 (N = 280).

	M	SD	r_t	1.	2.	3.	4.	5.	6.	7.	8.	8a.	8b.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Gender [a] (1)	0.16	0.37	-																				
2. Age (1)	40.3	8.96	-	.11																			
3. Education (1)	3.40	1.47	-	.11	-.20*																		
4. Effort (1)	1.93	0.63	.52*	-.06	-.04	.12*																	
5. Mental demands (1)	2.92	0.72	.46*	-.08	-.14*	.14*	.72*																
6. Emotional demands (1)	2.99	0.66	.68*	-.02	-.23*	.19*	.35*	.47*															
7. Physical demands (1)	2.95	0.96	.71*	-.17*	-.15*	-.25*	.39*	.45*	-.38*														
8. Rewards (1)	3.72	0.45	.40*	-.12	-.05	-.19*	-.52*	-.37*	-.27*	-.18*													
a) Salary (1)	3.66	0.67	.36*	.15*	-.01	-.20*	-.37*	-.31*	-.26*	-.14*	.81*												
b) Esteem (1)	3.79	0.43	.26*	-.03	-.05	-.18*	-.45*	-.30*	-.24*	-.12*	.79*	.39*											
9. Overcommitment (1)	2.17	0.65	.40*	-.07	-.01	.04	.40*	.41*	-.24*	.19*	-.35*	-.22*	-.40*										
10. Job satisfaction (1)	3.93	0.89	.36*	-.14*	.06	-.08	-.34*	-.33*	-.17*	-.20*	.51*	.44*	.41*	-.22*									
11. Psychosomatic complaints (1)	4.63	3.14	.67*	-.12*	.02	-.18*	.39*	.31*	.27*	.39*	-.34*	-.20*	-.35*	.49*	-.26*								
12. Exhaustion (1)	1.48	1.07	.56*	-.08	-.09	.03	.56*	.50*	.33*	.41*	-.40*	.26*	-.38*	.44*	-.36*	.62*							
13. Sickness absence – FI (1)	1.14	1.40	.38*	-.01	-.10	.08	.18*	.21*	.25*	.12	-.16*	-.11	-.17*	.10	-.19*	.22*	.24*						
14. Sickness absence – T-LI (1)	2.71	3.48	.17*	.02	-.02	.01	.15*	.20*	.10	.15*	-.16*	-.09	-.13*	.07	-.18*	.13*	.16*	.60*					
15. Job satisfaction (2)	4.01	0.84	.36*	-.01	.10	-.19*	-.21*	-.21*	-.11	-.15*	.27*	.25*	.20*	-.14*	.36*	-.15*	-.19*	-.17*	-.13*				
16. Psychosomatic complaints (2)	4.62	3.08	.67*	-.13*	.00	-.16*	.29*	.21*	.21*	.30*	-.19*	-.07	-.24*	.38*	-.15*	.67*	.44*	.17*	.12*	-.23*			
17. Exhaustion (2)	1.43	0.98	.56*	-.16*	-.10	.01	.35*	.30*	.18*	.22*	-.24*	-.10	-.28*	.35*	-.27*	.48*	.56*	.17*	.11	-.31*	.64*		
18. Sickness absence – FI (2)	0.99	1.28	.38*	-.10	-.19*	-.05	.18*	.14*	.18*	.18*	-.02	-.02	-.05	.17*	-.06	.24*	.25*	.38*	.21*	-.12	.23*	.13*	
19. Sickness absence – T-LI (2)	2.06	2.64	.17*	-.11	-.19*	-.00	.08	.04	.09	.12*	-.05	-.04	-.05	.18*	.03	.18*	.13*	.23*	.17*	-.05	.18*	.05	.70*

* $p < .05$, two-tailed.

[a] Gender was coded 0 (males) and 1 (females); [b] internal consistency is represented by KR-20 as the scale only comprises two answer possibilities.

Key (1) = Time 1; (2) = Time 2; FI = Frequency Index; T-LI = Time-Lost Index.

Table A7.9 Regression results: effects of Time 1 overcommitment on Time 2 job satisfaction, exhaustion, psychosomatic health complaints, time-lost index, and frequency index for Study 1 (*n* = 225 due to listwise deletion)

	Job satisfaction		Exhaustion		Psychosomatic health complaints		Time-lost index		Frequency index	
	B	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2
1 Sex	-.11		-.01		-.39		-1.15		.10	
Age	-.01*		.02**		.04*		.04		.01	
Education	-.03	.017	-.03	.039	-.20	.067	-.09	.024	-.01	.015
2 Dep. T1	.36**	.170	.45**	.243	.55**	.282	.15*	.025	.39**	.186
3 Overcommitment	-.09	.003	.03	.000	.24	.002	.62	.008	-.13	.002
R^2		.190		.282		.351		.057		.203
Incr. *F*		0.84		0.07		0.52		1.73		0.65

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1
† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.10a Regression analyses including moderating effects of overcommitment on job satisfaction over time in Study 1
(n = 223 due to listwise deletion)

	Job satisfaction																							
	Effort						Mental demands						Emotional demands						Physical demands					
	Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem	
	B	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2
1 Gender	-.12		-.10		-.17		-.15		-.12		-.20		-.15		-.13		-.18		-.15		-.13		-.21	
Age	-.01†		-.01†		-.01		-.01†		-.01		-.01*		-.01†		-.01†		-.01*		-.01†		-.01†		-.01†	
Education	-.03	.024	-.02	.024	-.01*	.024	-.02	.024	-.02	.024	-.02	.024	-.03	.024	-.02	.024	-.01	.024	-.02	.024	-.01	.024	-.02	.024
2 Dep. T1	.29**	.162	.27**	.162	.33**	.162	.27**	.162	.27**	.162	.32**	.162	.28**	.162	.26**	.162	.32**	.162	.28**	.162	.27**	.162	.32**	.162
3 Effort	.04		.02		-.03		-.02		-.04		-.04		-.03		-.03		-.15		-.01		-.02		-.04	
Rewards	.33*		.25**		.15		.39**		.31**		.19		.28†		.27**		.05		.33*		.26**		.20	
OVC	-.06	.035	-.08	.053	-.07	.014	-.05	.035	-.06	.053	-.06	.013	-.09	.035	-.07	.054	-.11	.015	-.06	0.35	-.08	.050	-.08	.014
4 E*R	.18		.17		.09		-.10		-.08		.04		.46		.20		.60†		.08		.12		-.02	
E*OVC	-.06		-.04		-.10		-.08		-.08		-.08		-.21		-.21		-.14		-.01		-.00		-.03	
R*OVC	-.16	.008	-.06	.013	-.15	.004	-.03	.002	.11	.005	-.06	.001	-.04	.011	.04	.009	.02	.008	-.08	.003	.02	.009	-.10	.001
5 ERI*OVC	.19	.001	.33	.005	.05	.004	-.06		.08	.000	-.23	.001	-.41	.002	.01	.000	-.99†	.012	.11	.000	.10	.001	.04	.000
*R*²		.230		.257		.204		.223		.244		.201		.234		.249		.221		.224		.249		.201
Incr. *F*		0.27		1.54		0.02		0.02		0.10		0.47		0.61		0.00		3.38†		0.18		0.29		0.02

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; OVC = overcommitment; E = Efforts; R = Rewards.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.10b Regression analyses including moderating effects of overcommitment on exhaustion over time in Study 1 (*n* = 223 due to listwise deletion)

	Exhaustion																							
	Effort						Mental demands						Emotional demands						Physical demands					
	Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem	
	B	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2
1 Gender	-.00		-.00		.01		-.00		.01		.00		.02		.01		.03		.05		.03		.05	
Age	.02**		.02*		.02**		.02**		.02**		.02**		.02**		.02**		.02**		.02**		.02*		.02*	
Education	-.00	.035	-.02	.035	-.00	.035	-.01	.035	-.01	.035	-.01	.035	.01	.035	.01	.035	.01	.035	-.01	.035	-.01	.035	-.00	.035
2 Dep. T1	.48**	.261	.48**	.261	.47**	.261	.46**	.261	.46**	.261	.45**	.261	.47**	.261	.47**	.261	.47**	.261	.46**	.261	.46**	.261	.46**	.261
3 Effort	-.08		-.10		-.05		.05		.03		.05		-.17		-.18		-.17		.08		.06		.09	
Rewards	-.02		-.02		-.04		.02		-.01		-.04		-.10		-.06		-.12		.12		.01		.14	
OVC	.07	.002	.06	.002	.06	.002	.05	.003	.05	.003	.06	.003	.10	.008	.09	.008	.08	.007	.07	.004	.06	.004	.08	.004
4 E*R	-.18		-.22		.02		-.01		-.11		.27		-.06		-.03		.16		-.13		-.06		-.17	
E*OVC	.11		.12		.10		-.04		.03		-.06		.43†		.41†		.40†		-.20		-.19†		-.18	
R*OVC	.07	.003	.05	.007	.08	.001	-.04	.000	.00	.003	.05	.001	.16	.010	.06	.010	.15	.011	-.25	.011	-.10	.010	-.26	.010
5 ERI*OVC	.14	.000	.16	.001	-.03	.000	-.31	.002	-.02	.000	-.57	.008	.40	.002	.29	.002	.15	.000	.23	.002	.09	.001	.38	006
R^2		.301		.306		.299		.301		.302		.308		.316		.316		.314		.313		.311		.316
Incr. *F*		0.12		0.28		0.01		0.59		0.00		2.41		0.49		0.59		0.07		0.72		0.23		1.95

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; OVC = overcommitment; E = Efforts; R = Rewards.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.10c Regression analyses including moderating effects of overcommitment on psychosomatic health complaints over time in Study 1 (n = 223 due to listwise deletion)

		Psychosomatic health complaints											
		Effort						Mental demands					
		Rewards		Salary		Esteem		Rewards		Salary		Esteem	
		B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1	Gender	-.35		-.35		-.37		-.26		-.31		-.25	
	Age	.04*		.05*		.04*		.05*		.04*		.05*	
	Education	-.18	.072	-.16	.072	-.20	.072	-.20	.072	-.18	.072	-.20	.072
2	Dep. T1	.55**	.291	.55**	.291	.55**	.291	.54**	.291	.54**	.291	.54**	.291
3	Effort	.14		.02		.21		.34		.27		.31	
	Rewards	.50		.16		.63		.14		-.10		.29	
	OVC	.29	.007	.36	.007	.30	.008	.30	.008	.33	.008	.34	.009
4	E*R	-.96		-1.10*		-.41		.60		.09		.70	
	E*OVC	-.56		-.31		-.59		-.25		-.01		-.24	
	R*OVC	.31	.015	.59	.022	-.04	.009	-.35	.002	-.11	.001	-.39	.003
5	ERI*OVC	-1.45	.004	-1.11	.004	-1.39	.004	-1.45	.004	-.30	.000	-1.47	.005
	R^2		.389		.396		.384		.377		.372		.380
	Incr. F		1.38		1.51		1.40		1.34		0.11		1.66

		Psychosomatic health complaints											
		Emotional demands						Physical demands					
		Rewards		Salary		Esteem		Rewards		Salary		Esteem	
		B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2	B	ΔR^2
1	Gender	-.24		-.30		-.26		-.06		-.14		-.07	
	Age	.04*		.04*		.04*		.03†		.03†		.03	
	Education	-.19	.072	-.17	.072	-.20	.072	-.15	.072	-.14	.072	-.14	.072
2	Dep. T1	.56**	.291	.54**	.291	.56**	.291	.53**	.291	.53**	.291	.54**	.291
3	Effort	.13		.01		.14		.39*		.35†		.45*	
	Rewards	.33		-.06		.34		.40		-.01		.83	
	OVC	.36	.004	.39	.005	.33	.005	.42	.016	.41	.015	.50	.017
4	E*R	-.86		-.40		.16		-.17		.01		-.69	
	E*OVC	-.38		-.19		-.27		-.09		-.02		-.12	
	R*OVC	-.45	.003	-.14	.002	-.42	.002	-.27	.002	.08	.000	-.94	.005
5	ERI*OVC	.40	.001	.29	.000	-.48	.000	-.24	.000	-.26	.001	.68	.002
	R^2		.371		.370		.370		.381		.379		.387
	Incr. F		0.05		0.06		0.07		0.08		0.18		0.65

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; OVC = overcommitment; E = Efforts; R = Rewards.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.10d Regression analyses including moderating effects of overcommitment on the sickness absence time-lost index over time in Study 1 (n = 217 due to listwise deletion)

	Time-lost index																							
	Effort						Mental demands						Emotional demands						Physical demands					
	Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem	
	B	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2
1 Gender	-.85		-.89		-.76		-.92		-.95		-.76		-.88		-.94		-.81		-.71		-.78		-.68	
Age	.04		.04		.05		.05†		.04		.05†		.04		.04		.04		.04		.04		.04	
Education	.01	.019	-.00	.019	-.01	.019	-.04	.019	-.04	.019	-.04	.019	-.04	.019	-.03	.019	-.07	.019	.03	.019	.03	.019	.02	.019
2 Dep. T1	.10	.014	.09	.014	.10†	.014	.09	.014	.10	.014	.10	.014	.11†	.014	.10†	.014	.10†	.014	.11†	.014	.09	.014	.11†	.014
3 Effort	-.06		.09		-.02		.39		.52		.39		.16		.24		.38		.23		.26		.24	
Rewards	-1.06		-.80†		-.71		-1.01		-.64		-.66		-.63		-.56		-.13		-.63		-.57		-.34	
OVC	.40	.014	.41	.020	.43	.008	.30	.020	.40	.027	.39	.016	.20	.015	.25	.022	.33	.011	.47	.008	.47	.025	.45	.014
4 E*R	.42		.55		.06		1.14		.49		.74		-1.64		-.67		-2.36		-.75		-.21		-.73	
E*OVC	.47		.45		.31		-.67		-.41		-.52		-.14		.04		-.43		.07		.11		-.14	
R*OVC	1.61	.007	.41	.005	1.60	.008	.77	.005	-.02	.003	.99	.004	1.45	.012	.91	.003	.97	.024	1.47	.013	.56	.002	1.18	.018
5 ERI*OVC	-1.38	.003	-.44	.001	-1.33	.003	-4.08*	.021	-3.22**	.028	-2.38	.009	-4.00	.010	-2.79	.012	-2.03	.002	-.85	.002	-.17	.000	-1.29	.005
R^2		.057		.059		.052		.079				.062		.075		.070		.070		.066		.059		.070
Incr. F		0.52		0.10		0.55		4.73*		6.37**		2.00		2.14		2.53		0.55		0.45		0.03		1.07

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; OVC = overcommitment; E = Efforts; R = Rewards.
† p < .10; * p < .05; ** p < .01.

Table A7.10e Regression analyses including moderating effects of overcommitment on the sickness absence – frequency index over time in Study 1 (n = 217 due to listwise deletion)

	Frequency index																							
	Effort						Mental demands						Emotional demands						Physical demands					
	Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem		Rewards		Salary		Esteem	
	B	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2	*B*	ΔR^2
1 Gender	.19		.20		.21		.20		.19		.21		.20		.20		.21		.26		.28		.22	
Age	.01		.01		.01		.01		.01		.01		.01		.01		.01		.01		.01		.01	
Education	-.03	.017	-.03	.017	-.03	.017	-.05	.017	-.04	.017	-.05	.017	-03	.017	-.03	.017	-.03	.017	-.02	.017	-.02	.017	-.02	.017
2 Dep. T1	.35**	.162	.35**	.162	.37**	.162	.35**	.162	.35**	.162	.35**	.162	.36**	.162	.36**	.162	.37**	.162	.36**	.162	.36**	.162	.37**	.162
3 Effort	-.02		-.02		-.02		.33*		.32*		.31*		-.20		-.15		-.15		.11		.12		.09	
Rewards	-.07		-.05		-.20		.06		.02		-.11		-.09		-.05		-.09		.04		.03		-.07	
OVC	-.11	.002	-.13	.002	-.08	.002	-.16	.025	-.16	.025	-.11	.025	-.18	.004	-.17	.004	-.08	.003	-.11	.009	-.14	.009	-.07	.009
4 E*R	-.13		-.11		.07		.12		-.02		.34		-.58		-.25		-.80		-.18		-.03		-.17	
E*OVC	.20		.17		.27		-.20		-.16		-.13		.44		.44		.46		.10		.11		.10	
R*OVC	.11	.002	-.18	.004	.54	.008	-.15	.001	-.28	.003	.33	.005	.45	.023	.15	.012	.58	.032	.31	.009	.12	.004	.55	.016
5 ERI*OVC	.07	.000	.15	.000	-.11	.000	-.45	.002	-.49	.005	-.39	.002	-1.70†	.011	-1.16†	.013	-.55	.001	-.55	.006	-.46	.008	-.50	.005
R^2		.183		.185		.189		.207		.212		.211		.217		.208		.215		.203		.200		.209
Incr. F		0.01		0.08		0.03		0.45		1.11		0.42		3.05†		3.44†		0.31		1.49		1.85		1.26

Note. Regression coefficients (B) from the final step of the regression analysis are displayed.
Key. Dep. T1 = dependent variable at Time 1; OVC = overcommitment; E = Efforts; R = Rewards.
† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.11 Explained variance in Study 1 and Study 2 (validation group) and the resulting shrinkage values for the ERI Model

	Effort			Mental Demands			Emotional Demands			Physical Demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
Job satisfaction												
R^2 Study 1	.225	.247	.200	.221	.238	.197	.228	.240	.205	.221	.243	.198
R^2 Study 2	.127	.120	.129	.152	.154	.135	.096	.112	.114	.127	.124	.137
Shrinkage value (ΔR^2)	.098	***.127***	.007	.069	.084	.062	***.132***	***.128***	.091	.094	***.119***	.061
Exhaustion												
R^2 Study 1	.299	.303	.297	.298	.301	.299	.303	.303	.303	.299	.299	.299
R^2 Study 2	.304	.288	.306	.304	.298	.306	.304	.303	.308	.301	.299	.305
Shrinkage value (ΔR^2)	.005	.015	.009	.006	.003	.007	.001	.000	.005	.002	.000	.006
Psychosomatic health complaints												
R^2 Study 1	.381	.388	.375	.370	.368	.370	.365	.365	.364	.374	.373	.375
R^2 Study 2	.441	.430	.437	.424	.429	.426	.444	.442	.437	.434	.434	.433
Shrinkage value (ΔR^2)	.060	.042	.062	.054	.061	.056	.079	.077	.073	.060	.061	.058
Time-lost index												
R^2 Study 1	.044	.052	.039	.053	.060	.047	.059	.054	.061	.056	.054	.058
R^2 Study 2	.056	.044	.062	.045	.038	.047	.005	.025	.014	.043	.046	.062
Shrinkage value (ΔR^2)	.012	.008	.023	.008	.022	.000	.054	.029	.047	.013	.008	.004
Frequency index												
R^2 Study 1	.180	.181	.179	.201	.200	.203	.197	.185	.202	.195	.188	.200
R^2 Study 2	.144	.135	.154	.153	.145	.144	.047	.092	.081	.139	.116	.154
Shrinkage value (ΔR^2)	.036	.046	.025	.048	.055	.059	***.150***	.093	***.121***	.056	.072	.046

Note Shrinkage values over .100 are printed in Bold Italics.

Table A7.12 Cross-validation by means of multi-sample analyses for job satisfaction

	Job satisfaction											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dep. T1	.27**	.26**	.31**	.26*	.26**	.30**	.26**	.27**	.30**	.26**	.26**	.30**
2 D	-.03	-.05	-.08	-.04	-.04	-.07	-.04	-.04	-.08	-.04	-.04	-.05
R	.31**	.24**	.12	.34**	.25**	.17†	.36**	.28**	.12	.34**	.24**	.18*
DxR	-.09	-.04	-.04	-.25*	-.16*	-.16	-.29*	-.22**	-.03	.18*	-.03	-.21*
3 Study	.12†	.13†	.09	.14*	.16*	.11	.13†	.15*	.09	.12†	.13†	.09
1 Dep. T1	.27**	.26**		.26**	.26**		.27**	.27**		.26**	.26**	
2 D	-.03	-.04		-.05	-.05		-.02	-.01		-.04	-.05	
R	.30*	.20*		.28*	.17*		.37**	.24**		.28*	.18*	
DxR	-.23†	-.17†		-.31*	-.21*		-.42**	-.31**		-.32**	-.12†	
3 Study	-.03	-.26		-.44	-.46		.57	.15		-.16	-.33	
4 D x Study	.04	.05		.03	.01		-.05	-.05		.02	.03	
R x Study	.04	.10		.13	.17		-.07	.05		.07	.12	
DxR x Study	.44†	.38*		.20	.11		.79*	.46*		.40*	.23†	
R^2	.170	.184	.148	.175	.187	.151	.182	.195	.153	.182	.184	.168
Incr. F	1.50	2.33†		0.64	1.12		2.21†	2.23†		2.24†	2.05	
Incr. R^2	.008	.012		.003	.006		.011	.011		.012	.011	

Note. Regression coefficients (B) from the last (two) step(s) of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. Step 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; R = Rewards; DxR = interaction between Demands and Rewards.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.13 Cross-validation by means of multi-sample analyses for exhaustion

	Exhaustion											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dep. T1	.49**	.50**	.49**	.49**	.49**	.48**	.51**	.51**	.50**	.49**	.49**	.48**
2 D	.01	.02	-.00	.03	.04	.03	-.07	-.06	-.08	.03	.04	.04
R	-.02	.01	-.07	-.04	.01	-.11	-.09	-.01	-.15	-.06	.01	-.10
DxR	-.02	.00	-.05	.08	.04	.10	.14	.06	.18	.13	.06	.08
3 Study	-.21**	-.20**	-.21**	-.22**	-.21**	-.23**	-.21**	-.20**	-.21**	-.21**	-.20**	-.22**
1 Dep. T1	.49**	.50**	.48**	.49**	.50**	.48**	.51**	.51**	.50**	.49**	.50**	.48**
2 D	.06	.09	.03	.02	.05	.01	-.04	-.02	-.07	-.01	.00	.00
R	-.02	.07	-.12	-.08	.06	-.22	-.12	.04	-.26†	-.10	.04	-.19
DxR	-.00	.05	-.07	.16	.12	.14	.17	.06	.25	.19†	.11	.08
3 Study	.02	.52	-.51	-.60	.24	-1.11	-.11	.67	-.86	-.97	-.20	-1.22†
4 D x Study	-.13	-.18	-.07	-.00	-.04	.02	-.11	-.15	-.08	.09	.07	.08
R x Study	.01	-.11	.12	.10	-.09	.22	.06	-.12	.23	.13	-.06	.21
DxR x Study	-.11	-.20	.07	-.23	-.21	-.06	-.17	-.01	-.20	-.18	-.12	-.03
R^2	.315	.318	.317	.316	.318	.318	.318	.318	.321	.320	.319	.320
Incr. F	0.36	1.16	0.55	0.34	0.91	0.49	0.37	0.59	0.80	0.63	0.74	0.70
Incr. R^2	.002	.005	.002	.001	.004	.002	.002	.003	.003	.003	.003	.003

Note. Regression coefficients (B) from the last two steps of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. Step 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; R = Rewards; DxR = interaction between Demands and Rewards.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.14 Cross-validation by means of multi-sample analyses for psychosomatic health complaints

	Psychosomatic health complaints											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dep. T1	.63**	.63**	.63**	.64**	.63**	.63**	.64**	.63**	.64**	.62**	.61**	.61**
2 D	.27	.24	.22	.17	.16	.15	.16	.15	.12	.32**	.31**	.30**
R	.58*	.29	.36	.25	.15	.12	.35	.23	.12	.28	.17	.17
DxR	-.81*	-.69**	-.44	-.14	-.08	-.02	-.57	-.47†	-.11	-.15	.02	-.31
3 Study	-.50*	-.52*	-.58**	-.62**	-.62**	-.65**	-.57**	-.56*	-.61**	-.62**	-.62**	-.66**
1 Dep. T1	.64**	.63**	.63**	.64**	.63**	.64**	.64**	.64**	.63**	.62**	.62**	.61**
2 D	.41	.41	.21	.16	.19	.06	.22	.27	.15	.22	.23	.22
R	.76†	.53*	.13	.38	.38	.03	.50	.49*	.05	.29	.35	-.02
DxR	-.66	-.51	-.08	-.36	-.15	-.12	-.59	-.54†	-.13	-.14	.07	-.36
3 Study	1.37	2.04	-2.04	.20	1.19	-1.87	1.36	2.75	-.71	-1.26	.30	-2.87
4 D x Study	-.35	-.45	-.04	.12	.03	.21	-.22	-.36	-.11	.21	.16	.22
R x Study	-.34	-.50	.39	-.31	-.54	.16	-.35	-.63†	.11	.01	-.40	.42
DxR x Study	-.61	-.61	-.77	.67	.27	.31	-.14	.22	.13	.02	-.03	.07
R^2	.426	.431	.419	.418	.419	.416	.418	.423	.415	.424	.426	.425
Incr. F	0.59	1.50	0.38	0.42	0.90	0.24	0.22	1.07	0.07	0.27	0.75	0.51
Incr. R^2	.002	.005	.001	.002	.003	.001	.001	.004	.000	.001	.003	.002

Note. Regression coefficients (B) from the last two steps of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. Step 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; R = Rewards; DxR = interaction between Demands and Rewards.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.15 Cross-validation by means of multi-sample analyses for sickness absence – time-lost index

	Time-lost index											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dep. T1	.11**	.12**	.12**	.11**	.11**	.11**	.11**	.12**	.12**	.11**	.11**	.11**
2 D	.11	.12	.16	.17	.16	.20	.25	.23	.31	.32*	.30†	.34*
R	-.51	-.40†	-.29	-.45	-.35	-.30	-.49	-.40†	-.20	-.24	-.30	-.11
DxR	.43	.41	.05	.52	.43	.12	.58	.49	-.19	-.22	.06	-.64†
3 Study	1.12**	1.10**	1.18**	1.09**	1.06**	1.14**	1.14**	1.10**	1.20**	1.16**	1.14**	1.16**
1 Dep. T1	.11**	.11**	.12**	.12**	.11**	.12**	.12**	.12**	.12**	.11**	.11**	.12**
2 D	.15	.14	.13	-.09	-.08	-.04	.16	.16	.15	.24	.23	.26
R	-.20	-.09	-.33	-.32	-.11	-.37	-.46	-.20	-.43	-.08	-.06	-.16
DxR	.45	.38	.32	.73	.57	.31	1.15*	.74†	.77	.14	.21	-.37
3 Study	3.72	3.73	.85	.83	1.54	-.83	.00	1.95	-2.57	1.59	2.63	-.41
4 D x Study	-.06	.03	.03	.56	.57	.54	.16	.14	.40	.14	.11	.16
R x Study	-.69	-.76	.06	-.41	-.64	.08	.11	-.39	.63	-.26	-.53	.28
DxR x Study	-.15	.22	-.63	-.27	-.06	-.24	-3.45*	-1.33	-3.67**	-.97	-.33	-.74
R^2	.069	.075	.065	.075	.081	.069	.084	.081	.080	.078	.079	.081
Incr. F	0.39	0.89	0.18	0.99	1.58	0.59	2.45†	1.47	2.41†	0.87	0.82	0.42
Incr. R^2	.002	.005	.001	.006	.009	.004	.015	.009	.014	.005	.005	.003

Note. Regression coefficients (B) from the last two steps of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. Step 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; R = Rewards; DxR = interaction between Demands and Rewards.

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.16 Cross-validation by means of multi-sample analyses for sickness absence – frequency index

	Frequency index											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dep. T1	.36**	.36**	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**
2 D	.18†	.14	.16	.20*	.18	.20*	.09	.08	.10	.17**	.15*	.16**
R	.11	.00	.09	.10	.02	.08	-.01	-.05	.06	.12	.02	.11
DxR	.10	.14	.01	.17	.19	.06	.28	.26†	-.08	-.06	.05	-.25†
3 Study	.28*	.26*	.28*	.23*	.22†	.23*	.27*	.26*	.29*	.28*	.28*	.27*
1 Dep. T1	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**	.35**
2 D	.35*	.24†	.29†	.11	.07	.12	.17	.16	.16	.17*	.16†	.17*
R	.32	.09	.25	.12	.06	.09	.00	.00	.01	.16	.06	.08
DxR	.12	.25	-.06	.30	.38**	.00	.53*	.36*	.27	.09	.14	-.16
3 Study	2.41†	1.33	1.81	-.00	-.10	-.17	1.08	1.38	.34	.48	.56	-.10
4 D x Study	-.39†	-.28	-.29	.18	.21	.20	-.31	-.30	-.23	-.02	-.02	-.03
R x Study	-.38	-.16	-.26	-.10	-.10	-.05	.01	-.08	.15	-.05	-.07	.11
DxR x Study	-.26	-.39	.05	-.25	-.43†	.20	-1.52**	-.64†	-1.44*	-.44	-.23	-.28
R^2	.185	.185	.180	.189	.196	.185	.195	.189	.189	.190	.188	.192
Incr. F	1.38	1.39	0.66	1.24	1.93	0.56	3.46*	1.77	2.85*	0.92	0.60	0.36
Incr. R^2	.007	.007	.004	.004	.010	.003	.018	.009	.015	.005	.003	.002

Note. Regression coefficients (B) from the last two steps of the regression analysis are displayed. Incremental F and R^2 are displayed for Step 3 vs. Step 4. Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dep. T1 = dependent variable at Time 1; D = Demands; R = Rewards; DxR = interaction between Demands and Rewards.

† $p < .10$; * $p < .05$; ** $p < .01$.

Tables A7.17 Explained variance in Study 1 and Study 2 (validation group) and resulting shrinkage values for overcommitment (direct and moderating effects)

	Direct effect	Moderating effect of overcommitment											
	Over-	Effort			Mental demands			Emotional demands			Physical demands		
	commitment	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
Job satisfaction													
R^2 Study 1	.190	.230	.245	.204	.223	.224	.201	.234	.249	.221	.224	.249	.201
R^2 Study 2	.152	.121	.084	.127	.162	.123	.142	.127	.101	.102	.127	.114	.140
Shrinkage value (ΔR^2)	.038	***.109***	***.161***	.077	.061	***.101***	.059	***.107***	***.148***	***.119***	.097	***.135***	.061
Exhaustion													
R^2 Study 1	.282	.301	.306	.299	.301	.302	.308	.316	.316	.314	.313	.311	.316
R^2 Study 2	.291	.303	.298	.311	.306	.304	.317	.264	.286	.271	.295	.289	.289
Shrinkage value (ΔR^2)	.009	.002	.008	.012	.005	.002	.009	.052	.030	.043	.018	.022	.027
Psychosomatic health complaints													
R^2 Study 1	.351	.389	.396	.384	.377	.372	.380	.371	.370	.370	.381	.379	.387
R^2 Study 2	.416	.424	.420	.411	.420	.437	.403	.442	.441	.440	.440	.444	.428
Shrinkage value (ΔR^2)	.065	.035	.024	.027	.043	.065	.023	.071	.071	.070	.059	.065	.041
Time-lost index													
R^2 Study 1	.057	.057	.059	.052	.079	.091	.062	.075	.070	.070	.066	.059	.070
R^2 Study 2	.082	.063	.061	.048	.015	.017	.020	.000	.005	.008	.069	.090	.041
Shrinkage value (ΔR^2)	.025	.006	.002	.004	.064	.074	.042	.075	.065	.062	.003	.031	.029
Frequency index													
R^2 Study 1	.203	.183	.185	.189	.207	.212	.211	.217	.208	.215	.203	.200	.209
R^2 Study 2	.159	.138	.105	.137	.100	.069	.112	.012	.026	.070	.118	.113	.119
Shrinkage value (ΔR^2)	.044	.045	.080	.052	***.107***	***.143***	.099	***.205***	***.182***	***.145***	.085	.087	.090

Note Shrinkage values over .100 are printed in Bold Italics

Table A7.18 Cross-validation by means of multi-sample analyses for direct effects of overcommitment

	Job satisfaction	Exhaustion	Psychosomatic health complaints	Time-lost index	Frequency index
1 Dependent T1	.34 **	.47**	.60**	.14 **	.37**
2 OVC	-.08	.09	.31	.64*	.07
3 Study	-.03	.19*	.51*	-1.48**	-.32**
1 Dependent T1		.47**	.60**	.14**	.37**
2 OVC		-.04	.04	.55	-.15
3 Study		-.25	-.42	-1.78	-1.07**
4 OVC x Study		.21	.45	.14	.36†
R^2	.147	.303	.399	.089	.206
Incr. F (Step 3 vs. 4)		.004	.002	.000	.006
Incr. R^2 (Step 3 vs. 4)		2.67	1.41	.008	3.64†

Note. Regression coefficients (B) from the last (two) step(s) of the regression analysis are displayed.
Key. Dependent T1 = dependent variable at Time 1; OVC = overcommitment
† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.19a Cross-validation by means of sub-group analyses of moderating effects of overcommitment on job satisfaction

	Job satisfaction											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dependent T1	.27**	.28**	.31**	.26**	.27**	.30**	.26**	.27**	.31**	.26**	.27**	.31**
2 Demands	-.00	-.01	-.08	-.03	-.02	-.06	-.05	-.05	-.11	-.02	-.03	-.04
Rewards	.44**	.29**	.17	.47**	.32**	.23*	.47**	.31**	.17	.48**	.28**	.28*
OVC	-.07	-.09	-.04	-.05	-.07	-.04	-.05	-.08	-.05	-.04	-.07	-.04
DxR	.22	.18†	.13	-.07	-.04	-.06	-.16	-.12	.16	-.18†	-.01	-.23*
DxOVC	-.06	-.05	.02	-.11	-.09	-.07	-.19†	-.18†	-.09	-.06	-.02	-.08
RxOVC	-.29†	-.20*	-.12	-.24†	-.19*	-.09	-.31*	-.19*	-.10	-.36**	-.27**	-.18†
DxRxOVC	-.32†	-.32*	-.12	-.30†	-.32**	-.17	-.16	-.22†	-.30	.02	.01	-.03
3 Study	.15*	.14†	.10	.15*	.16*	.11	.15*	.15*	.10	.15*	.15*	.09
1 Dependent T1	.27**	.28**		.25**	.27**		.26**	.26**		.26**	.26**	
2 Demands	-.04	-.05		-.07	-.05		-.03	-.04		-.02	-.04	
Rewards	.52**	.32**		.54**	.34**		.53**	.31**		.52**	.27**	
OVC	-.07	-.12		-.05	-.07		-.02	-.07		-.02	-.07	
DxR	.29	.25†		.07	.06		-.24	-.13		-.31*	-.07	
DxOVC	.00	.00		-.10	-.10		-.19	-.19†		-.08	-.03	
RxOVC	-.31	-.25*		-.33†	-.31**		-.44*	-.30**		-.43**	-.37**	
DxRxOVC	-.44†	-.47**		-.39†	-.37**		-.04	-.18		.05	-.02	
3 Study	.50	.03		.30	.06		.91	.25		.70	.02	
4 Demands x Study	.07	.06		.06	.02		-.01	-.02		.09	.02	
Rewards x Study	-.15	-.04		-.10	-.01		-.16	-.01		-.13	.02	
OVC x Study	.03	.06		.02	.03		-.05	.01		-.01	.01	
DxR x Study	-.11	-.09		-.19	-.16		.32	.24†		.35	.16	
DxOVC x Study	-.09	-.06		.00	.01		-.03	.01		.06	.03	
RxOVC x Study	.11	.19		.24	.40*		.25	.29		.29	.36†	
DxRxOVC x Study	.57	.73*		.30	.44		-.24	.11		.11	.14	
R^2	.195	.223	.154	.196	.220	.158	.198	.221	.159	.200	.211	.168
Incr. *F*	0.67	1.76†		0.27	0.94		0.59	1.22		1.03	1.49	
Incr. R^2	.008	.020		.004	.011		.007	.014		.012	.017	

Note. Regression coefficients (B) from the last (two) step(s) of the regression analysis are displayed. Incremental *F* and R^2 are displayed from Step 3 vs. Step 4.
Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dependent T1 = dependent variable at Time 1; OVC = overcommitment; DxR = demands-rewards interaction; DxOVC = demands-overcommitment interaction; RxOVC = rewards-overcommitment interaction; DxRxOVC = three-way interaction between demands, rewards, and overcommitment

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.19b Cross-validation by means of sub-group analyses of moderating effects of overcommitment on exhaustion

	Exhaustion											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dependent T1	.47**	.47**	.47**	.46**	.46**	.46**	.48**	.48**	.47**	.47**	.47**	.46**
2 Demands	-.02	-.02	-.03	.01	.02	-.01	-.06	-.05	-.11	.05	.04	.05
Rewards	-.01	.00	-.04	-.01	.00	-.04	-.04	-.02	-.07	.01	.01	.02
OVC	.10	.12†	.09	.11	.12†	.08	.13†	.14*	.11	.12†	.12†	.12†
DxR	.06	-.03	.16	.16	.02	.32*	.11	.01	.39†	.09	.07	.01
DxOVC	.08	.10	.05	.09	.10	.10	.07	.08	.07	-.07	-.08	-.08
RxOVC	.05	.04	.08	-.01	.02	.01	-.12	-.03	-.08	-.10	.03	-.13
DxRxOVC	-.11	.06	-.27	-.11	.06	-.32*	.16	.22	-.17	.03	-.05	.05
3 Study	-.19*	-.18*	-.19*	-.19*	-.19*	-.19*	-.19*	-.19*	-.18*	-.19*	-.20**	-.20**
1 Dependent T1	.48**	.48**	.47**	.47**	.47**	.47**	.48**	.49**	.48**	.48**	.48**	.47**
2 Demands	-.02	.01	-.04	-.07	-.03	-.09	-.04	-.02	-.11	-.03	-.01	-.01
Rewards	.07	.08	-.01	.11	.10	.04	.04	.04	.00	.06	.08	.03
OVC	.16†	.17†	.14	.19*	.21*	.16†	.21*	.20*	.20*	.18*	.20*	.16†
DxR	.22	.11	.28	.43*	.18	.59*	.11	.04	.43†	.27†	.15†	.14
DxOVC	.06	.06	.03	.14	.13	.18	-.03	.00	-.03	-.00	-.03	-.02
RxOVC	-.05	-.00	.00	-.16	-.07	-.13	-.30	-.09	-.26	-.12	.00	-.15
DxRxOVC	-.19	-.05	-.30	-.20	.00	-.36†	.24	.18	-.07	-.11	-.11	-.07
3 Study	.62	.79	.17	.41	.64	.11	1.01	.98	.76	-.37	.24	-.77
4 Demands x Study	-.06	-.11	-.00	.09	.03	.12	-.13	-.16	-.04	.13	.10	.13
Rewards x Study	-.13	-.14	-.03	-.13	-.15	-.08	-.15	-.11	-.13	.03	-.10	.12
OVC x Study	-.12	-.14	-.12	-.19	-.20	-.16	-.14	-.15	-.15	-.15	-.18	-.12
DxR x Study	-.41	-.31	-.27	-.45	-.27	-.36	-.19	-.17	-.13	-.35	-.17	-.28
DxOVC x Study	.11	.10	.10	-.12	-.05	-.18	.47†	.39	.43	-.19	-.15	-.15
RxOVC x Study	.15	.03	.10	.20	.10	.21	.55†	.20	.49	-.07	-.07	-.08
DxRxOVC x Study	.45	.32	.33	-.01	.03	-.10	.32	.23	.18	.31	.20	.43
R^2	.324	.327	.326	.330	.329	.335	.335	.335	.336	.334	.333	.333
Incr. F	0.52	0.75	0.28	0.84	0.87	0.65	1.16	1.07	0.99	0.97	1.00	0.87
Incr. R^2	.005	.008	.003	.008	.009	.006	.011	.011	.010	.010	.010	.009

Note. Regression coefficients (B) from the last (two) step(s) of the regression analysis are displayed. Incremental F and R^2 are displayed from Step 3 vs. Step 4.
Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dependent T1 = dependent variable at Time 1; OVC = overcommitment; DxR = demands-rewards interaction; DxOVC = demands-overcommitment interaction; RxOVC = rewards-overcommitment interaction; DxRxOVC = three-way interaction between demands, rewards, and overcommitment

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.19c Cross-validation by means of sub-group analyses of moderating effects of overcommitment on psychosomatic health complaints

	Psychosomatic health complaints											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dependent T1	.61**	.61**	.61**	.61**	.61**	.61**	.61**	.61**	.61**	.58**	.57**	.58**
2 Demands	.22	.17	.20	.06	.08	.08	.14	.11	.06	.28*	.30*	.31*
Rewards	.54†	.28	.46	.32	.23	.29	.38	.22	.28	.34	.20	.41
OVC	.32	.33	.36†	.31	.33	.36†	.37†	.35†	.38†	.40*	.40*	.43*
DxR	-.81†	-.68*	-.45	.19	.03	.13	-.54	-.45	.28	.14	.13	-.23
DxOVC	-.16	-.08	-.14	.13	.07	.18	.11	.12	.22	.21	.20	.16
RxOVC	.37	.45	-.11	.19	.19	-.19	.08	.26	-.12	.13	.18	-.21
DxRxOVC	-.29	-.38	.04	-.71	-.68†	-.01	.03	-.16	-.18	-.47	-.34	-.04
3 Study	-.50*	-.52*	-.54*	-.54*	-.54*	-.54*	-.53*	-.53*	-.53*	-.54*	-.55*	-.55*
1 Dependent T1	.61**	.61**	.61**	.61**	.60**	.61**	.61**	.60**	.61**	.58**	.57**	.58**
2 Demands	.32	.27	.13	-.14	-.03	-.08	.09	.13	-.01	.09	.16	.13
Rewards	.83†	.57*	.41	.65	.67*	.31	.62	.54*	.39	.53	.48*	.33
OVC	.44	.40	.52†	.49†	.50†	.58*	.47†	.45†	.49†	.54*	.54*	.50†
DxR	-.56	-.29	.02	.36	.29	.01	-.04	-.12	.72	.48	.27	.04
DxOVC	-.19	-.14	-.09	.25	.10	.22	.29	.25	.40	.32	.29	.29
RxOVC	.13	.27	-.45	.34	.17	-.22	.20	.27	-.11	.10	.04	-.11
DxRxOVC	-.24	-.52	.22	-1.11	-1.14**	.19	-.49	-.55	-.40	-.78	-.43	-.30
3 Study	2.19	2.28	-.50	1.23	2.47	-.56	.84	2.36	-.72	-.50	1.10	-3.50
4 Demands x Study	-.26	-.32	.03	.41	.24	.34	-.09	-.26	.08	.38	.26	.41
Rewards x Study	-.44	-.51	.18	-.59	-.85	-.01	-.23	-.52	.11	-.19	-.54	.52
OVC x Study	-.30	-.22	-.37	-.40	-.37	-.45	-.16	-.17	-.23	-.24	-.25	-.12
DxR x Study	-.48	-.79	-.46	.14	-.18	.51	-1.53*	-1.18**	-1.24*	-.54	-.19	-.67
DxOVC x Study	-.19	-.03	-.38	-.20	.09	-.18	-.55	-.38	.66	-.30	-.22	-.33
RxOVC x Study	.28	.33	.38	-.51	-.19	-.18	-.24	-.12	-.11	-.28	.11	-.84
DxRxOVC x Study	-.84	-.30	-1.41	.17	1.02	-1.17	2.23	1.43	1.12	.60	.22	1.05
R^2	.432	.438	.425	.428	.434	.424	.431	.438	.426	.437	.438	.436
Incr. F	0.38	0.78	0.45	0.58	1.11	0.42	1.11	1.67	0.75	0.55	0.72	0.56
Incr. R^2	.003	.007	.004	.005	.009	.004	.009	.014	.006	.005	.006	.005

Note. Regression coefficients (B) from the last (two) step(s) of the regression analysis are displayed. Incremental F and R^2 are displayed from Step 3 vs. Step 4.
Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dependent T1 = dependent variable at Time 1; OVC = overcommitment; DxR = demands-rewards interaction; DxOVC = demands-overcommitment interaction; RxOVC = rewards-overcommitment interaction; DxRxOVC = three-way interaction between demands, rewards, and overcommitment

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.19d Cross-validation by means of sub-group analyses of moderating effects of overcommitment on sickness absence – time-lost index

	Time-lost index											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dependent T1	.12**	.12**	.12**	.12**	.11**	.12**	.12**	.11**	.12**	.11**	.11**	.11**
2 Demands	-.12	-.09	.06	-.03	-.00	.12	.27	.20	.45†	.25	.25	.33*
Rewards	-.82†	-.49*	-.33	-.76†	-.40†	-.38	-.66	-.47†	-.20	-.57	-.96†	-.17
OVC	.62*	.66*	.62*	.58*	.62*	.61*	.62*	.63*	.64*	.63*	.64**	.65*
DxR	-.17	.03	-.58	.26	.29	-.45	-.21	.13	-1.40†	-.35	-.04	-.82†
DxOVC	.17	.03	-.12	.05	-.18	-.08	.14	.16	-.19	.52*	.55*	.35
RxOVC	1.32*	.96*	.47	1.28*	.98**	.41	.90	.84†	.08	1.27*	1.01**	.58
DxRxOVC	.17	.07	.48	-.21	-.49	.67	.88	.40	1.81*	.29	.21	.57
3 Study	1.13**	1.12**	1.22**	1.11**	1.10**	1.19**	1.11**	1.11**	1.18**	1.18**	1.19**	1.24**
1 Dependent T1	.12**	.12**	.12**	.12**	.12**	.12**	.13**	.12**	.12**	.12**	.11**	.12**
2 Demands	-.02	-.14	.14	-.35	-.40	-.08	.34	.22	.42	.14	.12	.24
Rewards	-.47	-.32	-.00	-.58	-.25	-.27	-.35	-.30	.01	-.33	-.21	-.11
OVC	.90*	.92**	.97**	.93**	.94**	1.01**	.86*	.82*	.98**	.77*	.80*	.80*
DxR	-.61	-.28	-1.00	.16	.31	-.96	-.51	-.12	-1.19	-.01	.08	-.60
DxOVC	-.22	-.19	-.57	.15	-.05	-.18	.01	.10	-.15	.76*	.77*	.60†
RxOVC	.67	1.04*	-.82	.96	1.06*	-.30	.22	.85†	-1.00	1.00	1.05*	.46
DxRxOVC	.88	.30	1.62†	.31	-.27	1.74*	1.78†	.79	3.03**	.46	.34	.81
3 Study	4.70	3.74	5.52	2.36	1.40	3.05	6.07	4.14	5.11	2.39	2.56	2.46
4 Demands x Study	-.04	.22	-.14	.70	.87	.45	-.18	.08	-.14	.19	.24	.11
Rewards x Study	-.63	-.52	-.71	-.50	-.45	-.42	-.72	-.53	-.49	-.29	-.37	-.19
OVC x Study	-.55	-.58	-.61	-.70	-.65	-.71	-.82	-.66	-.76	-.35	-.38	-.39
DxR x Study	1.03	.87	1.04	1.00	.24	1.63	.93	.75	.44	-.60	-.19	-.05
DxOVC x Study	.85	.72	1.02	-.57	-.20	-.10	.03	.00	-.01	-.66	-.65	-.72
RxOVC x Study	1.07	-.66	2.50†	.10	-1.00	1.44	1.39	-.09	2.20†	.66	-.40	.79
DxRxOVC x Study	-1.93	-.51	-2.71	-3.82*	-2.73*	-3.67*	-7.04**	-3.71*	-6.33**	-1.40	-.58	-2.06†
R^2	.096	.103	.092	.107	.122	.098	.110	.112	.109	.114	.117	.110
Incr. F	0.47	0.69	0.89	1.29	1.86	1.30	1.28	1.16	1.38	0.69	0.62	0.86
Incr. R^2	.007	.010	.013	.018	.025	.018	.018	.016	.019	.009	.009	.012

Note. Regression coefficients (B) from the last (two) step(s) of the regression analysis are displayed. Incremental F and R^2 are displayed from Step 3 vs. Step 4.

Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dependent T1 = dependent variable at Time 1; OVC = overcommitment; DxR = demands-rewards interaction; DxOVC = demands-overcommitment interaction; RxOVC = rewards-overcommitment interaction; DxRxOVC = three-way interaction between demands, rewards, and overcommitment

† $p < .10$; * $p < .05$; ** $p < .01$.

Table A7.19e Cross-validation by means of sub-group analyses of moderating effects of overcommitment on sickness absence – frequency index

	Frequency index											
	Effort			Mental demands			Emotional demands			Physical demands		
	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem	Rewards	Salary	Esteem
1 Dependent T1	.35**	.35**	.35**	.35**	.35**	.35**	.36**	.35**	.36**	.35**	.34**	.35**
2 Demands	.11	.09	.12	.17†	.16†	.20*	.10	.07	.17	.14*	.13*	.16*
Rewards	-.04	-.05	.01	-.03	-.03	-.00	-.11	-.09	.01	.03	-.02	.02
OVC	.15	.15	.15	.13	.11	.14	.17†	.14	.19†	.18†	.16†	.19†
DxR	-.18	-.06	-.24	-.02	.10	-.23	.15	.22	-.46	-.07	.03	-.28
DxOVC	.18	.09	.11	.03	-.04	-.01	.59**	.54**	.46*	.31**	.31**	.25*
RxOVC	.45†	.28†	.25	.33	.28†	.12	.41†	.34*	.08	.47*	.37*	.29
DxRxOVC	.24	.22	.24	.22	.08	.41†	.42	.19	.95**	.12	.06	.25
3 Study	.28*	.27*	.29*	.22†	.21†	.23†	.28*	.27*	.29*	.30*	.31**	.30*
1 Dependent T1	.35**	.35*	.35**	.36**	.36**	.35**	.37**	.36**	.36**	.36**	.35**	.36**
2 Demands	.27	.14	.30†	.01	-.05	.12	.24†	.17	.29*	.13	.11	.17†
Rewards	.14	-.03	.29	-.03	-.02	.04	.02	-.06	.19	.04	-.02	.09
OVC	.33*	.32*	.35*	.37**	.35**	.41**	.34**	.29*	.42**	.34**	.32**	.34*
DxR	-.37	-.10	-.73†	.03	.24	-.64†	-.01	.10	-.47	.01	.06	-.26
DxOVC	.06	.01	-.10	.16	.08	-.01	.51*	.50*	.41*	.40**	.41**	.32*
RxOVC	.37	.43*	-.17	.44	.41*	-.06	.19	.44*	-.45	.44†	.49**	.22
DxRxOVC	.44	.27	.74*	.21	.02	.88**	.85*	.39	1.59**	.27	.22	.40†
3 Study	2.76†	1.70†	3.82*	.37	.27	1.62	3.80*	2.40*	4.58**	1.51	1.23	2.15
4 Demands x Study	-.30	-.16	-.31	.31†	.36*	.18	-.43†	-.30	-.46*	-.02	.01	-.07
Rewards x Study	-.26	-.05	-.51	.04	-.00	-.18	-.28	-.06	-.46	-.05	.01	-.18
OVC x Study	-.46*	-.47*	-.46*	-.57**	-.56**	-.56*	-.59**	-.50*	-.56**	-.47*	-.48*	-.44*
DxR x Study	.21	-.02	.77	.07	-.26	.94†	.15	-.08	.37	-.18	-.08	.09
DxOVC x Study	.17	.18	.38	-.33	-.21	-.09	-.01	-.03	.16	-.29	-.29	-.22
RxOVC x Study	-.23	-.61†	.71	-.53	-.67	.40	.33	-.25	1.05*	-.09	-.36	.33
DxRxOVC x Study	-.32	-.07	-.83	-.59	-.47	-1.21†	-2.96**	-1.50*	-2.81**	-.83†	-.67†	-.91†
R^2	.207	.209	.204	.212	.222	.216	.240	.235	.241	.232	.237	.226
Incr. F	1.10	1.50	1.42	1.46	2.23*	1.92†	2.35*	2.17*	2.73**	1.48	1.96†	1.25
Incr. R^2	.014	.018	.017	.014	.027	.023	.028	.026	.032	.018	.023	015

Note. Regression coefficients (B) from the last (two) step(s) of the regression analysis are displayed. Incremental F and R^2 are displayed from Step 3 vs. Step 4.
Study was coded 1 (Study 1) and 0 (Study 2).

Key. Dependent T1 = dependent variable at Time 1; OVC = overcommitment; DxR = demands-rewards interaction; DxOVC = demands-overcommitment interaction; RxOVC = rewards-overcommitment interaction; DxRxOVC = three-way interaction between demands, rewards, and overcommitment

† $p < .10$; * $p < .05$; ** $p < .01$.

Acknowledgements

In a way, I was not prepared to write an acknowledgement. Not that I am not grateful to the people who helped me finishing this PhD thesis, but just because I do not like the underlying reasons why acknowledgements are read. That is, the acknowledgement is one of the most read parts of a thesis, just to see (1) if your own name is mentioned, (2) if underlying feelings towards other persons can be discovered (as they are not just written down, but can be discovered in cryptograms), and (3) to talk about with the author in case nothing else of the PhD thesis was read. I thought I had a solution, by just saying:
"THANK YOU, *to whom it concerns*!!!"
Although it solves some of the problems of acknowledgements (i.e., you do not forget to mention certain names, everybody can decide for him or herself whether [s]he is one of the "concerned"), it does not make up for everything that some people have done and meant for me during the process of writing this PhD thesis.
So, against my principles, here we go…

Of course, my supervisors have played an important role in writing my PhD thesis. Wilmar, during the years in Utrecht I have known you as a broadly skilled professor, who can talk and write about it *extensively*. Thanks for sharing this with me. Advice: watch the sidewalks in Utrecht, they can be dangerous…
Jan, you have played a major role in my scientific career. First, you were one of my supervisors for my Master's thesis. You convinced me to start a PhD research. After our short and turbulent project in Sweden, we continued the project at Utrecht University. I have learned a lot from you, theoretically as well as statistically, and the introduction into scientific work groups truly made the PhD project an international success. At the end you started to run… marathons. Jan, thanks for everything, and good luck in your new position.
Christian, although you were a supervisor at distance, you were always there to answer my emails with difficult questions in a short time notice. Also, you were there for me, to help me finalize and improve my papers. Thanks for doing that!

In addition, I would like to thank my colleagues at the department of Social and Organizational Psychology. Especially, I would like to thank Saar, Janna, Despoina, Ray and Linda. Saartje and Janna, did you know that there are many similarities between you two? You are both from the North of The Netherlands. Although, we all know that Brabant is the best place to stay, you made me realize people from the North can be at least as crazy as the "Brabo's". Also, you both were my roommates, and together we changed our room into the nicest and especially most cozy room of the department (and perhaps of the entire university). And finally, considering those things, it is no surprise that you are both my paranimphs… Janna and Saartje, thanks for being there!

Despoina, you are great: keep up the good work! That is, keep up being critical, and cynical in particular. As long as there is no exhaustion and deterioration in performance, there is no harm as you know!

There are some persons at Utrecht University, I also would like to thank.
The receptionists Wim and Richard. Starting a day of work is just more fun if you can start with a nice chit-chat. Thanks!
Lizet, waiting for a meeting with Wilmar was never boring: you definitely are the best secretary of Utrecht University!

I also owe my gratitude to Prof. dr. Rob Karasek and Prof. dr. Johannes Siegrist. Of course, as the godfathers of the work stress models (DC Model and ERI Model) you inspired my research, which, I guess, is normal. But in addition to that, you also personally inspired me by the interesting discussions and conversations we had in the expert meetings.

In addition, I would like to thank Michaël Munnich and Jan Driessen, my new employers from DA&A Driessen. You gave me the opportunity to put theory into practice (which is great!) and were immediately enthusiastic about publishing this thesis and related articles. Thanks for your confidence!

And last, but definitely not least, my family and friends. As you know, work is not my (entire) life. I really like working, but you are far more important to me. Adrie, it is great to be part of the Bekkers-family and your ability to put things in perspective has helped me a lot. Also, I would like to thank my mom and Gerrit (even though you would not consider this necessary) just for being there for me, no matter what. You know this PhD thesis is in a way dedicated to you and to the only person who called me a "doctorandus". Esther, Arjan, Daniëlle and Twan, the Sundays with you are great, and I just want to thank you for *not* being scientists.

Perhaps, I forgot someone… so, just in case: thank you to whom it concerns!

Curriculum Vitae

Natasja van Vegchel was born on September 29th, 1976 in Venray, The Netherlands. In 1994, she graduated from high school (VWO) in Stevensbeek, and started a Bachelor's program in Social Work of which she passed the preliminary exam. From 1995 until 1999, she studied Work and Organizational Psychology at the Radboud University Nijmegen (formerly: the Catholic University of Nijmegen), which resulted in a "cum laude" graduation at this university. In 2000, she was employed as a research assistant at the National Institute for Working Life in Malmö, Sweden. After that, she conducted a short research project regarding autonomous teams. In November 2000, she started working as a PhD-student at the department of Social and Organizational Psychology, Utrecht University. During her PhD-work, she participated in expert meetings of the JCQ group (led by Karasek) and the ESF Working group II (led by Siegrist), and was treasurer of the Dutch Working Group of Occupational Health Researchers (WAOP). As from June 2005, she started working as a P&O Consultant for DA&A Driessen, a high-quality P&O service provider for the (semi-)government, putting theory into practice.

List of author's publications

English scientific publications

de Jonge, J., Peeters, M. C. W., Hamers, J. P. H., van Vegchel, N., & van der Linden, S. (2003). Gender differences in the relationship between work-home interference, job characteristics and employee well-being in health care work. In: J. Hellgren, K. Näswall, M. Sverke, & M. Söderfeldt (Eds.), *New organizational challenges for human service work* (pp. 157-175). Mering: Rainer Hampp Verlag.

van Vegchel, N., de Jonge, J., Bakker, A. B., & Schaufeli, W. B. (2002). Testing global and specific indicators of rewards in the Effort-Reward Imbalance Model: Does it make any difference? *European Journal of Work and Organizational Psychology*, *11*, 403-421.

van Vegchel, N., de Jonge, J., Bosma, H., & Schaufeli, W. (2005). Reviewing the effort-reward imbalance model: Drawing up the balance of 45 empirical studies. *Social Science & Medicine*, *60*, 1117-1131.

van Vegchel, N., de Jonge, J., Meijer, T., & Hamers, J. P. H. (2001). Different effort constructs and effort-reward imbalance: Effects on employee well-being in ancillary health care workers. *Journal of Advanced Nursing*, *34*, 128-136.

van Vegchel, N., de Jonge, J., & Landsbergis, P. A. (2005). Occupational stress in (inter)action: The interplay between job demands and job resources. *Journal of Organizational Behavior*, *26*, 535-560.

van Vegchel, N., de Jonge, J., Söderfeldt, M., Dormann, C., & Schaufeli, W. (2004). Quantitative vs. emotional demands among Swedish human service employees: Moderating effects of job control and social support. *International Journal of Stress Management*, *11*, 21-40.

van Vegchel, N., de Jonge, J., Dormann, C., & Schaufeli, W. Karasek's Demand-Control Model: Testing specific demands and specific control. Manuscript submitted for publication.

van Vegchel, N., de Jonge, J., Dormann, C., & Schaufeli, W. Enhancing the Effort-Reward Imbalance Model by specifying its components: A longitudinal study among human service workers. Manuscript submitted for publication.

Dutch scientific publications

de Jonge, J., Dormann, C., & van Vegchel, N. (2004). Taakeisen, hulpbronnen en psychische gezondheid: Het Demand-Induced Strain Compensation (DISC) Model [Demands, resources and mental health: The Demand-Induced Strain Compensation (DISC) Model]. *Gedrag & Organisatie*, *17*, 59-79.

de Jonge, J., Hamers, J. P. H., Peeters, M. C. W., van der Linden, S., & van Vegchel, N. (2003). Sekse-specifieke verschillen in de relatie tussen werk-thuis interferentie, werkkenmerken en psychische gezondheid [Gender differences in the relationship between work-home interference, job characteristics and mental health]. *Verpleegkunde: Nederlands-Vlaams wetenschappelijk tijdschrift voor verpleegkundingen*, *16*, 145-155.