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The Role of Work-home Interference and Workplace Learning in the Energy-depletion Process**

In this study, we tested a work stress model which incorporates both an energy-depletion and a workplace learning process. In the energy-depletion process, work-home interference was assumed to mediate the relationship between job demands (workload, emotional demands) and psychological fatigue. In the workplace learning process it was hypothesized that workplace learning mediated the relationship between job resources (autonomy, task variety) and psychological fatigue. Results of a multi-group structural equation modelling ($N = 9738$) confirmed our hypotheses and as such contribute to a better understanding of the interplay between job characteristics and stress-related outcomes.

Key words: **learning opportunities, psychological fatigue, work-home interference, Job Demands-Resources model**
(JEL: J24, J81)

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** For this study, the researchers made use of SERV-data from the Flemish Workability Monitor. Only the authors are responsible for the content of this article.

Article received: October 14, 2010
Revised version accepted after double blind review: March 16, 2011.

management revue, 22(2), 151-168 DOI 10.1688/1861-9908_mrev_2011_02_Ruysseveldt
ISSN (print) 0935-9915, ISSN (internet) 1861-9908

Introduction

It is generally acknowledged that stress-related problems in the workplace are not only costly for human well-being, but also for societies at large (European Commission, 2002). As such, there is a strong need to understand both the processes leading to stress and the processes preventing the development of stress problems and stimulating the quality of working life. Numerous studies have shown that effective job design is a powerful tool for managers in order to prevent work-related problems such as psychological fatigue (e.g., de Croon, Blonk, de Zwart, Frings-Dresen, & Broersen, 2002), absenteeism (e.g., Dwyer & Ganster, 1991; Schaufeli, Bakker, & van Rhenen, 2009) and higher turnover rates (e.g., Schaufeli & Bakker, 2004). Most of these studies fall into the category of *work stress studies* (i.e., research into the effects of work characteristics on strain and other negative work outcomes) and only a relatively smaller amount of studies has been conducted on the effects of work characteristics on learning and positive learning-related outcomes, referred to as *workplace learning studies* (e.g., Parker, Wall, & Cordery, 2001; Rau, 2006; Taris & Kompier, 2004). Within the latter (Frese & Zapf, 1994; Karasek & Theorell, 1990; Paulsson, Ivergård, & Hunt, 2005), it has been suggested that workplace learning can be an important mechanism through which job redesign can be used to prevent the development of stress problems.

In 2002, Holman and Wall advocated in favour of greater research efforts aiming at the integration of these two areas of inquiry, suggesting that only by examining both strain and learning in the context of a single study, a more complete picture of work design effects can be obtained. Moreover, they expected that learning and strain not only share common antecedents but influence one another and as such should be considered in combination in studies on work design. This idea was also put forward by Karasek in his widespread Job Demands Control (JDC) model (Karasek, 1979; Karasek & Theorell, 1990) in which he already acknowledged that the working place is also a place for learning and that strain and learning outcomes are interrelated.

The present research intends to contribute to these challenges by developing and testing a work stress model in which the process of energy depletion is integrated with a process of workplace learning. The aim is to gain a deeper insight into these two processes and their interrelationships in order to enhance our understanding of work-related stress phenomena (i.e., psychological fatigue, see van Veldhoven & Meijman, 1994). Specifically, our research model comprises two processes. The first one builds upon the 'classical' process of energy depletion. In any work environment, job demands such as high workload or emotional demands, may exhaust the energy reserves of an employee, causing stress-related problems, which may lead to health problems. Moreover, and in line with previous research (e.g., Demerouti, Bakker, & Schaufeli, 2005; Peeters, Montgomery, Bakker, & Schaufeli, 2005), we suggest that energy-depleting job demands spill over to other life domains, in particular the home situation, causing negative work-home interference and consequently adding to psychological fatigue.

The second process tackles workplace learning. This process states that characteristics of the job can lead to increased opportunities to learn and consequently to opportunities for skill utilization, job enhancement and professional growth. These fac-

tors, in turn, allow employees to realise their goals more effectively and to adequately manage the physiological and psychological demands they encounter in their jobs (Bakker & Demerouti, 2007), as such relating negatively to stress-related problems (see Kelchtermans & Strittmatter, 1999; Lee & Ashforth, 1996; Van Ruysseveldt & Taverniers, 2010). In this study, it is suggested that job resources such as autonomy and task variety, but also job demands such as workload and emotional demands, lead to increased learning opportunities, which in turn relate negatively to psychological fatigue of employees.

Job demands, work-home interference and psychological fatigue

The energy-depletion process is at the core of most stress models. Job demands (Bakker & Demerouti, 2007; Karasek, 1979; Schaufeli et al., 2009) require mental or physical effort which corrodes the energy reserves. In the Job Demands-Resources (JD-R) model (Bakker & Demerouti, 2007), job demands refer to all physical, psychological or social aspects of the job that require sustained physical or mental effort and are therefore associated with physiological and psychological costs, such as emotional exhaustion (Maslach, Schaufeli, & Leiter, 2001) or psychological fatigue (van Veldhoven & Meijman, 1994). More specifically, research has found consistently positive relationships between workload and emotional demands on the one hand and work stress on the other hand (e.g. Bakker & Demerouti, 2007; van der Doef & Maes, 1999; Schaufeli & Bakker, 2004; van Veldhoven, Taris, de Jonge, & Broersen, 2005). Based on these findings we expect that workload and emotional demands are positively linked to psychological fatigue (hypothesis 1).

As a result of the growing number of dual-earner couples, WHI has received more and more attention in stress research and more specifically, in the process of energy depletion and health impairment (Greenhaus & Beutell, 1985; Kossek & Ozeki, 1999). Demerouti, Bakker, and Bulters (2004) define WHI as the negative impact of the work domain on the home domain, when participation at home and recovery are inhibited by virtue of the experiences, behaviours and demands built up or faced at work. Specifically, demanding job characteristics deplete one's energy, limiting the allocation of resources to other roles (i.e., role stress theory, see Kahn, Wolfe, Quinn, Snoeck, & Rosenthal, 1964) and as such leading to WHI (Greenhaus & Beutell, 1985). The experience of WHI in turn, can be considered as an additional, extra-organizational stressor and has been found to lead to health impairment in terms of depression and psycho-somatic complaints (Allen, Herst, Bruck, & Sutton, 2000) and burnout (Demerouti et al., 2004; Demerouti et al., 2005; Proost, De Witte, De Witte, & Evers, 2004; Peeters et al., 2005).

The mediational process of energy-depletion, starting with a demanding job, spilling over to the home environment and as such leading to impaired health, has also received more direct empirical support. For example, the studies of Peeters et al. (2005) and Bacharach, Bamberger, and Conley (1991) found that WHI partially mediated the effect of job demands on work-related outcomes such as emotional exhaustion, burnout and job satisfaction. A similar result has been described by Demerouti et al. (2005), who found that WHI mediated the relationship between workload and emotional demands on the one hand and emotional exhaustion on the other. In line with

these studies, we suggest that workload and emotional demands are positively related to WHI (hypothesis 2) and that WHI mediates the relationship between workload and emotional demands on the one hand and psychological fatigue on the other hand (hypothesis 3).

Job resources, learning opportunities and psychological fatigue

As described above, job demands can trigger a process of energy-depletion. Job resources, on the other hand, can play a role in the energy-depletion process as stress reducers. Job resources refer to those aspects of the job that are functional in achieving work goals, in stimulating personal growth and development, and in reducing job demands and the associated psychological costs (Bakker & Demerouti, 2007; Korunka, Kubicek, Schaufeli, & Hoonakker, 2009). Job resources enable employees to cope with threatening circumstances and protect them against the adverse effects of negative events such as job demands (Hobfoll, 2002). Moreover, a lack of resources has been found to lead to health impairing consequences (Hakanen, Schaufeli, & Ahola, 2008; Lee & Ashforth, 1996; Schaufeli et al., 2009). As such, in this study, we assume that job resources lead to reduced psychological fatigue (hypothesis 4).

However, the mechanisms underlying the stress-reducing effects of job resources remain to a certain extent unclear or implicit. The present study focuses on one possible, and practically relevant mechanism, linking job resources into the energy-depletion process, namely workplace learning. According to the JD-R model, job resources play an intrinsic motivational role since they foster employee's growth, learning and development (Schaufeli et al., 2009; see also: Bakker & Demerouti, 2007). As such, they increase the likelihood of successful goal achievement at lower psychological costs, thus reducing work stress.

At the core of workplace learning is informal learning, which Marsick and Volpe (1999) qualify as unstructured, experimental, non-institutional and integrated in the daily routines at work. Central to informal learning is the presence of adequate learning opportunities at work. In this study, learning opportunities are conceptualized as a work characteristic, indicating the extent to which employees perceive their workplace as requiring the use of existing knowledge and skills, as well as offering them opportunities to develop new skills and competencies (Holman & Wall, 2002; Morrison et al., 2005). We do not assume that learning opportunities in themselves will lower stress, but they do so to the extent that they affect knowledge and skill acquisition. In line with previous research in this domain (e.g. Holman & Wall, 2002, Morrison et al., 2005; Rau, 2006), we applied learning opportunities at work as a proxy for workplace learning. Recent research (Van Ruysseveldt & Taverniers, 2010) concluded that the presence of learning opportunities was strongly and positively related to the actual acquisition of new, work related competencies, thus indicating that learning opportunities can be used as a valid proxy for workplace learning outcomes.

In this study, we expect that workplace learning opportunities are advanced by two pivotal job resources, autonomy and task variety. In line with Karasek's JDC model (Karasek & Theorell, 1990), and building on action theory (Frese & Zapf, 1994), Holman and Wall (2002) stress the crucial role of autonomy as a prerequisite for skill development and use. If (problematic) demands are considered as challenges

to be met, then autonomy offers the opportunity for active engagement with the problem domain on which learning and problem solving depends. Autonomy enables workers to choose adequate strategies to deal with problems in the work context (Frese & Zapf, 1994; see also Karasek & Theorell, 1990). Indeed, research has found a positive relationship between autonomy and learning opportunities (e.g. Holman & Wall, 2002; Paulsson et al., 2005; Rau, 2006), as well as other learning-related constructs (e.g., Wielenga-Meijer, Taris, Kompier, & Wigboldus, 2010).

In this study, we included task variety as another job resource which might play a pivotal role in workplace learning processes. Several scholars have pointed to the importance of this task characteristic in workplace learning (Ellström, 2001; Hackman & Oldham, 1980; Parker et al., 2001; Skule, 2004). As Wielenga-Meijer et al. (2010) emphasize, task variety is expected to increase task challenge and could therefore affect intrinsic motivation to perform well, which will often require learning. However, the relationship between task variety and learning-related constructs is under researched in a work context. Reviewing 85 studies on the relationship between task characteristics and learning, Wielenga-Meijer et al. (2010) could only find two studies examining the association between task variety and learning consequences (see also Van Ruysseveldt, Verboon, & Smulders, in press). In this study, we assume that autonomy and task variety are positively related with learning opportunities at work (hypothesis 5).

Consequently, through learning opportunities in the job, employees can develop their skills, deploy creativity and build energy (Voydanoff, 2004), which increases the likelihood of successful goal achievement at lower psychological costs (Schaufeli et al., 2009). Holman and Wall (2002) found evidence for such a mediation effect: skill utilization, as their proxy for workplace learning, mediated the relationship between job control and depression. They concluded that greater job control enables employees to deploy and develop a wider range of skills and that such skill utilization in turn helps them to cope with demands more effectively and thus reduces depression (see also Van Ruysseveldt et al., in press). Using job satisfaction as the dependent variable, this mediation process has also been empirically demonstrated by Morrison et al. (2005). From this line of argument, we suggest that learning opportunities mediate the relationship between autonomy and task variety on the one hand and psychological fatigue on the other (hypothesis 6).

Study design

To test our hypotheses we fitted the model on a large, existing dataset, containing a random sample from the Flemish working population (N = 9,738). This large, heterogeneous dataset was split into subsamples, thus enabling the application of a cross-validation procedure. Our aim was to test whether a mediation model describes the data better than a model with direct effects only and whether full or partial mediation better fitted the data.

Method

Sample and procedure

Data were obtained from the Flemish Workability Monitor 2007. This is a cross-sectional survey that monitors – every three years – the working conditions in a sam-

ple of the Flemish working population (Bourdeaud'hui & Vanderhaeghe, 2007). 20.000 employees, living in the Flemish Region of Belgium, were asked to complete a written questionnaire, send to them by post by the Crossroads Bank for Social Security. These 20.000 employees were randomly selected from DIMONA, a personnel registry that gives the most real time overview of the labour market. In order to increase the response percentage, intensive and repeated communication was spread out to the respondents (see Dillman, 2000), for example through a media campaign and articles in union journals, through emphasizing that the study was initiated by the government, is supported by all social partners and will be used by policy makers in order to improve the quality of working life. Respondents received an introduction letter and the questionnaire. After one week, a small reminder was sent and after three weeks, non-respondents again received the questionnaire. As such, an overall response rate of 53% was obtained.

The sample was representative for the Flemish working population with respect to gender, age and sector of employment. The total sample consisted of 9,738 persons. It included 51% male respondents. Respondents' ages varied between 20 and 64 years (M = 40.38 years; SD = 10.32 years); 6% of the respondents completed only primary school, 53% secondary school and 41% higher education, of which 14% held a university degree. Most had a permanent contract (94%) and average weekly working time was 37.71 hours (SD = 10.31).

Measures

Data were collected in Flanders. All questionnaires were administered in Dutch. All scales had an acceptable internal consistency (see table 1).

Workload was measured with eleven items from the Questionnaire on the Experience and Evaluation of Work (QEEW, van Veldhoven, Meijman, Broersen, & Fortuin, 2002), which was itself based conceptually on Karasek's Job Content Questionnaire (Karasek, 1998). Items were answered on a four-point Likert-type scale ranging from 0 (= *never*) to 3 (= *always*). A sample item is "Do you experience a high workload?" (Cronbach's alpha = .80).

Emotional demands were measured with seven items from the QEEW (van Veldhoven et al., 2002). Items were answered on a four-point Likert-type scale ranging from 0 (= *never*) to 3 (= *always*). A sample item is "Does it happen that you end up in an emotional situation in your job?" (Cronbach's alpha = .79).

Negative work-home interference was measured with four items of the SWING (Geurts, 2001; Geurts et al., 2005). Items were answered on a four-point Likert-type scale ranging from 0 (= *never*) to 3 (= *always*). A sample item is "How often does it happen that you find it difficult to fulfil your domestic obligations because you are constantly thinking about your work?" (Cronbach's alpha = .86).

Autonomy was measured with eleven items from the QEEW (van Veldhoven et al., 2002). Items were answered on a four-point Likert-type scale ranging from 0 (= *never*) to 3 (= *always*). A sample item is "Can you decide on the planning of your work activities?" (Cronbach's alpha = .91).

Task variety was measured with six items from the QEEW (van Veldhoven et al., 2002). Items were answered on a four-point Likert-type scale ranging from 0 (= *never*)

to 3 (= *always*). A sample item is "Is your job characterized by variation in tasks?" (Cronbach's alpha = .83).

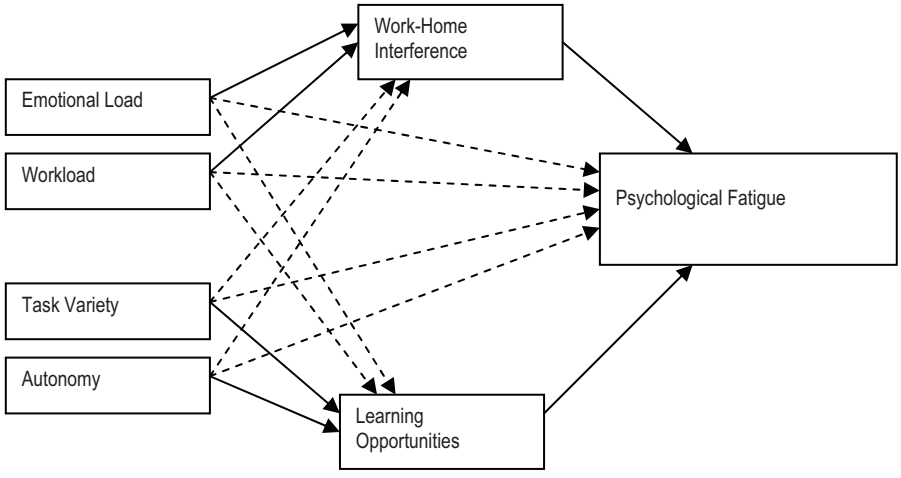
Learning opportunities. Learning opportunities were measured with four items from the QEEW (van Veldhoven et al., 2002). Items were answered on a four-point Likert-type scale (0 = *never;* 3 = *always*). A sample item is "Do you learn new things while doing your job?" (Cronbach's alpha = .86).

Psychological fatigue was measured with eleven items from the QEEW (van Veldhoven et al., 2002). Items were answered with no/yes. A sample item is "At the end of a working day, I am really feeling worn-out." (Cronbach's alpha = .89).

Analyses

Structural equation modelling (SEM) was used to test the hypotheses. The analysis consisted of two steps (Anderson & Gerbing, 1988). In the first step, the measurement model was tested to assess its construct validity. In the second step the structural models were tested. All analyses were conducted in AMOS 5 (Arbuckle, 2005). Figure 1 depicts the structural models tested in this study.

Figure 1: Research model: the process of energy-depletion and learning opportunities related to work stress. Solid lines indicate indirect effects and dashed lines direct effects



In the analyses, we controlled for the relationships between job demands and workplace learning and between job resources and negative work-home interference. A suggested positive relationship between job demands and learning or learning-related outcomes is in line with theoretical argumentations (see e.g., JDC model, Karasek & Theorell, 1990; action theory, Frese & Zapf, 1994; see also Holman & Wall, 2002 and Skule, 2004) as well as with empirical evidence (see Wielenga-Meijer et al., 2010 for an overview). Also a significant relationship between job resources (i.e., task variety, task challenge, autonomy) and negative work-home interference has been supported in the

literature (see e.g., Butler, Grzywacz, Bass, & Linney, 2005; Jones & Butler, 1980; Proost, De Witte, De Witte, & Schreurs, 2010).

In order to reduce chance capitalization, the total sample was split randomly into a model development sample (Sample 1, N = 3910) that was used to test both measurement and structural models, and two model validation samples (Sample 2, N = 3888 and Sample 3, N = 3817) in which the optimal model was cross-validated (see also Schaufeli, Bakker, van der Heijden & Prins, 2009). To judge the goodness of fit of the models, the root-mean-square error of approximation (RMSEA, Steiger, 1990), the non-normed fit or Tucker–Lewis index (NNFI, TLI, Tucker & Lewis, 1973; Bentler & Bonnet, 1980) and the comparative fit index (CFI, Bentler, 1990) were used. Values above .90 for the NNFI and the CFI are considered to indicate acceptable fit values (Byrne, 2001). For the RMSEA, values below .06 are considered to indicate good fit. However, the RMSEA depends on model complexity. Therefore, the p-value for the test of close fit is also given, which tests the alternative hypothesis that the RMSEA is larger than .05. To indicate close fit, p-values should be larger than .05 (Jöreskog & Sörbom, 1992).

Table 1: Descriptive statistics, internal consistencies (Cronbach's alpha) and correlations (N = 9.738)

	Mean	SD	1	2	3	4	5	6	7
1. Workload	45.08	17.27	(.89)						
2. Emotional demands	26.68	17.27	.40**	(.83)					
3. WHI	27.03	20.40	.53**	.44**	(.81)				
4. Autonomy	46.02	22.10	-.22**	.02*	-.11**	(.91)			
5. Task variety	42.33	21.41	.05**	.27**	.12**	.42**	(.83)		
6. Learning opportunities	51.59	23.47	-.07**	.17**	.02	.43**	.63**	(.85)	
7. Psychological fatigue	37.91	32.15	.51**	.34**	.63**	-.23**	-.06**	-.17**	(.89)

* p < .05; ** p < .01

Results

Preliminary analyses

Descriptive statistics and correlations among the variables of interest are presented in table 1. Workload, emotional demands and WHI correlated positively with psychological fatigue, while the relationship with autonomy, task variety and learning opportunities was significantly negative.

Before testing the hypotheses, we examined the construct validity of the measures by testing the measurement model in Sample 1. The model with seven latent variables was compared with a 1-factor model and a 3-factor model. In the 3-factor model, the items measuring workload, emotional demands and WHI were assumed to load on a single latent factor (job demands), whereas the items belonging to autonomy, task variety and learning opportunities loaded on another (job resources), while the third factor consisted of the psychological fatigue items. The 7-factor model's fit appeared to be good: $\chi^2(350) = 3659.43$, RMSEA = .049 (p_{close} = .77), CFI = .94, TLI = .93. Com-

pared to the fit of the 1-factor model ($\Delta\chi^2$ (18) = 23637.56, $p < .001$) and of the 3-factor model ($\Delta\chi^2$(14) = 12025.06, $p < .001$) the 7-factor model provided a clearly better fit to the data. All standardized factor loadings were significant, ranging from .53 to .86. These results support the validity of our measurement model.

Table 2: Fit indices for the structural model selection and validation

Exploration on Sample 1 (*N*=3910)						
Model	χ^2	DF	TLI	CFI	RMSEA	*P*-close
1. Direct effects	6803.23	353	.87	.89	.069	.00
2. Full mediation	3722.71	351	.93	.94	.050	.63
3. Partial mediation	3629.88	347	.94	.94	.049	.77
Validation on Sample 2 (*N*=3888)						
Model	χ^2	DF	TLI	CFI	RMSEA	*P*-close
3. Partial mediation	3667.12	347	.93	.94	.050	.46
Validation on Sample 3 (*N*=3817)						
Model	χ^2	DF	TLI	CFI	RMSEA	*P*-close
3. Partial mediation	3628.16	347	.93	.94	.049	.82

In order to assess the invariance of the measurement model across all three samples a model was simultaneously tested to the data of these three samples in which all factor loadings, path coefficients and errors were constrained to be equal across samples. The fit of the resulting constrained multi-group model χ^2 (1122) = 11111.83, RMSEA = .028 (p_{close} = .99), CFI = .94, NNFI = .93 was compared to that of the freely estimated model χ^2 (1050) = 11038.19, RMSEA = .029 (p_{close} = .99), CFI = .94, NNFI = .93. Compared with the constraint model, the fit of the freely estimated model did not deteriorate significantly: $\Delta\chi^2$ (84) = 73.63, $p < .50$. This means that invariance of the measurement model was demonstrated across all three samples.

Hypothesis testing

In order to test the hypotheses, we compared the fit of the mediated models with the fit of the direct effects model. Table 2 contains the fit indices for the three structural models. Results indicate that both (partial and full) mediation models fitted the data better than the direct effects model. The partial mediation model appeared to have good fit indices: χ^2 (347) = 3629.88, RMSEA = .049 (p_{close} = .77), CFI = .94, TLI = .94. The difference in chi-square between the fully and partially mediated model is significant ($\Delta\chi^2$(4) = 92.83, $p < .001$), indicating that the direct effects cannot be ignored.

Based on the results from the model exploration in Sample 1, the partial mediation model was cross-validated in Samples 2 and 3. The fit indices from this model showed good fit with the data (see table 2). In order to assess the invariance of the research model across all three samples a model was simultaneously tested to the data of these three samples in which all structural paths were constrained to be equal across

samples. The fit of the resulting constrained multi-group model χ^2 (1110) = 11010.15, RMSEA = .028 (p_{close} = .99), CFI = .94, NNFI = .93 was compared to that of the freely estimated model χ^2 (1044) = 10954.01, RMSEA = .029 (p_{close} = .99), CFI = .94, NNFI = .93. Compared with the constraint model, the fit of the freely estimated model did not deteriorate significantly: $\Delta\chi^2$ (66) = 56.14, p < .50. This means that invariance of the research model was demonstrated; the path coefficients did not differ significantly across samples.

Table 3: Standardized path coefficients in partial mediation model (Sample 1; *N*=3910)

	WHI	Learning opportunities	Psychological fatigue
Work load	.43 ***	-.02	.12 ***
Emotional demands	.35 ***	.04 *	.03
WHI			.61 ***
Autonomy		.07 ***	-.08 ***
Task variety		.74 ***	-.02
Learning opportunities			-.15 ***
R^2	.41 ***	.61 ***	.52 ***

[a] levels of significance refer to the joint indirect and direct effect
* p < .05; ** p < .01; *** p < .001

The parameter estimates of the structural path coefficients and the squared multiple correlation coefficients in the partial mediation model, tested on Sample 1, are depicted in table 3. In line with hypothesis 1, workload and emotional demands were significantly positively related to psychological fatigue and in line with hypothesis 2, also significant relationships were found with negative work-home interference. The relationships between job demands and psychological fatigue were, in line with hypothesis 3, mediated by negative work-home interference. For workload, the relationship with psychological fatigue was only partially mediated by negative work-home interference while full mediation was found for emotional demands.

In line with hypothesis 4, a significant negative relationship was found for autonomy and task variety with psychological fatigue and a significant positive relationship was found with learning opportunities, supporting hypothesis 5. Also in line with hypothesis 6, the relationships between autonomy and task variety on the one hand and psychological fatigue on the other hand was mediated by learning opportunities. Again, full mediation was found for task variety while partial mediation was found for autonomy. About 52% of the variance in psychological fatigue was explained by our model.

Additionally, we tested whether there were any gender and family-related differences with respect to work-home interference as well as whether gender and family-related aspects moderated the relationship between work-home interference and psychological fatigue. We indeed found significant differences between men and women in the average level of work-home interference experienced, t (9530) = 22.45, p = .00. The average level of work-home interference was higher for women (M = 28.05) than

for men (M = 26.07). However, we did not find any moderating effect of gender on the relationship between work-home interference and psychological fatigue (β = .01, p = .57). We found significant differences between singles and couples in the average level of work-home interference experienced, t (9516) = 41.37, p = .00. The average level of work-home interference was higher for couples (M = 27.76) than for singles (M = 24.57). However, no moderating effect was found of marital status on the relationship between work-home interference and psychological fatigue (β = .01, p = .91). We also found significant differences between respondents with and without children in the average level of work-home interference experienced, t (9529) = 75.22, p = .00. The average level of work-home interference was higher for respondents with children (M = 28.64) than for respondents without children (M = 24.95). However, we did not find any moderating effect of children on the relationship between work-home interference and psychological fatigue (β = -.01, p = .81).

Discussion

This study aimed at integrating generally acknowledged insights from both work stress and workplace learning studies, in order to obtain a more complete picture of work design, as advocated by Holman and Wall (2002). This integration provides a deeper insight into mechanisms underlying the interrelationships between demands, resources, and stress-related outcomes, as well as in the mediating role of work-home interference and learning opportunities. We also tried to identify an important mechanism underpinning the role of job resources into the energy-depletion process, namely through workplace learning. This mechanism was suggested to counter negative outcomes of the energy-depletion process.

The results that were obtained were largely in line with these suggestions. Workload and emotional demands increased psychological fatigue, (partially) because they increased the level of negative work-home interference. Job resources, (i.e., autonomy and task variety) reduced psychological fatigue, (partially) because they promoted learning opportunities in the workplace. These results are in line with the core assumptions of the JD-R model and with previous research (Demerouti et al., 2004; Peeters et al., 2005; Demerouti et al., 2005). In the energy-depletion process, job demands exhaust the energy reserves of an employee, causing stress-related problems, which may lead to health problems. Moreover, depletion of energy reserves has consequences for other life domains, in particular, the home situation. Spill over effects, manifested in increasing WHI, contribute to these health problems.

In line with the results of scarce research on workplace learning (Holman & Wall, 2002; Paulson et al., 2005; Rau, 2006; Van Ruysseveldt et al., in press), our findings also supported the stress-reducing potential of learning opportunities. In particular, our findings seem to suggest that learning opportunities contribute to individuals' potential to successfully control and influence the environment, while, reversely, the lack, loss or potential loss of highly valued resources may be viewed as primary causes of stress (Hobfoll, 2002). When employees are confronted with unforeseeable work-related problems they cannot always rely on work routines, but they have to exploit learning opportunities for exploration (Karasek & Theorell, 1990) or reflection (Frese & Zapf, 1994) to find an effective solution (see also Proost, Van Ruysseveldt, & van

Dijke, in press). These learning opportunities can be created through giving employees autonomy in their jobs and through task variety.

In our study, we also tackled the relationship between job demands and learning opportunities. We expected job demands to act as triggers to workplace learning, assuming a positive relationship between demands and learning opportunities (Frese & Zapf, 1994; Karasek & Theorell, 1990; Taris & Kompier, 2004; Wielenga-Meijer et al., 2010). However, in this respect, our research showed mixed results. While emotional demands were weakly, though significantly and positively associated with learning opportunities, workload was not significantly related. Remarkably, these divergent results are in line with previous empirical research (Taris & Kompier, 2004; see also Van Ruysseveldt et al., in press). Some researchers found a positive relationship between demands and learning outcomes (e.g. De Witte, Verhofstadt, & Omey, 2007; Rau, 2006; Wielenga-Meijer et al., 2010), some found a non-significant relationship (e.g. Morrison et al., 2005; Parker & Sprigg, 1999), and still others a negative relationship (Parker & Sprigg, 1999; Taris, Kompier, de Lange, Schaufeli, & Schreurs, 2003). Evidently, this relationship between job demands and workplace learning needs further theoretical elaboration. Possibly, a more sophisticated, differential approach, distinguishing between the workplace learning potential of specific demands, might provide a more refined and fruitful understanding of the complex relations between demands and learning at work. An example of such an approach is found in the work of LePine, Podsakoff and colleagues (e.g. Podsakoff, LePine, & LePine, 2007). These researchers developed a two-dimensional work stressor framework, distinguishing between challenge and hindrance stressors. Hindrance stressors (e.g. role ambiguity, role conflict) refer to those aspects of the job that place a burden on workers' capacities and completely wear out their personal resources, whereas challenge stressors (e.g. time pressure, cognitive demands, task complexity) are characterized as demanding obstacles that can be overcome and that provide opportunities for growth and learning. These challenge stressors enhance workers' well-being by promoting personal growth and development. Evidence underpinning the differential effects of challenging and hindering stressors was found for exhaustion, motivation to learn and learning performance (LePine, LePine, & Jackson, 2004; Van den Broeck, Vansteenkiste, & De Witte, 2009) and for job attitudes, turnover and withdrawal behavior (Podsakoff et al., 2007). More research is needed into the differential effects of specific challenging and hindering stressors on workplace learning outcomes (see also Van Ruysseveldt et al., in press).

The results also showed that learning opportunities only partially mediated the relationship between job resources and psychological fatigue. Therefore, it should be stressed that these job resources own a stress reducing potential beyond their learning promoting role. In this regard, the results showed a significant negative relationship between autonomy and work-home interference, which in turn was positively related to the level of psychological fatigue experienced. As such, the results suggest an alternative pathway in which job resources can reduce health problems namely by reducing the level of work-home interference experienced by employees. This suggestion is also in line with a study of Janssen, Peeters, de Jonge, Houkes, and Tummers (2004) who

found that workplace social support was negatively related to negative work-home interference, which in turn was positively related to emotional exhaustion.

Limitations and directions for future research

As our analysis was conducted on cross-sectional data, no conclusions can be drawn on the direction or causality in the assumed relationships between the study variables. Future research on longitudinal data should bring a better understanding of causality within and between the processes in the model. Also, in our study, self-reports were used. This might have led to an overestimation of the associations between the study variables, due to common method variance. Rau (2006), however, using objective measures for work characteristics (expert judgments based on standardized workplace assessments) and stress-related problems (reduction of nocturnal heart rate and reduction of blood pressure after load), found results very similar to ours. Although this argument cannot guarantee that all relationships can be interpreted in this direction and that reversed causation does not exist (e.g., Houkes et al., 2003), together with the results of the Harman's single factor test conducted (see Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), it increases our confidence that our argument accurately reflects how our constructs relate to one another and that common method variance is not driving our results.

The use of secondary data limits the model to those factors for which information was available. Possibly, other task characteristics play a role in workplace learning, e.g. task complexity (Van Ruysseveldt et al., in press), feedback (Frese & Zapf, 1994) and social support from colleagues or supervisors (Coetzer, 2007). Future research should take into account the potential role of these other job resources in workplace learning processes.

As Rau (2006) points out, the fact that workers have learning opportunities, does not automatically mean that they also learn, i.e., that they actually use these opportunities for the development of work-related competencies. Future research could shed more light on the association between the availability of learning opportunities and the effectiveness of competency development. Recent Dutch research (Van Ruysseveldt & Taverniers, 2010) provided empirical evidence of a significant relationship between learning opportunities and an increase in new, work-related competencies.

Finally, up till now, research mainly focused on informal and/or formal learning processes (e.g. Marsick & Volpe, 1999; Skule, 2004). However, besides these, there are also other learning mechanisms, e.g., social learning from colleagues and supervisors or the prevalence of an organizational climate supporting workplace learning (Skule, 2004; Coetzer, 2007), which might play a role in the workplace learning processes.

Practical implications

Based on the results obtained, at least two practical guidelines can be formulated in order to improve the quality of working life. First, this study confirms the spill over mechanisms of high job demands to other life domains, especially the home situation. Because WHI seems to add to the health-impairment process instigated by high workload and emotional demands, interventions in job demands also might produce a positive effect in the interplay between work and home. Moreover, since managers are in-

creasingly involved in helping their employees to balance work and family life, implementing work-family policies (e.g., flextime, see Christensen & Staines, 1990) as well as creating a family-supportive work environment (Allen, 2001) requires the continued attention of policy makers and HR managers (see Kossek & Ozeki, 1998).

Second, our model identifies a process which enables workers to cope more effectively with the energy-depleting properties of high job demands. In order to reduce work-related stress and associated health-impairing effects, it is necessary to identify and analyse also processes preventing the development of stress problems. Workplace learning seems to play a role as a potential stress-reducing mechanism. Interventions aiming at promoting workplace learning seem to yield a twofold benefit: (1) they enable workers to exploit the stress-reducing potential of workplace learning and (2) they support the continuous development of knowledge, skills and abilities necessary to deal with the consequences of successive organizational change (Coetzer, 2007; Ellström, 2001). Along with education and formal training, informal learning is seen as a key to corporate competitiveness, as well as to employment and employability. From this perspective, it is noteworthy that, according to some researchers, informal learning provides a more effective way of acquiring and developing the skills and competencies required at work than formal learning (Skule, 2004). Our studies contribute to a better understanding of the link between specific task characteristics and workplace learning, from which lessons for job (re)design could be drawn. To stimulate workplace learning, jobs need to be characterized by a sufficient level of autonomy and task variety. At the same time, our study results caution against the view that job demands automatically increase learning opportunities.

This study shows that job (re)design is an important step in the creation of a learning-focused culture. However, further steps need to be taken which require a strong involvement of all HR departments as well as managers at all levels of the organization, for example through advocating a facilitative rather than a directive management style, through selective hiring, strategic training and facilitating employees to be creative and to invent new ideas instead of practicing tested methods and solutions (see Gardiner & Whiting, 1997; López, Peón, & Ordás, 2006). When employees in the organization are pinned down to a passive role (e.g., in the case of limited possibilities for active participation), it is unrealistic for managers and supervisors to expect them to contribute creative ideas or knowledge to help achieve organizational objectives (López et al., 2006).

Creating a learning culture furthermore does not only require interventions at the individual level, but also at the team level through creating 'learning communities' (Iles, 1994) and at the organizational level. Specifically, in order to create a learning *organization*, organization-wide learning policies should be aligned with business strategy (Gardiner, Leat, & Sadler-Smith, 2001).

In conclusion, this study integrated work stress studies with workplace learning studies by showing that the relationship between job resources and psychological fatigue was mediated by learning opportunities. Through this mechanism, learning opportunities seemed to be able to counter the negative outcomes of the energy-depletion process.

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