Work-Home Interference in Effort-Recovery Perspective

Madelon van Hooff

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in

Effort-Recovery Perspective

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Promotor:	prof. dr. M.A.J. Kompier
Co-promotor:	dr. S.A.E. Geurts

Beoordelingscommissie:	prof. dr. D.H.J. Wigboldus
	prof. dr. A.M.L. Coenen
	dr. E. Demerouti (Universiteit Utrecht)
	dr. P.G.W. Smulders (TNO Kwaliteit van Leven)
	prof. dr. F.R.H. Zijlstra (Universiteit Maastricht)

We shall not cease from exploration

T. S. Eliot

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General Introduction

1.1 The Work-Nonwork Interface

Changes in Work and in the Composition of the Work Force

In the past decades, a number of striking changes have taken place on Western labour markets, as well as in the nature of work itself. One of the most eye-catching developments is that women have increasingly found their way to paid employment. In The Netherlands, for example, the percentage of women working at least 12 hours a week rose from 18% in 1975 to 47% in 2000 (Social and Cultural Planning Office of The Netherlands [SCP], 2001). In 2005, 58.7% of Dutch women were employed in, or searching for, jobs covering at least this number of hours (Statistics Netherlands, 2006). Similar figures are visible in other Western countries: Women's participation in the Canadian labour force was 61.8% in 2005 (Statistics Canada, 2006), and in the United States women's participation rate reached 60% in 2000 (Toossi, 2002). In the European Union, over 60% of women were employed in 2003 (European Foundation for the Improvement of Living and Working Conditions [European Foundation], 2005).

This high number of working women has resulted in a shift from male-breadwinner families to a situation in which both partners work: In the United States, 78% of married employees nowadays live in dual-earners couples (Bond, Thompson, Galinsky & Prottas, 2002), and in the European Union only 39% of employees indicate to be the sole household income earner (European Foundation, 2001). In The Netherlands, the percentage of dual-earner couples was 55% in 2002 (Statistics Netherlands, 2003). Consequently, in this country, the proportion of men and women combining work ($\geq$ 12 hours) and household and/or care tasks ($\geq$ 8 hours) increased from 25% in 1975 to 49% in 2000 for men and from 15% to 45% for women (SCP, 2001).

The nature of work itself has changed as well. Many jobs nowadays require mental and emotional effort rather than physical effort, and employees are often requested to work irregular hours or during 'unsocial' hours (i.e. evening-work, night-work, weekend-work and working overtime; Geurts, Rutte, & Peeters, 1999). Furthermore, due to the development of new technologies such as e-mail, internet and cell-phones, boundaries between work and home are becoming more and more blurred. Also, work intensity has become high during recent years: In the European Union, employees reported to work in high-speed on average 40% of the time and under very tight and short deadlines on average 44% of the time in 2000 (European Foundation, 2003a). Furthermore, in The Netherlands, a continuous increase in the pace of work of 1.5% per annum took place during a 20-year period. This levelled off in

1997 (European Foundation, 2003b). Between 1997 and 2004 almost 30% of Dutch employees indicate that they have to work under high time pressure *and* in a high pace regularly, and almost 50% indicate to work under high time pressure *or* in high pace regularly (Statistics Netherlands, 2004).

What is Work-Home Interference?

Considering these developments (i.e., more employees combining work and nonwork obligations, higher workload), it is not surprising that successfully combining work and nonwork has become a major challenge for many employees. Balancing these multiple roles may create problems or conflicts, albeit work is more likely to negatively affect family life than the other way around (e.g., Geurts et al., 2005; Kinnunen & Mauno, 1998; Leiter & Durup, 1996). The process whereby work demands negatively affect functioning at home is labelled 'work-home interference' (WHI) or 'work-family conflict', whereas negative influence in the opposite direction is labelled 'family-work conflict' or 'home work-interference' (HWI). This thesis focuses on work-home interference, because of the higher prevalence of this type of conflict.

Work may interfere with functioning in the nonwork domain in three ways (Greenhaus & Beutell, 1985). *Time-based work-home interference* develops when the time devoted to work obligations makes it physically impossible to meet obligations in the home domain (e.g., when long working hours interfere with participation in family activities). *Strain-based work-home interference* refers to the process in which tension developed at work is transferred to the home domain (e.g., when people have difficulty to relax at home after a stressful working day). *Behavior-based work-home interference* refers to a situation in which specific behaviors expected at work are incompatible with behaviors that are expected at home (e.g., when teachers continue to act as teachers in relationship with their own children). Time- and strain-based WHI are considered the two major components of WHI and have, therefore, received most attention in empirical research. Studies examining behavior-based conflict are scarce, and this form of interference will not be addressed in this thesis.

What do we know from previous research?

The work-nonwork interface in general and work-home interference in particular have been investigated by researchers from various disciplines, such as psychology, sociology, demography, and anthropology (see Kossek, Sweet & Pitt-Catsouphes, 2006). The subject has

been topic of books (e.g., Jones, Burke & Westman, 2005; Poelmans, 2005, Pitt-Catsouphes, Kossek, Sweet, 2006), chapters in handbooks of occupational health psychology (e.g., Geurts & Demerouti, 2003; Frone, 2003), review articles (e.g., Eby, Casper, Lockwood, Bordeaux, & Brinley, 2005) and special issues of scholarly journals [e.g., *Journal of Occupational Health Psychology* (Westman & Piotrowski, 1999) and *International Journal of Stress Management* (Carlson, 2004)].

Due to this vast amount of research, we now know a lot about the interaction between work and nonwork and about the presumed antecedents and consequences of WHI. With respect to the possible *antecedents* of WHI, a meta-analysis by Byron (2005) provides valuable information. She examined antecedents of WHI and HWI in 61 studies published until 2002. Regarding *work variables*, she found especially work role overload to be (positively) related to WHI (.65). Furthermore, hours at work (.26) were positively and work support was negatively (-.19) related to WHI. As to *nonwork variables* she found the strongest, and positive, relationship for family conflict (.35). Family support, on the contrary, was negatively and moderately related to WHI (-.11). The number of children living at home was positively, but weakly (.08), and the age of the youngest child was negatively (-.17) related to WHI. Sex and marital status were not significantly related to WHI. This latter finding corresponds with MacDermid & Harvey's (2006, p.570) conclusion that 'on its own, membership in social categories such as gender, earner or minority status has not proven very fruitful in revealing the causes of work-family conflict'.

Regarding its potential *consequences*, 'the most recent and comprehensive review of existing evidence' (MacDermid & Harvey, 2006, p. 568) is a meta-analysis by Allen, Herst, Bruck and Sutton (2000). These authors conducted a meta-analysis of 67 quantitative studies examining presumed consequences of WHI, published between 1980 and 1999. The studies were categorized into three groups, according to the outcome variables included. Generally, the strongest relationships were observed between WHI and *stress-related outcomes*: Across studies, WHI was positively related to burnout (.42), depression (.32), general psychological strain (.29), physical symptoms or somatic complaints (.29), and alcohol abuse (.13). Regarding *work-related outcomes*, the strongest, and positive, relationship was found for turnover intention (.29). WHI was negatively related to job satisfaction (-.24), which is the most widely studied outcome variable across all three groups (38 samples). Negative associations were also observed for organizational commitment (-.23), and job performance (-.12). Furthermore, no significant relationships were observed between WHI and career

satisfaction (-.04) and absenteeism (-.02), but both variables were examined in only two studies included in the review. With respect to the relations between WHI and *nonwork outcomes*, negative associations were observed for life-satisfaction (-.28), marital satisfaction (-.23) and family satisfaction (-.17). Family-stress and work-stress were discussed both as antecedents and as consequences: Whereas Byron (2005) considered these variables antecedents and reported weighted average corrected correlations of .30 and .48 with WHI, Allen et al. (2002) regarded these variables as consequences. These latter authors found weighted mean correlations of .31 and .41 respectively.

In view of the background described so far, the main objective of this thesis will be to further disentangle the (long-term and short-term) processes underlying the associations between WHI and its presumed antecedents and consequences. More specifically, by employing different time frames (i.e., a one-year time lag and detailed day-to-day observations) it will examine the relationships between WHI, on the one hand, and employees' activity patterns and their health and well-being, on the other. The theoretical background for this study is mainly provided by Effort-Recovery Theory (Meijman & Mulder, 1998).

1.2 Theoretical Framework: Effort-Recovery Theory

So far, it has been discussed that work characteristics are assumed to act as antecedents of WHI and that WHI on its turn is related to health and well-being. As to how work may negatively affect functioning in the nonwork domain and why WHI is related to health and well-being, Effort-Recovery Theory (Meijman & Mulder, 1998) offers valuable insights. According to this work-psychological model, effort expenditure at work has, besides benefits in terms of productivity (e.g., the product or service delivered), also psychological and physiological costs (e.g., accelerated hearth rate, fatigue). Under normal circumstances, these costs or load effects are reversible: After a short respite from work, the psychophysiological systems (e.g., cardiovascular system) that were activated will stabilize at a level that appears in a situation where no special demands are posed on the individual (baseline level). This process is called recovery. Hence, recovery is a 'process of psycho-physiological unwinding that is opposite to the activation of psycho-physiological systems during effort expenditure' (Geurts & Sonnentag, 2006).

One of the central assumptions of the E-R model is that effort expenditure at work is likely to have adverse health consequences if the opportunities for recovery are insufficient.

Recovery can take place during work time (i.e., 'internal recovery'; Geurts & Sonnentag, 2006) when workers have the possibility to take an occasional break or to alternate demanding tasks and tasks that require less effort. Internal recovery is at risk when employees do not have these possibilities.

Recovery opportunities after work time (i.e., 'external recovery'; Geurts & Sonnentag, 2006) exist in-between workdays, during weekends and during vacations. This time off-the-job may contribute to the recovery process by providing a direct release from daily exposure to job demands (a more or less 'passive' mechanism) and/or by facilitating the engagement in non-work activities that may contribute to the recovery process (a more or less 'active' mechanism; Geurts & Sonnentag, 2006). For example, Sonnentag (2001) showed time spent on low-effort leisure activities, social activities and physical activities to be positively related to recovery. Also, Strauss-Blasche, Reithofer, Schobersberger, Ekmekcioglu and Marktl (2005) demonstrated that recuperation during vacation was facilitated by free time to one's self, by exercising and by making new acquaintances.

External recovery may be inadequate in terms of quantity or quality. The quantity may be in danger when employees engage in activities during nonwork time that appeal to the same psycho-physiological systems as those that were activated during work time. As a result, these systems will remain activated ('sustained activation'; Ursin, 1980), implying that opportunities for recovery are limited during the time spent on these activities. Overtime work (especially when the same type of tasks are fulfilled as during regular work time) is probably the most illustrative example to this reasoning, but leisure activities that activate the same psycho-physiological systems as work activities do may limit the time available for recovery as well: For example, in terms of recovery, a web-designer should probably not fix crashed computers in his/her leisure time, as this activates the same psycho-physiological systems as his/her work activities.

The quality of external recovery may be endangered when, for instance, individuals' psycho-physiological systems show prolonged activation even if not exposed to any special demands during the recovery period ('sustained activation'; Ursin, 1980). This may happen if workers have difficulty to relax after a stressful working day. Brosschot, Pieper and Thayer (2005) recently showed that when workers worry in their private time about the past or upcoming working day, the psycho-physiological systems that were activated during work time remain activated, which interferes with the recovery process (see also Ursin & Erikson, 2004).

If recovery is insufficient, the worker, still in a sub-optimal state (e.g., still tired of the previous working period), has to invest additional effort to perform adequately during the next working period. This compensatory effort will result in an increased intensity of load effects, and thus poses even higher demands on the recovery process. This may trigger a downward spiral of an accumulating lack of recovery, which in the end may lead to chronic health problems such as prolonged fatigue, chronic tension, persistent sleep problems and/or manifest diseases (e.g., Kompier, 1988; Sluiter, Frings-Dresen, Van der Beek & Meijman, 2001)

Effort-Recovery theory is not very specific as to which psycho-physiological systems are crucial within the recovery process. Here McEwen's (1998) Allostatic Load Theory provides valuable insights. According to this theory, 'allostatic' systems [i.e., the autonomic nervous system, HPA-system (i.e., the hypothalamus-pituitary-adrenocortical system that releases the hormone cortisol in reaction to situations that evoke psychological stress), metabolic systems, and the immune system] will be activated to protect the organism against potential stressors, and will be turned down again when activation is no longer needed. This process of adaptation is called 'allostasis' and refers to the maintenance of homeostasis despite changes in the external environment (cf. Sterling & Eyer, 1990).

In case of repeated or prolonged activation (indicating lack of recovery) the allostatic systems may remain activated, a phenomenon referred to as 'sustained activation' (Ursin, 1980). This may cause the original adaptive systems to malfunction, by showing either hyperactivity (the systems fail to shut-off) or hypoactivity (the systems are not turned on when needed). McEwen (1998) uses the term 'allostatic load' to describe 'the wear and tear on the body and brain resulting from chronic overactivity or inactivity of physiological systems that are normally involved in adaptation to environmental challenge' (p.37). This 'allostatic load', which can be measured by means of, for example, changes in systolic and diastolic blood pressure levels, constitutes a serious risk for health (e.g., hypertension).

In Effort-Recovery theory, employees' behaviour and activities in the work and nonwork domain play an important role. For example, it is the amount of effort expended in work activities that relate to the need for recovery. In a similar line of reasoning, activities in the nonwork domain (e.g., working overtime, engaging in social and physical activities) may interfere with or contribute to the recovery process. This is in line with other work-psychological approaches such as action theory (Frese & Zapf, 1994; Taris & Kompier, 2005) and with the demand-control model (Karasek & Theorell, 1990), which implicitly or explicitly

assume that work characteristics (such as work load and autonomy) affect worker well-being (e.g., fatigue or positive mood) through worker behaviour; it is what people do that makes them feel tired or enthusiastic.

Drawing on Effort-Recovery theory, in this thesis, work-home interference is defined as 'a process in which a worker's functioning and recovery at home are hampered by negative load effects that have built up in the work domain' (Geurts & Demerouti, 2003; Geurts, Kompier, Roxburgh, & Houtman, 2003; Geurts et al., 2005). WHI is defined here in terms of recovery, i.e., a high level of work-home interference implies that recovery during nonwork time is impeded due to insufficient recovery time (i.e., time-based WHI) and/or due to the transfer of work-related strain to the home domain (i.e., strain-based WHI).

1.3 Unresolved issues in research on work-home interference

Over the last decades, ample knowledge has been gathered about WHI, but there is still much to be learned. Therefore, this thesis will address three unresolved issues in research on WHI, namely (1) the long-term causal relationships between WHI and employee health, (2) the manifestation of WHI in employees' daily activity patterns and daily reports of health and well-being, and (3) the relationship between work-related effort on the one hand and employees' daily activity patterns and health and well-being on the other, both during the week and in the weekend.

This thesis will also focus on one methodological issue not specific to research on WHI, but very relevant in diary research. That is, it will examine the validity of a single-item measure of daily fatigue.

Causality in the long-term relationships between work home-interference and employee health

Despite the fact that many studies have examined the relationships between work-home interference and employee health and well-being, so far, the *causal* character of these relationships is still largely unclear. This is due to the cross-sectional nature of most previous studies [cf. most of the studies in Allen et al.'s (2000) and Byron's (2005) meta-analyses]. Based on such a design, it is impossible to make claims about causality, as all variables are measured on the same point in time. To allow causal inferences, employing a full panel design is an essential requirement. Such a longitudinal design, in which both the independent and the dependent variables are measured multiple times in the same sample, enables the examination of three types of causation, namely 'normal causation' (i.e., work-home interference →

health), 'reversed causation' (i.e., health → work-home interference) and 'reciprocal causation' (i.e., work-home interference → health; and health → work-home interference).

The few studies that examined the longitudinal relationships between work-home interference and employee health did not always employ such a design, or examine all three types of causation, and reported mixed results regarding the causal relationships between work-home interference and employee health and well-being. It has been found that WHI acts as a precursor of heavy alcohol use, but not of health and well being (Frone, Russell & Cooper, 1997), whereas another study showed WHI to be a predictor of decreased health/well-being (Grant-Vallone & Donaldson, 2001). This direction of effect was also reported by Kinnunen, Geurts and Mauno (2004), but only for women. On the contrary, Kelloway, Gottlieb and Barham (1999) found WHI to be a consequence rather than a precursor of stress complaints. These mixed results underline the need for further investigation.

Yet, by 'simply' employing a full-panel design and testing all three types of causation it is still not possible to completely disentangle the causal associations between WHI and health. This approach does not acknowledge the fact that, within a large population, different subgroups of workers exhibit different courses of WHI and/or health over time. Instead, it puts an 'arbitrary temporal window' (Kasl & Jones, 2003) on a 'steady-state cohort' that, schematically, may include three types of workers: (1) those who are studied 'too early' (i.e., the process has not started yet), (2) those who are studied 'too late' (i.e., the effects of the process are already observed at the first measurement point), and (3) those for whom the 'temporal window is just right'. Thus, the level of WHI and/or the level of health complaints may be high for (part of) the participants at the start of the study, whereas for others these levels may be low at this point in time. Furthermore, some workers may have gone through a change in experienced WHI (e.g., low WHI → high WHI, or high WHI → low WHI) during the observation period, whereas the situation of others is characterized by stable levels of (high or low) WHI. Therefore, a closer examination of theoretically derived subgroups (Taris & Kompier, 2003) that are characterized by different WHI starting points and courses across time (De Lange, Taris, Kompier, Houtman & Bongers, 2002; Kinnunen, Geurts & Mauno, 2004) will yield more insight into the process that may underlie the longitudinal relationships between WHI and employee health.

This thesis will therefore investigate a first unresolved issue of previous research on WHI:

1. What are the (longer term) causal relationships between work-home interference and employee health?

Global WHI and daily activities and well-being in everyday life

Even though it may be obvious that work and nonwork affect each other on a daily basis, so far, surprisingly little insight has been obtained in what the experience of WHI actually signifies in everyday life. This is due to the already mentioned fact that most studies addressing the work-nonwork interface are cross-sectionally designed (cf. Allen et al., 2000; Byron, 2005). Also, insofar as longitudinal designs are employed, they cover relatively long time lags, varying from six weeks (Demerouti, Bakker & Bulters, 2004) to four years (Frone, Russell, & Cooper, 1997). Such intermediate-to-long-term longitudinal studies are largely irrelevant for mapping the specific shorter-term processes accompanying the global experience of WHI. Thus, due to the research designs that have been utilised so far, we do not know how this global experience relates to employees' daily activities and their daily health and well-being.

The research designs employed up to now also provide little insight in how employees' activity patterns in the work and home domain relate to the occurrence of global WHI. If activity patterns are addressed at all, mostly an indirect and limited indicator is used, namely global retrospective measures of the time spent on work-related activities (see Byron, 2005). Such global measures do not acknowledge the type of work activities and variations in hours spent on these activities across days. Furthermore, activities in the home domain have only occasionally been incorporated (Geurts & Demerouti, 2003; Eby, 2005), despite the fact that, from the perspective of Effort-Recovery Theory (Meijman & Mulder, 1998) the home domain deserves an equal amount of attention: Potentially, this domain offers ample opportunities for external recovery (see for exceptions, Stanton-Rich & Iso-Ahola, 1998; Sonnentag, 2001; Sonnentag & Natter, 2004; Sonnentag & Bayer, 2005; Rook & Zijlstra, 2006). Also regarding the home domain, day-to-day measures would allow the more detailed mapping of the type of activities and the time spent on each of them.

Hence, in order to identify how the global experience of WHI is manifested in specific day-to-day activities and daily health and well-being, research should move beyond the cross-sectional and longer-term longitudinal studies conducted so far. Diary methods, in which the same individual is assessed multiple times within a relatively short time interval, provide a proper alternative, as these enable researchers to 'capture life as it is lived' (Bolger, Davis & Rafaeli, 2003). Only few studies have examined the work-nonwork interface from such a day-to-day perspective, though (MacEwen & Barling, 1994; Williams & Alliger, 1994; Grzywacz, Almeida, & McDonald, 2002; Butler, Grzywacz, Bass & Linney, 2005).

Thus, this thesis will address a second unresolved issue regarding WHI:
2. How does a global measure of WHI manifest itself in everyday work and home life?

Relationships between daily work-related effort and (potential) recovery time
When investigating WHI, it is of course important to examine its relationship with possible antecedents and consequences. Yet, it may also be fruitful to study the direct relationships between work and nonwork, without explicitly measuring WHI. More specifically, when placing WHI in an effort-recovery perspective, it is essential to have insight in the daily relationships between effort expended at work, and its relationship with (lack of) recovery in the home domain. The majority of studies addressing effort at work and recovery in-between work episodes (i.e., in the home domain) nonetheless focus either on cross-sectional or on more global long-term relations between job demands, lack of recovery and outcomes such as prolonged fatigue, sleep deprivation and other manifest health problems (e.g., Kompier, 1988; Sluiter, Frings-Dresen, Van der Beek & Meijman, 2001). Only few studies focused on effort expended daily at work and its relation with daily health and well-being and daily activities in potential recovery time (see Geurts & Sonnentag, 2006 for an overview). One notable example is a study by Meijman, Mulder, Van Dormolen and Cremer (1992), who found that higher workload of driving-examiners was not only related to higher levels of adrenaline secretion during the workday, but also to higher levels of adrenaline during the free evening. Also, Sonnentag (2001) and Sonnentag and Bayer (2005) examined the recovering effect of various activities in the home domain. The day-to-day mapping of the associations between work and nonwork also provides excellent opportunities to investigate how experiences during the workweek relate to activity patterns and health and well-being in the weekend. In the theoretical framework it was already noted that weekends may provide powerful opportunities for recovery (at least for employees working from Monday to Friday). Up to now, though, weekends have not often been incorporated in research on effort and recovery time. One interesting exception is a recent study by Fritz and Sonnentag (2005), who found well-being after the weekend to be higher when individuals had engaged in social activities during the weekend. Thus, this thesis will address a third unresolved issue of research on WHI:
3. What is the relationship between work-related effort and 1) activity patterns and 2) health and well-being during work time and during potential recovery time, in-between workdays and during the weekend?

Validity issues in diary studies

The fourth and final contribution of the present thesis moves beyond the direct scope of the work-nonwork interface and relates to the use of diary studies in (occupational health) psychology. An advantage of this type of studies it that they make it possible to 'capture life as it is lived' (Bolger, Davis & Rafaeli, 2003). However, partaking in diary research is rather demanding, because it usually requires participants' commitment during a period of several days. This emphasizes the importance of making participation as accessible as possible, in order to not scare off potential respondents in advance, and to limit drop-out during the course of the study. One possible way to achieve this is to employ short, comprehensible questionnaires to measure the constructs under study. In the most extreme case, this implies the use of single-item measures. Before such measures can be used, their validity has to be established, though. Until now, various studies have investigated, and confirmed, the validity of single-item measures as alternatives for multiple-item measures assessing the same construct (e.g., Wanous, Reichers, & Hudy, 1997; Elo, Leppänen, & Jahkola, 2003). This thesis strives to provide validity evidence for a single-item measure in a diary context. Particularly, as fatigue is an important concept in occupational health psychology and a relevant indicator of recovery, it will validate a single-item measure of fatigue. To do so, convergent as well as discriminant validity evidence has to be obtained. The first can be investigated by relating a measure to questionnaires that measure similar constructs (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999), whereas the latter can be studied by examining relationships with measures that are supposed to measure different constructs (American Educational Research Association et al., 1999).

Thus, this thesis addresses the fourth unresolved issue of previous research:

4. Is it possible, in a diary context, to use a valid single-item measure of fatigue?

1.4 Outline of this Thesis

Table 1.1 gives an overview of the unresolved issues that are addressed in this thesis, and shows for each issue the specific research questions that will be answered in each chapter.

Chapter 2 presents the empirical results for Research Questions 1a and 1b and, thus, will focus on the causal relationships between work-home interference and employee health. Within a one-year full panel study with two measurements, we will examine whether work-home interference acts as a precursor of employee health, whether health complaints act as

precursors of work-home interference, or whether both processes operate (Research Question 1a). To obtain more detailed insight in these relationships, additionally, we will examine how these health complaints develop over time as a function of stable and changing levels of work-home interference (Research Question 1b).

Research Questions 2a, 2b and 2c will be addressed in *Chapter 3*. This chapter presents results of a five-day diary study that focused on the daily experience of work-home interference. We will examine how a global measure of this construct is related to employees' daily health and well being (Research Question 2a) and to their daily activities in the work (Research Question 3a) and home domain (Research Question 3b)

In *Chapter 4*, the empirical results for Research Questions 3a, 3b and 3c are presented. In a seven-day diary study addressing five weekdays followed by a weekend, we examine the relationships of daily effort-expenditure at work with daily activity patterns, and indicators of health and well-being during work time (Research Question 3a), in-between workdays (Research Question 3b) and in the weekend (Research Question 3c).

Chapter 5 focuses on Research Questions 4a and 4b. To provide convergent validity evidence for a single-item measure of fatigue, we examine its relationships between a single-item report mark of fatigue and other measures assessing both fatigue and other 'stress-related' constructs (Research Question 4a). Discriminant validity evidence (Research Question 4b) is investigated by relating this single-item measure to more distant variables. To these purposes, we use daily as well as more 'global' measures.

Chapter 6, finally, starts with a summary of the results obtained in Chapter 2 to 5. It further addresses the specific strengths and limitations of this thesis, and concludes with the theoretical and practical implications that can be formulated on the basis of the results presented in the previous four chapters.

Table 1.1. Four unresolved issues, research questions deduced from these issues, and chapters providing answers to these research questions

Unresolved Issue Earlier Research	**Research Questions**	**Results in Chapter**
1. What are the longer term causal relationships between work-home interference and employee health?	*Question 1a:* Which longer-term causal relationships exist between work-home interference and employee health?	Chapter 2
	Question 1b: How do health complaints develop over time as a function of stable and changed levels of work-home interference?	Chapter 2
2. How does a global measure of WHI manifest itself in everyday work and home life?	*Question 2a:* How do global reports of work-home interference relate to daily indicators of employee health and well-being?	Chapter 3
	Question 2b: How do global reports of work-home interference relate to the time spent daily on (effortful) work activities?	Chapter 3
	Question 2c: How do global reports of work-home interference relate to daily time spent on home activities?	Chapter 3
3. What is the relationship between work-related effort and 1) activity patterns and 2) health and well-being, during work time and during potential recovery time, in-between workdays and during the weekend?	*Question 3a:* How is work-related effort associated with 1) activities, 2) experiences of these activities and 3) health and well-being during work time?	Chapter 4
	Question 3b: How is work-related effort associated with 1) activities, 2) experiences of these activities and 3) health and well-being in- between work days?	Chapter 4
	Question 3c: How is work-related effort associated with 1) activities, 2) experiences of these activities and 3) health and well-being in the weekend?	Chapter 4
4. Is it possible, in a diary context, to use a valid single-item measure of fatigue?	*Question 4a:* What is the convergent validity of a single-item measure of fatigue?	Chapter 5
	Question 4b: What is the discriminant validity of a single-item measure of fatigue?	Chapter 5

In this thesis data from two empirical studies are used.

The data in *Chapter* 2 were originally collected among 828 members of the Dutch police force by TNO Work & Employment as part of a two-wave (1999 and 2000) longitudinal survey on the aetiology of burnout and depressive complaints among members of the Dutch police force. Only participants who did not report a (very) high level of burnout complaints at the time of the first wave of the study, took part in the second wave of the study.

The data in *Chapters 3, 4, and 5* were collected among 120 faculty members of a Dutch university, who had substantial work obligations. Furthermore, since all participants had partners who worked in paid jobs, it could be assumed that they had to fulfil (at least part of) domestic obligations as well. Participants were asked to fill in a 'general' questionnaire and took part in a diary study: They were requested to fill in three short questionnaires daily for a period of nine consecutive days (starting on a Saturday and finishing on Sunday one week later). More details with respect to data collection are provided in the next chapters.

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2

Disentangling the causal relationships between work-home interference and employee health

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Van Hooff, M. L. M., Geurts. S. A. E., Taris. T. W., Kompier, M. A. J., Dikkers, J. S. E., Houtman, I. L. D., & Van den Heuvel, F. M. M. (2005). Disentangling the causal relationships between work-home interference and employee health. *Scandinavian Journal of Work, Environment, and Health, 31(1)*, 15-29.

Abstract

Objectives The present study was designed to shed more light on the causal relationship between (time- and strain-based) work-home interference (WHI, i.e., work demands interfere with functioning at home) and employee health (i.e., fatigue and depressive complaints). Effort-Recovery (E-R) theory provided the theoretical basis for this study.

Method Drawing on two-wave longitudinal data (with a one-year time lag) from 730 Dutch police officers, alternative causal hypotheses were tested by using Structural Equation Modelling, that is, (i) WHI predicts health deterioration ('normal causation'), (ii) health complaints precede increased levels of WHI ('reversed causation'), or (iii) both processes operate ('reciprocal causation'). In addition, the relationship between stable and changed WHI levels across time and their relationships with the course of health were tested with a group-by-time analysis of variance. For this purpose, we created four subgroups that differed in their starting point and development of WHI across time.

Results The 'normal causal model' (i) in which strain-based (but not time-based) WHI was longitudinally related to increased health complaints one year later fitted the data well and significantly better than the 'reversed causal model' (ii). Although the 'reciprocal model' (iii) also provided a good fit, it was less parsimonious compared to the 'normal causal model' as the crucial reversed causal relationships (from fatigue and depressive complaints to increased levels of WHI one year later) were not significant. In addition, and in line with the E-R model, both an increment in (strain-based) WHI across time and a long-lasting experience of high (strain-based) WHI were associated with a deterioration of health.

Conclusions We conclude that (strain-based) WHI is likely to act as a precursor of health impairment, and that different patterns of (strain-based) WHI across time are related to different health courses. Particularly a long-term experience of (strain-based) WHI seems to be responsible for an accumulation of health complaints.

2.1 Introduction

Nowadays many employees have difficulty combining work and domestic obligations. Empirical research has consistently shown that work demands interfere with private life (i.e., work-home interference) more often than the other way around (i.e., home demands interfering with work life) (Frone, 2003 and Geurts & Demerouti, 2003 for reviews). In light of the higher prevalence of work-home interference (WHI), the current study focused exclusively on WHI and more specifically on the temporal relationship between WHI and employee health.

In the literature, three different types of WHI have been distinguished (Greenhaus & Beutell, 1985). Time-based WHI develops when the time devoted to work obligations makes it physically impossible to meet obligations in the private domain (e.g., when long working hours interfere with participation in family activities). Strain-based WHI refers to the process in which tension developed at work is transferred to the home domain (e.g., when people have difficulty to relax at home after a stressful working day). Behavior-based WHI refers to a situation in which specific behaviors expected at work are incompatible with behaviors that are expected at home (e.g., teachers who continue to act as teachers in relationship with their own children). Previous research has demonstrated that especially time- and strain-based WHI are negatively associated with employee health (Allen, Herst, Bruck & Sutton, 2000, for a meta-analysis). Therefore, in the current study we focused on these two types of WHI.

Previous research

A considerable amount of knowledge on WHI and its presumed consequences has been gathered (Frone, 2003; Geurts & Demerouti, 2003). A recent meta-analysis (Allen et al., 2000) showed that WHI was particularly associated with stress-related 'outcomes'. In fact, the highest weighted mean correlations were found with burnout (r_w =.42), work-related stress (r_w =.41) and depressive complaints (r_w =.32). However, one notable weakness of *previous WHI* research is that findings mainly rely on cross-sectional data, meaning that as yet little insight in the causal nature of these relationships has been gathered.

To demonstrate such relationships, a longitudinal design is required. The small number of longitudinal studies that have examined the relationship between WHI and employee health provide nonetheless mixed results with respect to the causal direction of effects. It has been found that WHI acts as a precursor of heavy alcohol use (but not of depressive complaints) over a four-year period (Frone, Russell & Cooper, 1997) and of decreased levels of (self- and

co-worker) reported well-being over a six-month period (Grant-Vallone & Donaldson, 2001). In contrast, the results of a six-month longitudinal study (Kelloway, Gottlieb & Barham, 1999) showed that strain-based WHI was a result rather than a precursor of stress complaints. Finally, a recent study (Kinnunen, Geurts & Mauno, 2004) showed that WHI was related to various indicators of well-being one year later, but only for women.

Although in field studies the use of a longitudinal design is a precondition to map causal relationships, it is not a *sufficient* condition (in fact, we can never fully prove causality, we can only bring up evidence that makes such relations plausible). In their critical consideration of longitudinal research, Taris and Kompier (2003) point at the importance of the theoretical plausibility of the presumed causal relationship. It is important that researchers specify the process that underlies a particular, presumably causal, association -- the mere significance of an across-time correlation is not enough to make us believe that there is a causal relationship between two concepts.

This issue embodies a second limitation of previous WHI research. Many studies (including several longitudinal ones) that addressed the relationship between WHI and employee health were not guided by a strong theoretical framework that sheds light on the underlying (psychological or physiological) mechanisms (cf. Geurts & Demerouti, 2003; Geurts, Kompier, Roxburgh & Houtman, 2003). Often studies confine themselves to the presentation of significant regression weights, suggesting that health scores are 'predicted' by WHI and possibly other concepts. *If* a theory was used, it was predominantly based on role stress theory (Kahn, Wolfe, Quinn, Snoek & Rosenthal, 1964). In research inspired by this theory it remains unclear, however, how WHI should be embedded in the classical stressor-stress-strain relationship. Some researchers consider WHI as a stressor (e.g., Frone, Russell & Cooper, 1992; Kinnunen & Mauno, 1998), whereas others view it as an indicator of strain (Frone, Yardley & Markel, 1997; Burke, 1988), or as an intervening variable in the stressor-strain relationship (e.g., Grandey & Cropanzano, 1999). Moreover, from the role stress perspective, no assumptions can be made concerning the impact of a long-lasting experience of WHI on employee health. Yet, it would seem particularly interesting to find out how worker health develops in response to persistent exposure to high levels of WHI.

A third inadequacy that applies, in particular, to previous longitudinal research in the field of occupational health psychology (OHP, including the domain of WHI) (Taris & Kompier, 2003) is that it leaves indistinctness concerning causality. Mostly no attention is paid to the existence of possible reciprocal relationships (e.g., WHI → health complaints *and* health

complaints → WHI) which requires the use of a 'full panel design' (i.e., both independent and dependent variables are measured at all measurement points). A notable exception is a recent study conducted by Demerouti, Bakker, and Bulters (2004) who examined the reciprocal relations among work pressure, WHI and exhaustion in a three-wave full panel study with time lags covering the period of six weeks. Although they found support for normal and reversed causal relationships between WHI and exhaustion, their study could not shed light on the long-term temporal relationships between WHI and health as the time intervals between the waves were too short. Moreover, even if reciprocal effects are tested in a full panel design, 'it is still impossible to exclude the possibility that particular associations are due to variables that were not measured in the study design' (Taris & Kompier, 2003, p. 1). The inconsistent and often inconclusive results from longitudinal studies in this area might be, at least partly, caused by the impact of these (often unmeasured) third variables (cf. Dormann & Zapf, 2002).

A fourth and insufficiently acknowledged constraint that also applies to longitudinal research within the area of OHP is that it examines a process that proceeds in time with often arbitrary chosen measurement points. This implies that it is unknown at exactly what point in time we start measuring the process. According to Kasl and Jones (2003, p. 9), we put an 'arbitrary temporal window' on a 'steady-state cohort' that may include three types of workers: (1) those who are studied 'too early' (i.e., the process has not started yet), (2) those who are studied 'too late' (i.e., the effects of the process are already observed at the first measurement point), and (3) those for whom the 'temporal window is just right'. Also in the current study, the level of WHI and/or the level of health complaints may already be high for (part of) the participants at the first wave, whereas for others these levels may be low at this point in time. Furthermore, some workers may have gone through a change in experienced WHI (e.g., low WHI → high WHI, or high WHI → low WHI) during the observation period, whereas the situation of others is characterized by stable levels of (high or low) WHI. A closer examination of theoretically derived subgroups (Taris & Kompier, 2003) that are characterized by different WHI starting points and courses across time (e.g., De Lange, Taris, Kompier, Houtman & Bongers, 2002; Kinnunen et al., 2003) will probably yield more insight into the processes that may underlie the longitudinal relationships between WHI and employee health.

The present study was designed to overcome these theoretical and methodological shortcomings, i.e., the use of cross-sectional designs (i), the lack of theory (ii), unclear causality (iii), and the neglect of different WHI starting points and courses across time (iv).

Therefore, in the current study, the relationship of WHI with two health indicators (i.e., fatigue and depressive complaints) is examined (i) by using a two-wave longitudinal full-panel design with a one-year time lag, (ii) from a relevant theoretical perspective (i.e., the Effort-Recovery Model (Meijman & Mulder, 1998), (iii) by addressing possible reciprocal relationships while controlling for the impact of potential third variables, and (iv) by studying the development of health complaints in theoretically derived subgroups of workers that have different WHI starting points and courses across time. A distinction is made between time-based and strain-based WHI in order to find out whether the two types of WHI have a similar or a different relationship with health.

Theoretical framework

To date, various theoretical perspectives, e.g., role stress theory (Kahn et al., 1964) and (to a lesser extent) conservation of resources theory (Hobfoll, 1989), have been employed to examine the relationship between WHI and its health consequences (Geurts & Demerouti, 2003, for an overview). We believe that another theoretical framework, i.e., the Effort-Recovery model (Meijman & Mulder, 1998), may shed more light on the mechanisms that underlie the relationship between (long-lasting) WHI and employee health (Geurts et al., 2003). According to this work psychological model, effort expenditure at work has, besides benefits in terms of productivity, also short-term psychological and physiological costs. Under normal circumstances, these costs or negative load effects are reversible: when effort is no longer expended, the psychobiological systems that were activated will stabilize within a certain period of time to a baseline level. This process is called recovery. One of the central assumptions of the Effort-Recovery model is that effort expenditure at work is likely to have adverse health consequences when the opportunities to recuperate during (i.e., internal recovery) or after (i.e., external recovery) the working period are insufficient. Internal recovery is, for instance, jeopardized when workers unremittingly expend effort at work without the possibility to take an occasional break or to alternate strenuous tasks with tasks that require less effort. External recovery may be endangered, for instance, when effort expenditure is prolonged and recovery time is insufficient because demands continue to exist after working time (e.g., due to extensive domestic obligations), and/or when workers are slowly unwinding. In this latter situation, also referred to as 'sustained activation' (Ursin, 1980), load effects built up at work do not unfold immediately but last during nonwork time, e.g., when workers have difficulty to relax after a demanding working period (Sonnentag,

2001). When (internal and/or external) recovery is insufficient, the worker, still in a sub-optimal state, has to invest additional (compensatory) effort to perform adequately during the next working period, which may result in an increased intensity of load effects that make an even higher demand on the recovery process. Eventually, insufficient recovery results in an accumulation of negative load effects that in the long run may seriously affect health (e.g. prolonged fatigue, sleep deprivation and manifest health problems; Kompier, 1988; Sluiter, Van der Beek & Frings-Dresen, 1999).

Drawing on the Effort-Recovery Model, the current study defines WHI as 'a process in which a worker's functioning and recovery at home are hampered by negative load effects that have built up at work' (Geurts et al., 2003). Note that WHI is defined here in terms of recovery, i.e., a high level of WHI implies that recovery during nonwork time is impeded due to insufficient recovery time (i.e., time-based WHI) and/or due to the transfer of work-related strain to the home domain (i.e., strain-based WHI).

Hypotheses

The present study was conducted in two parts. In the first part we investigated the temporal relationship between time- and strain-based WHI and health complaints. From the perspective of the Effort-Recovery model, we hypothesize that relatively high levels of time- and strain-based WHI at time 1 are related to increased levels of fatigue and depressive complaints one year later (Hypothesis 1a). In order to find out whether WHI acts primarily as a precursor of health complaints, or as an outcome of health complaints as well (e.g., a higher level of WHI is experienced due to poor health and a diminished capacity to deal with high work load), we also tested the reversed causal pathways. An alternative (but not per se competing) hypothesis is, therefore, that relatively high levels of fatigue and depressive complaints at time 1 are associated with increased levels of time- and strain-based WHI one year later (Hypothesis 1b).

In the second part of this study, we examined the course of health complaints as a function of stable and changed levels of time- and strain-based WHI. To map this process, we created four subgroups that differed in their starting point and development of WHI across time. This approach was inspired by that of De Lange et al. (2002), who studied in a similar way the across time effects of work characteristics on employee health. We expect that workers who reported a high level of WHI at both points in time (i.e., stable high group) also experienced

more health complaints (at both points in time) than workers who reported a relatively low level of WHI (*Hypothesis 2).* Moreover, because this 'stable high group' is characterized by a long-term (at least one-year) experience of relatively high WHI (indicating insufficient recovery), health complaints should have aggravated over time for this particular subgroup (*Hypothesis 3).* We expect the subgroup that reported a low level of WHI at both points in time (i.e., stable low group) to experience fewer health complaints than workers who reported a relatively high level of WHI (*Hypothesis 4*), without any significant change in health over time.

A third subgroup is characterized by an increase in WHI across time, that is, by the experience of low WHI at time 1 and a relatively high level of WHI one year later (i.e., change low→high group). Based on the Effort-Recovery model, we expect that in this group a deterioration of health can be observed (*Hypothesis 5).* Finally, the fourth subgroup is characterized by a favorable change in WHI across time, i.e., by the experience of high WHI at time 1 and low WHI one year later (i.e., change high→low group). Because of the decrease in WHI during the one-year period, we expect to observe a decrease in health complaints in this subgroup over time (*Hypothesis 6).*

2.2 Method

Sample

The data used in this study were originally collected as part of a two-wave longitudinal survey on the aetiology of burnout and depressive complaints among members of the Dutch police force. At time 1 (1999) a random sample of 10,000 employees was drawn from the whole population of police personnel in the Netherlands. Of this number, 5,277 police officers (response rate of 53%) completed a questionnaire that included questions about work characteristics, WHI and health. Of these respondents, 2,732 (response rate of 52%) agreed on participating in the follow up study, which took place one year later (2000). Police officers who already reported a (very) high level of burnout complaints (Maslach & Jackson, 1984) at time 1 were excluded from further participation in the study, as those with a history of burnout at the first wave cannot offer insight in the incidence and aetiology of burnout (Kasl & Jones, 2003). To determine whether the level of burnout complaints was (very) high, a comparison was made with an independent representative sample of the Dutch work force (Schaufeli & Van Dierendonck, 2000): those police officers with a 75th percentile score or higher on all three burnout components (i.e., $\geq$ 2.20 on exhaustion, $\geq$ 2.00 on distance and $\leq$

3.66 on competence) were excluded. This resulted in a sample of 1,667 participants who did not suffer from serious burnout complaints at the first wave. From this sample, a random sample of 1,000 employees was contacted for the follow-up study, of which 828 (response rate of 83%) completed a second questionnaire (that was highly similar to the first questionnaire). Analysis of variance revealed several differences between the time 1-scores of those who agreed to participate in the follow up study and those who did not (the non-response group, N =2,545). Females and those with lower salary levels agreed less often on further participation than males and those with higher salary levels, respectively. This matches earlier findings concerning the characteristics of non-respondents compared to respondents (Taris, 2000, for a review). Furthermore, in the response group higher scores on exhaustion (Δ M = .09, $p < .05$) and lower competence scores were observed (Δ M = .16, $p<.05$) compared to the non-response group, suggesting that those with relatively high levels of burnout complaints (but not as high levels as of those workers who were already excluded) considered it more important to contribute to the follow up study than the group with less complaints.

The analyses in the present study are based on the longitudinal part of the original study, meaning that our sample consisted of 828 of a possible 1000 participants (= the number of workers contacted for the time 2 follow-up study), which implies a response rate of 82,2% for our study. We restricted our analyses to those who were employed full time at both waves of the study, thus excluding at least one potential confounder (i.e. part time vs. full time status) of the relationship between WHI and health (cf. Grzywacz & Marks, 2000; Van der Hulst & Geurts, 2001). The final sample therefore consisted of 730 full time working police employees (91% male and 9% female, M_{age} at time 1 was 42.3 years, sd = 7.7, $M_{experience}$ at time 1 was 20.4 years, sd = 9.0, of which on average 10.5 years in their present job, sd = 8.5). Eighty-six per cent worked as an executive police officer (47% base police force, 14% research squad, 4% foreign police, 3% traffic police, 15% other), and 14.4% were in the administrative or technical support services. At the second wave, 21 per cent of the participants reported that they had experienced a change in their work situation (i.e. changed job type or police force) since the first wave, and a similar proportion (21%) went through a change in their family situation (e.g. birth of a child, a child leaving the house, marriage or divorce) in-between the two waves.

Measures

Work Home Interference. Time-based and strain-based WHI were each measured with 4 items from the SWING (i.e., the Survey Work-home Interaction-NijmeGen; Van der Hulst &

Geurts, 2001; Bakker & Geurts, 2004; Demerouti, Geurts, Bakker & Euwema, 2004). These scales measure the extent to which employees believe that their functioning at home is hampered by work demands. The four items covering time-based WHI are: 'How often does it happen that... (i) you have to cancel appointments with your spouse/family/friends due to work-related commitments?'; (ii) your work schedule makes it difficult for you to fulfill your domestic obligations?'; (iii) your work takes up time that you would have liked to spend with your spouse/family/friends?', and (iv) you have to work so hard that you do not have enough time for any of your hobbies?'. The four items measuring strain-based WHI are: 'How often does it happen that... (i) you are irritable at home because your work is demanding?'; (ii) you do not fully enjoy the company of your spouse/family/friends because you worry about your work?'; (iii) you find it difficult to fulfill your domestic obligations because you are constantly thinking about your work?', and (iv) your work obligations make it difficult for you to feel relaxed at home?'. For both WHI scales, respondents answered on a four-point scale (0 = '(almost) never', 1 = 'sometimes", 2 = 'often', and 3 = 'always'), with higher scores reflecting higher levels of WHI. Cronbach's α's for time-based WHI were .73 (time 1) and .76 (time 2), and for strain-based WHI .77 (time 1) and .81 (time 2).

Fatigue was measured with 5 items from a Dutch adaptation of the Maslach Burnout Inventory -- General Survey (Schaufeli & Van Dierendonck, 2000), that were developed to measure the exhaustion component of burnout. Example items are 'I feel fatigued when I get up in the morning and have to face another day on the job' and 'I feel used up at the end of the workday' (0 = 'never', 6 = 'always'), with higher scores indicating higher levels of complaints. As in the current study workers with (very) high scores on this scale at wave 1 were excluded, we considered the term 'exhaustion' to be inappropriate to describe the (only low to moderate) scores on this scale, and preferred to use the term 'fatigue'. Cronbach's α was .71 (time 1) and .83 (time 2).

Depressive complaints were measured with 8 items of a Dutch translation of the short version (Iowa form) of the Center for Epidemiologic Studies Depression (CES-D) scale (Kohout, Berkman, Evans & Cornoni-Huntley, 1995; Radloff, 1977). Each participant was offered brief statements of feelings or behaviours and was asked to indicate how often he or she felt that way during the last two weeks. Examples are 'I felt depressed', 'I was happy' (reversed), and 'I felt everything I did was an effort' (1 = 'seldom', 2 = 'sometimes', 3 = 'mostly'), with higher scores signifying higher levels of depressive complaints. Cronbach's α's were .78 (time 1) and .80 (time 2).

Covariates. In order to ensure that the statistical association between WHI and each health indicator was not due to third variables, the impact of two important job characteristics (i.e., work load and job control, time 1 measures only) was controlled for (working hours were already controlled by the inclusion of only participants who worked on a full time basis at both waves). Both constructs were measured by subscales from the NOVA-WEBA (Dhondt & Houtman, 1992; Houtman, Bloemhoff, Dhondt & Terwee, 1994), a Dutch questionnaire developed to identify risk factors for work stress. The psychometric qualities (i.e., reliability, validity and factor structure) of this instrument have been tested with satisfactory results (Dhondt & Houtman, 1997). *Work load* was measured with 5 items from a Dutch modified version of the psychological demands scale of the Job Content Questionnaire (JCQ; Karasek, Pieper & Schwartz, 1985; Karasek et al., 1998). A typical question is: 'Do you have to work very fast?'. Cronbach's α's were .73 (time 1) and .74 (time 2). Each question could be answered by 'no' (0) or 'yes' (1), with higher scores indicating higher levels of work load. As the JCQ items were originally constructed with four answer categories (1 = 'strongly disagree' to 4 = 'strongly agree'), psychometric properties of this modified version have been tested and considered satisfactory (Houtman et al., 1998). *Job control* was measured with 9 items (one was derived from the JCQ (Karasek et al., 1985), three were borrowed from a Dutch questionnaire on organization stress (VOS-D; Bergers, Marcelissen & De Wolff, 1986), and five were self-developed by the authors of the NOVA-WEBA) that again could be answered by 'no' (0) or 'yes' (1), with higher scores reflecting higher levels of job control. An exemplary item is: 'Do you have a choice in deciding how to do your work?'. Cronbach's α were .78 at both waves. In addition to these two job characteristics, respondent *gender* (male = 0, female = 1) and *age* (in years) were included as covariates.

Reported job and/or family changes. In the follow-up questionnaire (time 2), respondents were asked whether changes had occurred in (1) their job type, (2) the police force they were participating in and/or (3) their family circumstances since they responded to the first questionnaire. The response categories were 'yes' and 'no'. In case participants responded positively ('yes'), they were asked to specify their current job type, police force or family condition. With respect to the latter, participants could indicate whether their current situation had changed during the last year in terms of, e.g., marriage, divorce, the birth of a child, a child leaving the house, moving in with parents, or a spouse entering or leaving the labour market.

Means and standard deviations of all survey measures, as well as correlations between the measures and *t*-values regarding the across-time differences, are presented in Table 2.1.

Analyses

Preliminary analyses. At first (Step 1), it was important to examine whether the four core variables under study (i.e., time-based WHI, strain-based WHI, fatigue and depressive complaints) were indeed empirically distinct constructs. Therefore, at each wave we examined the fit of several models for the relations among the items of these core variables using Confirmative Factor Analysis (CFA, Jöreskog & Sörbom, 1993). In a first model, all items were constrained to load on only one latent factor. In a second model, we created two latent factors: one for the items that measured WHI (irrespective of the type of interference), and one for the items that measured health (irrespective of the type of complaints). In a third model, an additional distinction was made between fatigue and depressive complaints, which resulted in three latent factors. In the fourth model, four factors were created in line with the four core variables under study.

As it cannot be excluded that relations between WHI and health are influenced by actual changes in the job type, the police force, and/or the family circumstances, an additional analysis was conducted to find out whether the relationships among all eight variables under study (i.e., the four core variables and the four covariates) were the same for all participants, irrespective of these changes. Therefore, by using the LISREL 8.30 program (Jöreskog & Sörbom, 1993), we tested a model in which the covariance matrices (i.e., the relations among all variables) were set equal across four groups of workers, that is, (i) those who reported no change in their work or family situation vs. those who did report (ii) a change in their work situation, (iii) a change in their family situation, or (iv) a change in both domains.

Causal relations (Hypotheses 1a and 1b). Secondly (Step 2), we mapped the temporal relationship between time- and strain-based WHI on the one hand, and fatigue and depressive complaints on the other hand, by using Structural Equation Modeling (SEM, Jöreskog & Sörbom, 1993). The model included four dependent (endogenous) variables, that is, the four core variables (time-based WHI, strain-based WHI, fatigue and depressive complaints) measured at time 2. The time-1 measures of these four variables served as independent (exogenous) variables, together with the four covariates (i.e., work load (time 1), job control (time 1), age, and gender).

Table 2.1. Correlations, means, standard deviations and t-tests for the core variables and the covariates in the study

	M	Sd	t^a	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Time-based WHI T1	0.87	0.47		1												
2. Time-based WHI T2	0.86	0.48	-0.94	.62**	1											
3. Strain-based WHI T1	0.68	0.44		.46**	.37**	1										
4. Strain-based WHI T2	0.71	0.47	1.93	.30**	.48**	.62**	1									
5. Fatigue T1	1.09	0.55		.25**	.20**	.50**	.34**	1								
6. Fatigue T2	1.21	0.76	4.67**	.17**	.29**	.37**	.51**	.47**	1							
7. Depressive complaints T1	1.18	0.27		.09*	.06	.26**	.19**	.33**	.25**	1						
8. Depressive complaints T2	1.21	0.29	2.75**	.10*	.12**	.23**	.30**	.18**	.41**	.40**	1					
9. Workload T1	0.58	0.33		.31**	.32**	.33**	.27**	.29**	.22**	.07	0.03	1				
10. Workload T2	0.56	0.34	-1.66	.30**	.35**	.35**	.37**	.24**	.32**	.05	.09*	.63**	1			
11. Job control T1	0.73	0.26		.18**	.14**	.03	.02	.08*	.08*	.07	0.04	.14**	.11**	1		
12. Job control T2	0.74	0.25	-1.68	.14**	.17**	.04	.09*	.04	.15**	.07	.11**	.11**	.14**	.62*	1	
13. Gender	-	-	-	-.08*	-.07	-.12**	-.08*	-.03	.07	.04	.10*	-.09*	-.05	.07	.09*	
14. Age	42.3	7.68	-	-.08*	-.10**	.12**	.09*	.03	.00	.05	.02	.06	.05	.15*	.19*	-.38**

Note * = $p<.05$ ** = $p<.01$ [a] Due to occasional missing values, *df's* for this comparison range from 697 to 729. A repeated measures MANOVA revealed that in general there were differences across time for these variables: $F(6,677) = 6.28$, $p<.01$

Four models were tested against each other. Model 1 (M1; no causation model) included only lagged effects from the time-1 measure of each core variable on the time-2 measure of the same variable. Thus, this model assumed that time- and strain-based WHI and both health indicators do not affect each other temporally. Model 2 (M2; normal causal model), corresponding with Hypothesis 1a, was identical to M1 but included additional effects of time- and strain-based WHI (time 1) on fatigue and depressive complaints (time 2). Note that health status at time 1 is controlled for (as M2 is an extension of M1 that already included lagged effects from each health indicator at time 1 on the same health indicator at time 2). Model 3 (M3; reversed causal model), corresponding with Hypothesis 1b, was also identical to M1 but included additional effects of fatigue and depressive complaints (time 1) on both types of WHI (time 2). Note here that WHI at time 1 is controlled (as M3 is an extension of M1 that already included lagged effects from WHI at time 1 on WHI at time 2). Finally, Model 4 (M4; reciprocal model) integrates all three previous models, including cross-lagged reciprocal effects (a) from fatigue and depressive complaints (time 1) on (time- and strain-based) WHI (time 2), and (b) from (time- and strain-based) WHI (time 1) on fatigue and depressive complaints (time 2). This model corresponds with both Hypothesis 1a and Hypothesis 1b, assuming that (time- and strain-based) WHI may result in increased levels of health complaints one year later, as well as the other way around (health complaints may result in increased levels of WHI one year later).

The fit of these four models in Step 2 as well as of the four models in Step 1 (the preliminary analyses) were compared using the standard Chi-square (χ^2) test, and Bentler's (Bentler & Bonett, 1980) Non-normed Fit Index (NNFI), the Adjusted Goodness-of-Fit Index (GFI), the Root Mean Square Error of Approximation (RMSEA), and the Comparative Fit Index (CFI; Bentler, 1990). Values of .90 and over (NNFI, AGFI and CFI) and .08 or under (RMSEA) indicate an acceptable fit (Byrne, 2001).

Subgroup analysis (Hypotheses 2 to 6). In a final step (Step 3), we examined the relationship between stable and changed levels of (time- and strain-based) WHI and the development of health complaints over time. Therefore, four subgroups with different patterns of (time- and strain-based) WHI across time were created using the median-split method. For each type of WHI, those who scored above the median on both waves were assigned to the 'stable high' group, whereas those who scored below the median on both occasions formed the 'stable low' group. Incumbents of the 'change low→high' group had WHI scores below the median at time 1 and above the median at time 2. Incumbents of the

'change high→low' group had WHI scores above the median at time 1 and below the median at time 2.

To examine the course of health complaints for the four WHI subgroups, three types of analyses of variance were conducted. At first, a 4 (Group: the four WHI subgroups) x 2 (Time: Time 1 vs. Time 2) x 2 (Health: fatigue and depressive complaints) MANCOVA was executed, with Time and Health as within-participant factors. Work load (time 1), job control (time 1), gender, and age were included as covariates. Secondly, a series of ANOVAs (with each health indicator at each wave as dependent variable and the four WHI subgroups as factor) were conducted to map differences among the subgroups at each wave. Post-hoc tests were conducted to test which groups differed significantly from each other (*Hypotheses 2 and 4*). Additional *T*-tests were conducted within each WHI subgroup to determine whether the level of health complaints changed across time within each subgroup (*Hypotheses 3, 5, and 6*).

The fact that WHI levels may alternate over time for some of the participants does not yet explain *why* such changes took place. Therefore, some additional analyses were conducted to address this query. It is plausible that changes in WHI levels were related to 'reported job and/or family changes' (i.e., changes in job type, in police force, or in objective family conditions) or to changes in 'reported work characteristics' (e.g., work load or job control; changes in 'reported family characteristics', such as changed domestic or care-giving responsibilities, were not measured in the current study). Concerning the 'reported job/family changes', χ^2-tests were conducted to reveal whether or not the change (high→low and low→high) WHI subgroups included a larger proportion of workers who reported a change in job type, police force and/or objective family circumstances than the stable (high and low) groups. To find out whether the two change groups reported more alterations in reported work load and/or job control across time than both stable groups, a 4 (Group: the four WHI groups) x 2 (Time: Time 1 vs Time 2) x 2 (Work characteristics: work load and job control) MANOVA was conducted.

2.3 Results

Step 1: Preliminary analyses

Four models for the associations among the items of the four core variables were tested and compared, at each wave. Our analyses revealed that only the model in which four latent factors were created for time-based WHI, strain-based WHI, fatigue and depressive complaints, respectively, fitted the data well (time 1: $\chi^2_{(183, 706)} = 539.97$, NNFI = .89, GFI =.93,

RMSEA = .054, and CFI = .90; time 2: $\chi^2_{(183,706)}$ = 575.73, NNFI = .91, GFI = .93, RMSEA = .057 and CFI = .92). The three other models (assuming one, two and three latent factors, respectively) did not show an acceptable fit (all NNFIs, GFIs, CFIs < .90, all RMSEAs > .05)[1]. Thus, the four core variables in our study can be regarded as empirically distinct, though related (cf. Table 2.1), constructs.

Concerning the possible differences in relationships among these core variables for those workers who reported no change in their work or family situation (i) vs. those who reported a change in their work situation (ii), in their family situation (iii), or in both domains (iv), LISREL analysis showed that the model in which the covariance matrices were set equal, showed an acceptable fit ($\chi^2_{(234)}$ = 342.49, RMSEA=.03, NNFI=.95 and CFI=.95). Thus, the relationships among the core variables were equal for the four groups and these are not affected by changes that may have occurred in job type, police force and/or objective family circumstances.

Step 2: Causal relations

Table 2.2 presents the fit of the four alternative models (no causation, normal causal, reversed causal and reciprocal) to map the temporal relationships between both types of WHI and both health indicators.

All models fitted the data reasonably well. A closer inspection of the fit indices reveals that Model 2 (M2: *normal causal model* assuming that (time- and strain-based) WHI (time 1) is related to increased levels of fatigue and depressive complaints (time 2)) fitted the data significantly better than Model 1 (M1: *no causation model,* $\Delta \chi^2$ (M2 - M1) = 28.1 with 4 *df*, $p < .001$). Model 3 (M3: reversed causal model assuming that health complaints (time 1) are associated with increased (time- and strain-based) WHI (time 2)) on the other hand, did not provide a better fit than M1 ($\Delta \chi^2$ (M3 – M1) =3.71 with 4 *df*, $p > .05$). Also Model 4 (M4: *reciprocal model* assuming cross-lagged reciprocal relationships between (time- and strain-based) WHI and both health indicators) fitted the data slightly better than Model 1 ($\Delta \chi^2$ (M4 - M1) = 25.1 with 8 *df*, $p < .001$) as well as Model 3 ($\Delta \chi^2$ (M4 - M3) = 26.83 with 4 *df*, $p < .001$). Although Model 2 and Model 4 fitted the data about equally well, the crucial reversed causal relationships (from fatigue and depressive complaints (time 1) to increased levels of

[1] Due to limitations of space, the table presenting the fit indices of the each of the four models at both waves is not presented here, but is available from the first author on request.

(time- and strain-based) WHI (time 2)) specified in Model 4, were *not* significant. As Model 4 was less parsimonious (4 *df*), Model 2 (8 *df*), Model 2 was accepted as the best fitting model ($\chi^2_{(8, 698)} = 17.89$, NNFI = .96, AGFI = .96, RMSEA = .042, CFI = 1.00).

Table 2.2. Fit indices of five alternative models for the causal relations among (time- and strain-based) WHI and health complaints (i.e., fatigue and depressive complaints)

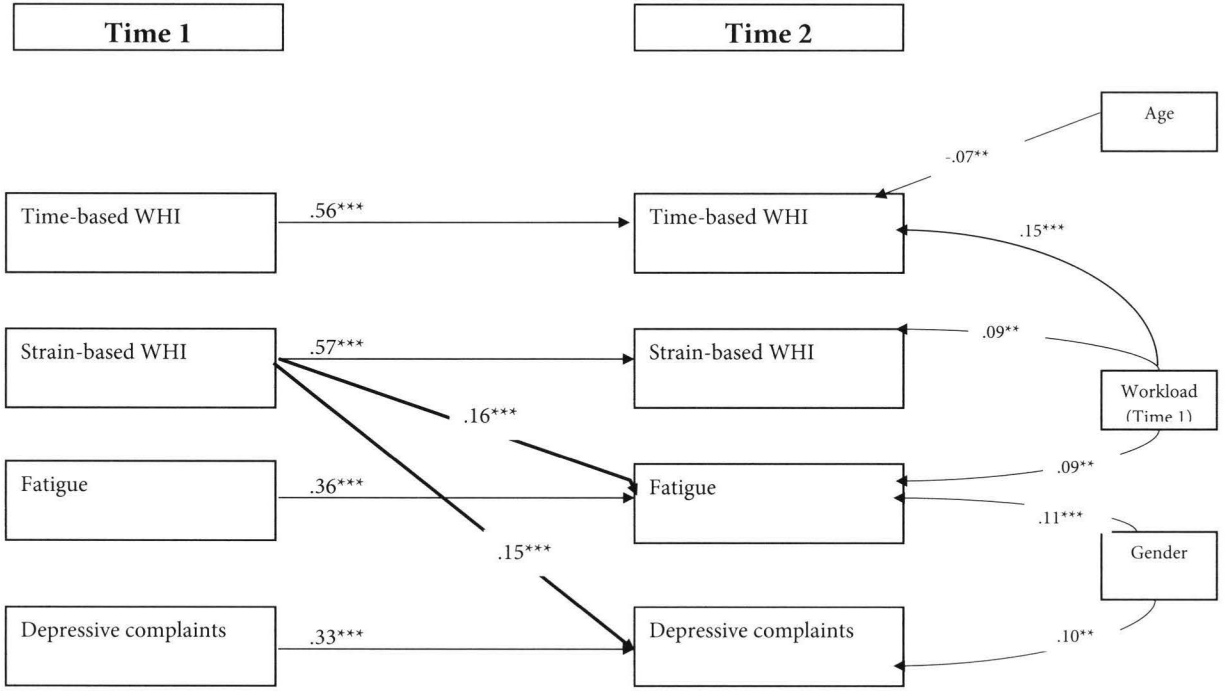
Model	χ^2	df	NNFI	AGFI	RMSEA	CFI
M1 *(no causation model)*	46.01	12	.91	.93	.063	.98
M2 (*normal causal model*)	17.89	8	.96	.96	.042	1.00
M3 (*reversed causal model*)	42.30	8	.87	.90	.077	.98
M4 (*reciprocal model*)	15.47	4	.91	.93	.064	.99
M5 (*final model*)	24.04	20	.99	.98	.017	1.00

M1: includes only lagged effects (measure (t 1) → same measure (t 2))
M2: identical to M1, but extended with normal causal relationships (WHI (t1) → health complaints (t 2))
M3: identical to M1, but extended with reversed causal relationships (health complaints (t 1) → WHI (t 2))
M4: integrates models M1, M2 and M3 (i.e., lagged effects, normal and reversed causal relationships)
M5: identical to M2, but with non-significant paths being constrained to zero

Not all paths in Model 2 were statistically significant. Most importantly, the relationships of *time-based* WHI (time 1) and both health indicators one year later were not significant, indicating that increases in health complaints could not be predicted from time-based WHI one year earlier. After omitting these and other (less relevant) non-significant paths in a stepwise fashion, the fit of the *final model* (M5) remained acceptable ($\chi^2_{(20, 698)} = 24.04$, NNFI = .99, AGFI = .98, RMSEA = .017, CFI = 1.00). This model is presented in Figure 2.1.

In sum, the results provide support for *Hypothesis 1a,* but only for strain-based WHI. Higher levels of strain-based WHI at time 1 are associated with increased levels of fatigue (β = .16, p<.001) and depressive complaints (β = .15, p<.001) one year later (after controlling for gender, age, fatigue (time 1), depressive complaints (time 1), work load (time 1) and job control (time 1)). In addition (not shown in Figure 2.1), some covariates were related to the core variables at time 1 (see Table 2.1). Concerning the relationships between the covariates and the core variables at time 2 (see Figure 2.1), work load (time 1) was positively related to time- and strain-based WHI (β = .15 and β = .09, respectively) and fatigue (β = .09), job control was not related with the core variables at time 2, females reported slightly higher levels of fatigue and depressive complaints than males (β = .10 and β = .11, respectively), and age was negatively (though weakly) associated with time-based WHI (β = -.07). Finally, the across-

Figure 2.1: The final Model (M5)



Note : **= p<.01 ***= p<.001

time correlations of the core variables were rather high: the levels of (time- and strain-based) WHI at time 2 were relatively strongly predicted by the levels of these measures at time 1 ($\beta_{\text{time-based}}$ = .56 and $\beta_{\text{strain-based}}$ = .57), and this was also true, though to a lesser extent, for the two health indicators (β_{fatigue} = .36 and $\beta_{\text{depressive complaints}}$ = .33).

Step 3: Subgroup analysis

In Step 3, we examined the course of health complaints in each WHI subgroup. For this purpose, we created four subgroups by using the scores on strain-based WHI only (as time-based WHI maintained no temporal relationship with each of the two health indicators, *cf.* Step 2). Table 2.3 presents the number of incumbents in each WHI subgroup (*N*) as well as the means and standard deviations on each health indicator for each WHI subgroup at each wave. The *T*-values indicate for each WHI subgroup whether the observed change in health complaints between time 1 and time 2 is significant.

Table 2.3. Means and standard deviations of each health indicator for each wave and for each WHI subgroup

		Fatigue					Depressive complaints				
		time 1		time 2			time 1		time 2		
Subgroup	*N*	*M*	*Sd*	*M*	*Sd*	*T*	*M*	*Sd*	*M*	*Sd*	*T*
Stable low	357	.89	.53	.88	.60	-.39	1.12	.21	1.13	.24	.92
Change high→low	63	1.24	.54	1.14	.63	-1.14	1.30	.40	1.27	.35	.81
Change low→high	104	1.12	.50	1.61	.85	5.58**	1.18	.30	1.27	.32	2.71**
Stable high	204	1.35	.50	1.59	.73	4.60*	1.25	.26	1.30	.29	2.50**

Note: * = $p < .05$; ** = $p < .01$

The results of MANCOVA showed no significant main effect of *Time* ($F(2, 674) = .61$, *ns*), indicating that for the whole sample (disregarding the WHI subgroups) the level of health complaints did not differ significantly between the two waves. A significant main effect of *Group* did exist ($F(6,1350) = 28.39$, $p<.001$) for both fatigue ($F(3, 675) = 53.72$, $p < .001$) and depressive complaints ($F(3, 675) = 22.18$, $p < .001$). This indicates that the four WHI subgroups differed in their levels of fatigue and depressive complaints (irrespective of the development of these complaints over time). Finally, MANCOVA revealed a significant *Group by Time interaction* ($F(6,1350)=9.27$, $p<.001$) for both fatigue ($F(3)=18.24$, $p<.001$) and depressive complaints ($F(3)= 4.09$, $p<.001$), pointing to the fact that the four WHI subgroups differed with respect to their health course across time. Graphical representations of these

differences are shown for fatigue and depressive complaints in Figures 2.2 and 2.3, respectively.

Follow-up ANOVA revealed that the four WHI subgroups differed in their levels of health complaints at both time 1 (fatigue: $F(3,724) = 43.65$, $p<.001$; depressive complaints: $F(3, 704) = 7.48$, $p<.001$) and time 2 (fatigue: $F(3, 723) = 42.49$, $p<.001$; depressive complaints: $F(3, 706) = 12.88$, $p<.001$). Post-hoc tests were conducted to examine these differences in more detail.

Differences among the subgroups at each wave. At time 1, the *stable high group* reported significantly higher levels of fatigue and depressive complaints than the stable low group (time 1: $\Delta M = .46$, $p < .01$ for fatigue, $\Delta M = .13$, $p < .01$ for depressive complaints) and significantly higher levels of fatigue than the change low → high group (time 1: $\Delta M = .23$, $p < .01$). At time 2, the stable high group reported a significantly higher level of fatigue than the stable low group (time 2: $\Delta M = .71$, $p < .01$) and than the change high → low group (time 2: $\Delta M = .45$, $p < .01$). In addition, the stable high group reported significantly more depressive complaints than the stable low group (time 2: $\Delta M = .17$, $p < .01$). In general, these results support *Hypothesis 2,* stating that those who experienced higher levels of WHI at both waves (stable high group) would experience more health complaints than those who reported relatively low levels of WHI at the respective measurement points.

Support was also found for *Hypothesis 4,* predicting that those who experienced low levels of WHI at both waves (*stable low group*) experienced less health complaints than those who reported relatively high levels of WHI at the respective measurement points. In fact, as was already shown, the stable low group reported less health complaints than the stable high group at both waves. Additionally, this group reported lower levels of fatigue than the change high→low group (time 1: $\Delta M = .35$, $p < .01$; time 2: $\Delta M = .27$, $p < .05$) and than the change low→high group (time 1: $\Delta M = .23$, $p < .01$; time 2: $\Delta M = .73$, $p < .01$) at both waves. As to depressive complaints, the stable low group reported less complaints than the change high→low group at both waves (time 1: $\Delta M = .18$, $p < .01$; time 2: $\Delta M = .13$, $p < .01$) and than the change low→high group at time 2 ($\Delta M = .14$, $p < .01$).

Development of fatigue and depressive complaints across time. In order to map the development of health complaints within each WHI subgroup, within each subgroup *T*-tests were performed to determine whether time-1 and time-2 scores differed significantly (see Table 2.3). Within the stable high group, the levels of both fatigue ($T = 4.60$, $p < .01$) and depressive complaints ($T = 2.50$, $p < .05$) appeared to increase significantly over the one year period. This supports *Hypothesis 3,* arguing that health would deteriorate during the

Figure 2.2. Development of fatigue over time in each WHI subgroup

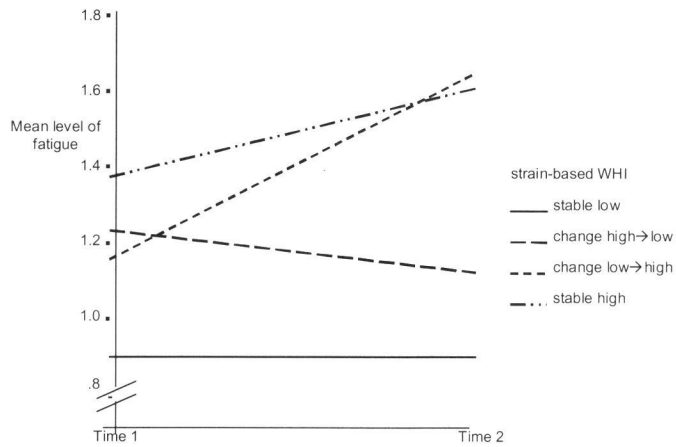
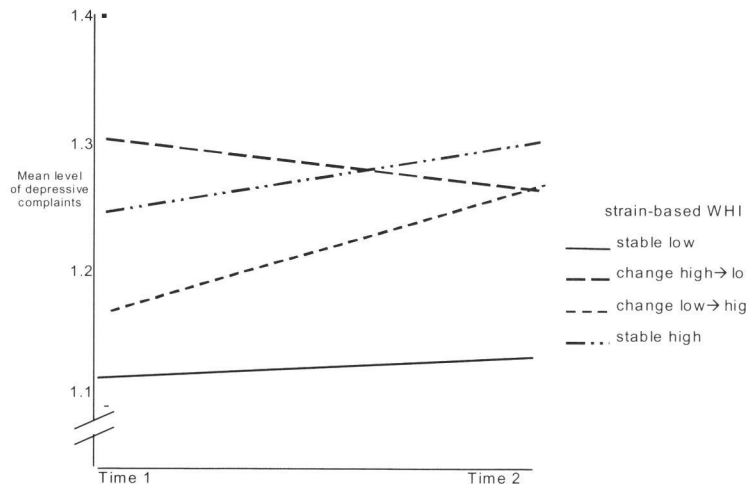


Figure 2.3. Development of depressive complaints over time for each WHI subgroup



observation period for this group of workers. In the stable low group, the health status remained stably well during the one year period. In accordance with *Hypothesis 5*, a significant increase in the levels of both fatigue ($T = 5.58$, $p < .01$) and depressive complaints ($T = 2.71$, $p < .01$) across time was observed in the change low→high group. Finally, and in disagreement with our expectations, no significant decrease in health complaints was observed in the change high→low group (*Hypothesis 6* not supported).

With respect to the possible causes of changed levels of WHI over time, these were *not* related to reported changes in job type, police force or family circumstances, as were measured in this study (all χ^2s were not significant). However, with respect to changes in reported work load and job control, MANOVA revealed a significant Group x Time interaction ($F(6,1422)=4.19$, $p<.01$) for both work characteristics ($F(3,711) = 6.46$, $p < .01$, and $F(3,711) = 2.68$, $p < .05$, respectively). Additional *T*-tests revealed that incumbents of the change high→low group reported, in contrast with the other WHI subgroups, favourable changes in work characteristics across time, i.e., a decrease in work load ($T(61) = 2.3$, $p < .05$) and an increase in job control ($T(62) = 2.62$, $p < .05$). Similar changes in an unfavourable direction were not found, though, for the change low→high group.

2.4 Discussion

In the current study, the temporal relationships between time- and strain-based work-home interference (WHI) and two health indicators (fatigue and depressive complaints) were examined from the perspective of the Effort-Recovery model. The goal of this study was twofold. Firstly, we addressed the question of causality in the relationship between (time- and strain-based) WHI and health. Secondly, we were interested in how health developed in theoretically derived subgroups that differed in their starting point and development of WHI across time.

Causality in the relationship between WHI and health

We examined the hypothesis that time- and strain-based WHI predict health deterioration one year later ('normal causation'), as well as an alternative (but not per se competing) hypothesis that health complaints act as precursors of increased levels of (time- and strain-based) WHI one year later ('reversed causation') (*cf.* Kelloway et al., 1999; Zapf, Dormann & frees, 1996). The results provided support for a temporal relationship between strain-based

WHI and increased levels of fatigue and depressive complaints one year later (Hypothesis 1a supported). No support was found, however, for a reversed causal relationship between prior health complaints and increased levels of WHI (Hypothesis 1b not supported). Whereas the conclusion that strain-based WHI is likely to act as a precursor of health deterioration seems to be justified, the conclusion that reversed causation would not exist, is not that straightforward. We should notice here that due to the exclusion of workers with (very) high levels of burnout at the first wave, our sample incorporated relatively healthy workers (i.e., the healthy worker effect). As a consequence, the relatively low levels of fatigue and depressive complaints reported at the first wave were possibly less powerful in predicting changes in WHI across time than they would have been when no such health-based selection was made.

Although the causal relationships of strain-based WHI with fatigue (β = .16) and depressive complaints (β = .15) did not seem very strong at first sight, we must realize that a substantial proportion of the variance in each health indicator was already accounted for by the same indicator measured one year earlier. In fact, the high across-time correlations of fatigue (.47) and depressive complaints (.40) indicate that these levels of complaints were rather stable. As a consequence, the proportion of variance left to be explained that may be linked to *change* in the levels of health complaints, was only small. Furthermore, also in studies that examined the causal relationships between stressors and strain, β's reported are on average only .12 (Dormann & Zapf, 2002). In this light, the relevance of the causal associations found in the current study should not be underestimated (cf. Semmer, Zapf & Greif, 1996).

Although a causal relationship was found for strain-based WHI and health, a similar result for time-based WHI was lacking. One explanation is that time-based WHI might be better manageable than strain-based WHI. For instance, one can, (within certain limits) decide to better manage working hours, to reduce or avoid working overtime, and to discuss with one's spouse what time investment at home can reasonably be expected. It seems more difficult, though, to cope with feelings of work-related tension that carried over to the home domain (i.e., strain-based WHI). A second explanation is that this work-related tension impeding functioning and recovery at home (i.e., strain-based WHI) acts as a more immediate precursor of increased levels of fatigue and depressive complaints than time-based WHI. To put it differently, time- and strain-based WHI may not occur at the same stage in the causal process resulting in health impairment, but may very well occur at different stages in this causal chain.

Health course in subgroups with different WHI starting points and patterns

The results of this study matched our hypotheses 2 to 6 remarkably well. An increase in strain-based WHI (change low→high group) was associated with an increase in health complaints across time (Hypothesis 5 supported). More interestingly, workers who experienced a relatively high level of WHI at both waves (stable high group) did not only report more health complaints than those who reported a low WHI-level at the respective wave (Hypothesis 2 supported), but also showed a deterioration in health over time (Hypothesis 3 supported). This latter finding is in line with the Effort-Recovery model, suggesting that the persistence of a relatively high level of WHI (and related lack of recovery) is accountable for an accumulation of health complaints. Alternatively, a decrease in strain-based WHI (change high→low group) did *not* result in an accompanying significant decrease in health complaints (Hypothesis 6 not supported). Possible explanations might be that the one-year time lag was too short for health complaints to diminish and/or that unknown factors (unmeasured third variables) in the work or home domain may have preserved a high level of health complaints, independent of a decreased level of WHI. Finally, and as expected, those who experienced low strain-based WHI at both waves (stable low group) experienced less health complaints than workers who reported a high level of WHI at the respective wave (Hypothesis 4 supported) and showed no health changes over time.

With respect to the *causes* of changed levels of strain-based WHI across time, none of the variables measured in this study was able to offer a full explanation. Reported changes in job type, police force and/or objective family circumstances did not explain changes in WHI since workers who showed a (favorable or unfavorable) change in WHI did not report such environmental changes more often than workers who showed a stable (high or low) level of WHI. However, changes in reported job characteristics did help us – at least partly – to understand what might have caused changes in WHI. A decrease in WHI turned out to be associated with favourable changes in work load and job control. However, an increase in WHI could not be explained in a similar way by unfavourable changes in these job characteristics, implying that these WHI changes were probably related to other (unmeasured) variables in the work or home domain.

Strengths and limitations

We believe that the current study contributed to previous research in the area of WHI, both theoretically and methodologically. First, and in contrast with the abundance of cross-

sectional studies in this field, we provided evidence for a causal relationship of strain-based WHI and health impairment (i.e., increased levels of fatigue and depressive complaints) one year later. Second, whereas most studies solely explore normal causal relationships (i.e., WHI acts as a precursor of health impairment), in the current study also reversed causal relationships (i.e., health complaints act as precursors of increased WHI) as well as reciprocal relationships (i.e., WHI and health affect each other mutually across time) were carefully tested, whereby potential third variables that might cause spurious relations between WHI and health were controlled for (e.g., working hours, work load, and job control). Our results did not provide support for a reversed causal relationship between WHI and employee health. Third, we studied the relationship between WHI and employee health from an original and relevant theoretical perspective (i.e., the effort-recovery model) that provided insight as to why high levels of WHI would result in health impairment. Fourth, our study is one of the first in the field of research on WHI (Kinnunen et al., 2004), for a notable exception) that acknowledged the fact that workers have different starting points and courses of WHI across time. By creating subgroups with different WHI patterns, we were able to demonstrate that (favorable or unfavorable) changes in WHI across time were accompanied by (favorable or unfavorable) changes in health status, and, more importantly, that a long-lasting experience of high WHI resulted in an accumulation of health complaints.

Although our study addressed a number of important shortcomings in previous research, it still has some limitations of its own. First, our study relied exclusively on self-report measures, which may have resulted in an overestimation of the statistical associations found due to common method variance. However, this cannot explain why some relationships were found to be statistically significant, whereas others were not. Moreover, as Semmer, Grebner, and Elfering (2004) have recently argued, alternative measures (e.g., observational or physiological measures) will not provide more reliable estimates of the relationships studied as they are not free of error variance as well, and should therefore not be considered superior substitutes for self-report measures. Besides, we have reason to believe that the statistical associations found in the current study may have been underestimations (rather than overestimations) of the true relationships between WHI and employee health, and this relates to our second and third point of concern.

As was already discussed earlier in this section, participants who reported a (very) high burnout level at the first wave were excluded from the follow-up study. Although there were good reasons to do so from the perspective of burnout aetiology, it is plausible that, due to this

health-based selection and a related restriction of range in the core variables under study (and particularly in the health indicators), associations among these variables were underestimations of the true associations, or did not reach significance at all (e.g., the reversed causal relationships).

Another concern is that the one-year time lag used in the current study may not have been appropriate to detect substantial effects of WHI on health impairment. In general, there is hardly any consensus about what time lag is appropriate to study the effects of, e.g., work characteristics on employee health (Taris & Kompier, 2003) and, consequently, there is a wide variation in time lags chosen. A recent review of 45 longitudinal studies (De Lange, Taris, Kompier, Houtman & Bongers, 2003) that addressed the relationships between work characteristics and (psychological) health revealed that in (high quality) studies (e.g., with a full panel design and a theory-guided choice for a time lag) the most consistent effects were demonstrated over a one-year period. Although the time lag chosen in the current study aligns with this evidence, we cannot exclude the possibility that this particular time lag deviated from the underlying causal interval, and that the statistical associations found in our study were, thus, underestimations of the true strength of the causal relationships (*cf.* Taris, 2000).

A final limitation is that we were unable to provide a satisfactory explanation for why subgroups of workers experienced changes in WHI during the observation period (only a favorable change in job characteristics could partly explain a decrease in WHI). It may be that changes responsible for changed WHI levels did occur in the work or family domain, but were not measured (or not sensitively enough) in the current study. In fact, the changes that we addressed were rather radical life events (e.g., marriage, divorce, birth of a child, transfer to another job or force). Moreover, whereas some more subtle changes in the work domain were detected (e.g., changed levels of work load and job control), other changes in this domain (e.g., changes in quality of relationships at work or in career perspectives) as well as more subtle changes in the home domain (e.g., changed participation in domestic activities or in other non-work activities, such as volunteer aid or courses) were not addressed.

Future directions and practical implications

Considering these limitations, our study provides some directions for future research. At first, future research should explore different time lags in order to determine what time interval is appropriate to detect the effects of WHI on employee health (Taris & Kompier, 2003; De

Lange et al., 2003). One could also include additional indicators of health and well being in order to determine the appropriate time lag for different health indicators. As results of previous longitudinal research in this area (Kinnunen et al., 2004) also suggest that the effects of WHI on health may be observed for men and women in different periods of time, a related recommendation is to address possible gender differences when exploring time lags of different lengths. Another unresolved issue is *if* and where time-based WHI fits in the causal chain. We have suggested that time-based WHI might be a more distant antecedent of health compared to strain-based WHI. In most studies, including our own, both types of WHI are positioned equally in the stressor-stress-strain relationships, whereas it is possible that the two types of WHI occur at different stages in the causal process. Longitudinal studies (preferably employing more than two waves) including the two types of WHI as well as various health indicators might further disentangle the possible causal relationships. A final recommendation is to include, in addition to work load and job control, also other job characteristics (e.g., quality of relationships at work) as well as relevant home characteristics (e.g., domestic obligations) that may provide insight as to why some workers experience alterations in WHI levels whereas others do not. We follow Geurts and Demerouti (2003) in their suggestion 'to assess the home situation with high and the same preciseness as the work place is assessed' (p. 306).

From a practical point of view, our study identified (strain-based) WHI as a serious risk for the occurrence and increase of fatigue and depressive complaints. Such health impairment is obviously undesirable from an employee perspective, but also from an organizational perspective as relationships with sickness and absenteeism have been well established. E.g., in recent studies it was shown that a high level of fatigue resulted in an increased incidence of infections (Mohren, Swaen, Kant, Borm & Galema, 2001), and that a high need for recovery after work, indicative of the spill over of strain built up at work (i.e., strain-based WHI), was linked to increased risks of sickness absence (De Croon, Sluiter & Frings-Dresen, 2003). The linkages of (strain-based) WHI and experienced fatigue with manifest problems as infection diseases and sickness absence stress the importance of a company *policy* heading for the prevention of WHI. In order to promote balance and to prevent interference between work and private life, companies should provide work-family facilities than enable employees to better align both life spheres, for instance, by offering flexible working time facilities (e.g., part time jobs, compressed work schedules, and having flexible start and finishing times), and dependent care facilities (e.g., (subsidized) parental leave and (subsidized) child care facilities)

(Den Dulk, 2001; Dikkers, Geurts, Den Dulk, Peper & Kompier, 2004). In addition, companies should create a company *culture* in which employees who experience WHI do feel entitled to use the facilities that are available (Geurts & Demerouti, 2003). We hope that the current study will encourage companies to develop a supportive work-family policy and culture, and that researchers will be inspired to further disentangle the temporal relationships between WHI and health.

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3

Work-home interference:

How does it manifest itself from day to day?

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Abstract

Although work-home interference (WHI) refers to a process of negative interaction between the work and home domains, little attention has been paid to the actual processes involved in the within-person, day-to-day management of work and home. Therefore, this study investigated if, and how, global reports, for the individual, of WHI are reflected in daily reports of WHI, in employees' daily activity patterns in the work and home domain, and in their daily health and well-being. Effort-Recovery theory (Meijman & Mulder, 1998) provided the theoretical basis for this study. Data were collected among 120 academic staff members (62% male) who completed a general questionnaire, addressing global WHI as well as demographical information, and who also participated in a 5-day daily diary study. Results show that global WHI (1) was positively related to daily WHI; (2) was positively related to the time spent daily on overtime work in the evening; (3) was negatively related to the time spent daily on low-effort activities; and (4) was positively related to daily fatigue and sleep complaints. We conclude that Effort-Recovery theory seems promising to study WHI, and that diary studies are valuable, as these provide detailed insight in what global reports of WHI actually signify from day to day.

Key words: work-family conflict, diary studies, work-related stress, recovery

3.1 Introduction

Successfully combining work and nonwork is a major issue for many employees, and sometimes creates serious problems or conflicts between the two domains. Empirical research (among others, Geurts et al., 2005; Kinnunen & Mauno, 1998; Leiter & Durup, 1996) has consistently shown that work demands negatively affect private life (i.e., create work-home interference, WHI) more often than the other way around (i.e., home-work interference). In the light of the reported higher prevalence of WHI, the current study focuses exclusively on this type of interference and specifically on its relationships with employees' well-being and their activity patterns in the work and home domains.

WHI has been defined as 'a form of inter-role conflict in which the role pressures from the work and family domains are mutually incompatible so that participation in one role [home] is made more difficult by participation in another role [work]' (Greenhaus & Beutell, 1985, p. 77). WHI may occur in three distinct ways (Greenhaus & Beutell, 1985). It may arise from time demands that make it physically impossible to be in two places at the same time (e.g., when long hours in paid work prevent participation in family activities); from the spillover of strain from one domain to the other (e.g., when strain built up at work makes it more difficult to feel relaxed in the home environment); or when specific behaviours that are expected at work are incompatible with behaviours that are expected at home (e.g., teachers may continue to act as teachers in their relationships with their own children or spouse). As previous research demonstrated that particularly the first two types of conflict are related to health-related outcomes and work- and family-related antecedents (see, for instance, the meta-analyses by Allen, Herst, Bruck & Sutton, 2000; Eby, Casper, Lockwood, Bordeaux & Brinley, 2005), the present study focused on these two types of conflict.

Although WHI refers to a *process* of negative interaction between the work and home domains (Geurts & Demerouti, 2003), remarkably little attention has been paid to the actual processes involved in the within-person, day-to-day management of work and home demands. WHI is typically measured on single occasions, retrospectively, at times detached from the occurrence of specific activities and experiences, and in terms of the 'average' level of interference. Moreover, insofar as longitudinal designs are employed, they cover relatively long time lags, varying from six weeks (Demerouti, Bakker & Bulters, 2004) to four years (Frone, Russell, & Cooper, 1997). Such intermediate-to-long-term longitudinal studies are largely irrelevant for mapping the specific shorter-term processes underlying the global experience, for the individual, of WHI. To understand WHI more fully, it is vitally important

to identify the specific day-to-day activities and experiences and processes associated with the experience of (global) WHI and its consequences for worker health and well-being.

To date, four studies have examined WHI from such a day-to-day perspective. Williams and Alliger (1994) showed that working parents reported higher daily levels of WHI on days on which they were highly involved with their jobs. In addition, Butler, Grzywacz, Bass and Linney (2005) concluded that higher levels of daily WHI were associated with higher daily levels of job demands and lower levels of job control. Further, MacEwen and Barling (1994) found that daily WHI was related to daily psychological strain, which in turn was related to marital behaviour (withdrawal and anger). Finally, Grzywacz, Almeida and McDonald (2002) related a global measure of negative work-family spillover to daily reports of work-family stress (i.e., the co-occurrence of work- and family-related stressors on the same day) and reported a significant (although modest) association between the two.

The present study

The present study aimed at investigating *to what extent* and *how* global WHI manifests itself in everyday life. To this aim, we conducted a diary study covering five consecutive week days, preceded by a questionnaire tapping several general and background constructs. This diary approach is very convenient for mapping the everyday activities, behaviours and feelings of the participants, although this approach has several drawbacks as well. (The most notable of these is the fact that only a limited number of issues can be addressed daily, to keep the burden placed on the participants within acceptable limits, Bolger, Davis & Rafaeli, 2003). The present study specifically focused on the associations between global WHI and (1) daily reports of WHI, (2) time spent daily on (effortful) work-related activities, (3) time spent daily on home activities, and (4) subjective health.

Theoretical framework. Effort-Recovery theory (Meijman & Mulder, 1998) provided the theoretical basis for our study, describing how day-to-day effort expenditure and recovery processes relate to health and well-being. One central assumption in Effort-Recovery theory is that time demands and/or work-related strain (two core components of WHI) will have detrimental health effects when opportunities for recovery between successive periods of effort expenditure are insufficient. Recovery may be insufficient in terms of *quantity* (recovery time is too short due to, for example, long working hours) and/or *quality* (workers' preoccupation with work and/or sustained activation prevents them to relax during nonwork time; Ursin, 1980). Day-to-day incomplete recovery will eventually initiate a cumulative

process that - in the long run - may seriously affect health (e.g., result in prolonged fatigue, sleep deprivation and other health problems; -see, for instance, Sluiter, Frings-Dresen, Van der Beek & Meijman, 2001; Taris et al., 2006).

Employees' behaviour and activities in the work and nonwork domains play an important role in Effort-Recovery theory. It is the effort invested in work activities that relates to the subjective need to recover from work. Similarly, *activities* in the nonwork domain (e.g., working overtime) may interfere with the recovery process. This is in line with other work-psychological approaches such as action theory (Frese & Zapf, 1994; Taris & Kompier, 2005) and the demand-control model (Karasek & Theorell, 1990), which implicitly or explicitly assume that work characteristics (such as work load and autonomy) affect worker well-being (e.g., fatigue or positive mood) through worker behaviour: It is what people *do* that makes them feel tired or enthusiastic. This reasoning underscores the necessity to map day-to-day activities and experiences to understand the WHI phenomenon in more detail.

Research questions. Based on this theoretical perspective, four research questions were addressed:

(1) How do global reports of WHI correspond with daily reports of WHI?

As we expect a global report of WHI to reflect an aggregate of day-to-day experiences, we assume the global and daily measures of WHI to be positively related. Previous research has failed to address this issue, perhaps because this association seems quite obvious. Yet, it is important to establish the validity of the commonly-used global indexes of WHI by examining the extent to which the scores on this global measure relate to daily experiences. This gives us our first hypothesis.

Hypothesis 1: Global reports and daily measures of WHI are positively related.

(2) How do global reports of WHI relate to time spent daily on (effortful) work activities?

The amount of time occupied by the job is one of the most obvious ways for work to affect private life. The time devoted to work activities may interfere with the time available for home activities, and/or long working hours may impose such demands on employees' resources that they may lack the energy to engage in certain home activities. Empirical research has indeed shown that long weekly working hours (i.e., long regular work time and/or overtime hours) are associated with higher levels of WHI (Geurts & Demerouti, 2003, for a review). An 8-month cohort study revealed that long regular working time, overtime hours and commuting time to work were longitudinally related to higher levels of WHI (Jansen, Kant, Nijhuis, Swaen, & Kristensen, 2004). However, as yet, to our knowledge, only

global measures of work-related time spent have been related to WHI. By using such global measures, both the type of work activities and variations in hours spent on these activities across days are ignored. Two exceptions are the diary studies conducted by Sonnentag (2001) and Rau and Triemer (2003), revealing negative associations between overtime hours and individuals' well-being before going to sleep.

When examining work time in relation to WHI, not only the hours spent on work activities are important, but also the extent to which the workday was considered effortful. According to Effort-Recovery theory (Meijman & Mulder, 1998), it is the expenditure of effort during work time that may result in the spillover of load effects to the home domain and, thus, to functioning in this domain. Assessing effort expenditure is somewhat less relevant in case of overtime work, because this again activates the psychobiological systems that were already turned on during regular work time. In this sense working overtime is likely to interfere with the recovery process, irrespective of the amount of effort it requires. This results in our next hypothesis.

Hypothesis 2: We expect global WHI to be positively related to (1) (effortful) work activities by day *(Hypothesis 2a),* and (2) overtime hours in the evening (*Hypothesis 2b).*

(3) How do global reports of WHI relate to time spent daily on home activities?

Although occupational health psychologists traditionally focus on the work domain in relation to WHI and health, the home domain deserves the same amount of attention (Geurts & Demerouti, 2003). Activities in the latter domain may be divided into three categories, (i) domestic activities (such as doing household chores), (ii) active leisure activities (such as exercising and visiting friends), and (iii) low-effort activities (such as watching TV or reading a novel). The time available for home activities will obviously be limited by the time spent on work activities. Strain developed at work may also prevent employees from engaging in certain nonwork activities (e.g., when after a stressful workday employees do not feel like exercising). As WHI may originate from the experience that private time is insufficient for doing the things people must or want to do at home, or from the spillover of strain built up at work, this gives us our third hypothesis.

Hypothesis 3: We expect that global WHI manifests itself as less time spent on domestic activities (*Hypothesis 3a)*, active leisure activities (*Hypothesis 3b*), and low effort activities (*Hypothesis 3c).*

(4) How do global reports of WHI relate to daily reported recovery indicators?

Theoretically, WHI implies a lack of quantitative (due to lack of time) and/or qualitative (due

to spillover of strain) opportunities for recovery. Previous research supported the assumption that global WHI is positively related to measures indicating such a lack of recovery, such as fatigue (Van Hooff et al., 2005) and sleep complaints (Geurts, Rutte & Peeters, 1999). From an Effort-Recovery perspective it can also be assumed that global WHI will manifest itself in day-to-day incomplete recovery. Therefore, we formulate our next hypothesis.

Hypothesis 4: We expect global WHI to be positively related to sleep complaints (*Hypothesis 4a*) and fatigue (*Hypothesis 4b*) on a day-to-day basis.

A recent one-year two-wave study among Dutch police officers revealed that health was impaired across time among workers experiencing chronically high WHI (Van Hooff et al., 2005). The authors suggested that the persistence of a relatively high level of WHI (and related lack of recovery) accounted for an accumulation of health complaints. Similarly, in the current study we expect that a high level of global WHI manifests itself in an increasing lack of recovery. This results in our last hypothesis:

We expect to observe an increment of sleep complaints and fatigue during the workweek for those experiencing high levels of global WHI, relative to others *(Hypothesis 4c)*.

3.2 Method

Participants and procedure

The study was conducted among academic staff members of a Dutch university. In order to be eligible, they had to meet three criteria: they (i) should have substantial *work* obligations (i.e., they should work at least three days a week), (ii) should not have a job outside that university (in order to keep the variation in work activities within acceptable limits), and (iii) should live together with a partner who worked at least 2.5 days a week. This last criterion was added to increase the likelihood that the participants fulfilled at least some *home* obligations.

The study was conducted in three stages. First, all faculty members ($N = 696$) who met the first criterion received a letter explaining the goal, content and time schedule of the study, clarifying that only those who passed the second and third criteria could participate. A total of 146 employees agreed to participate. Secondly, these participants completed a general questionnaire that was sent to them by mail and that addressed background information as well as a global report of WHI. During the third stage (about ten days after filling out the general questionnaire), participants completed paper and pencil diaries during five consecutive week days (Monday to Friday), addressing daily WHI, work-related activities and

home activities, and recovery indicators. Before the start of this third stage, the researchers met face-to-face with each participant (except in a few cases when it was not possible) to hand over the diaries and to once more explain the study's procedure.

Each day, the respondents completed three short questionnaires incorporated in a small booklet: (i) a morning questionnaire (to be completed after waking up, preferably between 7.30 and 8.30 AM), (ii) an afternoon questionnaire (to be completed preferably around 6 PM), and (iii) an evening questionnaire (to be completed before going to bed, preferably between 10 and 11 PM). Participants were requested to return each booklet the day after it had to be completed (which was either by internal university or by standard mail, using prepaid envelopes). By having the participants indicate the exact time at which they filled out each questionnaire, we gained information about possible differences between the preferred and actual moment of completion.

Of the 146 employees who agreed to participate, 133 completed the general questionnaire (91% response). Data from 13 of these 133 were removed as they apparently did not meet the second and third criterion. The final sample comprised 120 participants (62% male; 68% had at least one child living in the household; M_{age} was 45 years, SD = 7.8; they worked on average 34 (SD = 5.5) contractual hours weekly; 46% worked as an assistant professor, 17% as an associate professor, 11% as a full professor, and the remaining 26% had other jobs, such as researcher or lecturer). Due to strict privacy regulations, we could not obtain more information with respect to the approached 696 academics, except for their gender. Therefore, we do not know how many of those employees were actually eligible for participation in the study, meaning that the overall response rate and the representativeness of our sample are unknown. However, compared to the number of academics who were approached, women were overrepresented in our sample ($\chi^2 = 17.06$, $df = 1$, $p < .01$).

With respect to the daily diaries the response rate ranged from 82% to 86%. Diaries were discarded if they were (i) not filled in at all, (ii) completed without any time specification, or (iii) completed at a time that deviated substantially from the requested time range (e.g., if afternoon questionnaires were filled in before 4.30 PM, after 8 PM, or less than three hours after the morning questionnaire). The percentages of valid diaries was 71% in the morning, 72% in the afternoon, and 76% in the evening.

Measures derived from the general questionnaire

Global Work-home interference (WHI) was measured with the eight-item WHI subscale of the

SWING (Survey Work-home Interaction NijmeGen; Geurts et al., 2005). Previous research has established the validity of this instrument, showing that its factor structure is invariant across different samples and subgroups (i.e., according to gender, parental status, and work hours), and that the dimensions of the SWING retain meaningful relationships with external (theoretically relevant) variables. The SWING was developed in such a way that items were preferably not confounded with possible antecedents (e.g., social support) or consequences (e.g., fatigue) of WHI (Geurts et al., 2005). Two examples of items are 'How often does it happen that your work takes up time that you would have liked to spend with your spouse/family/friends?' and 'How often does it happen that you find it difficult to fulfill your domestic obligations because you are constantly thinking about your work?'. All items are scored on a 4-point scale [0 = '(almost) never', 1 = 'sometimes', 2 = 'often' 3 = '(almost) always'] and higher scores reflect higher levels of WHI (α = .73, M = 1.02, SD = 0.42 in the present sample). This mean score is higher than the mean score found in a heterogeneous reference group (M = 0.86, sd = 0.48; $T(1975)$ = 3.56; Geurts et al., 2005), indicating that the present sample experienced relatively high levels of global WHI.

Demographic variables. Parental status (0 = 'no children living in the household' and 1 = 'at least one child living in the household'), *gender* ('0' for 'male' and '1' for 'female'), *age* (in years) and *contractual work hours* (number of hours) were included to reduce the risk of finding spurious associations between global WHI and the daily measures, due to their possible common variation with both.

Measures derived from the daily questionnaires

Daily Work-home interference (WHI) was measured by asking participants to report in the diaries every evening to what extent their work demands had interfered that day with their home life. For this purpose, we adapted Geurts et al.'s (2005) eight-item global measure of WHI to fit the daily questionnaires, both in terms of item wording and response options. Two examples of items were 'Today, I had to cancel or reschedule appointments with my spouse/family/friends due to work-related commitments' and 'Today, I found it difficult to fulfill my domestic obligations, because I was constantly thinking about my work' (1 = 'no', 2 = 'a little' and 3 = 'yes'). This version of the WHI-subscale of the SWING was especially developed for the present study, meaning that research into the validity of this scale is as yet not available. However, as the items are strongly based on those of the global WHI scale, there seems little reason to question the face validity of the items. Further, the reliability of our

instrument was quite acceptable, $\alpha = .82$ across all five consecutive days.

Time spent on work-related activities. Following a job description approach, participants were given a list of 13 possible work activities, i.e., 'preparing a lecture', 'giving a lecture', 'reading (Ph.D.) students' assignments', 'appointments with (Ph.D.) students', 'conducting research', 'data-analysis', 'reading specialist literature', 'writing papers', 'preparing a meeting', 'attending a meeting', 'e-mail/phone', 'informal contact with colleagues', or 'other'. This list of work activities resulted from interviews that had been held previously with 10 male and female faculty members within 'an average' department, who reported the most relevant activities of a typical working day (these faculty members did not participate in the main study). Note that all these work activities are in principle relevant to all participants, i.e. in The Netherlands lecturers also have some research time, whereas researchers will usually also have some teaching duties. For each activity, participants indicated the amount of time they had devoted to it during regular work time, i.e., until 6 PM (afternoon questionnaire), as well as during nonwork time, i.e., from 6 PM onwards (evening questionnaire). In order to simplify completion of the diaries, participants could check a number indicating a time range (0 = none, 1 = < 1 hour, 2 = 1-2 hours, ..., 6 = 5-6 hours, and 7 = > 6 hours) rather than the actual time spent. We recoded these responses to obtain an estimate of the actual time in hours, by assuming that the actual time spent on an activity would be in the middle of the two extremes associated with each answer category (e.g., the category '<1 hour' was recoded as '0.5' and the category 2 as '1.5'). The validity of our list of activities was supported by the fact that the time spent on 'other' activities ranged from only 0.38 hours (Friday) to 0.55 hours (Thursday). *Time spent on work activities by day* (i.e. in regular work time) was computed by summing the time spent on all 13 work activities until 6 PM. *Time spent on effortful work activities by day* was computed by adding up the time spent on the most effortful work activities until 6 PM. To determine which activities were generally considered most effortful, for each activity we averaged respondents' evaluations of how much effort this activity had required: 1 = 'no effort at all' to 10 = 'extremely effortful'. Three activities received average group ratings of 5 and higher (i.e., 'giving a lecture' with 6.6, 'conducting research' with 5.2 and 'writing papers' with 5.1), and were, therefore, considered as most effortful. *Overtime (evening)* was computed by summing the time spent on all 13 work activities after 6 PM (the university did not teach evening courses).

Time spent on home activities. Home activities included *domestic* activities, *active leisure* and *low-effort* activities. Participants indicated in both the afternoon (until 6 PM) and

evening questionnaires (from 6 PM) the amount of time they had spent that day on each of 10 home activities, that is, 'household activities', 'doing odd jobs in or around the house', 'doing the groceries', 'care giving activities', 'businesslike private-activities', 'physical activities', 'creative activities', 'social activities', 'low effort activities', and 'other' (Sonnentag, 2001). To ease interpretation of the categories, we supplied the participants with examples of activities falling in each category. Answer categories and coding procedure were identical to those used for the work activities. Again, the validity of our activities list was supported by the fact that the time spent on 'other' activities ranged from only 0.11 hours (Friday) to 0.38 hours (Thursday). The *Time spent on domestic activities* was estimated by summing the total time (i.e., before and after 6 PM) devoted each day to the first five of the home activities listed above. *Time spent on active leisure activities* comprised the total time spent daily on 'physical activities', 'creative activities' and 'social activities'. To compute the total time spent daily on 'low effort activities', the time devoted to these activities before and after 6 P.M. was summed.

Recovery indicators. To assess *sleep complaints*, a sum score was computed of five items adapted from a sleep quality scale derived from the Questionnaire on the Experience and Evaluation of work (VBBA; Van Veldhoven & Broersen, 1999; Van Veldhoven en Meijman, 1994). This instrument has been widely used in scholarly research (e.g., Van Veldhoven, De Jonge, Broersen, Kompier, & Meijman, 2002). As these items were originally developed to measure chronic sleep complaints, some of them were slightly adapted to make them suitable for day-to-day measurement. Two examples of items were 'I slept well last night' (reversed) and 'Last night, I woke up several times' (1 = 'yes', 0 = 'no', α = .73 across all five consecutive days). Note that for sleep complaints each day's value refers to the previous night.

Fatigue was measured in the evening questionnaire with the six-item fatigue subscale of a short version of the Dutch Profile of Mood States questionnaire (POMS; Wald & Mellenbergh, 1990). The POMS (McNair, Lorr, & Droppelman, 1971;1992) has been used in some 3,000 scholarly publications since its development (McNair, Heuchert & Shilony, 2003), and its validity has firmly been established (e.g., Boyle, 1987; Jacobson, Weiss, & Steinbook, 1978; Norcoss, Guadagnoli, & Prochaska, 1984; Reddon, Marceau, & Holden, 1985).

Based on factor- and item-analyses, a short version of the Dutch translation of the POMS was developed (Wald & Mellenbergh, 1990), in which the fatigue subscale comprised six items. In a previous study examining the factor-structure of the 65-item version of the POMS, these six items showed the highest factor loadings on the fatigue factor (Norcoss, Guadagnoli, & Prochaska, 1984). Wicherts and Vorst (2004) found support for the factor structure of the

shortened Dutch POMS in a sample of 5,880 psychology freshmen and reported measurement invariance across gender for the fatigue-subscale as well. Items were scored on a five-point scale (1 = 'not at all', 2 = 'a little', 3 = 'moderately', 4 = 'quite a bit', 5 = 'extremely'), and the scale-score was obtained by computing the mean of the six items, with higher scores reflecting more fatigue. Two examples of items are 'Right now, I feel exhausted' and 'Right now, I feel fatigued' ($\alpha = 0.89$ across all five days).

Analyses

The relationships between global WHI and the daily variables under study were examined using multilevel analysis (Hox, 2002; Snijders & Bosker, 1999). This method controls for the fact that our day-level data (level 1) are nested within persons (level 2), and, thus, are not independent of each other. It therefore yields more conservative estimates than ordinary least squares regression analysis. We used the MLWiN 2.0 software package (Centre for Multilevel Modelling, 2005) and all variables (except for age and contractual work hours) were standardized based on their grand mean.

For each of the daily measures (i.e., daily WHI, work activities by day, effortful work time, overtime, domestic activities, active leisure, low-effort leisure, sleep complaints and fatigue) a series of analyses was conducted, in which the respective daily measure served as dependent variable. Although this procedure is not always in accordance with knowledge about 'causes' and 'consequences' of WHI (e.g., time spent on overtime is more likely to be a cause rather than a consequence of WHI), multilevel analysis requires the dependent variable to be on the lowest – i.e., day – level. Moreover, we were not primarily interested in mapping *causal relationships* between global WHI and daily variables, but in disentangling *associations* between these measures.

For each daily measure, we started with a *Null model*, in which only an intercept was specified. In *Model 1* gender (0 = male, 1 = female), parental status (0 = no child(ren) living in the household, 1 = at least one child living in the household), age and number of contractual work hours were included as possible covariates, because these may affect the relationship between the daily variables in this study and global WHI. To acknowledge possible day-to-day variation in the respective daily dependent variable, in *Model 2*, Time was modeled by including the five days of the research period by means of four dummy variables (with Monday as a reference category). Global WHI was added as a predictor variable in Model 3. To examine the hypothesized increase in sleep complaints and fatigue for those experiencing

relatively high levels of WHI, for these two daily variables an additional Model 4 was specified that included four Global WHI x Day interactions.

3.4 Results

Table 3.1 presents for all diary measures the means and standard deviations on each of the five week days for the whole sample. The relatively low amount of time spent on regular work on Wednesday (M = 5.74) and Friday (M = 5.71) is probably due to the fact that Dutch children under the age of eight do not attend primary schools on Wednesday and Friday afternoons.

Correlations between the study variables are shown in Table 3.2. These correlations are computed on basis of *mean* week scores (allowing for missing values on one or more measurement occasions), which explains why sample sizes in Table 3.2 are slightly higher (n between 97 and 120) than those in Table 3.1 (n between 67 and 96). Table 3.3 presents the multilevel estimates for models predicting the daily variables.

Table 3.1. Means and standard deviations of the diary measures for each day (n varies from 67 to 96 depending on missing values; median n = 85)

	Monday		Tuesday		Wednesday		Thursday		Friday	
	M	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*
WHI [e]	1.37	*0.40*	1.41	*0.43*	1.43	*0.47*	1.38	*0.42*	1.30	*0.42*
Work-related activities										
Time spent on work activities (by day) [a]	6.51	*1.73*	6.33	*1.92*	5.74	*2.51*	6.18	*1.97*	5.71	*2.61*
Time spent on effortful work activities [a]	1.21	*1.88*	1.23	*1.67*	1.20	*1.83*	1.28	*1.83*	1.11	*1.74*
Overtime (evening) [e]	1.07	*1.21*	0.86	*1.07*	0.92	*1.31*	0.90	*1.21*	0.45	*0.99*
Home activities										
Time spent on domestic activities [a+e]	2.31	*2.16*	2.24	*2.26*	2.91	*2.60*	2.15	*2.37*	2.74	*2.65*
Time spent on active leisure [a+e]	0.81	*0.95*	0.90	*1.22*	0.93	*1.73*	0.87	*1.31*	1.26	*1.65*
Time spent on low effort leisure [a+e]	0.91	*0.99*	0.90	*0.85*	1.25	*1.36*	1.31	*1.35*	2.15	*2.08*
Recovery indicators										
Sleep complaints [m]	1.73	*1.72*	1.69	*1.53*	1.62	*1.57*	1.41	*1.48*	1.23	*1.38*
Fatigue (POMS) [e]	1.70	*0.72*	1.77	*0.69*	1.82	*0.74*	1.90	*0.89*	1.90	*0.80*

[m] = variable is measured in the morning, [a] = variable is measured in the afternoon, [e] = variable is measured in the evening.

Table 3.2. Correlations between the variables under study (n varies from 97 to 120, depending on missing values; median n = 98): for the daily variables, correlations are based on mean values across the five days of the research period

Variable	Correlations								
	1	2	3	4	5	6	7	8	9
1. Global WHI	1								
2. Daily WHI	.66**	1							
3. Time work activities (by day)	.08	.05	1						
4. Time effortful work activities	-.05	-.03	.20*	1					
5. Overtime (evening)	.29**	.36**	.27**	.20	1				
6. Time domestic activities	.02	.00	-.33**	-.08	-.21*	1			
7. Time active leisure	.12	-.04	-.16	-.18	-.17	.03	1		
8. Time low effort leisure	-.15	-.23*	.08	-.05	-.15	-.14	-.10	1	
9. Sleep complaints	.42**	.41**	-.02	.07	.23*	.18	.07	-.07	1
10. Fatigue (POMS)	.51**	.63**	.05	-.03	.22*	.01	.19	-.18	.42**

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

Question 1: How do global reports of WHI correspond with daily reports of WHI?

As evidenced by a statistically significant decrease in the -2 log-likelihood, Model 1 (in which the covariates are modeled) improved significantly upon the Null model ($p<.05$), although none of the individual covariates reached significance (β_{gender} = .35, *ns*; $\beta_{parental\ status}$ = -.15, *ns*; β_{age} = -.00, *ns*; $\beta_{contract\ hours}$ = -.02, *ns*). Model 2 included the Day-effects, but did not fit better than Model 1. Finally, Model 3 fitted the data better than Model 2 ($p<.001$), revealing that the expected association between global WHI and daily WHI (β = .49, $p<.01$, *Hypothesis 1* supported; R^2 of this model = .31), but showing no significant relationship between any of the covariates and daily WHI.

Question 2: How do global reports of WHI relate to time spent daily on work-related activities?

With respect to *regular work time,* Model 1 fitted the data better than the Null model ($p<.001$). Daily work time was less for those with children (β = -.27, p <.05) and, not surprisingly, higher for those with more contractual work hours (β = 0.06, p < .01). Gender (β = 0.01, *ns*) and age (β = 0.00, *ns*) were unrelated to daily work time. A similar pattern of results for the covariates was observed in Model 2 ($p<.01$), which also showed that daily work time is lower on Wednesday (β = -.39, p<.01) and Friday (β = -.42, p<.01) than on Monday

(the reference category). Model 3 (that included global WHI) did not fit better than Model 2, indicating that global WHI was unrelated to daily work time (*Hypothesis 2a* rejected for work time).

Regarding *daily effortful work time,* none of the specified models improved upon each other. Thus, this daily variable is not related to the covariates, the days of the week and global WHI (*Hypothesis 2a* rejected for effortful work time).

Finally, concerning *daily overtime,* Model 1 did not fit the data better than the Null Model, indicating that the covariates were not related to daily overtime. Conversely, Model 2 fitted significantly better than Model 1 ($p<.001$), showing that the time spent on overtime work was lower on Friday ($\beta = -.54$, $p<.01$) compared to Monday, but not on Tuesday ($\beta = -.18$, *ns*), Wednesday ($\beta = -.13$, *ns*) and Thursday ($\beta = -.15$, *ns*). This model did not include any significant effects of the covariates. A similar pattern of results was also observed in Model 3 ($p<.001$), which additionally revealed that global WHI was positively related to daily overtime ($\beta = .21$, $p<.01$, *Hypothesis 2b* supported; R^2 of Model 3 = .09).

Question 3: How do global reports of WHI relate to time spent daily on home activities?

As for *domestic activities,* Model 1 fitted better than the Null Model ($p<.001$). Women ($\beta = .26$, $p<.05$) and employees with children ($\beta = .76$, $p<.01$) spent more time daily on domestic activities than men and those without children living in the household, whereas the number of contractual work hours was related to the time spent daily on this type of activities ($\beta = -.02$, $p <.05$). Neither Model 2 nor Model 3 fitted the data better than Model 1, indicating that the time spent on domestic activities did not depend on day of the week and was unrelated to levels of global WHI (*Hypothesis 3a* rejected).

Regarding the time spent daily on *active leisure activities*, Model 1 fitted the data better than the Null model ($p<.05$), showing that the time spent daily on these types of activity was negatively related to the number of contractual work hours ($\beta = -.03$, $p<.05$), but not to age ($\beta = .01$, *ns*), gender ($\beta = .15$, *ns*) and parental status ($\beta = -.15$, *ns*). Neither Model 2 nor Model 3 fitted the data better than Model 1, indicating that the time spent on active leisure activities did not vary with the day of the week or global WHI (*Hypothesis 3b* rejected).

Regarding the time spent daily on *low-effort leisure activities*, Model 1 (in which the effects of the covariates were modeled) did not improve upon the Null Model. Thus, the time spent daily on these activities was unrelated to age, contractual work hours, gender or parental status. Model 2 fitted the data better than Model 1 ($p<.001$), revealing that employees

on average spent more time on low-effort leisure activities on Wednesday (β = .25, p < .05) and Friday (β = .83, p < .01) than on Monday. This model also showed that employees with children spent less time daily on low-effort activities (β = -.31, p < .05) than those without children living in the household. This was also observed in Model 3, which improved significantly upon Model 2 (p<.05), and showed that global WHI was significantly negatively related to the time spent daily on low-effort leisure activities (β = -.13, p < .05; *Hypothesis 3c* supported; R^2 of Model 3 = .14).

Question 4: How do global reports of WHI relate to daily reported recovery indicators?

With respect to *sleep complaints,* Model 1 did not improve upon the Null Model. However, Model 2 (p<.05) indicated that sleep complaints varied with the day of the week. Compared to Monday, sleep complaints were lower on Friday (β = -.34, p<.05) but not on other days. Also in this model, none of the covariates reached significance. This also applied to Model 3 (p<.001), which further revealed that global WHI was positively related to daily sleep complaints (β = .27, p < .01, *Hypothesis 4a* supported; R^2 of Model 3 = .12). Inclusion of the Global WHI x Day interactions (Model 4) did not improve upon Model 3, meaning that the level of sleep complaints during the week did not depend on levels of global WHI (*Hypothesis 4c*, which assumed an increment of sleep complaints during the workweek for those experiencing high levels of global WHI, rejected for sleep complaints).

As to *fatigue*, Model 1 fitted the data better than the Null Model (p<.05). Women generally reported higher levels of daily fatigue than men (β = .36, p<.05), whereas older employees were less fatigued than others (β = -.02, p<.05). Although Model 2 did not improve significantly upon Model 1, Model 3 fitted the data better than Model 2 (p<.001), revealing that global WHI was positively related to daily fatigue (β = .36, p<.01; *Hypothesis 4b* supported; R^2 of Model 3 = .21). With respect to the covariates, only the effect of age remained significant in this model. Finally, Model 4, including the Global WHI x Day interactions, provided a better fit than Model 3 (p<.05). Thus, levels of daily fatigue during the week varied with the level of global WHI. A closer examination of the β-weights revealed that this interaction was significant on Thursday (β = .30, p<.01), but not on the other days of the week. As there was no consistent pattern of interactions, these results do not support *Hypothesis 4c* (which hypothesized an increase in fatigue during the workweek for those employees experiencing high levels of global WHI).

Table 3.3. Multilevel estimates for daily WHI, daily work activities, daily home activities, and daily recovery indicators (table continues overleaf)

	Variable	Model	-2*LL	Level 2 intercept variance (SE)	Level 1 intercept variance (SE)
	Daily WHI	M 0	1000.39	.51 (.09)	.50 (.04)
	(n = 393)	M 1	990.05*	.42 (.08)	.50 (.04)
		M 2	983.61	.44 (.08)	.49 (.04)
		M 3	928.76***	.20 (.05)	.49 (.04)
Work activities	Work Time	M 0	1129.44	.21(.06)	.78(.06)
	(n = 408)	M 1	1094.45***	.08(.04)	.79(.06)
		M 2	1080.96**	.08(.04)	.76(.06)
		M 3	1079.19	.08(.04)	.76(.06)
	Effortful Work Time	M 0	1103.61	.31(.07)	.68(.05)
	(n = 408)	M 1	1100.72	.30(.07)	.68(.05)
		M 2	1099.72	.30(.07)	.68(.05)
		M 3	1099.15	.30(.07)	.68(.05)
	Overtime	M 0	1239.77	.24(.06)	.76(.06)
	(n = 450)	M 1	1236.45	.23(.06)	.76(.06)
		M 2	1217.23***	.24(.06)	.72(.05)
		M 3	1205.94***	.19(.05)	.72(.05)
Home activities	Domestic Activities	M 0	1074.57	.31(.07)	.67(.05)
	(n = 400)	M 1	1014.58***	.10(.04)	.66(.05)
		M 2	1006.39	.10(.04)	.64(.05)
		M 3	1006.06	.10(.04)	.64(.05)
	Active Leisure Activities	M0	1128.89	.11(.05)	.89(.07)
	(n = 400)	M 1	1116.99*	.07(.04)	.89(.07)
		M 2	1110.73	.08(.04)	.87(.07)
		M 3	1110.72	.08(.04)	.87(.07)
	Low-Effort Activities	M 0	1096.22	.31(.07)	.71(.06)
	(n = 400)	M 1	1090.25	.28(.07)	.71(.06)

	Variable	Model	-2*LL	Level 2 intercept variance (SE)	Level 1 intercept variance (SE)
		M 2	1037.19***	.29(.07)	.60(.05)
		M 3	1033.25*	.27(.06)	.60(.06)
Recovery Indicators	Sleep complaints (n = 424)	M 0	1158.56	.28(.07)	.72(.06)
		M 1	1150.70	.25(.06)	.72(.06)
		M 2	1140.93*	.26(.06)	.70(.05)
		M 3	1122.43***	.19(.05)	.69(.05)
		M 4	1119.74	.19(.05)	.69(.05)
	Fatigue (n = 444)	M 0	1108.52	.54(.09)	.48(.04)
		M 1	1095.85*	.46(.08)	.48(.04)
		M 2	1086.75	.46(.08)	.47(.04)
		M 3	1061.25***	.33(.06)	.47(.04)
		M 4	1051.25*	.33(.06)	.45(.03)

*p<.05; **p<.01; ***p<.001

Note: M0: Intercept only
M1: Intercept, Covariates
M2: Intercept, Covariates, Days
M3: Intercept, Covariates, Days, Global WHI
M4: Intercept, Covariates, Days, Global WHI, Global WHI * Day interactions

3.4 Discussion

The aim of this study was to gain insight in the short-term day-to-day experiences accompanying global reports of work-home interference. For this purpose, we investigated the relationships between these global reports of WHI and daily reports of WHI (*research question 1*), time spent daily on work-related activities (*research question 2*) and home activities (*research question 3*), and daily reported recovery indicators, as well as the course of recovery indicators over time (*research question 4*).

We found that reports of global WHI related positively to daily WHI, supporting the validity of our global WHI measure. However, we cannot exclude the possibility that this positive association reflects a common underlying response bias, as both measures contained identical items and only differed regarding when the interference had occurred: on a specific

day (diary questionnaire), or generally (general questionnaire). Thus, to obtain further insight into the global WHI measure's validity, these findings should be replicated with measures that show less overlap with regard to their items.

With respect to work-related activity patterns, global WHI was not related to daily activity patterns within the work domain as such (i.e., time spent daily on (effortful) work activities until 6 P.M.). However, we observed a relationship between global WHI and work activities carried out at the intersection of work and home life. That is, global WHI was positively related to the time spent on overtime work in the evening. Thus, especially employees reporting high levels of global WHI were still expending effort during the time that might be used to recover from load effects that were built up during regular work time.

Concerning home activities, we did not find the hypothesized negative relations between global reports of WHI and time spent daily on domestic and active leisure activities. In a sense this is understandable, as many domestic activities are obligatory in nature (e.g., it is difficult to circumvent doing the household chores or caring for one's children), whereas active leisure activities are often part of routines (e.g., running 5 miles on Monday evenings) that will not be easily broken.

Furthermore, global WHI was negatively related to the time spent daily on low-effort leisure activities. This may be due to the fact that - in contrast to domestic and active leisure activities - one is relatively free in deciding whether to engage in this type of activity, which increases the possibility that work obligations will limit the time spent on them. As previous research (Sonnentag, 2001) revealed that engagement in low effort activities contributes to recovery from work demands, our result suggests that the experience of global WHI is negatively associated with opportunities for recovery.

Regarding the subjective recovery indicators, this study showed that global WHI was positively related to fatigue and sleep complaints, indicating that WHI indeed reflects a lack of recovery. However, we found neither the expected increasing lack of recovery nor the increase in sleep complaints and fatigue during the workweek for those experiencing high levels of global WHI. The period of five consecutive weekdays covered by our study may have been too short for these differences to become visible. Further, the fact that some items of the POMS reflect extreme levels of fatigue may be responsible for the lack of results for this concept; this instrument may not be sensitive enough to measure differences in fatigue among healthy workers. Therefore, we conducted an additional multilevel analysis using an

alternative single-item measure ('How fatigued do you currently feel'[2]; 1 = 'not at all', 10 = 'extremely', measured in the evening questionnaire). This presumably more sensitive measure replicated the findings obtained for fatigue, and also did not reveal an increase of fatigue across the week for those experiencing high levels of global WHI (results can be obtained from the first author). Thus, it may be that lack of sensitivity does not account for the absence of an increase in fatigue during the week for those experiencing relatively high levels of global WHI. However, it may also be that that the single-item measure is not sensitive enough to capture differences in fatigue among healthy participants either.

Although no firm inferences can be drawn from this study regarding the causal direction of the relationships between WHI and daily activities, the present findings are consistent with the position that WHI develops as a function of the time spent on overtime. If this is correct, one practical, albeit preliminary, implication based upon our findings would be that employees should be cautious regarding the amount of time they spend on overtime in the evening, in order to limit the development of negative effects associated with WHI. It may also be important to reduce WHI itself, as this is negatively related to the time available for low effort activities, which contribute to recovery (Sonnentag, 2001). This study's finding that WHI is related to fatigue and sleep complaints - both indicators of lack of recovery - strengthens this position, as previous longitudinal research (e.g., Van Hooff et al., 2005) also identified WHI as a cause of such health complaints.

Limitations and suggestions for future research

We believe that six issues are worth discussing. First, our study relied exclusively on self-report measures, which may have resulted in an overestimation of the associations among the variables due to common method variance. However, this cannot explain why some relationships were found while others were not. Moreover, as Semmer, Grebner and Elfering (2004) argue, alternative measures such as observational or physiological measures are not free of error variance either, and should therefore not be considered superior to self-report measures. In addition, Podsakoff, MacKenzie, Lee, and Podsakoff (2003) state that common method bias can be reduced by creating a temporal separation between the measurement of the 'predictor' and the 'criterion' variables. This procedure was followed in our study, as there was a ten day time lag between the completion of the general questionnaire and the start of

[2] See chapter 5

the daily diary study. Thus, we believe that common method bias did not affect our findings severely. Future studies could further diminish the risk of common method variance by using physiological and performance measures in addition to self-reports.

Secondly, except for global WHI, daily sleep complaints and daily regular work time, the distributions of our variables were rather skewed [skewness ranged from 1.34 (sd = .12) for fatigue to 2.65 (sd = .12) for daily time spent on active leisure activities]. To investigate whether this affected our results, we employed a square-root transformation on all variables and repeated the multilevel analysis with these normalized variables. The results of the new analyses were virtually identical to those obtained with the original data (results not reported but can be obtained from the first author). Thus, the skewness of our variables did not significantly affect the relationships found in this study.

A third issue relates to the composition of our sample. It would seem possible that employees experiencing very high levels of WHI are underrepresented in our study, as taking part in the study would place too great a burden on their already busy lives. Conversely, it is possible that particularly those employees who did not experience any WHI did not see the use in participating in the study, leading to an under representation of this group as well. Neither alternative can be excluded, suggesting that the associations among the variables in this study have been estimated conservatively due to restriction-of-range effects in WHI. In addition, all participants were academic staff members, who work at least three days a week and who lived together with a partner who worked at least 2.5 days a week. This makes it difficult to generalize our findings to employees in other professions, in other family situations or with other working hours. Thus, future studies should employ samples from other occupational groups to provide a clearer picture of how global WHI is related to various day-to-day outcome measures.

Fourth, our definition of overtime work as all work activities executed after 6 PM may be questioned. It is possible that for some employees this point of time does not correctly reflect the transition from regular work time to overtime work. For example, for part-time workers, overtime work may have started earlier on the day, whereas for other employees, working after 6 PM is still part of ones normal work routine. However, in the case of part-time workers, our definition would have resulted in a restriction of range in overtime, and thus in conservative estimates of the relationship between overtime work and global WHI. For full-time workers, our definition is probably not so problematic either, as, in The Netherlands, even academics are used to fulfill their contractual work hours during regular 'office hours'.

Fifth, our study focused on the time spent on various work and home activities, and paid only limited attention to the experience of each activity (namely by asking how effortful each work activity was experienced to be). These experiences (e.g., pleasure, detachment from work) may play a vital role in the understanding of the (absence of) associations between WHI and work and home activities. We therefore suggest that future studies pay attention to the experience of work and home activities.

Finally, our study was limited to five consecutive weekdays. To obtain more insight into the relationships between global WHI, activities and recovery and to find out if and when the course of recovery starts diverging for groups of participants with different levels of global WHI, longer observation periods are needed, during which a detailed level of assessment is practised. Furthermore, as most opportunities for recovery exist during weekends and vacations, we recommend that future research assess these specific periods as well.

Contributions of this study

In spite of these important limitations, we believe that the present study extends and enhances previous research into WHI in at least two respects. Firstly, this study adds to previous research by using a theoretical framework -- Effort-Recovery theory -- that seems to hold promise for studying WHI, and by addressing employees' daily activities in the work and home domain. That is, by mapping employees' activity patterns at work and at home and by relating these to their global experience of WHI, this study obtained a detailed picture of how WHI is related to what people do in their everyday lives. Further, this study underlined the potential of Effort-Recovery theory for studying WHI. It shows that global WHI is positively related to the amount of effort expended on a day-to-day basis (i.e. the positive association found between global WHI and the time spent on overtime in the evening), and negatively to opportunities to recover from work demands (i.e. the negative association found between global WHI and the time spent on low effort activities). Consistent with previous findings (Van Hooff et al., 2005), WHI was indeed positively associated with health complaints reflecting lack of recovery (i.e. fatigue, sleep complaints). Also, the percentage of variance accounted for in these variables was quite acceptable and ranged from 9% for overtime work to 31% for daily WHI.

Secondly, our study underlines the validity of global measures of WHI by showing that differences in levels of global WHI for an individual are reflected in their day-to-day reports of WHI. This is an important finding, in that virtually all instruments used to tap WHI

globally. Our findings suggest that instruments such as ours mirror workers' real day-to-day experiences and problems in combining their multiple roles in the work and home domain. In this sense, we believe our study provides interesting insights in what a global report, for the individual, of WHI actually signifies from day to day.

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Workdays, In-between Workdays, and the Weekend: A Diary study on Effort and Recovery

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Abstract

Objectives: Effort-recovery theory (Meijman & Mulder, 1998) proposes that effort expenditure may have adverse consequences for health in the absence of sufficient recovery opportunities. Thus, insight in the relationships between effort and recovery is imperative to understand work-related health. This study therefore focused on the relation between work-related effort and recovery a) during workdays, b) in-between workdays and c) in the weekend. For these three time periods, we compared a group of employees reporting relatively low levels of work-related effort ('low-effort group') and a group of employees reporting relatively high levels of work-related effort ('high-effort group') with respect to a) activity patterns, b) the experience of these activity patterns, and c) health and well-being indicators.

Methods: Data were collected among university staff members. Participants ($N_{\text{high-effort group}}$= 24 and $N_{\text{low-effort group}}$= 27) completed a general questionnaire and took part in a seven-day daily diary study covering five weekdays and the following weekend. Differences between the two effort-groups were examined by means of Analysis of Variance.

Results: Compared to the low-effort group, the high-effort group a) engaged less often in active leisure activities during the week and worked more overtime in the weekend, b) considered both work and home activities as more effortful, but not as less pleasurable, and c) reported higher levels of sleep complaints (weekdays only) and fatigue, more preoccupation with work (weekdays only) and lower motivation to start the next workweek during the weekend.

Conclusions: Work-related effort is associated with various aspects of work time and (potential) recovery time in-between workdays and in the weekend. High levels of work-related effort are associated with activity patterns that are less beneficial in terms of recovery, with higher effort expenditure during and after work time, and with diminished health and well-being.

Key words: effort, recovery, diary study, university staff

4.1 Introduction

Much research has shown that high levels of job demands are related to increased levels of physical and psychological health problems across time (e.g., De Lange, Taris, Kompier, Houtman, & Bongers, 2003). Despite this strong focus on the relations between job demands and health, relatively little attention has been paid to the psychological and physiological processes that may explain *why* health is adversely affected by high job demands. One notable exception is Effort-Recovery (ER) theory (Meijman & Mulder, 1998, Geurts & Sonnentag, 2006). ER theory argues that working inevitably requires effort as an appeal is made to workers' abilities and their willingness to dedicate these abilities to the work task. Expending effort at work ('work-related effort') produces two kinds of outcomes: the tangible result of work activities, i.e. a product or service, and the psychological and physiological 'costs' or load reactions (e.g., fatigue) associated with working. These load reactions are usually short-lived and reversible: they disappear after respite from work. However, under certain circumstances the recovery process may be insufficient or inadequate, and then short-term work-related load reactions may turn into adverse and more chronic health problems, such as prolonged fatigue, chronic tension, and sleep deprivation (Åkerstedt, 2006; Härmä, 2006 Sluiter, Frings-Dresen, Van der Beek, & Meijman, 2001; Van Hooff et al., 2005).

Recovery opportunities after work may be inadequate in terms of quantity (time) and/or quality. Recovery time may be insufficient in case of *prolonged exposure* to high demands, for instance, when workers continue to pursue job-related activities during non-work time (e.g., by working overtime) or engage in other demanding (e.g., domestic) activities. Recovery is particularly at stake when during private time an appeal is made upon the same psychophysiological systems that were activated on the job. The quality of recovery may be endangered when individuals' psychophysiological systems show prolonged activation even if not exposed to any special demands during the recovery period. This may happen when workers have difficulty to relax at home after a stressful working day. For example, Brosschot, Pieper and Thayer (2005) showed that when workers worry in their private time about the past or upcoming working day, the psychophysiological systems that were activated on the job remain activated, thus impeding the recovery process (cf. Ursin & Erikson, 2004). Due to repeated or prolonged activation of psychophysiological systems, these systems are in danger of chronic overactivity, producing lasting changes in homeostatic mechanisms (i.e., allostatic load; McEwen, 1998). Consequently, these originally adaptive systems may start to malfunction by showing either hyperactivity (the systems fail to shut-off) or hypoactivity (the

systems are not turned on when needed), constituting a serious health risk. For example, chronic stress may cause the immune system to be not sensitive enough (hypoactivity), allowing infectious agents (viruses and bacteria) to enter the body and cause infectious diseases. Alternatively, the system may become overreactive so that the immune system itself causes ill health (such as autoimmune diseases and allergic diseases; Clow, 2001).

The present study

Effort and recovery are nowadays salient research topics (Zijlstra & Sonnentag, 2006). The present study builds on and extends this body of knowledge in at least four regards:

Firstly, although the effort-recovery process is assumed to unfold on a daily basis, there is only a limited number of studies examining this process from such a day-to-day perspective (e.g., Meijman & Van Dormolen, 1992; Sonnentag, 2001; Cropley, Dijk & Stanley, 2006; Rook & Zijlstra, 2006; Sonnentag & Zijlstra, 2006; Totterdell, Spelten, Smith, Barton & Folkard, 1995). The majority of research in this area still focuses on either cross-sectional or on global long-term relations between job demands, lack of recovery and health (e.g., Kompier, 1988; Sluiter et al., 2001). Thus, in order to obtain more insight in de day-to-day relations between effort and recovery, the present study examines the relation between work-related effort and recovery on a daily basis, both during and after working time.

Furthermore, although weekends may offer important opportunities for recovery, they are hardly included in previous studies. Exceptions are Fritz and Sonnentag's (2005) diary study, which showed that well-being after the weekend was higher when individuals had engaged in social activities during that weekend. Also, Totterdell et al. (1995) reported that sleep, mood and social satisfaction were worse on the first rest day following work shifts in comparison with subsequent rest days. In a study among shift-working nurses, Rook and Zijlstra (2006) found weekends to be important for recovery as well. To increase the understanding of the weekend as potential recovery period, the present study also included the weekend.

Thirdly, only limited attention has been given to actual activity patterns during work and non-work time in research on effort and recovery until now (see for exceptions: Sonnentag, 2001; Fritz & Sonnentag, 2005; Sonnentag & Bayer, 2005). This is remarkable, as several work psychological theories (e.g., action theory, Frese & Zapf, 1994; Taris & Kompier, 2005) assume that job characteristics affect worker well-being through worker *behavior:* it is what people *do* that makes them feel tired or enthusiastic. Thus, in order to fully understand effort-

recovery patterns during and in-between work days, we must know how people spend their time on work as well as on home activities. Therefore, the present study provided a detailed assessment of employees' activity patterns during and in-between working time.

Finally, what can be a burden for one individual may constitute a pleasure to the other. Consequently, insight in activity patterns in the work and private domain is insufficient to fully understand workers' effort-recovery patterns, and preferably workers' *experience* of the time spent on (non)work activities must be examined in this context (see also the recommendations by Sonnentag, 2001). Until now, the extent to which workers experience their daily work and home activities as effortful and/or pleasant, has nonetheless remained largely ignored. Therefore, the present study provided a detailed assessment of how employees experience their activities during and in-between working time in terms of effort and pleasure.

We distinguished between workers who reported a relatively high level of work-related effort (i.e., who generally experienced their workdays as effortful) during a standard work week (further referred to as the 'high-effort group') and workers who reported a relatively low level of work-related effort ('low-effort group'). This division of our sample was employed in order to maximize the contrast between the two subgroups in terms of reported effort. The two effort-groups were compared with respect to (i) activity patterns (i.e., the time spent on/frequency of engaging in work activities, domestic activities, active leisure, and passive leisure), (ii) experiences of activities (i.e., the specific effort and pleasure experienced while engaging in a specific work or home activity), and (iii) health and well-being indicators (i.e., fatigue, sleep quality, sleep time, preoccupation with work, and work motivation). Fatigue is included an indicator of (lack of) recovery. As sleep provides the most 'natural' recovery opportunity for humans, sleep quality and sleep time are incorporated as well (Åkerstedt, 2006). Preoccupation with work is assessed, because it may prolong physiological activation and therefore interfere with the recovery process (Brosschot, Pieper, & Thayer 2005). Finally, to avoid focusing exclusively on the 'negative' consequences of working, work motivation is added in this study to acknowledge that work may be related to positive aspects of worker behaviour as well. These constructs were measured in three time periods: (a) during work time, (b) in-between successive workdays, and (c) during the weekend. In order to minimize the amount of time elapsed between the occurrence and the reports of a certain activity or experience, we utilized a diary design covering five uninterrupted weekdays directly followed by two weekend days. In this vein, the risk of retrospection bias was reduced (Bolger, Davis, &

Rafaeli, 2003).

This study examines three interrelated research questions:

1. *How is work-related effort associated with a) time spent on work activities, b) experiences of work activities, and c) health and well-being during the workday?*

As the distinction between the two groups is based on employees' reports of work-related effort, we expect that the high-effort group will also report to have expended higher effort on (at least some of) the specific work activities compared to the low-effort group (*Hypothesis 1a*). Support for this hypothesis is important from the perspective of validation of the effort-measure used to differentiate between the two effort-groups.

As the high-effort group should have invested higher levels of effort during the work day than the low-effort group, we expect to observe higher levels of fatigue at the end of the workday (*Hypothesis 1b*) as well as a (stronger) increase in fatigue during the workday (*Hypothesis 1c*) in the first group. We do not hold a priori expectations concerning the experiences of pleasure associated with work activities and with respect to the time spent on and the frequency of engaging in each work activity.

2. *How is work-related effort associated with a) time spent on home activities, b) experiences of home activities, and c) health and well-being in-between successive workdays?*

We distinguish among four categories of home activities, i.e. (i) domestic activities (e.g., household chores), (ii) overtime work, (iii) active leisure activities (e.g., exercising), and (iv) passive leisure activities (e.g., reading for pleasure, watching TV, listening to music) (see also Sonnentag, 2001). The latter category is considered as 'passive', whereas the other three categories of activities demand effort to some extent, and are therefore labeled as 'active'. Based on ER theory, it can be argued that our capacity to expend effort is limited, and that the more effort is expended at work, the less remains for home activities. Accordingly, the high-effort group is expected to spend less time on and to engage less often in active home activities, and consequently, will spend more time on and to engage more often in passive leisure activities (*Hypothesis 2a*). Because of the supposed limited amount of energy left in the high-effort group, we further expect that this group will experience engagement in active home activities as more effortful relative to the low-effort group (*Hypothesis 2b*). As we do not have a priori expectations regarding differences between the groups in the pleasure experienced in home activities, possible differences are examined in an exploratory fashion.

Further, we expect that those who have expended high effort on the job (high-effort group) will report higher levels of fatigue and more sleep complaints in-between workdays

compared to the low-effort group (*Hypothesis 2c*). In order to obtain a full picture of the participants' recovery in-between work days, sleep time is also examined. Finally, we assume that workers who have expended higher effort during working time, will also be more preoccupied with their job after work (*Hypothesis 2d*). This expectation is in line with Sonnentag and Bayer's (2005) finding that those who experienced high workload during the work day found it more difficult to detach from work during evenings than others. We do not formulate a priori expectations regarding possible differences in work motivation between the two effort-groups.

3. *How is work-related effort associated with a) time spent on home activities, b) experiences of home activities, and c) health and well-being during the weekend days?*

The hypotheses formulated for the period in-between workdays (research question 2) can be extended to the weekend. Hence, we expect that those who have spent high effort on the job during week days (the high-effort group), will – during the weekend – spend less time on and engage less often in active and will spend more time on and will engage more often in passive home activities (*Hypothesis 3a*), experience active home activities as more effortful (*Hypothesis 3b*), report more fatigue and more sleep complaints during the weekend (*Hypothesis 3c*), and will be more preoccupied with the upcoming workweek, than the low-effort group (*Hypothesis 3d*).

4.2 Method

Participants and procedure

This study was conducted in two stages among academic staff members of a medium-sized Dutch university. Of the 696 employees who were tenured and worked at least three days a week, only those could participate who (i) did not have a job outside this university (to keep the variation in work activities within acceptable limits), and (ii) lived with a partner who worked at least 2.5 days a week (to increase the likelihood that the participants fulfilled at least some home obligations). Of the 146 employees who agreed to participate, 133 (19%) completed a general questionnaire (1st stage of the study). Data from 13 of these 133 were removed as they apparently did not meet one or both of the selection criteria. To already reduce the influence of one possible confounder (i.e., working hours) of the associations between work-related effort and the variables of interest, this study was restricted to employees who worked at least 32 contractual hours a week. As a result, our sample comprised 93 employees (69.6% male; 67.7% > 1 child living in the household; M_{age} = 45.0

years, *sd* = 7.6; 49.5% was assistant professor, 16.1% associate professor, 12.9% full professor, 21.5% other jobs, e.g. researcher or lecturer). Due to strict privacy regulations, we did not know how many of the employees who were approached for participation in the study actually met our inclusion criteria (i.e. had no job outside the university and lived together with a partner who worked at least 2.5 days a week). Therefore, we do not have insight in how many employees were in fact eligible for participation in the study, meaning that the overall response rate and the representativeness of our sample are unknown.

In the second stage of this study starting about ten days after the completion of the general questionnaire, the daily variables of interest were assessed by means of short questionnaires that were completed three times a day, from Monday to Sunday: (1) a morning questionnaire (to be completed after awaking in the morning, between 7.30 and 8.30 AM), (2) an afternoon questionnaire (to be completed around 6 PM), and (3) an evening questionnaire (to be completed before bedtime, between 10 and 11 PM). Only diaries that were completed within an acceptable time range around the requested time were included in the final database. We thus removed morning questionnaires that were completed more than 2 hours after awakening; afternoon questionnaires that were completed before 4.30 PM, after 8 PM, or less than 3 hours after the morning questionnaires; and evening questionnaires that were filled in less than 2 hours after the afternoon questionnaire or after 3 AM. This procedure resulted in 76.2% valid morning diaries, 73.4% valid afternoon diaries, and 72.5% valid evening diaries.

Variables derived from the general questionnaire (general measures)

Job types included 'assistant professor', 'associate professor', 'full professor', and 'other', such as researcher and teacher. *Age* was measured in years; *Gender* was coded as '0' for 'male' and '1' for 'female'. *Parental status* was coded as '0' for having no children living in the household and '1' for having > 1 child living in the household. The last three variables are potential confounders in the relationships of interest and are therefore included as covariates in further analyses.

General fatigue was assessed with the 10-item Fatigue Assessment Scale (Michielsen, De Vries, & Van Heck, 2003). An exemplary item is 'I am bothered by fatigue' (1 = '(almost) never', 5 = '(almost) always'), with higher scores reflecting higher levels of fatigue ($\alpha = 0.86$).

Work engagement was measured with five items adapted from Rothbard (2001). An example is 'When I am working, I often lose track of time' (1 = 'strongly disagree', 5 =

'strongly agree'; $\alpha = 0.78$).

Job pressure was measured with five items from the Job Content Questionnaire (Karasek, 1985), that were rephrased as questions (e.g., 'Do you have to work very fast?'; 1 = '(almost) never', 4 = '(almost) always'; $\alpha = 0.74$).

Job control was measured with six items from Van Veldhoven, De Jonge, Broersen, Kompier, and Meijman (2002). An exemplary item is: 'Can you take a short break if you feel this is necessary?' (1 = '(almost) never', 4 = '(almost) always'; $\alpha = 0.67$).

Social support from colleagues (e.g., 'My colleagues show their appreciation for the way I do my job', 1 = '(almost) never', 4 = '(almost) always'; $\alpha = 0.86$), and *Social support from supervisor* (e.g., 'My supervisor shows her/his appreciation for the way I do my job', 1 = '(almost) never', 4 = '(almost) always'; $\alpha = 0.90$) were both measured with four items adapted from Geurts, Rutte, and Peeters (1999).

Positive Affect and *Negative Affect* were measured by means of the Positive and Negative Affect Schedule (PANAS; Watson & Clark, 1988). Following Rothbard (2001), we distinguished between positive and negative affect regarding *work* and positive and negative affect regarding *family*. Sample items for negative affect are 'upset' and 'distressed', and examples for positive affect are 'enthusiastic' and 'proud' (1 = very slightly or not at all, 5 = extremely), with higher scores indicating higher negative or positive affect (Negative affect: Cronbach's $\alpha = .83$ for work and .84 for home; Positive affect: Cronbach's $\alpha = .87$ for work and .90 for home).

Life events. Participants could report for 10 events (e.g., birth of a child, financial troubles, change of job) whether or not they had experienced this event during the past year. The number of events experienced was summed.

Measures derived from the daily questionnaires (daily measures)

To limit the participants' burden, the questionnaires contained a combination of validated scales as well as single-item report-marks.

Work-related effort. In the afternoon questionnaire, participants were requested to indicate with a report mark the extent to which they considered the preceding workday as effortful (1 = 'not at all', 10 = 'extremely').

Time spent daily on work activities. Participants received a list of 13 major work activities and indicated the time (0 = 'none', 1 = '< 1 hour', 2 = '1-2 hours',..., and 7 = '> 6 hours') they had spent on each activity during regular work time, i.e., until 6 PM (afternoon

questionnaire), and during nonwork time, i.e., after 6 PM (evening questionnaire). We recoded this time range to obtain an estimate of the actual time in hours by assuming that the actual time spent on an activity would lie halfway the two extremes (e.g., the category '<1 hour' was recoded as '0.5'). *Time spent on research activities by day* comprised the time spent on 'conducting research', 'data-analysis', 'reading specialist literature', and 'writing papers' (until 6 PM). *Time spent on teaching activities by day* included the time spent on 'preparing a lecture', 'giving a lecture', 'reading (Ph.D.) students' assignments', and 'appointments with (Ph.D) students' (until 6 PM). *Time spent on administrative activities by day* consisted of time spent on 'preparing a meeting', 'attending a meeting' and 'e-mail/phone'. The category 'informal contact with colleagues' was entered in the analyses separately. A 13th activity, 'other', was not incorporated in further analyses, as on average only 0.42 hours were devoted daily to these activities. All work activities are potentially relevant to all participants as in The Netherlands lecturers also have some research time, and researchers will usually also teach.

Overtime work was computed by summing the time spent on all 13 work activities after 6 PM (this university did not offer evening classes) during weekdays, and by summing the total time spent on work activities before and after 6 PM on Saturday and on Sunday.

Time spent daily on home activities. Participants indicated in both the afternoon (until 6 PM) and evening questionnaires (from 6 PM) the amount of time they spent that day on ten categories of home activities [largely based on those used in Sonnentag's (2001) diary study]. Answer possibilities and recoding procedure were identical to those used for work activities. To ease interpretation of the categories, participants received examples of activities in each category. *Time spent on domestic activities* was calculated by summing the total time (i.e., before and after 6 PM) devoted each day to 'household activities', 'doing odd jobs in or around the house', 'doing the groceries', 'care giving activities' and 'businesslike activities'. *Time spent on active leisure activities* comprised the total time spent daily on 'physical activities', 'creative activities' and 'social activities'. The total *Time spent on passive leisure activities* was computed by summing the time devoted to these activities (e.g., reading for pleasure, watching TV, listening to music) before and after 6 P.M. The tenth category, 'other', was omitted from further analysis as the mean time spent on these activities ranged from only 0.15 hours on Saturday to 0.21 hours during weekdays.

Experiences. Participants indicated for each engaged work and home activity, the extent to which they considered it as effortful and as pleasant (1 = 'not at all', 10 = 'extremely'). An estimate of the average daily effort and pleasure for each category of activities was obtained by

computing a weighted mean score. Thus, the summed product of hours spent on each activity within a category and the effort (pleasure) experienced while executing the activity was divided by the total hours spent on the activities in the respective category. By employing such a weighted score, the time spent on an activity is controlled for, assuring that the effort (pleasure) score really reflects effort (pleasure).

Health and well-being. Fatigue at work (weekdays' afternoon questionnaire) was measured with eight items adapted from Van Veldhoven et al. (2002), for example 'I felt tired mentally' (1 = 'not at all', 10 = 'extremely'). Participants rated each item twice: a) with respect to the *first* hour of the workday (Cronbach's $\alpha = 0.87$) and b) with respect to the *last* hour of the workday (Cronbach's $\alpha = 0.86$).

Fatigue was measured in the morning, afternoon and evening questionnaires. Participants rated their current state of fatigue ('How fatigued do you currently feel?'[3]) with a report mark varying from '1' ('not at all') to '10' ('extremely').

Sleep complaints (each morning questionnaire) were assessed using a five-item sleep quality scale (Van Veldhoven et al. 2002), slightly adapted to make it suitable for day-to-day measurement. An exemplary item is: 'Last night I woke up several times' (1 = 'yes', 0 = 'no', $\alpha = 0.73$ across all seven consecutive days). Note that each day's values for this scale refer to the previous night.

Sleep time (each morning questionnaire) was computed by calculating the self-reported number of hours in-between the time they went to sleep last night ('what time did you go to sleep last night?') and the time they woke up this morning ('what time did you wake up this morning?'). Again, each day's values for this scale refer to the previous night.

Preoccupation with work (each morning questionnaire) was assessed with one self-developed item: 'I am already mentally involved with the things I have to do at work today [next week]' (1 = 'not al all', 5 = 'extremely').

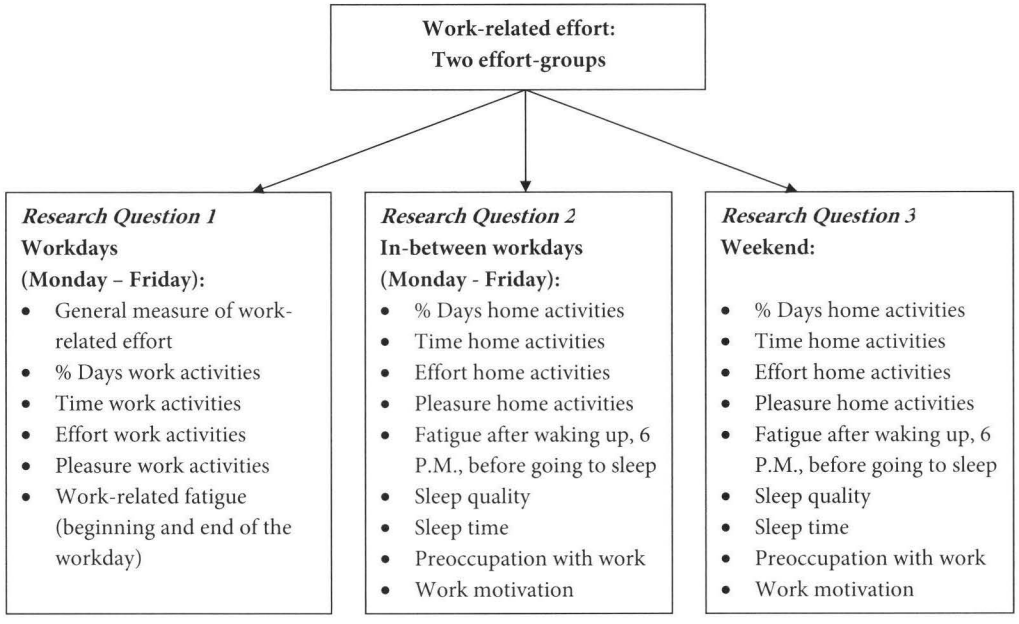
Work motivation (each morning questionnaire) regarding the upcoming workday (during weekdays) or the next workweek (during weekend-days) was assessed with one self-developed item: 'I feel like starting the next workday [workweek]' (1 = 'not al all', 5 = 'extremely').

A table with correlations between the study variables can be obtained from the first author on request.

Figure 4.1 gives an overview of the measurement structure.

[3] see chapter 5

Figure 4.1. Overview of the measurement structure



Creation of the two effort-groups.

The global report mark for *work-related effort* as assessed in the afternoon questionnaire was used to create the two effort-groups. A workday was labeled as effortful if a report mark of 6 or higher was given. The number of effortful workdays was summed for each participant to obtain an estimate of how effortful he/she considered the workweek. To increase reliability only participants who gave a report mark during at least 3 out of the 5 possible workdays were selected, resulting in a final sample of 72 of the 93 original participants. The *low-effort group* (n = 27; M_{effort} = 3.39) consisted of participants who considered none (out of three) or only one workday (out of four or five) as effortful (> 6). The *high-effort group* (n = 24; M_{effort} = 6.77) included participants who labeled two or three (out of three), three or four (out of four) or four or five (out of five) workdays as effortful.

Statistical Analyses

Data were analyzed by means of (M)ANCOVA, which allows the examination of relationships between a categorical independent variable (the effort-subgroups) and continuous dependent variables (Maxwell & Delaney, 2005). Gender, age, number of children in the household and number of contractual work hours (32 or more) were included as covariates in the analyses, because these may affect the relationships between work-related effort and the other variables of interest in this study. One key assumption of MANCOVA is that the criterion variables are multivariately normally distributed (Maxwell & Delaney, 2005). To examine whether this assumption could be maintained, the distributions of the criterion variables were inspected for univariate normality, both for the total sample and for the low and high effort subgroups. The skewness of the criterion variables was for 61out of 64 variables in the study lower than 1.00. As this number is already expected on basis of chance, this finding suggests that the assumption of a multivariate normal distribution of the criterion variables could be maintained for practical purposes.

4.3 Results

Preparatory analyses

Table 4.1 shows the descriptive statistics for the general measures for the total sample as well as for the two effort groups. The total sample can be characterized as middle-aged, rather engaged, and not very tired. The mean level of fatigue in the sample does not significantly differ from that in a heterogeneous sample of 1,123 employees (M = 1.97, sd = 0.57, $T(1214)$ =

1.29, *ns*; Geurts et al. 2005). Participants report relatively high levels of work pressure and job control. Levels of job control are higher than those in a heterogeneous sample of 1,740 employees ($M = 2.54$, $sd = 0.63$, $T(1831) = -10.29$, $p<.001$; Geurts et al. 2005).

Table 4.1. Means and standard deviations for the total sample and for the two effort-groups for the measures derived from the general questionnaire

	Total Sample ($N = 93$)		Low-effort group ($N = 27$)		High-effort group ($N = 24$)	
	M	*Sd*	*M*	*Sd*	*M*	*Sd*
Age	44.95	*7.63*	46.74	*6.69*	44.17	*7.80*
Work engagement	3.94	*0.69*	3.92	*0.63*	4.05	*0.67*
Fatigue	1.89	*0.61*	1.87	*0.57*	2.04	*0.60*
Work pressure	2.47	*0.54*	2.23	*0.53*	2.49	*0.60*
Job control	3.22	*0.42*	3.25	*0.46*	3.30	*0.39*
Social support colleagues	2.59	*0.65*	2.62	*0.53*	2.60	*0.66*
Social support supervisor	2.35	*0.87*	2.49	*0.79*	2.19	*0.90*
Positive affectivity work	3.61	*0.53*	3.57	*0.62*	3.51	*0.51*
Positive affectivity home	3.59	*0.63*	3.74	*0.71*	3.47	*0.52*
Negative affectivity work	1.93	*0.57*	1.93	*0.50*	2.04	*0.67*
Negative affectivity home	1.83	*0.56*	1.83	*0.59*	1.95	*0.47*
Life events	1.98	*1.53*	2.04	*1.34*	2.17	*1.81*

To investigate possible differences in the composition of the two effort-groups, these groups were compared with respect to the general measures. No significant differences were observed regarding age ($T = 1.27$, $df = 49$, *ns*), gender ($\chi^2 = 0.07$, $df = 2$, *ns*), parental status ($\chi^2 = 0.14$, $df = 1$, *ns*), job type ($\chi^2 = 1.43$, $df = 3$, *ns*), general fatigue ($T = -1.00$, $df = 49$, *ns*) and work engagement ($T = -0.72$, $df = 49$, *ns*). Also, the MANOVA executed with respect to job characteristics (job pressure, job control, social support from colleagues and supervisor) was not significant, $F(4, 45) = 0.98$, *ns*. Furthermore, the groups report comparable levels of positive and negative affect (work: $T(49) = -0.71$, *ns*; family: $T(49) = -0.13$, *ns*) and positive affect (work: $T(49) = -0.39$, *ns*; family: $T(49) = 1.01$, *ns*). Finally, the two effort-groups did not differ significantly regarding the number of events experienced ($T(49) = -0.29$, *ns*). Thus, in sum, there were no significant differences between the two effort-groups with respect to the general measures.

Differences between Saturday and Sunday. Preliminary analyses showed that the variables under study did not differ significantly between Saturday and Sunday [*F*-values ranged from $F(1, 27) = 0.00$, *ns* for effort reported for active leisure, to $F(1, 8) = 1.95$, *ns* for effort reported for overtime work]. Therefore, further analyses are based on mean scores across the two weekend days.

Research Question 1

Table 4.2 presents the means, standard deviations and *F*-statistics for the daily variables for the total sample and for each of the two effort-groups. As to work activities, two analyses were conducted. First, for each participant the percentage of days on which time was spent on each work activity was computed. MANCOVA revealed that these percentages did not differ significantly between the two effort-groups. Secondly, for each participant we computed the mean time they spent daily on each work activity across the five weekdays. Again, MANCOVA did not reveal any significant difference between the two effort-groups. Thus, the two effort-groups did not differ significantly in their work activity patterns during the work day.

To study possible differences in experiences, two MANCOVA's were conducted, both based on mean scores across the five workdays. The first analysis revealed that the two effort-groups differed significantly in the average amount of effort reported with respect to the four work activities. Univariate tests showed that the high-effort group experienced each activity as more effortful (*Hypothesis 1a* supported). The second analysis revealed that the two effort groups did not differ significantly with respect to the pleasure they derived from their work activities.

Possible differences between the two effort-groups in fatigue at work were examined in a 2 (Time: first hour vs last hour) x 2 (Group: low vs high effort) repeated-measures ANCOVA. The development of fatigue during the work day differed significantly between the two effort-groups (significant Time x Group interaction). Post-hoc analyses showed that there were no significant differences between the two groups in their level of fatigue during the first hour of the workday ($T = -1.20$, $df = 49$, *ns*). However, the high-effort group reported a significantly higher mean level of fatigue during the last hour of the workday ($T = -2.66$, $df = 49$, $p < .05$), indicating that the high-effort group reported more fatigue at the end of the work day (*Hypothesis 1b* supported), and showed a stronger increase in fatigue (*Hypothesis 1c* supported) during the work day.

Table 4.2. Activity patterns, experiences and recovery indicators during the workday: *F*-statistics ,*p*-values and means and standard deviations for the total sample and for the two effort-groups

Hypothesis			Total Sample (N = 93)		Low-effort group (N = 27)		High-effort group (N = 24)		F (df)	p
			M	*sd*	*M*	*sd*	*M*	*sd*		
									Multivariate: 1.29 (4, 42)	.29
-	% Days	Research	61%	*33%*	60%	*37%*	62%	*30%*	0.60 (1, 45)	.81
		Teaching	75%	*30%*	67%	*37%*	79%	*27%*	3.33 (1, 45)	.07
		Administrative	90%	*16%*	90%	*16%*	86%	*20%*	0.00 (1, 45)	.99
		Informal contacts	55%	*33%*	55%	*33%*	55%	*30%*	0.32 (1, 45)	.57
-	Time								Multivariate: 0.31 (4, 42)	.87
		Research	1.5	*1.3*	1.7	*1.5*	1.6	*1.3*	0.29 (1, 45)	.59
		Teaching	2,0	*1.4*	2,0	*1.7*	2.1	*1.4*	0.36 (1, 45)	.55
		Administrative	1.9	*1,0*	1.9	*1.2*	1.7	*1,0*	0.02 (1, 45)	.90
		Informal contacts	0.4	*0.3*	0.4	*0.3*	0.3	*0.2*	0.89 (1, 45)	.35
Hypothesis 1a	Effort (1-10)								Multivariate: 9.94 (4, 29)	<.001
		Research	4.87	*2.2*	3.24	*1.66*	6.44	*1.78*	26.53 (1, 32)	<.001
		Teaching	4.47	*1.76*	3.24	*1.49*	5.87	*1.22*	29.59 (1, 32)	<.001
		Administrative	4.05	*1.89*	2.74	*1.34*	5.44	*1.80*	25.64 (1, 32)	<.001
		Informal contacts	2.60	*1.48*	1.85	*1.18*	3.30	*1.62*	7.76 (1, 32)	<.01
-	Pleasure (1 – 10)								Multivariate: 0.07 (4, 29)	.99
		Research	7.18	*1.09*	7.14	*1.37*	7.23	*1.05*	0.00 (1, 32)	1
		Teaching	6.69	*1.04*	6.88	*1.34*	6.61	*0.60*	0.01 (1, 32)	.94
		Administrative	5.76	*1.52*	5.94	*1.46*	5.92	*0.91*	0.02 (1, 32)	.89
		Informal contacts	7.52	*0.95*	7.31	*1.21*	7.54	*0.88*	0.17 (1, 32)	.68
Hypothesis 1b and hypothesis 1c	Health and Well-Being	Work-related fatigue first hour	1.89	*1.03*	1.69	*0.65*	1.96	*0.91*	Time: 0.00 (1, 45); Group 4.63 (1, 45); Time x Group: 6.09 (1, 45)	.96 <.05 <.05
		Work-related fatigue last hour	2.56	*1.30*	2.13	*0.86*	3.00	*1.43*		

In sum, the participants in the two effort-groups do not engage in different types of work activities, nor do they experience their work activities differently in terms of pleasantness. However, the high-effort group reports to spend significantly more effort on each of the work activities, experiences significantly higher work-related levels of fatigue at the end of the work day, as well as a stronger increase in fatigue during the work day.

Research Question 2

Means, standard deviations and *F*-statistics are presented in Table 4.3. As to home activity patterns, two analyses were performed. First, for every participant, we computed the percentage of work days they spent time on each type of home activity (domestic, active leisure, overtime work, and passive leisure). For each of these activities, an ANCOVA was conducted. Results showed that the groups only differed significantly with respect to active leisure activities: whereas the high-effort group spent on less than half of the work days (43%) time on this type of activities, the low-effort group spent on more than half of the work days (62%) time on this type of activities. Secondly, we conducted four ANCOVA's based on each participant's mean time spent daily on each of the four activities during the five weekdays, but these revealed no differences between the two effort-groups. These results provide partial support for *Hypothesis 2a* by showing that participants in the high-effort group engage on average less often in active leisure activities.

In order to investigate possible differences in their experiences of home activities, two MANCOVA's were computed, both based on mean scores across the five weekdays. The first analysis showed an overall significant difference between the two effort-groups in the extent to which they considered home activities as effortful. Univariate tests demonstrated that the high-effort group considered active leisure activities and overtime work as more effortful (*Hypothesis 2b* supported). The second analysis revealed that the two effort-groups did not differ significantly as to their pleasure regarding their home activities.

Regarding health and well-being, three analyses were conducted, each based on mean scores across the five work days. For fatigue, a 3 (Time: morning vs afternoon vs evening) x 2 (Group: low vs high effort) repeated-measures MANCOVA indicated that fatigue did not vary significantly as a function of Time. However, the two effort-groups did differ significantly in their average level of fatigue (main effect of Group). Post-hoc analyses demonstrated that the high-effort group reported higher levels of fatigue ($M = 5.76$)

Table 4.3. Activity patterns, experiences and recovery indicators in-between workdays. *F*-statistics ,*p*-values and means and standard deviations for the total sample and for the two effort-groups

Hypothesis			Total Sample ($N = 93$)		Low-effort group ($N = 27$)		High-effort group ($N = 24$)		*F* (df)	p
			M	*sd*	*M*	*sd*	*M*	*sd*		
Hypothesis 2a	% Days	Domestic	86%	*20%*	90%	*22%*	83%	*18%*	1.34 (1, 45)	.25
		Active Leisure	56%	*33%*	62%	*26%*	43%	*31%*	8.12 (1, 45)	<.01
		Overtime	49%	*23%*	43%	*27%*	58%	*34%*	4.92 (1, 45)	<.05
		Passive Leisure	73%	*27%*	78%	*28%*	70%	*34%*	0.63 (1, 45)	.43
Hypothesis 2a	Time	Domestic	2.3	*1.6*	2.2	*1.4*	2.0	*1.5*	1.47 (1, 45)	.23
		Active Leisure	0.9	*0.7*	0.9	*0.5*	0.7	*0.7*	1.90 (1, 45)	.18
		Overtime	0.9	*0.8*	0.8	*0.7*	1.1	*1.0*	2.42 (1, 45)	.13
		Passive Leisure	1.3	*1.1*	1.3	*0.8*	1.2	*0.8*	0.36 (1, 45)	.55
Hypothesis 2b	Effort (1-10)								Multivariate 10.90 (4, 27)	<.001
		Domestic	2.96	*1.57*	2.46	*1.22*	3.32	*1.76*	0.80 (1, 30)	.38
		Active Leisure	3.58	*1.76*	2.91	*1.36*	4.56	*1.99*	7.24 (1, 30)	<.05
		Overtime	4.34	*1.76*	3.13	*1.48*	5.82	*1.15*	26.11 (1, 30)	<.001
		Passive Leisure	2.06	*1.24*	1.50	*0.82*	2.81	*1.58*	3.37 (1, 30)	.08
-	Pleasure (1-10)								Multivariate 0.67 (4, 27)	.62
		Domestic	5.79	*1.40*	6.08	*1.34*	5.60	*1.21*	0.38 (1, 30)	.54
		Active Leisure	7.31	*1.23*	7.43	*1.20*	7.71	*0.75*	0.03 (1, 30)	.86
		Overtime	6.34	*1.29*	6.33	*1.49*	6.16	*0.95*	0.07 (1, 30)	.80
		Passive Leisure	6.87	*1.43*	7.19	*1.05*	6.87	*1.33*	0.21 (1, 30)	.65
Hypothesis 2c and Hypothesis 2d	Health and Well-Being	Fatigue t1	3.76	*1.93*	2.90	*1.47*	4.87	*1.72*	Time: 2.16 (2, 44);	.13
		Fatigue t2	4.92	*1.74*	3.90	*1.56*	5.88	*1.40*	Group: 22.46 (1, 45);	<.001
		Fatigue t3	5.71	*1.98*	4.87	*2.07*	6.52	*1.50*	Time x Group: 0.06 (2, 44)	.95
		Sleep Complaints	1.54	*1.12*	1.25	*1.00*	1.95	*0.95*	4.12 (1, 45)	<.05
		Sleep Time	7.09	*0.88*	6.85	*1.05*	7.13	*0.70*	1.85 (1, 45)	.18
		Preoccupation Work	3.32	*1.00*	3.19	*0.90*	3.75	*0.95*	4.41 (1, 45)	<.05
		Work Motivation	3.40	*0.70*	3.49	*0.85*	3.21	*0.50*	3.00 (1, 45)	.09

compared to the low-effort group (M = 3.89, T = -4.78, df = 49, $p < .001$; *Hypothesis 2c* supported for fatigue). The development of fatigue during the day did not vary significantly as a function of effort-group (Time x Group interaction, *ns*). Furthermore, ANCOVA revealed that the high-effort group reported significantly more sleep complaints (*Hypothesis 2c* supported for sleep complaints). The third analysis (ANCOVA) showed that the two effort-groups did not differ significantly with regard to sleep time. Concerning preoccupation with work, ANCOVA revealed that the high-effort group was significantly more preoccupied (*Hypothesis 2d* supported). A similar analysis conducted for work motivation did not reveal any significant differences between the two effort-groups.

In sum, the high-effort group engaged less often in active leisure activities in-between successive work days, but did not differ significantly from the low effort-group regarding the experience of pleasure associated with these activities. Further, the high-effort group experienced the home activities as more effortful. In addition, we systematically observed higher levels of fatigue, more sleep complaints, and a higher preoccupation with work in the high-effort group in-between work days.

Research Question 3

Table 4.4 presents the relevant means, standard deviations and F-statistics for the total sample and for the two effort-groups. To map possible differences in activity patterns between the two effort-groups, two analyses were conducted. First, we computed for each participant the percentage of weekend days on which time was spent on each home activity: The four ANCOVA's (one for each percentage) conducted for these percentage revealed no differences between both effort-groups. Secondly, with respect to the time spent on the four types of home activities, also for each activity an ANCOVA was conducted. Results revealed one important difference in activity patterns: the high-effort group spent significantly more time on overtime work during the weekend compared to the low-effort group (*Hypothesis 3a* partially supported).

Conducting multivariate analyses for 'pleasure' and 'effort' would result in very restricted sample sizes (n = 13 in both groups). Therefore, only univariate tests were computed, revealing that the high-effort group considered all four activities significantly more effortful (*Hypothesis 3b* supported). Again, the two effort-groups did not differ significantly with respect to pleasure associated with their activities.

Table 4.4. Activity patterns, experiences and recovery indicators during the weekend. *F*-statistics ,*p*-values and means and standard deviations for the total sample and for the two effort-groups

Hypothesis			Total Sample (N = 93)		Low-effort group (N = 27)		High-effort group (N = 24)		F (df)	p
			M	*sd*	*M*	*sd*	*M*	*sd*		
Hypothesis 2a	% Days	Domestic	97%	*13%*	98%	*10%*	96%	*14%*	0.13 (1, 45)	.74
		Active Leisure	70%	*32%*	76%	*29%*	63%	*30%*	3.16 (1, 45)	.08
		Overtime	43%	*39%*	37%	*41%*	50%	*42%*	2.23 (1, 45)	.61
		Passive Leisure	87%	*26%*	85%	*27%*	79%	*33%*	0.27 (1, 45)	.14
Hypothesis 2a	Time	Domestic	5.0	*2.4*	5.0	*2.0*	5.3	*2.5*	0.14 (1, 43)	.71
		Active Leisure	2.5	*2.0*	2.4	*1.6*	2.4	*2.6*	0.11 (1, 43)	.74
		Overtime	1.2	*1.4*	0.8	*0.9*	1.4	*1.7*	6.14(1, 43)	<.05
		Passive Leisure	2.6	*1.6*	2.7	*1.5*	2.7	*1.9*	0.38 (1, 43)	.54
Hypothesis 2b	Effort (1-10)	Domestic	3.33	*1.80*	2.65	*1.44*	3.91	*1.97*	5.87 (1, 45)	<.05
		Active Leisure	3.24	*1.92*	2.41	*1.64*	3.87	*2.13*	6.50 (1, 42)	<.05
		Overtime	4.54	*2.01*	3.42	*1.72*	5.49	*1.80*	9.01 (1, 24)	<.01
		Passive Leisure	2.09	*1.42*	1.73	*1.24*	2.65	*1.59*	5.49 (1, 41)	<.05
-	Pleasure (1-10)	Domestic	6.24	*1.10*	6.20	*1.31*	6.07	*1.02*	0.15 (1, 45)	.70
		Active Leisure	7.68	*0.88*	7.58	*0.97*	7.61	*0.82*	0.02 (1, 42)	.89
		Overtime	6.03	*1.57*	6.28	*1.78*	5.96	*1.25*	0,58(1, 24)	.45
		Passive Leisure	7.47	*0.95*	7.41	*1.10*	7.57	*0.86*	0.14 (1, 41)	.71
Hypothesis 2c and Hypothesis 2d	Health and Well-Being	Fatigue t1	3.43	*2.10*	2.69	*1.69*	4.00	*2.24*	Time: 3.39 (2, 41);	<.05
		Fatigue t2	4.26	*2.04*	3.56	*1.64*	4.72	*2.21*	Group: 7.80 (1, 42);	<.05
		Fatigue t3	5.69	*2.09*	4.56	*2.19*	6.38	*1.57*	Time x group 0.15 (2, 41)	.87
		Sleep Complaints	1.04	*1.11*	0.94	*1.07*	1.40	*1.31*	1.44 (1, 44)	.24
		Sleep Time	7.88	*1.05*	7.74	*1.10*	7.91	*0.94*	0.69 (1, 43)	.41
		Preoccupation Work	2.41	*1.07*	2.09	*0.94*	2.69	*1.15*	2.28 (1, 44)	.14
		Work Motivation	3.30	*0.98*	3.50	*0.91*	2.89	*0.99*	5.27 (1, 44)	<.05

Three analyses were conducted to examine possible differences between the two effort-groups regarding health and well-being indicators. A 3 (Time: morning vs afternoon vs evening) x 2 (Group: low vs high-effort) repeated-measures ANCOVA revealed a main effect of Time. Post-hoc analyses indicated that fatigue increased significantly during the day, that is, was lowest in the morning (M = 3.32), somewhat higher in the afternoon (M = 4.08) and highest in the evening (M = 5.41). Furthermore, overall, the two effort-groups reported different levels of fatigue (significant main effect of Group). Post-hoc analyses showed that the high-effort group reported significantly higher levels of fatigue (M = 5.03) than the low-effort group (M = 3.61; *Hypothesis 3c* supported for fatigue). Finally, fatigue did not vary significantly between the effort-groups as a function of time of the day (non-significant Time x Group interaction). Two ANCOVAs indicated that sleep complaints and sleep time did not vary significantly between the effort-groups (*Hypothesis 3c* rejected for sleep complaints).

Two additional ANCOVAs indicated that the two effort-groups did not significantly differ with respect to preoccupation with work during the weekend (*Hypothesis 3d* rejected), but that the high-effort group felt less like starting the next working week (work motivation).

In sum, the two effort-groups did not show significantly different activity patterns during the weekend regarding domestic work, active and passive leisure. However, the high-effort group spent significantly more hours on overtime work during the weekend than the low-effort group. Furthermore, the high-effort group experienced all home activities as significantly more effortful, although not as less pleasant, than the low effort-group. We also observed significantly higher levels of fatigue during the weekend and less motivation to start the upcoming workweek in the high-effort group.

4.4 Discussion

The present study was devised to enhance our insight in the associations between work-related effort and recovery from that effort. To this purpose, we compared two groups of employees reporting different levels of work-related effort (high vs. low) with respect to their activities, experiences, and health and well-being in three time-periods: (i) during work time, (ii) in-between work days and (iii) during the weekend.

Activity patterns

Our results revealed that the two effort-groups did not differ significantly in terms of their activity patterns at work. However, two significant differences were observed in the home

domain. The first manifested itself in-between work days: the high-effort group performed active leisure activities on fewer days than the low-effort group, which is unfortunate, as active leisure activities seem to promote recovery (Sonnentag, 2001).

A second difference appeared during the weekend. Contrary to our expectations (hypothesis 3c), employees in the high-effort group spent more time on working overtime in the weekend. This implies that these employees devote part of potential recovery time during the weekend to activities that may interfere with the recovery process (cf. Sonnentag, 2001).

The amount of time devoted to domestic activities during the weekdays and weekend days did not vary significantly between the two effort-groups. This may be due to the fact that many domestic activities are obligatory in nature (e.g., it is difficult to circumvent doing the household chores). Finally, no significant differences between the groups emerged concerning low-effort activities, both during weekdays and weekend days.

Experiences

Regarding experiences, we distinguished between effort and pleasure. The high-effort group reported significantly more effort for all work activities. In the home domain, the high-effort group judged all activities as more effortful during weekdays (except domestic activities) and during the weekend. No significant differences between the groups were observed with respect to pleasure, neither during work time nor in-between work days, nor in the weekend. Hence, work-related effort is independent of the pleasure derived from work and home activities.

Health and well-being

We observed a stronger increase in work-related fatigue during the workday for the high-effort group than for the low-effort group. Thus, whereas the two groups did not differ significantly in work-related fatigue at the start of the working day, the high-effort group was more fatigued at the end of the working day. This difference persisted in-between work days. This finding might explain why the high-effort group engaged less often in active leisure in-between work days than the low-effort group. Also during the weekend, the high-effort group remained significantly more fatigued than the low-effort group. Possibly, this may be due to the fact that the former group spent more time on overtime.

A somewhat different pattern of results was observed with respect to sleep complaints: The high-effort group reported more sleep complaints during the week, but not in the

weekend. The additional finding that the two groups did not differ significantly with respect to sleep time suggests that work-related effort relates to sleep quality, but not sleep quantity.

During the week, the high-effort group was apparently more preoccupied with work than the low-effort group. However, it cannot be excluded that this is partly due to our item wording. Although we asked participants to indicate the extent to which they were *already* preoccupied with the upcoming workday, it would seem possible that this measure (also) reflects the extent to which participants were *still* ruminating about their past working day. In the weekend, the two groups did not differ significantly in their preoccupation with the upcoming workweek. This is surprising, as the high-effort group spent more time on work-related activities during these days. The high-effort group nonetheless reported less work motivation than the low-effort group.

Limitations and suggestions for future research

Six issues with respect to the present study must be discussed. First, as we employed a single item report mark to create the two effort-subgroups, the reliability and validity of this measure can be questioned. However, we believe that there are good arguments in favor of employing this report mark: (i) we did not rely on a single observation of this measure, as each participant completed the item on at least three occasions; (ii) employees in the high-effort group considered each of the four categories of work activities as more effortful than the low-effort group, thus suggesting that the report mark correctly reflects the effort experienced during the workday; and (iii) there is a correlation of .85 ($p<.001$) between our single-item effort-measure and a weighted mean score of the effort experienced during the separate work activities. The latter was computed by first weighting the number of hours spent on each activity by the effort expended to this activity; the sum of these weighted scores was divided by the total number of work hours. Thus, our single-item report mark seems to measure a very similar quantity as a much more refined measure of effort).

A second point of concern is the procedure used to create the two effort-subgroups. These groups were created based on the number of days participants considered their work as effortful. To probe the possibility that our findings are biased by this somewhat arbitrary procedure we repeated our analyses using a slightly different effort indicator. For each participant who completed the report mark of global work-related effort on at least three occasions, the mean score on this report mark across the week was computed. Based on these scores, two new subgroups were created: One including participants with scores in the highest

tertile, and a second with participants having scores in the lowest tertile. Analyses were repeated for these two groups, yielding results that were highly similar to those found for the original subgroups (results can be obtained from the first author on request). Thus, our findings appear robust across different measures of effort expenditure.

Thirdly, our study relied exclusively on self-report measures, and this might have resulted in an overestimation of the associations among the variables due to common method variance. However, this should have inflated all relations studied and not just part of these: The fact that some relationships were found while others were not, argues against the influence of common method variance in our study. Besides, alternative measures such as observational or physiological measures are not free of error variance either, and should therefore not be considered superior to self-report measures (Semmer, Grebner, & Elfering, 2004; see also Kompier, 2005). Furthermore, by demonstrating a) that using self-reports does not guarantee finding significant results, b) that potential biasing variables (social desirability, negative affectivity and acquiescence) do not generally inflate correlations among study variables and c) that monomethod correlations are not by definition higher than multimethod correlations, Spector (2006) concludes that 'the popular position suggesting common method variance automatically affects variables measured with the same method is a distortion and oversimplification of the true state of affairs' (p. 221). Thus, all in all we do not believe that common method bias severely biased our findings. However, the use of physiological and performance measures in addition to self-reports could provide interesting insights in future research.

A fourth issue is the impact of potential third variables. One might argue that differences between the two effort-groups regarding (experiences of) activities and health and well-being indicators might be due to personality characteristics or other person or work-related constructs, rather than to work-related effort. However, in our study we attempted to exclude the influence of these variables to our best ability: The two effort-groups turned out not to differ regarding the number of life events experienced, general work characteristics (work pressure, job control, social support), fatigue, work engagement, age and positive and negative affect. This does not exclude the possibility that other third variables (e.g., other aspects of personality) may have acted as third variables in this study, but this does not seem highly probable.

Fifth, this study did not offer insight in the intriguing question into the origin of the differences in work-related effort between the two subgroups studied. It may be that these

differences are at least partly due to differences in participants' objective work performance (e.g., number of publications or student evaluations), but such measure was not incorporated in this study. Thus, it is unclear how the differences between the two effort-groups in their work-related effort are related to real output differences, and future studies on this topic should also include objective measures of task performance.

Finally, the present research employed a very specific sample, consisting of academic staff members who worked at least 32 hours a week and who lived together with a partner who worked at least 2.5 days a week, and who, as is common for tenured academics in the Netherlands, have relatively high job security and are not dependent on fund raising. Although we believe that our main findings on the relations among effort, recovery, health and well-being are not unique to this sample, it is desirable to replicate this study for employees in other professions, in other family situations and/or with other working hours. Thus, future studies should employ samples from other contexts to broaden our understanding of effort and recovery patterns.

Assets of this study

In spite of these limitations, we believe that the present study extends and enhances previous research on effort and recovery in at least four respects. First, this study is among the very few that examine effort and recovery from a day-to-day perspective, allowing us to demonstrate that work-related effort is related to various aspects of daily work and (potential) recovery time. In this vein, this study shows how effort expenditure at work is actually imbedded in everyday life, and how it relates to recovery during time-off-the job.

Secondly, this study emphasized the importance of the weekend as a (potential) opportunity for recovery. Whereas some differences between the two effort-groups persisted throughout the weekend (e.g., higher levels of fatigue and effort-investment for the high-effort group), other differences manifested themselves only during the working week (i.e., less active leisure, more sleep complaints and more preoccupation with work for the high-effort group) or only during the weekend (i.e., more overtime work and less work motivation for the high-effort group). Thus, not all workers employ the recovery opportunities offered by the weekend in a similar fashion: Some seem to employ the weekend as a means to catch up with their overdue tasks. These results suggest that it would be worthwhile to study the reasons why workers differ in the way they use their weekend.

Thirdly, by paying attention to employees' activity patterns at work and outside work, we

were able to show that effort expenditure at work relates to activity patterns in the home domain. Namely, high levels of effort expenditure at work were associated with less engagement in active leisure and more overtime work. This finding thus suggests that for some workers, high effort expenditure at work is not compensated by a corresponding degree of participation in recovery activities. Given that an imbalance between effort and recovery is associated with adverse health outcomes, this particular group of workers may, in the long run, be a risk group for the development of ill-health.

Fourthly, we demonstrated that experiences associated with engagement in work and home activities are important: Higher effort investment at work is related to experiences of higher effort expenditure outside work, but not to experiences of less pleasure regarding work or home activities.

Practical implications

Based on our study's results, three practical suggestions can be formulated. Firstly, adequate control opportunities in the job setting will allow workers to adjust their work behavior to their current need for recovery and, thus, to prevent the development of negative load reactions during working. Secondly, employees should be encouraged to engage in leisure activities that potentially contribute to the recovery process, such as active leisure. Finally, the time spent on overtime work should be kept within acceptable limits, as overtime work impedes the recovery process. Employers should not to demand excessive overtime work from their employees, in order to guarantee sufficient (potential) recovery time (see also Beckers, Van der Linden, Smulders, Kompier, Taris, & Van Yperen, in press).

Theoretical implications

Our study revealed that workers who invest high effort at work differ in their off-the-job activity patterns from those who invest low effort at work: members of the first group are to a lesser degree engaged in active leisure during evenings in-between work days, and they spend more time on overtime work during the weekend. This different activity pattern may have consequences for the recovery process, as previous research suggests that active leisure promotes recovery, whereas overtime work impedes this process (Sonnentag, 2001). That recovery is endangered in the high-effort group is also evidenced by the higher levels of fatigue during non-work time (evenings and weekends) and the lower sleep quality during the week. Apart from a different activity pattern, those expending high effort at work also expend

high effort on home activities, which also may endanger the recovery process. Therefore, despite the fact that those investing high effort at work do not experience their activities as less pleasant than those expending low effort, they may be considered at risk for developing health problems in the long run.

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5

"How fatigued do you currently feel?"

Convergent and discriminant validity of a single-item fatigue-measure

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Abstract

Objective: The main aim of this study was to establish the convergent and discriminant validity of a single-item measure of daily fatigue ('How fatigued do you currently feel?') in a daily diary context.

Methods: Convergent validity of our measure was examined by relating it to a validated multiple-item measure of fatigue (Profile of Mood States; McNair, Lorr, & Droppelman, 1971) and to other daily (work-home interference, sleep complaints, work-related effort) and global (fatigue, health complaints, work-home interference, job pressure) measures that are conceptually related to fatigue. Discriminant validity was assessed by relating the single-item fatigue measure to daily (work-pleasure) and global (job control, social support, motivation to learn) measures that are conceptually distinct from fatigue.

Data were collected among 120 academic staff members, who completed a general questionnaire (tapping the global measures under study) and who took part in a 9-day daily diary study (3 measurements daily).

Results: Correlation patterns and multilevel analyses revealed strong and significant associations between the single-item fatigue measure and the variables incorporated to assess convergent validity (especially with the POMS: r = .80), thus supporting the convergent validity of our measure. Relations with variables included to examine discriminant validity were weak or unsignificant, supporting the discriminant validity of the single-item fatigue measure.

Conclusion: Despite this study's limitations (i.e., exclusive use of self-reports, specific sample) we conclude that this single-item fatigue measure offers a valid way to assess daily fatigue.

Key words: fatigue, academics, validity, diary study

5.1 Introduction

Fatigue is a central concept in occupational health psychology. Research on fatigue started with Angelo Mosso's pioneering work at the end of the 19th century (Mosso, 1894) and gained momentum during and after both World Wars, when research focused on the development of performance standards and work and rest time schedules (Meijman & Schaufeli, 1996). In recent years, many studies have examined fatigue (or its more extreme variant 'exhaustion') in relation with, for example, high work pressure (De Lange, Taris, Kompier, Houtman & Bongers, 2004), work-home interference (Van Hooff et al., 2005) or lack of recovery (Sluiter, Frings-Dresen, Van der Beek, & Meijman, 2001).

The aim of the present study is to validate a single-item measure of daily fatigue. The seed-bed for such a study is provided by the increasing usage of diary studies (Van Eerde, Holman, & Totterdell, 2005). Although such studies offer good opportunities to 'capture life as it is lived' (Bolger, Davis, & Rafaeli, 2003), participation in a diary study is rather demanding as it usually requires respondents' commitment during a period of several days (with sometimes various occasions per day). For that reason, it is important to ensure that potential respondents are not scared off in advance, and do not drop-out during the course of the study by keeping participants' effort investment within acceptable limits and by creating user-friendly diaries. One possible way to achieve this is to employ short, simple, and comprehensible questions to measure the constructs under study (Taris, 2000). In this regard, single-item measures seem to offer important advantages over multiple-item measures.

Single-item measures

One of the advantages of single-item measures over multiple-items measures is their face validity (Wanous, Reichers, & Hudy, 1997). It is immediately clear to the respondents which construct is being measured. A second and related advantage is that such a measure probably evokes less participant boredom, fatigue and frustration because there is no item redundancy (Robins, Hendin, & Trzesniewski, 2001) or repetition of comparable items. A third and more practical advantage is that single-item measures are quite convenient when space or time constraints limit the number of items that can be incorporated in a (diary) survey (Wanous et al, 1997; Robins et al., 2001). Finally, single-item measures may be more cost-effective than multiple-item measures, given that the costs of short questionnaires are lower than those of long questionnaires assessing the same concepts (Wanous et al., 1997).

Despite these potential advantages of single-item measures, the common practice in

academic research is to use multiple-item scales. Using single-item measures is generally discouraged, and reviewers often consider using such scales a 'fatal error'(Wanous et al., 1997) (p. 247). Indeed, this type of measures may suffer from at least two psychometric problems (Robins et al., 2001). A first concern is that single-item measures assessing broad and multi-faceted constructs lack content validity, in that it is difficult to tap all aspects of such a construct with only one item. Conversely, if the construct under study is sufficiently unidimensional (as previous research has shown regarding fatigue; Michielsen, De Vries, Van Heck, Van de Vijver, & Sijtsma, 2004), and unambiguous to the respondents, single-item measures are not necessarily inferior to multiple-item measures (Sacket & Larson, 1990). A second issue is that, in case of broad psychological constructs, multi-item measurement is needed to obtain reliable estimates of the participants' true scores on the phenomena of interest. The scores on the separate items of these measures may contain a large error component, but as these errors are presumed to be due to random factors, these should largely cancel each other out. Multi-item measures will therefore generally give a more reliable indication of the participants' true scores than single-item measures.

In sum, in case of uni-dimensional constructs, single-item measures may be psychometrically acceptable substitutes for multiple item measures, and may be preferred for reasons of efficiency and user-friendliness (Robins et al., 2001). Indeed, previous research on single-item measures already demonstrated that such measures can be valid alternatives for multiple-item scales tapping concepts such as job satisfaction (Wanous et al., 1997; Nagy, 2002), self-esteem (Robins et al., 2001), the Big-Five dimensions of personality (Woods & Hampson, 2005), and stress symptoms (Elo, Leppänen, & Jahkola, 2003). With respect to the measurement of (chronic) fatigue, Rohland, Kruse, and Rohrer (2004) showed that a single item of burnout was a good alternative for the exhaustion subscale within a burnout questionnaire (Maslach Burnout Inventory). Furthermore, in their study on cancer-related fatigue, Kirsh, Passik, Holtsclaw, Donaghy and Theobald (2001) concluded that a single fatigue item ('I get tired for no reason') could be a fast and accurate way to screen patients for fatigue. Schwartz et al. (2002) concluded that a single-item 11-point fatigue scale ('What is your level of fatigue today?') is sensitive to moderate changes in fatigue and is easily administered in a clinical setting.

The present study

The present study contributes to previous research on the validity and utility of single-item

measures of fatigue in five ways: 1) we examined daily fatigue in a sample of the general working population instead of a clinical sample; 2) we tried to minimize retrospection bias by assessing current fatigue three times a day rather than requesting a global rating reflecting fatigue during a whole day (Schwartz et al., 2002); 3) we employed a nine-day daily diary study, which enabled us to obtain more reliable estimates of the relationships between the fatigue-measure and other variables, and to examine the robustness of these relationships across time; 4) we extended validity information by investigating relationships between daily fatigue and daily constructs closely related to fatigue (i.e. alternative daily measures of fatigue, and daily measures of work home interference, work-related effort, and sleep complaints), as well as with constructs conceptually different from fatigue (i.e. daily work pleasure); and 5) we examined relationships between the single-item daily fatigue measure and more habitual or 'global' indicators of closely related (e.g., global fatigue, health complaints, work-home interference and work pressure) and different constructs (such as job control, social support, and motivation to learn). Such 'global' measures are usually employed in survey research and may thus be considered the gold standard. As these measures should reflect an aggregate of day-to-day experiences, it is important to relate the single-item daily fatigue measure to these more 'global' measures as well.

The validity of a measure refers to the extent to which it actually measures what it claims to measure. One important source of validity evidence stems from relationships with other measures. *Convergent* validity evidence is obtained when a measure is positively related to questionnaires that tap similar constructs (American Educational Research Association et al., 1999). The absence of relationships with measures that tap different constructs provides *discriminant* validity evidence (American Educational Research Association et al., 1999).

In order to provide convergent and discriminant validity evidence for a single-item measure of daily fatigue, we related a single-item report mark of fatigue to various other daily and global scales. Convergent validity evidence was investigated by relating the single-item report mark to the fatigue subscale of a well-validated instrument to measure fatigue, the Profile of Mood States (POMS; McNair, Lorr & Droppelman, 1971/1982/1992). Both measures were assessed three times daily, for nine consecutive days. Convergent validity was further assessed by relating the single-item fatigue measure to other 'stress-related' constructs, which are supposed to be associated with, but not identical to, fatigue. These related constructs comprised day-to-day measures on the one hand, and more 'global' measures on the other. To establish discriminant validity evidence, we investigated whether our single-item

report mark exhibits weak or negative associations with external variables that are conceptually different from fatigue and that are, thus, supposed to be not or only weakly related to fatigue. Again, both daily and global measures are addressed.

In sum, in order to validate the daily single-item report mark of fatigue, we address three research questions:

1) How does the single-item report mark of daily fatigue relate to daily fatigue as measured by the POMS? (convergent validity evidence);
2) How does the single-item report mark of fatigue relate to measures assessing other stress-related constructs, that is, to a) daily measures (i.e., work-home interference, work-related effort and sleep complaints) and b) global measures (i.e., fatigue, health complaints, work pressure, and work-home interference)? (convergent validity evidence);
3) How does the single-item report mark of fatigue relate to measures that are conceptually different from fatigue, that is, to a) daily measures (i.e., work pleasure) and b) global measures (i.e., job control, social support, and motivation to learn)? (discriminant validity evidence).

5.2 Method

Participants and procedure

The study was conducted in two stages among academic staff members of a Dutch university. As the data of the present study were collected as part of a study focusing on the work-nonwork interface of academics, of 696 tenured employees who worked at least three days a week only those could participate who (i) did not have a second job outside this university (to keep variation in work activities within acceptable limits), and (ii) lived together with a partner who worked at least 2.5 days a week (to increase the likelihood that the participants fulfilled at least some home obligations). A total of 146 employees agreed to participate. Of these, 133 completed a general questionnaire (91% response), assessing demographical information and global measures of interest for this study (see the 'measures' section).

Data from 13 participants were removed as they apparently did not meet the second inclusion criterion. The final sample therefore comprised 120 participants (62% male; 67% had at least one child living in the household; M_{age} was 45.2 years, SD = 7.8; they worked on average 34.2 (SD = 5.5) contractual hours weekly; 46% worked as an assistant professor, 17% as an associate professor, 11% as a full professor, and the remaining 26% had other jobs, such as researcher or lecturer). Due to strict privacy regulations, it was unknown how many of the

employees who were approached for participation in the study actually met our inclusion criteria (i.e. had no job outside the university and lived together with a partner who worked at least 2.5 days a week). Therefore, we do not know how many employees were in fact eligible for participation in the study, meaning that the overall response rate and the representativeness of our sample are not known.

In the second stage of the study (starting approximately ten days after the completion of the general questionnaire), the daily variables of interest were assessed by means of short questionnaires that were completed during two weekend-days (1st Saturday and 1st Sunday), followed by five weekdays (Monday to Friday) and again ending with two weekend-days (2nd Saturday and 2nd Sunday). On each of these nine consecutive days, three questionnaires were completed: (1) a morning questionnaire (to be completed after awaking in the morning, i.e., between 7.30 and 8.30 AM), (2) an afternoon questionnaire (to be completed around 6 PM), and (3) an evening questionnaire (to be completed before bedtime, i.e., between 10 and 11 PM). Only diaries that were completed within an acceptable time range around the requested time were included in the final database. We removed morning questionnaires that were completed more than 2 hours after awakening, afternoon questionnaires that were completed before 4.30 PM or after 8 PM, or less than 3 hours after the morning questionnaires, and evening questionnaires that were filled in less than 2 hours after the afternoon questionnaire or after 3 AM. This resulted in a total of 72.1% morning, 72.6% afternoon, and 78.5% evening questionnaires.

Daily Measures.

The *single-item fatigue report mark* was obtained each day in the morning, afternoon and evening questionnaires. Participants rated their current state of fatigue ('How fatigued do you currently feel?') with a report mark varying from '1' ('not at all') to '10' ('extremely').

Daily fatigue POMS was measured each day in the morning, afternoon and evening questionnaires with the six-item fatigue subscale of a shortened version of the Dutch translation of the Profile of Moods States (POMS; Wald & Mellenbergh, 1990). The POMS (McNair, et al., 1971/1982/1992) is a questionnaire for the measurement of moods, and since its development, the instrument has been used in almost 3,000 scholarly publications (McNair, Heuchert, & Shiloney, 2003). There is ample evidence for the validity of this instrument (Jacobson, Weiss, & Steinbook, 1978; Norcoss, Guadagnoli, & Prochaska, 1984; Reddon, Marceau, & Holden, 1985; Boyle, 1987).

Based on factor- and item-analyses, a shortened version of the Dutch translation of the POMS was developed by Wald en Mellenbergh (1990), in which the fatigue subscale comprised six items. In a previous study examining the factor structure of the 65-item version of the POMS, these six items showed the highest loadings on the fatigue factor (Norcoss et al., 1984). Wicherts and Vorst (2004) found support for the factor structure of the shortened Dutch POMS in a sample of 5,880 psychology freshmen and reported measurement invariance across gender for the fatigue-subscale as well.

Items were scored on a five-point scale (1 = 'not at all', 2 = 'a little', 3 = 'moderately', 4 = 'quite a bit', 5 = 'extremely'), and scale scores were computed as the mean of the six items. Three exemplary items are 'Right now, I feel exhausted', 'Right now, I feel worn out', 'Right now, I feel bushed' (morning: $\alpha = 0.87$, afternoon: $\alpha = 0.89$, evening: $\alpha = 0.89$).

Daily Work-Home Interference was measured with eight items during weekdays in the evening questionnaire. To this purpose the work-home interference subscale of the Survey Work-Home Interaction NijmeGen (SWING; Geurts et al., 2005) was slightly adapted to make the items suitable for day-to-day measurement. Two exemplary items are 'Today, my work took up time that I would have liked to spend with my spouse/family/friends' and 'Today I found it difficult to fulfil my domestic obligations, because I was constantly thinking about my work' (1 = 'no', 2 = 'a little' and 3 = 'yes', $\alpha = 0.82$).

Work-related effort was measured during weekdays in the afternoon questionnaire. Participants were requested to indicate with a report mark the extent to which they considered the preceding workday as effortful (1 = 'not at all', 10 = 'extremely').

To assess daily *sleep complaints* (each morning questionnaire), a sum score was computed of five items from a sleep quality scale (Van Veldhoven, De Jonge, Broersen, Kompier, & Meijman, 2002), slightly adapted to make them suitable for day-to-day measurement. Two exemplary items are: 'Last night I woke up several times' and 'I slept well last night' (reversed) (1 = 'yes', 0 = 'no', $\alpha = 0.71$). Each day's value for this variable refers to the previous night.

Daily Work pleasure was measured with one item in each weekdays' afternoon questionnaire. Participants were asked to indicate with a report mark the extent to which they considered the preceding workday as pleasurable (1 = 'not at all', 10 = 'extremely').

Measures derived from the general questionnaire

General fatigue was assessed with the 10-item Fatigue Assessment Scale (Michielsen, De Vries, & Van Heck, 2003), which addresses mental as well as physical aspects of fatigue. Two

exemplary items are 'I am bothered by fatigue' and 'Mentally, I feel exhausted' (1 = '(almost) never', 5 = '(almost) always'), with higher scores reflecting higher levels of fatigue ($\alpha = 0.86$).

Health complaints were measured with a Dutch questionnaire on subjective health developed by Dirken (1969), the so-called VOEG. In this study the 13-item version (VOEG13) was used (Joosten & Drop, 1987), which is extensively validated in Dutch samples. Participants were asked whether or not they experienced each of 13 health complaints. Two exemplary items are: 'Do you fairly often suffer from headache?' and 'Do you fairly often feel dizzy?' ('yes' = 1; 'no' =0). For each participant, a sum score was computed reflecting the reported number of health complaints ($\alpha = 0.71$).

Global Work-home interference was measured with an eight-item subscale from the SWING (Geurts et al., 2005). Two exemplary items are 'How often does it happen that you find it difficult to fulfil your domestic obligations because you are constantly thinking about your work?' and 'How often does it happen that you have to work so hard that you do not have time for any of your hobbies?', 0 = '(almost) never', 1 = 'sometimes', 2 = 'often' 3 = '(almost) always'. Higher scores reflect higher levels of work-home interference ($\alpha = .73$).

Job pressure was measured with five items adapted from the Job Content Questionnaire (Karasek, 1985), that were rephrased as questions [e.g., 'Do you have to work very fast?' and 'Do you have enough time to get the job done?' (reversed) ; 1 = '(almost) never', 4 = '(almost) always'; $\alpha = .73$].

We used six items from Van Veldhoven et al. (2002) to measure *Job control.* Two exemplary items are: 'Can you take a short break if you feel this is necessary?' and 'Can you decide for yourself how to do your job?' (1 = '(almost) never', 4 = '(almost) always'; $\alpha = .68$).

Social support was measured with eight items adapted from Geurts, Rutte, and Peeters (1999). Four items assess support received from colleagues (e.g., 'My colleagues show their appreciation for the way I do my job'), and also four items measure support received from ones supervisor (e.g., 'My supervisor shows her/his appreciation for the way I do my job', 1 = '(almost) never', 4 = '(almost) always'; $\alpha = .90$).

To measure employees' motivation to learn in their job, we used seven items from the *Motivation to Learn* scale (Van Mierlo, Rutte, Seinen, & Kompier, 2001). Two exemplary items are: 'In my job, I feel encouraged to learn new things' and 'In my job, I can develop myself' (1 = '(almost) never', 4 = '(almost) always'; $\alpha = 0.76$).

Demographic variables. Sex (0 = male, 1 = female), age (in years) and job class [1 = assistant professor (both teaching and research) , 2 = associate professor (both teaching and

research), 2 = full professor (both teaching and research), 4 = researcher (no teaching), 5 = lecturer (no research), 6 = other) were included as demographic variables.

Statistical analyses

Global and Daily variables: Descriptive Analysis. Correlations were computed to obtain insight in the associations between the single-item fatigue report mark and the alternative fatigue measure (POMS, *Research Question 1*), and between the single-item fatigue report mark and the other (daily and global) variables that were incorporated in order to assess convergent (*Research Question 2*) and discriminant (*Research Question 3*) validity. For all daily variables (including both the fatigue report mark and the multiple item alternative, POMS), the correlations were based on their mean values across all measurement points.

Daily variables: Multilevel analyses. Correlations offer basic insight in the associations among the fatigue report mark, the POMS fatigue measure and the other daily variables under study. However, our 'rich' diary data allow us to examine the stability of the relationships of interest across all days of the observation period. To investigate this issue, multilevel analysis should be used (Snijders & Bosker, 1999; Hox, 2002) as our day-level data (level 1) are not statistically independent as they are nested within persons (level 2). Multilevel analysis takes into account that the data at the lowest level (in this case, the day level) are nested within a higher-order level (i.e., the participants), effectively resolving the statistical dependencies and the bias this may create. Using multilevel analysis it is possible to specify and compare models with each other. In the present case, the first model to be compared includes only an intercept and in the following models predictors (both on the person and on the day level) can be added consecutively. The improvement of one model above a previous one can be tested using a likelihood ratio statistic (following a χ^2-distribution with the number of additional predictors as df; Snijders & Bosker, 1999; Hox, 2002)

We used the MLWiN 2.0 software package (Centre for Multilevel Modelling, 2005) and all variables were standardized based on their grand mean. As there was no reason to expect relationships between independent and dependent variables to differ between the study's participants, we chose not to model random slopes, but only a random intercept.

To study the relationships between the fatigue report mark and the alternative fatigue measure (POMS; *Research Question 1*), a series of analyses was conducted, in which the POMS served as the dependent variable. We started with a Null model, in which only a random intercept was specified. In Model 1, the fatigue report mark was included to obtain

insight in the relationships between this measure and the POMS. Model 2 additionally included sex, age, and job class (entered as five dummy variables). Time and Day were subsequently added as covariates in Model 3, because fatigue may vary across time of the day as well as across day of the week. Time was entered as a continuous variable (0 = morning, 1 = afternoon, and 2 = evening). The nine days of the study were represented by eight dummy variables, with Monday as the reference category. In Model 4, two Time x Fatigue report mark and eight Day x Fatigue report mark interactions were incorporated to examine whether the strength of the relationship between the two fatigue measures (report mark and POMS) was stable across time of the day and/or the days of the study.

Four series of analyses were conducted to investigate the relationships between the fatigue report mark and each of the four daily variables that were assessed to obtain convergent (*Research Question 2*: sleep complaints, work-related effort and work-home interference) and discriminant validity evidence (*Research Question 3*: work pleasure). In each case, the respective daily measure served as the dependent variable. As these measures were assessed only once a day, we chose to calculate and include mean daily levels of the fatigue report mark in these analyses, instead of the original three values for each day. Similar to *Research Question 1*, for each of the four daily variables, a Null model was computed that only contained a random intercept. In Model 1, the fatigue report mark was entered as a predictor. Model 2 additionally included sex, age and job class as covariates. The Day covariates were entered as dummy variables (with again Monday as a reference category) in Model 3. Model 4, finally, incorporated eight (or four, if a measure was only assessed during week days) Day x Fatigue report mark interactions, to examine whether the strength of the association between fatigue and the daily dependent variable under study varied across the days of the study.

5.3 Results

Global and Daily variables: Descriptive Analysis

For each of the 27 measurement points the mean levels of both fatigue-measures are presented in Figure 5.1. This figure shows that both measures follow similar patterns during the research period (although the report mark's amplitude is higher due to its wider range, that is, 1-10 vs. 1-3 for the POMS measure).

Figure 5.1. Mean levels of the single-item fatigue report mark ('Report mark') and the POMS on all measurement occasions (Number of observations between 80 and 98 depending on missing values)

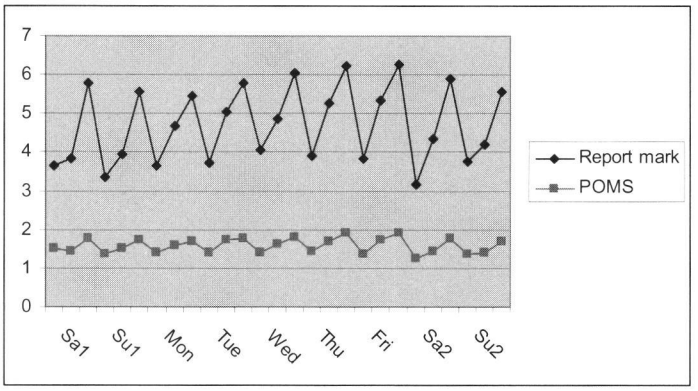

Table 5.1 presents the means, standard deviations and correlations of the variables under study. Levels of global fatigue in this sample (M = 1.89, sd = 0.59) did not significantly differ from those in a heterogeneous sample of 1,123 employees [Geurts et al., 2005; M = 1.97, sd = 0.57; $T(1241)$ = -1.46]. Also, levels of health complaints (M = 2.56, sd = 2.33) did not differ from those in a heterogeneous sample of 1,421 employees [Geurts, Kompier, Roxburgh, & Houtman, 2003; M = 2.62, sd = 2.67; $T(1539)$ = -0.24]. The levels of global WHI (M = 1.02, sd = 0.42) were higher than those in a heterogeneous sample of 1,857 workers [Geurts et al., 2005; M = 0.86, sd = 0.48; $T(1975)$ = 3.56], and levels of job control (M = 3.23, sd = 0.43) were higher than in a heterogeneous sample of 1,740 workers [Geurts et al. 2005; M = 2.54, sd = 0.63; $T(1858)$ = 11.81] as well.

Regarding convergent validity, Table 5.1 shows a high correlation between the POMS and the report mark (r = .80, p<.01). Furthermore, the fatigue report mark was substantially related to global fatigue (r = .51, p<.01) and global work-home interference (r = .55, p<.01). A somewhat lower association was observed with global health complaints (r = .35, p<.01). The fatigue report mark showed no significant association with global job pressure (r = .16, p>.05). As to the daily measures, the fatigue report mark was significantly related to all three measures incorporated to address convergent validity ($r_{\text{daily WHI}}$ = .45, p<.01; $r_{\text{daily sleep complaints}}$ = .45, p<.01; $r_{\text{dailywork-related effort}}$ = .47, p<.01). In sum, these results provide convergent validity evidence for the fatigue report mark. Furthermore, the single-item report mark was not significantly related to the global ($r_{\text{job control}}$ = -.12, p>.05; $r_{\text{social support}}$= .02, p>.05; $r_{\text{motivation to learn}}$ = -.02, p>.05) and daily ($r_{\text{work pleasure}}$ = -.02, p>.05) variables incorporated to provide discriminant validity evidence. As

Table 5.1. Means, standard deviations and correlations of the variables under study [number (%) of missing values between 0 (0%) and 22 (18,3%); mean number of missing values = 13 (10.8%)]. (*p<.05; **p<.01)

Measure	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1 fatigue report mark	1.60	0.44	1											
2 POMS	4.73	1.59	.80**	1										
3 daily WHI	1.38	0.36	.45**	.53**	1									
4 daily sleep complaints	1.40	0.88	.45**	.45**	.32**	1								
5 daily work-related effort	5.25	1.75	.47**	.28**	.34**	.22*	1							
6 global fatigue	1.89	0.59	.51**	.52**	.33**	.36**	.11	1						
7 global health complaints	2.56	2.33	.35**	.43**	.29**	.30**	-.03	.66**	1					
8 global WHI	1.02	0.42	.55**	.58**	.66**	.37**	.34**	.63**	.48**	1				
9 global job pressure	2.44	0.51	.16	.19	.20*	.10	.27**	.06	.03	.26**	1			
10 daily work pleasure	6.76	0.95	-.02	-.08	-.24*	-.06	-.08	-.23*	-.15	-.21*	-.09	1		
11 global job control	3.23	0.43	-.12	-.11	-.28**	-.20*	-.05	-.17	-.13	-.28**	-.25**	.25*	1	
12 global social support	2.46	0.69	.02	.08	-.17	-.10	-.07	-.12	-.21*	-.18*	-.07	.15	.18	1
13 global motivation to learn	2.60	0.43	-.02	.04	-.04	-.07	.00	-.18*	.03	-.04	.21*	.26**	.13	.27**

discriminant validity can be established by showing the construct under study not to be related to measures that tap conceptually different constructs (American Educational Research Association et al., 1999), these results offer support for the discriminant validity of the fatigue report mark.

Daily variables: Multilevel analyses

Research Question 1. Table 5.2 presents the multilevel estimates for the models predicting the POMS fatigue measure from the fatigue report mark. Model 1, which includes the fatigue report mark, provided a significantly better fit than the Null Model and revealed a strong and positive association between both fatigue measures ($\beta = .70$, $p<.01$). The covariates are added in Model 2, but this model did not improve upon Model 1. This indicates that sex, age and job class are not related to fatigue as measured with the POMS. The inclusion of Time and Day in Model 3 did provide a better fit than Model 2, but none of the separate time or day effects reached significance. Model 4, which fitted better than Model 3, included the Time x Fatigue report mark and Day x Fatigue report mark interactions. These interactions showed that the strength of the relationship between the fatigue report mark and the POMS increased slightly from morning to evening (Time x Fatigue report mark interaction: $\beta = .09$, $p<.01$), and during the course of the working week (Day x Fatigue report mark interaction: Wednesday: $\beta = .10$, $p<.05$; Thursday: $\beta = .16$, $p<.01$; Friday: $\beta = .17$, $p<.01$). Although statistically significant, the relevance of these variations can be questioned, as the model including these relationships explained only one percent more variance than the model not including them. In sum, these results provide convergent validity evidence for the fatigue report mark.

Research Question 2 and 3. Multilevel Estimates for models relating the daily variables to the single-item measure of fatigue are presented in Table 5.3.

Daily Sleep complaints. Model 1, in which the single-item fatigue measure is included, provided a significant improvement above the Null model. The model shows the report mark and sleep complaints to be positively related ($\beta = .51$, $p<.01$). Adding sex, age and job class in Model 2 did not significantly improve the fit compared to Model 1. However, including 'Day' in Model 3 did result in a better fitting model. The model shows that, generally, compared to

Monday, sleep complaints were lower in the weekends (1st Sunday: β = -.28, p<.05; 2nd Saturday: β = -.59, p<.01; 2nd Sunday: β = -.25,

Table 5.2. Multilevel estimates for Models Predicting Fatigue POMS from fatigue report mark

Model and variables	-2*LL	diff -2*LL (df)	Level 1 intercept variance (SE)	Level 2 intercept variance (SE)	R^2
Null model Intercept	5891.92		.65 (.02)	.38 (.06)	
Model 1 Intercept, report mark	4267.06	1624.86 (1) ***	.33 (.01)	.14 (.02)	.53
Model 2 Intercept, report mark, covariates	4261.99	5.07 (7)	.33 (.01)	.14 (.02)	.54
Model 3 Intercept, report mark, covariates, Time, Day	4243.87	18.12 (9)*	.32 (.01)	.14 (.02)	.54
Model 4 Intercept, report mark, covariates, Time, Day, Time*report mark, Day* report mark	4174.76	69.10 (9)***	.31 (.02)	.14 (.02)	.55

*p<.05; *** p<.001; *Note:* LL = log likelihood; diff = difference

p<.05) and in the second half of the working week (Thursday: β = -.37, p<.01; Friday: β = -.50, p<.01).Finally, Model 4, including the Fatigue report mark x Day interactions, did not provide a better fit, indicating that the strength of the relationship between sleep complaints and the fatigue report mark was constant during the observation period. Altogether, these results offer support for the validity of the fatigue report mark.

Daily Work-Home Interference. Model 1, which fitted the data significantly better than the Null Model, showed a positive association between the fatigue report mark and daily work-home interference (β = .35, p<.01). Model 2, in which the covariates are modelled, did not improve significantly upon Model 1, indicating that sex, age and job class are not related to daily work-home interference. 'Day' is included in Model 3, and this model fitted better than Model 2. This model revealed that work-home interference was generally lower on Friday (β = -.27, p<.05) compared to Monday. Note that weekend-days were not included in the model, as

work-home interference was only assessed during weekdays. As including interactions with Day did not improve model fit, it can be concluded that the strength of the association between fatigue and daily work-home interference was invariant across the week days. Thus, in sum, these findings provide support for the convergent validity of the fatigue report mark.

Daily work-related effort. Model 1 showed a positive association between the fatigue report mark and daily work-related effort (β = .35, p<.01) and provided a significantly better fit above the Null Model. The covariates were incorporated in Model 2, but this model did not fit better than Model 1, indicating that sex, age, and job class are not related to daily work-related effort. Model 3, in which 'Day' is included, did not fit better than Model 2, indicating that, generally, levels of work-related effort were stable during the week. Note that, again, weekend-days were not included in the model, as work-related effort was only assessed during weekdays. Including Fatigue report mark x Day interactions in Model 4 did not result in a better fitting model. Therefore, it can be concluded that the strength of the association between the fatigue report mark and work-related effort did not differ from day to day. Overall, these findings provide support for the convergent validity of the fatigue report mark.

Daily Work Pleasure. Model 1 provided a significant improvement above the Null model and showed that the fatigue report mark was negatively albeit relatively weakly related to daily work-pleasure (β = -.18, p<.01). Including the covariates in Model 2 did not result in a better fitting model, thus showing that age, sex and job class are not related to daily work pleasure. Model 3, in which 'Day' is included did not provide a better fit either. This indicates that levels of work pleasure were stable across the days of the week. As work pleasure was only assessed during weekdays, weekend-days were not included in the model. Incorporating Fatigue report mark x Day interactions in Model 4 did not improve the model fit, pointing out that the strength of the association between the fatigue report mark and daily work pleasure is stable during the observation period. As work pleasure is conceptually different from fatigue, its weak (negative) association with fatigue supports the discriminant validity of the fatigue report mark.

Table 5.3. Multilevel estimates for Models relating the fatigue report mark to the daily variables

Daily variable	Model and variables#	-2*LL	diff -2*LL(df)	Level 1 intercept variance (SE)	Level 2 intercept variance (SE)	R^2
Daily sleep complaints	Null model	2090.52		.80 (.04)	.19 (.04)	
	Model 1	1930.53	159.99 (1)***	.65 (.04)	.14 (.03)	.20
	Model 2	1927.03	3.5 (7)	.65 (.04)	.13 (.03)	.21
	Model 3	1890.56	36.47 (4)***	.62 (.03)	.14 (.03)	.23
	Model 4	1884.50	6.06 (4)	.61 (.03)	.14 (61)	.24
Daily WHI	Null model	985.58		.51 (.04)	.50 (.09)	
	Model 1	947.48	38.10 (1) ***	.49 (.04)	.35 (.07)	.16
	Model 2	939.47	8.01 (7)	.48 (.04)	.32 (.07)	.20
	Model 3	928.40	11.07 (4)*	.47 (.04)	.32 (.06)	.21
	Model 4	928.02	0.37 (4)	.47 (.04)	.31 (.06)	.22
Daily work-related effort	Null model	962.26		.48 (.04)	.53 (.10)	
	Model 1	922.60	39.66 (1)***	.45 (.04)	.38 (.07)	.19
	Model 2	918.69	3.91 (7)	.45 (.04)	.36 (.07)	.21
	Model 3	913.43	5.26 (4)	.45 (.04)	.35 (.07)	.22
	Model 4	910.41	3.02 (4)	.45 (.04)	.34 (.07)	.22
Daily work-pleasure	Null model	1028.29		.66 (.06)	.32 (.07)	
	Model 1	1019.17	9.11 (1)**	.64 (.05)	.33 (.07)	.02
	Model 2	1013.65	5.52 (7)	.64 (.05)	.30 (.07)	.05
	Model 3	1007.86	5.79 (4)	.62 (.05)	.30 (.07)	.06
	Model 4	1001.09	6.77 (4)	.61 (.05)	.30 (.07)	.07

*p<.05; **p<.01; ***p<.001
Note: LL = log likelihood
diff = difference

Null model: Intercept only
Model 1: Intercept, report mark
Model 2: Intercept, report mark, covariates
Model 3: Intercept, report mark, covariates, Day
Model 4: Intercept, report mark, covariates, Day, Day * report mark

5.4 Discussion

The present study was designed to establish convergent and discriminant validity evidence for a single-item report mark of fatigue in the context of a daily diary study. To this purpose, we related this report mark to other daily diary measures and to more habitual or 'global' measures derived from a general questionnaire.

Convergent validity

Results provided evidence for the convergent validity of the single-item fatigue report mark. First, crude correlations revealed a very strong association between the report mark and the alternative multiple item measure (POMS). This result was confirmed using multilevel analysis. Although this analysis also revealed some statistically significant variations in the strength of this association across the time of the day and days of the week, the relevance of these variations can be questioned, as they only explained one percent additional variance.

Secondly, the fatigue report mark was substantially correlated with other, supposedly related, daily variables: daily work-home interference, daily sleep complaints and daily work-related effort. These findings were confirmed by means of multilevel analysis. Moreover, this latter analysis showed that the associations between the report mark and these daily variables were stable across the observation period, and, thus, did not depend on the day they were measured.

Finally, the fatigue-report mark was related to three out of the four global variables included to investigate its convergent validity. It was substantially correlated with global fatigue, global health complaints and global work-home interference. No significant association was found with global job pressure.

Discriminant validity evidence

This study also supports the discriminant validity of the single-item fatigue report mark, as it revealed only nonsignificant or weak relationships with measures supposed to tap different constructs than fatigue. Correlations show that this measure is not significantly related to daily work pleasure and multilevel analysis revealed only a weak negative association with this variable. The report mark was also unrelated to any of the global measures incorporated to examine discriminant validity (i.e., global job control, global social support, global motivation to learn).

Single-item vs. multiple-items measures of fatigue

Whereas these results support the convergent and discriminant validity of our single-item measure of fatigue, they also raise the question how our single-item measure performs compared to the six-item fatigue scale of the POMS in this respect. To address this issue, post-hoc analyses were conducted. Regarding the correlations with the other daily measures and with the global measures in the study, results showed that both fatigue measures are equally strongly related to all measures except to daily work-related effort, where the report mark showed a somewhat stronger relationship (see Table 5.1). We also repeated the multilevel analyses for the daily measures that were included to examine convergent and discriminant validity, but now we included the POMS (instead of the report mark) as the independent variable (results can be obtained from the first author on request). For each daily variable, we compared the fit of two models (one the POMS and one including the report mark as independent variable) using Schwarz's Bayesian Information Criterion (BIC; Schwarz, 1978). Following this procedure, it became clear that the POMS and the single-item fatigue measure were equally related to the other daily measures (daily sleep complaints, daily WHI, daily work-related effort, and daily work-pleasure). Thus, based on these additional analyses, it can be concluded that the report mark is equivalent to a well-validated six-item measure of fatigue.

Limitations and suggestions for future research

We believe three limitations and suggestions for future research deserve to be mentioned. First, the present research employed a specific sample: academic staff members who worked at least 3 days a week and who lived together with a partner who worked at least 2.5 days a week. Although there seems no reason to assume that our main findings on the relations between the single-item fatigue measure and the other daily and global variables are unique to this sample, it is desirable that this study is replicated among employees in other professions, in other family situations and with other working hours.

Second, our study exclusively employed self-report measures. This may have led to an overestimation of the associations among the variables under study due to common method variance (Spector, 2006). However, common method variance should have inflated all associations studied, and not just part of these. Thus, the fact that some relationships were found in this study while others were not, argues against this possibility. Moreover, alternative measures such as physiological measures should not by definition be considered superior to

self-report measures, because these are not free of error variance either (Semmer, Grebner, & Elfering, 2004; Kompier, 2005; Sonnentag, in press). Furthermore, by demonstrating that a) using self-reports does not guarantee finding significant results, b) potential biasing variables (social desirability, negative affectivity and acquiescence) do not generally inflate correlations among study variables, and c) monomethod correlations are not by definition higher than multimethod correlations, Spector (2006) concluded that 'the popular position suggesting common method variance automatically affects variables measured with the same method is a distortion and oversimplification of the true state of affairs' (p221). In sum, we do not believe that common method bias severely biased our findings. In this respect, the use of physiological and performance measures in addition to self-reports could provide interesting insights in future research.

Third, although the present study sheds light on the associations between a single-item fatigue-measure and variables supposed to provide an indication of convergent and discriminant validity evidence, it did not examine the ability of this measure to capture differences in fatigue due to 'interventions' such as vacations or overtime reduction programs. Future research should therefore examine whether this single-item fatigue-measure is sensitive to the supposedly beneficial effects of these 'interventions' [cf. Schwartz et al. (2002)'s study on minimally important clinical differences].

Contributions and implications of this study

In addition to its limitations, we believe the present study's assets should be acknowledged as well. First, we employed a daily diary design with 27 repeated measurements (i.e., nine consecutive days and three measurements daily). This design enabled us to obtain reliable estimates of the relationships between the single-item fatigue-measure and the other daily variables included, and made it possible to investigate, and confirm, the stability of these relationships across the research period.

Secondly, we included relationships between our daily single-item fatigue-measure and both daily and global measures assessing constructs that could provide convergent and discriminant validity evidence.

Finally, and most importantly, the results of our study provide substantial and convincing evidence for the validity of a report mark as a daily measure of fatigue. As the single item measure is psychometrically equivalent to the well-validated six-item fatigue measure, our study has important practical implications for research in this area. It implies that, in contexts

where it is important to ask participants as few questions as possible (e.g., in daily diary studies), a single-item suffices to measure fatigue.

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6

General Discussion

6.1 Introduction

By employing different time frames (i.e., a two-wave one-year longitudinal study and detailed day-to-day observations) this thesis aimed at further disentangling the processes underlying the relationships between WHI and its presumed antecedents and consequences. In this final chapter, we summarize our findings (6.2), address the theoretical implications of our results and formulate recommendations for future studies (6.3), and discuss both the limitations and the contributions of our research (6.4). We conclude with a discussion of the practical implications of our findings (6.5).

6.2 Summary of main findings, theoretical implications, and suggestions for future research

In chapter 1, we discussed three unresolved issues of previous research on WHI. We indicated (1) that there was only limited insight in the causal relationships between WHI and employee health, (2) that it was still largely unclear how global reports of WHI manifest themselves in everyday life, (3) that we did not have insight in the relationship between work-related effort expended daily and employees' activities and health and well-being during work time and during potential recovery time in-between workdays and during the weekend. We also addressed an interesting and unresolved issue regarding daily diary research in general: We raised the question whether it is possible to use a valid single-item measure of fatigue in a daily diary context. These four issues were transformed into ten research questions that were answered in chapters 2 to 5. In this section, we briefly summarize the results relevant to each research question, address the theoretical implications of these findings, and formulate suggestions for future research. Table 6.1 presents for each research question a short overview of the results, theoretical implications and recommendations for future research.

Table 6.1. Unresolved issues, associated research questions, results, theoretical implications and recommendations of this thesis (table continues overleaf)

Unresolved Issue Earlier Research	Research Questions	Results	Theoretical implications	Future studies should:
1. What are the longer term causal relationships between work-home interference and employee health?	*Question 1a:* Which longer term causal relationships exist between work-home interference and employee health?	Strain-based, but not time-based WHI acts as predictor of fatigue and depressive complaints	Normal causal relationship between (strain-based) WHI and employee health exists	Employ varying time lags Further investigate reversed causal relationships between WHI and employee health
	Question 1b: How do health complaints develop over time as a function of stable and changed levels of work-home interference?	Increase in strain-based WHI and stable high level of strain-based WHI are associated with increase in fatigue and depressive complaints	Accumulation of health complaints for employees with stable high levels or increase in (strain-based) WHI	Examine position of time-based WHI in causal chain leading from WHI to health complaints
2. How does a global measure of WHI manifest itself in everyday work and home life?	*Question 2a:* How do global reports of work-home interference relate to daily indicators of employee health and well-being?	Positive relation with daily fatigue and sleep complaints	Global WHI is positively related to health complaints that indicate lack of recovery	Further examine if and when the course of health complaints starts to diverge between employees with high levels of global WHI and employees with low levels of global WHI
	Question 2b: How do global reports of work-home interference relate to the time spent daily on (effortful) work activities?	No relation with daily time spent on (effortful) work activities	Global WHI is positively related to activities interfering with recovery and negatively to activities contributing to recovery	
	Question 2c: How do global reports of work-home interference relate to daily time spent on home activities?	Related to daily time spent on overtime work in evening, to daily time spent on low-effort leisure, but not to daily time spent on active leisure and domestic activities		

Table 6.1 continued

Unresolved Issue Earlier Research	Research Questions	Results	Theoretical implications	Future studies should:
3. What is the relationship between work-related effort and 1) activity patterns and 2) health and well-being during work time and during potential recovery time, in-between workdays and during the weekend?	*Question 3a:* How is work-related effort associated with activities and health and well-being during work time?	No association with activity patterns during work time and with pleasure derived from these activities. Positive relationship with effort expended on separate work activities and with (increase of) work-related fatigue during day	Daily work-related effort is positively related to health complaints indicating lack of recovery, both during week and in weekend	Provide insight in causal chain that links daily work-related effort and activities, experiences and health and well-being during work time and in (potential) recovery time
	Question 3b How is work-related effort associated with activities and health and well-being in-between work days?	Negative relationship with engagement in active leisure activities. Positive association with effort expended in separate home activities, with fatigue and sleep complaints and with preoccupation with work. No relationship with work motivation, pleasure experienced in each home activity, and engagement in domestic activities, active leisure and overtime work	Daily work-related effort is positively related to activities interfering with recovery and negatively to activities contributing to recovery, both during week and in weekend	
	Question 3c: How is work-related effort associated with activities and health and well-being in the weekend?	Positive relationship with overtime work, effort expended in separate activities and fatigue. Negative relationship with work motivation. No relationship with domestic activities, active leisure low-effort leisure and pleasure experienced in each home activity	Daily work-related effort is positively related to effort expended in work and home activities during week and weekend, but not to pleasure derived from these activities	
4. Is it possible, in a daily diary context, to use a valid single-item measure of fatigue?	*Question 4a:* What is the convergent validity of a single-item measure of fatigue?	Support for convergent validity of the single-item measure	Convergent evidence supports validity of a single-item measure of fatigue in a daily diary context	Further examine validity of a single-item fatigue-measure
	Question 4b: What is the discriminant validity of a single-item measure of fatigue?	Support for discriminant validity of the single-item measure	Discriminant evidence supports validity of a single-item measure of fatigue in a daily diary context	

Unresolved Issue 1: What are the causal relationships between work-home interference and employee health?

Due to the cross-sectional nature of most previous studies that address WHI [cf. most of the studies in Allen et al.'s (2000) meta-analysis], there was only limited insight in the causal relationship between WHI and employee health. Also, the few longitudinal studies conducted on this subject reported mixed results regarding the direction of the causal relation between these variables (cf. Frone, Russell & Cooper, 1997; Grant-Vallone & Donaldson, 2001; Kinnunen, Geurts & Mauno, 2004; Kelloway, Gottlieb & Barham, 1999). This could at least partly be attributed to the fact that these studies did not acknowledge all three types of causation, namely 'normal causation' (i.e., WHI → health), 'reversed causation' (i.e., health → WHI) and 'reciprocal causation' (i.e., WHI → health and health →WHI). Therefore, in *Research Question 1a*, we raised the question which causal relationships exist between WHI and employee health. Within a one-year time lag, we examined all three types of causation (chapter 2), and found strain-based WHI, but not time-based WHI, to be longitudinally related to employees' levels of fatigue and depressive complaints one year later.

However, by just testing all three types of causation, it was still not possible to fully disentangle the causal associations between WHI and health. It might have been the case that the level of WHI was high for (part of) the participants at the start of the study, while this level was low for others at this point in time. Furthermore, some workers might have gone through a change in experienced WHI during the observation period, whereas the situation of others might have been typified by stable levels of WHI. *Research Question 1b* therefore focused on the question how health complaints develop over time as a function of stable and changed levels of WHI. We took a closer look at four theoretically derived subgroups that were characterized by different WHI patterns across time (cf. De Lange, Taris, Kompier, Houtman & Bongers, 2002; Kinnunen, Geurts & Mauno, 2004) and found that employees who showed an increase in WHI during the one-year study interval, also reported an increase in health complaints. More interestingly, workers who experienced a relatively high level of WHI at both waves did not only report more health complaints than those who reported a low WHI-level at the respective wave, but also showed deterioration in health over time. Furthermore, workers reporting stable low levels of WHI also reported low levels of health complaints on both measurement occasions, whereas those experiencing a change from high to low WHI during the course of the study did not report an accompanying decrease in health complaints.

From a theoretical point of view, these results support our assumption that WHI is associated with health complaints because it signifies a lack of recovery: WHI (time 1) was longitudinally related to fatigue and depressive complaints (time 2: one year later), and within the four WHI-subgroups these complaints developed across time according to the patterns that were expected on basis of Effort-Recovery theory (Meijman & Mulder, 1998).

These results nonetheless only concerned strain-based WHI. Time-based WHI did not exhibit longitudinal relationships with employee health within a one-year time-interval. Why is that? It may be that work-related tension impeding functioning and recovery at home (i.e. strain-based WHI) acts as a more immediate precursor of increased levels of health complaints than time devoted to work making it impossible to meet home obligations (i.e. time-based WHI). This is plausible given the fact that strain-based WHI is conceptually closer to the outcome variables than time-based WHI.

We examined the above relationships within a one-year time frame. Although previous research (De Lange, Taris, Kompier, Houtman, & Bongers, 2003) showed such a time lag to be valid to study causal relationships between work characteristics and employee health, we do not know if it covers the underlying causal interval in which WHI results in health complaints. Therefore, we recommend future studies to employ time lags of varying length (e.g., weeks, months, years) to study the effects of WHI on employee health. Furthermore, due to the exclusion of participants with relatively high burnout levels at the first wave of data-collection, this thesis did not provide satisfactory insight in possible reversed causal relationships between WHI and employee health. Future studies should address this issue in more detail. Finally, future studies should further examine the place of WHI in the causal chain leading from WHI to health complaints.

Unresolved Issue 2: How does a global measure of WHI manifest itself in everyday life?

Surprisingly little insight had been obtained in what the general experience of WHI actually signifies in everyday life. This is due to the cross-sectional design of most research addressing WHI (cf. Allen et al., 2000; Byron, 2005) and the relatively long time lags employed in the limited number of longitudinal studies conducted so far (e.g., Frone, Russell, & Cooper, 1997). Therefore, in chapter 3, we addressed three research questions to obtain more insight in the meaning of WHI in everyday life. *Research Question 2a* focused on the question how global reports of WHI relate to daily indicators of employee health and well-being within a five-day observation period (Monday - Friday). We found global WHI to be positively related to daily

fatigue and sleep complaints during this period. We did not find the expected deterioration of health and well-being across the week for those reporting relatively high levels of global WHI.

Due to the type of research designs employed so far in WHI-research, there was also only limited insight in how employees' activity patterns relate to the occurrence of global WHI. *Research Question 2b* therefore addressed how global reports of WHI relate to the time spent daily on (effortful) work activities. Results showed that global WHI was not related to the time spent daily on (effortful) work activities during regular work hours, but that it was positively related to hours devoted to overtime work in the evening.

Because of the potential opportunities for external recovery that the home domain offers (Meijman & Mulder, 1998), *Research Question 2c* focused on how global reports of WHI relate to time spent daily on home activities. We investigated if and how global WHI was related to the time spent daily on domestic activities, active leisure activities, and low effort leisure activities during the five days of a workweek (Monday - Friday). Whereas no associations were observed with domestic activities and active leisure activities, it turned out that higher levels of global WHI were related to less time spent daily on low effort leisure activities.

From a theoretical point of view, the study reported in chapter 3 shows that global WHI is positively related to the amount of effort expended on a day-to-day basis (i.e. positive association between global WHI and time spent on overtime in the evening), and negatively to activities that may contribute to recovery from work demands (i.e. negative association between global WHI and time spent on low effort activities). Consistent with previous findings (cf. chapter 2), WHI was positively associated with health complaints reflecting lack of recovery (i.e. fatigue, sleep complaints). However, our analyses in chapter 3 did not show the expected increase in health complaints during the week for employees experiencing high levels of WHI. As chapter 2 revealed that employees reporting stable high levels of global WHI across a one-year time period show an increase in these complaints, we recommend future studies to cover multiple day-to-day observation periods (e.g. every two months) to advance insight in this respect.

Unresolved Issue 3: What is the relationship between work-related effort and 1) activity patterns and 2) health and well-being during work time and during potential recovery time, in-between workdays and during the weekend?

When studying the work-nonwork interface in the perspective of effort and recovery, it is of course also essential to have insight in the daily relationships between effort expended at work and relevant aspects of the workday and (potential) recovery time. As yet, this issue has attracted only limited attention in the literature. Therefore, in chapter 4, we examined if and how daily reported work-related effort was related to activities and health and well-being during work time, in-between workdays and during the weekend. Regarding work time (*Research Question 3a*) we found that work-related effort was not associated with the time spent on various work activities, but that those employees experiencing relatively high levels of work-related effort considered all work activities as more effortful, but not as less pleasurable, compared to employees who report relatively low levels of work-related effort. Furthermore, employees experiencing high levels of work-related effort showed an increase in work-related fatigue during the day, and reported higher levels of work-related fatigue in comparison with workers who did not experience such high levels of work-related effort.

As to activities and health and well-being in-between work days (*Research Question 3b*), it was found that, compared to workers who experience relatively low levels of work-related effort, employees reporting relatively high levels of work-related effort 1) engaged less often in active leisure activities, 2) expended more effort in home activities, but did not consider these activities less pleasurable, 3) reported higher levels of sleep complaints and fatigue, and 4) reported more preoccupation with work.

Although weekends provide powerful opportunities for recovery (at least for employees working from Monday to Friday), until now, weekends have not often been incorporated in research on effort and recovery time. Therefore, we also examined if and how work-related effort experienced during the workweek was related to activities and health and well-being in the weekend (*Research Question 3c*). We found that employees reporting relatively high levels of work-related effort 1) worked more overtime, 2) considered activities in the home domain as more effortful, but not as less pleasurable, 3) reported higher levels of fatigue, and 4) lower motivation to start the next workweek.

From a theoretical point of view, chapter 4 revealed that high effort investment at work is accompanied by an off-the job activity pattern that is unfavorable in terms of recovery: It is related to less engagement in active leisure activities and to more time spent on overtime.

Previous research underlines this assumption, as it suggests that active leisure promotes recovery, whereas overtime work impedes this process (Sonnentag, 2001). High effort expenditure at work was also related to high effort invested in home activities, which also endangers the recovery process. Finally, the positive relationships between work-related effort and fatigue (end of workday, in-between workdays and during the weekend) and sleep complaints (weekdays) show that work-related effort is associated with health complaints indicative of a lack of recovery.

Although this chapter provided valuable insight in the associations between work-related effort on the one hand and (the experience of) activity patterns and employee health and well-being on the other, it did not provide causal evidence regarding these relationships. Future studies should therefore examine the causal chain by which work-related effort affects (the experience of) activity patterns and health and well-being in potential recovery time, and how these on their turn influence the amount of effort expended during the workday.

Unresolved Issue 4: Is it possible, in a daily diary context, to use a valid single-item measure of fatigue?

As taking part in a daily diary study is rather demanding, it is important to make participation as accessible as possible. This may be achieved by employing single-item measures. Before this type of measures can be used, their validity has to be established. In chapter 5, we aimed at validating such a single-item measure. More specifically, as fatigue is an important concept in occupational health psychology in general and a relevant indicator of recovery, we aimed to validate a single-item measure of fatigue. For this purpose, we examined to what extent a single-item measure of fatigue has convergent validity (*Research Question 4a*). We indeed found theoretically plausible relationships with a) a validated six-item fatigue scale, b) daily work-related effort, daily sleep complaints and daily work-home interference, and c) global fatigue, global health complaints, and global work-home interference.

To establish the validity of our single-item measure of daily fatigue, convergent validity evidence does not suffice. We therefore investigated the discriminant validity of the single-item fatigue-measure (*Research Question 4b*) as well, by relating this measure to daily work-pleasure and to global job control, global social support, and global motivation to learn. Our analyses revealed only weak relationships with these measures, which supports the discriminant validity of the single-item fatigue-measure.

From a theoretical point of view, chapter 5 showed a single-item fatigue measure to be a valid instrument to assess fatigue and also showed it to be psychometrically equivalent to a well-validated six-item fatigue measure (i.e., POMS; McNair, Lorr, & Droppelman, 1971; Wald & Mellenbergh, 1990). In this chapter, we did nonetheless not examine the ability of the single item fatigue measure to capture differences in fatigue due to 'interventions' such as vacations or overtime reduction programs. Future research should therefore examine whether this single-item fatigue-measure is sensitive to the supposedly beneficial effects of such 'interventions'

6.3 Limitations of this thesis

We believe three limitations of the present thesis deserve to be mentioned. These relate to (1) the composition of the samples studied, (2) the use of self-report measures and, (3) the extent to which causality could be 'supported'.

Composition of the Samples

A first limitation of this thesis concerns the composition of the samples used. In chapter 2, participants who reported a (very) high burnout level at the first wave of the study were excluded from further participation, and were, thus, not included in our longitudinal analyses. Due to this restriction of range in the health indicators under study (and probably also in WHI) the longitudinal relationships examined in chapter 2 were based on a relatively healthy sample. Therefore, the longitudinal associations found among the variables in the study may have been underestimations of the true associations. In particular, based on this sample, the existence of a reversed causal relationship between WHI and health complaints (i.e., health complaints → WHI) could in fact neither be confirmed nor excluded.

The composition of the sample studied in chapter 3 to chapter 5 also deserves attention. The demanding nature of daily diary studies carries the possibility that employees experiencing very high levels of WHI, work-related effort, or health complaints are underrepresented in our study, as participating would be too great a burden for them. Alternatively, it may be that employees who did not experience any WHI, work-related effort, or health complaints, did not see the relevance of participating in the study, which may have led to an underrepresentation of this subgroup of workers as well. As neither alternative can be excluded, the associations among the variables in this thesis may have been estimated conservatively due to restriction-of-range effects in (part of) the variables under study.

Another issue regarding the sample employed in chapters 3 to 5 is that all participants were academic staff members, who had no job outside the university, worked at least three days a week and lived together with a partner who worked at least 2.5 days a week. The relationships found in this thesis are, thus, based on a very specific sample. This may limit the generalization of our findings to employees in other professions, in other family situations or with other working hours. However, based on Effort-Recovery theory (Meijman & Mulder, 1998) it may well be expected that the processes underlying the relationships found will operate irrespective of these sample characteristics. Future studies should nonetheless examine if the associations found in this thesis can be replicated among workers in other professions, with other working hours, or in other family situations.

Self-report measures

A second limitation of this thesis comprises its exclusive reliance on self-report measures. Such measures are often criticized because they are 'subjective' and may suffer from biases due to respondents' response styles, attribution processes and personality characteristics and affective states (Kompier, 2005). It is often assumed that self-report measures are by definition susceptible to common method variance. This 'variance that is attributable to the measurement method rather than to the constructs the measures represent' (Podsakoff, MacKenzie, & Podsakoff, 2003, p. 879), then leads to an overestimation of the strength of the associations among the variables under study. Semmer, Grebner and Elfering (2004) nonetheless conclude that self reports contain valid information and Kompier (2005) states with respect to these measures that '...job incumbents are subject matter experts. It is their work, and it is their health, and, accordingly, they deserve to be taken seriously' (p. 406).

Recently, Spector (2006) critically examined the supposed biases caused by measuring all variables with the same method. Contrary to what would be expected on basis of the presumed omnipresence of common method bias in self-report measures, he showed that the use of this type of measures does not guarantee finding significant results, even within very large samples. Furthermore, he found that a number of potential biasing variables (social desirability, negative affectivity and acquiescence) do not generally inflate correlations among study variables. He also noted that monomethod correlations are not by definition higher than multimethod correlations (which they should be if common method variance automatically affects the strength of the relationship between two constructs measured with the same method). Based on these finding, he concludes that 'the popular suggestion that

common method variance is a distortion and oversimplification of the true state of affairs, reaching the status of an urban legend' (p. 221).

If common method variance would have been a problem in our study, it should, thus, have inflated all relationships that were examined. It can not explain why in our study some relationships were found and others were not. Besides, Podsakoff et al. (2003) state that common method bias can be reduced by creating a temporal separation between the assessment of the predictor and the criterion variables. This approach was followed in chapter 3 and in part of chapter 4 and 5, as the global measures were completed approximately ten days prior to the first daily questionnaires.

Often, as alternatives to the 'subjective' and supposedly inferior self-report measures, the use of alternative 'objective' measures such as observational and physiological measures is advocated, since these are assumed not to be affected by cognitive and emotional processing by the study participants (Kompier, 2005). However, also these measures may contain error variance and should therefore not by definition be considered superior to self-report measures (Semmer et al., 2004; Kompier, 2005). Specifically to physiological measurements is the notion that these 'refer to a different response level that follows is own laws and is only loosely coupled with psychological responses' (Semmer et al., 2004, p. 206) and, thus, may not be considered a substitute for self-report measures.

On basis of on above information, we do not think that the use of self-report measures strongly devaluates the findings reported in this thesis. The use of physiological and performance measures in addition to self-reports could nonetheless provide interesting insights in future research.

Causality

A third and final limitation of this thesis is its limited ability to 'prove' (or rather support) causality. To demonstrate causality, four conditions have to be satisfied (Taris & Kompier, 2003), namely: (1) the presumed 'cause' should precede the presumed 'consequence' in time, (2) the variables should be statistically associated, (3) the presumed causal relationship should be theoretical plausible, and (4) possible rival hypotheses for this relationship should be excluded. Applied to this thesis, criteria 1, 2 and 3 were met regarding the long-term relationships between WHI and employee health (chapter 2). As to criterion 4, we tried to eliminate the influence of as many potentially relevant third variables as possible. It cannot by definition be excluded, though, that we failed to address *all* relevant third variables. Thus,

although we could not fully confirm causality in chapter 2, we nonetheless provided strong evidence in support of a causal relationship between WHI and employee health.

With respect to the associations between global WHI and the daily variables (chapter 3), only criteria 2 and 3 were fully met, and possible third variables (criterion 4) were controlled for to our best ability. It can once more not be guaranteed that we incorporated all relevant third variables. Besides, we did not explicitly examine the temporal relationships between global WHI and the daily variables. All in all this limits the possibility to support causality in this chapter.

The same reasoning (i.e., criterion 1 not met, 2 and 3 met, 4 met to our best ability) applies to the part of chapter 4 that focuses on the relations between daily work-related effort and activities and health and well being during work days and in-between work days.

6.4 Contributions of this thesis

Notwithstanding its limitations, we believe this thesis contributed to previous research on WHI, by (1) employing a strong theoretical framework, (2) using different time perspectives, (3) addressing employees' activity patterns in the work and home domain and (4) providing validity evidence for a single-item fatigue measure.

Strong theoretical framework

We believe that the first asset of this thesis lies in its reliance on a strong theoretical framework that explains why and how WHI is related to 1) activity patterns in the work and nonwork domain and 2) to health and well-being. More precisely, Effort-Recovery theory (Meijman & Mulder, 1998; Geurts & Sonnentag, 2006) illuminates the importance of assessing employees activity patterns at work and at home, since these may either increase the need for recovery (e.g., effortful work activities), contribute to recovery (e.g., leisure activities), or interfere with recovery (e.g., working overtime). Furthermore, based on Effort-Recovery theory, the association between WHI and health complaints may be understood from the fact that the experience of WHI signifies a lack of recovery. The supposed relationship between insufficient recovery and health complaints has already been confirmed in previous empirical studies (e.g., Kompier, 1988; Sluiter, Frings-Dresen, Van der Beek & Meijman, 2001; see also Geurts & Sonnentag, 2006). Thus, by using Effort-Recovery theory as theoretical framework, we were not only able to establish the relationships between WHI and activity patterns and

employee health and well-being, but also to explain and understand why such associations exist.

Different time frames

A second strong point of the present thesis concerns its use of different time frames. By combining the possibilities of a one-year longitudinal design and detailed day-to-day observations, we were able to further disentangle the associations between WHI and its presumed antecedents and consequences. We employed a one-year time lag to show that a global measure of (strain-based) WHI acts as a precursor of fatigue and depressive complaints. By using a daily diary design we also demonstrated that such a global measure manifests itself in various aspects of everyday life (i.e., employees' activity patterns and health and well-being). Next, we investigated the work-nonwork interface from a more detailed point of view and examined if and how daily work-related effort was related to activities and employee health and well-being at work and in the home domain, in-between workdays as well as in the weekend. We indeed found work-related effort to be related to these aspects of employees' work and home life. Thus, this thesis contributed to previous research by showing that WHI and its relationships with theoretically relevant constructs are visible both within long and within short time intervals.

Activity patterns in the work and home domain

We believe that a third asset of this thesis concerns its attention for employees' activity patterns in the work and home domain. Contrary to most previous studies, we did not restrict ourselves to the use of retrospective global measures of hours worked. Instead, we 1) obtained a detailed picture of employees' daily work activities, 2) were among the first to acknowledge the relevance of activities in the home domain, by assessing these in a detailed, day-to-day fashion, and 3) paid attention to employees' experiences (pleasure, effort) of their daily work and home activity patterns. In this way, we were able to show that global WHI is related to daily time spent on overtime work and low-effort leisure activities. We also revealed daily work-related effort to be negatively associated with engagement in active leisure activities and positively associated with overtime work. Finally, we found work-related effort to be related to the effort expended in work and home activities, but not to the pleasure experienced while engaging in these activities. In sum, this thesis contributed to previous research by showing

that the experience of WHI and work-related effort are associated with employees' daily home and work-related activities.

Validation of a single-item fatigue measure

A fourth and final contribution of our study is that it provides strong validity evidence for a single item measure of daily fatigue. It added to previous research on single-item fatigue-measures (Kirsh, Passik, Holtsclaw, Donaghy & Theobald, 2001; Schwartz et al., 2002) by 1) assessing current fatigue three times a day during a nine-day observation period, which enabled us to obtain more reliable estimates of the relationships between the fatigue-measure and other variables, and to examine the robustness of these relationships across time, and 2) incorporating global as well as daily measures to examine convergent as well as discriminant validity.

We demonstrated that a single-item measure of daily fatigue is psychometrically equivalent to a well-validated six-item fatigue measure (POMS; McNair, Lorr, & Droppelman, 1971; Wald & Mellenbergh, 1990) and we showed this measure to be positively related to measures that are supposed to tap related constructs (convergent validity evidence) and not or negatively related to measures assessing different constructs (discriminant validity evidence).

6.5 Practical Implications

The findings in this thesis also have practical implications, regarding (a) the prevention of WHI, (b) employees' activity patterns in the home domain, (c) the use of single items measures.

Prevention of high levels of WHI

Chapter 2 identified (strain-based) WHI as a serious risk for the occurrence and increase of fatigue and depressive complaints. This finding underlines the need to prevent high levels of WHI. Policy makers are aware of this issue, which is underlined by the fact that many national governments have made the work-nonwork interface an important element of their policy, by introducing legislation in this area (Dikkers et al., 2004). In The Netherlands, for example, each parent is entitled 13 times the weekly number of working hours unpaid parental-leave for each child under the age of eight. Other arrangements include care-leave (to care for a sick child, spouse or parent) and calamity-leave (for unforeseen personal circumstances, such as a death, illness or a broken water supply). Reconciliation of work and family life has also

become a topic in other European countries' legislation and collective bargaining [see European Foundation (2006) for an overview of arrangements in European countries]. The United States is far behind when one examines the working conditions that are needed to care for children and other family members (Heymann, Earle, Simmons, Breslow, & Kuehnhoff, nd). For example, contrary to 163 countries around the world, the United States do not offer guaranteed paid leave to women in connection with childbirth (Heymann et al., nd).

In addition to their respective governments, employers can contribute to workers' ability to satisfactorily combine work and private life, by providing work-family facilities. For instance, they may offer arrangements that enlarge employees' temporal and spatial flexibility at work (e.g., teleworking, part-time work, having flexible start and finishing time), and dependent care facilities (e.g., (subsidized) parental leave and (subsidized) child care facilities) (Den Dulk, 2001; Dikkers, Geurts, Den Dulk, Peper, & Kompier, 2004).

Previous research showed that employees who used work-family facilities were significantly more committed to the organization and had lower intentions to quit than employees who did not use these facilities (Eaton, 2003; Grover & Crooker, 1995). Yet, it is important that companies not only offer facilities to better combine work and family life, but that they also create a company culture in which employees who experience WHI do feel entitled to use the arrangements that are available. There is some evidence that the corporate culture may prevent employees from using these (Thompson, Beauvais, & Lyness, 1999). Also, Dikkers et al. (2004) found that more supportive and less hindering company work-home cultures were associated with lower levels of WHI.

Finally, as previous research (see Byron, 2005, for an overview) has shown that unfavorable work characteristics are associated with high levels of WHI, employers can contribute to their workers' capacity to combine work and private life by creating favorable psychosocial work conditions. For example, based on the influential Job-Demand-Control(-Support) Model (Karasek & Theorell, 1990) it is recommended that job demands are not too high, that employees have adequate levels of job control and that they receive sufficient support from their colleagues and supervisors (see Kompier, 2003, for a discussion of the J-D-C(-S) model and six other important theoretical approaches in relation to the design of 'healthy' work). On basis of Effort-Recovery theory (Meijman & Mulder, 1998) workers are advised to keep their levels of effort expenditure at work within acceptable limits.

Activity patterns in the home domain

In chapters 3 and 4, associations were found between global WHI and daily work-related effort on the one hand, and time spent on overtime work and leisure activities (active and low-effort) on the other. Although we did not provide evidence concerning the causal directions of these relationships, we believe that two practical, albeit preliminary, implications can be formulated based on these results. First, excessive overtime work should be prevented, as, based on Effort-Recovery theory (Meijman & Mulder, 1998), it is assumed that overtime work impedes the recovery process (Van der Hulst, 2003), which may result in health complaints (see Geurts & Sonnentag, 2006, for an overview). As it seems plausible that WHI develops as a function of the time spent on overtime, limiting the amount of overtime work is also be important in light of the prevention of (high levels of) WHI.

Secondly, workers should be encouraged to engage in leisure activities that potentially contribute to the recovery process, such as active leisure and low-effort activities (cf. Sonnentag, 2001; Rook & Zijlstra). To achieve this, WHI and work-related effort should be kept within limits, as these are negatively related to the time and/or energy available for these type of activities. This thesis' finding that WHI across time is related to fatigue and sleep complaints - both indicators of lack of recovery - strengthens this position, as chapter 2 identified WHI as a cause of such health complaints.

Single-item measures

Chapter 5 provided strong and convincing evidence for the validity of a single-item measure to assess daily fatigue. As this single-item was psychometrically equivalent to a well-validated six-item fatigue-measure, our study has important practical implications for daily diary research: Given that this type of studies requires questionnaires to be as short as possible, the knowledge that a single-item measures suffices to validly assess daily fatigue is very valuable.

Notwithstanding its limitations, we thus believe that this thesis contributes to previous research on the work-nonwork interface. By employing a strong theoretical framework we showed that WHI is related to employees' activity patterns in the work and nonwork domain and to various aspects of their health and well-being. The use of different time intervals enabled us to illustrate that these relationships are not only visible on the long run, but that they are also clearly embedded in employees' daily lives. From a practical point of view, this thesis highlights the importance of preventing high levels of WHI, and advocates an activity

pattern that avoids excessive overtime work and allows for engagement in potentially recovering leisure activities. This thesis also added to research within the field of occupational health psychology in general, by supporting the validity of a single-item measure of daily fatigue: a finding that may be useful for future diary research in this area.

All in all, we hope this thesis will inspire future research on the relevant and dynamic theme of how employees combine their work and family lives.

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Summary

Summary

Due to changes in the composition of the work force (greater participation of women in the labour force, more dual-earner couples) and in the nature of work itself (increased work intensity, increased appeal on employees' flexibility), for many employees balancing work and family roles has become a major issue that sometimes creates problems or conflicts. As the process whereby work demands negatively affect functioning at home (i.e., 'work-home interference', WHI) is more prevalent than the process of interference in the other direction (i.e., 'home-work interference', HWI), this thesis focuses exclusively on WHI. Two major components of WHI are time-based WHI (that develops when the time devoted to work obligations makes it physically impossible to meet obligations in the home domain) and strain-based WHI (that refers to the process in which tension developed at work is transferred to the home domain). Research on this topic has so far shown that work characteristics (e.g., work hours, work role overload) may act as antecedents of WHI and that - regarding potential outcomes - WHI is especially related to stress-related outcomes (e.g., burnout, depression).

The present thesis aims to further disentangle the (long-term and short-term) processes underlying the associations between WHI and its presumed antecedents and consequences. By employing different time frames (i.e., a two-wave one-year longitudinal study and detailed day-to-day questionnaires) it examines the relationships between WHI, on the one hand, and employees' activity patterns and their health and well-being, on the other.

The theoretical framework of this thesis is provided by Effort-Recovery Theory. The core assumption of this theory is that episodes of effort-expenditure (e.g., a workday) have to be followed by a period of recovery (e.g., a free evening, a weekend) in which the psychophysiological systems (e.g., cardiovascular system) that were activated during effort expenditure can return to their baseline levels (i.e., recovery). On the long run, insufficient recovery will have negative consequences for employee health.

From this theory, WHI can be defined in terms of (lack of) recovery: A high level of WHI implies that recovery during nonwork time is impeded due to insufficient recovery time (i.e., time-based WHI) and/or due to the spillover of work-related strain into the home domain (i.e., strain-based WHI).

With this theoretical framework in mind, we address three unresolved issues in research on WHI, namely 1) the long-term causal relationships between WHI and employee health, 2) the manifestation of WHI in employees' daily activity patterns and daily reports of health and well-being, and 3) the relationship between work-related effort, on the one hand, and employees' daily activity patterns and daily reports of health and well being on the other, both

during the week and in the weekend. Finally, by examining the validity of a single-item measure of daily fatigue, this thesis also focuses on one methodological unresolved issue not specific to WHI, but very relevant diary research.

Question 1: What are the longer-term causal relationships between work-home interference and employee health?

In chapter 2 we examine, within a two-wave one-year full panel design among 730 police officers, what type of causal relationship exists between WHI and worker health (fatigue and depressive complaints): 'normal causation' (i.e., WHI → health), 'reversed causation' (i.e., health → WHI) or 'reciprocal causation' (i.e., WHI → health and health →WHI). We also investigate how the course of health changes across time as a function of stable and changed levels of WHI during the study period. To this purpose, we create four subgroups of employees (one with low levels of WHI at both measurement points; one with high levels of WHI at the first, and low levels of WHI at the second measurement point; one with low levels of WHI at the first, and high levels of WHI at the second measurement point; and one with high levels of WHI on both measurement points). In accordance with Effort-Recovery theory, results show that (strain-based) WHI acts as a predictor of fatigue and depressive complaints oneyear later and that both a stable high level of WHI and an increase in WHI over time are associated with an increase in fatigue and depressive complaints during a one-year period.

Based on these results, we conclude that a normal causal relationship exists between WHI and employee health. However, because police officers with high burnout scores at time 1 were excluded from participation in the longitudinal study, the possibility of a reversed causal relationship cannot be ruled out.

Question 2: How does a global measure of WHI manifest itself in everyday life?

In chapter 3, we investigate how global reports of WHI relate to 1) daily indicators of employee health and well-being (fatigue, sleep complaints) 2) daily time spent on (effortful) work activities, and 3) daily time spent on home activities (domestic activities, low-effort activities, active leisure activities, and overtime work). The study is conducted among 120 academic staff members, who completed a general questionnaire (to assess global WHI) and who participated in a five-day daily diary study (Monday-Friday, three measurements daily). Results show that global reports of WHI 1) are positively related to daily fatigue and sleep complaints, 2) are not related to daily time spent on (effortful) work activities, and 3) are

positively related to daily time spent on overtime work, and negatively related to daily time spent on low-effort leisure activities. No associations are observed with time spent on active leisure activities and domestic activities.

We conclude that global WHI is positively related to the amount of effort expended on a day-to-day basis (i.e. the positive association found between global WHI and the time spent on overtime in the evening), and negatively to opportunities to recover from work demands (i.e. the negative association found between global WHI and the time spent on low effort activities). WHI is also positively related to health complaints reflecting lack of recovery (i.e. fatigue, sleep complaints). On basis of this study's results, we can state that global WHI is reflected in various aspects of everyday life.

Question 3: What is the relationship between work-related effort and 1) activity patterns and 2) health and well-being during work time and during potential recovery time, in-between workdays and during the weekend?

This third unresolved issue is addressed in chapter 4. To answer this question, we compare two groups of workers – again academic staff members, as in chapter 3 – with respect to their activity patterns (at work and at home) and their health and well-being during worktime and during (potential) recovery time, both in-between workdays and in the weekend. One group comprises employees who reported relatively low levels of work-related effort during a regular workweek (the low-effort group; n = 27) and the second group includes workers who experienced relatively high levels of work-related effort during this period (the high-effort group; n = 24). Participants completed a general questionnaire (to assess background variables) and took part in a seven-day daily diary study (Monday - Sunday, three measurements daily).

Results show that the two groups are comparable regarding their background (e.g., negative affect, general work characteristics, general health). The two groups do not differ with respect to their activity patterns at work, nor with respect to the pleasure experienced while working. Compared to the low-effort group, the high-effort effort group nonetheless reports higher levels of effort expenditure in each work activity. This group also shows a stronger increase of work-related fatigue during the workday.

As to the period in-between workdays, we observe that the high-effort group engages less often in active leisure activities and that this group considers their home activities more effortful. The high-effort group also reports higher levels of fatigue, sleep complaints and

preoccupation with work. No associations are found with work motivation, pleasure derived from the home activities and engagement in domestic activities, low-effort leisure and overtime work.

Regarding the weekend, we find that, compared to the low-effort group, the high-effort group spends more time on overtime work, considers their home activities as more effortful, and reports higher levels of fatigue. This group also reports lower levels of work motivation regarding the next workweek. There are no associations with time spent on domestic activities, active leisure activities, low-effort leisure activities and with the pleasure derived from the home activities.

Based on these results, we can answer the above research question by stating that work-related effort is indeed related to various aspects of worktime and (potential) recovery time in-between workdays and in the weekend. High-levels of work-related effort are associated with activity patterns that are less beneficial in terms of recovery (less engagement in active leisure, more overtime work), with higher effort expenditure during and after work time, and with diminished health (fatigue, sleep complaints) and well-being (preoccupation with work, work motivation).

Question 4: Is it possible, in a daily diary context, to use a valid single-item measure of fatigue?
In Chapter 5, we examine the convergent and discriminant validity of a single-item measure of daily fatigue ('How fatigued do you currently feel?'). Convergent validity of our measure is examined by relating it to a validated multiple-item measure of fatigue (Profile of Mood States, POMS) and to other daily (work-home interference, sleep complaints, work-related effort) and global (fatigue, health complaints, work-home interference, job pressure) measures that are conceptually related to fatigue. Discriminant validity is assessed by relating the single-item fatigue measure to daily (work-pleasure) and global (job control, social support, motivation to learn) measures that are conceptually distinct from fatigue. The study is conducted among 120 academic staff members, who completed a general questionnaire (assessing the global measures) and who participated in a nine-day daily diary study (Saturday – Sunday one week later, three measurements daily).

Results show that the single-item fatigue measure is positively related to variables conceptually related to fatigue (especially to the POMS), which supports the convergent validity of our measure. Furthermore, the weak associations found between our measure and constructs conceptually distinct from fatigue support the discriminant validity of our

measure. Altogether, these results show that daily fatigue may be validly assessed by means of a single-item measure.

The contributions and the theoretical and practical implications of this thesis are addressed in chapter 6. In sum, this thesis contributes to previous research:

1) by employing a strong theoretical framework (Effort-Recovery Theory) that can explain why and how WHI is related to activity patterns in the work and nonwork domain and to health and well-being,

2) by using different time frames (one-year two-wave longitudinal design and daily diary study) that enables us to show that that WHI and its relationships with theoretically relevant constructs are visible both within long and within short time intervals,

3) by examining employees' activity patterns in both the work and the home domain and, thus, showing that the experience of WHI and work-related effort are associated with employees' daily home and work-related activities, and

4) by providing validity evidence for a single-item measure of daily fatigue.

Theoretically, this thesis' results indicate that a normal causal relationship exists between WHI and employee health (chapter 2) and that both a stable high level of WHI and an increase of WHI during a one-year time-interval are accompanied by an increase in health complaints (chapter 2). It further shows that global WHI as well as daily work-related effort are positively related to engagement in activities that interfere with recovery, and negatively to engagement in activities that contribute to recovery (chapters 3 and 4). Also, global WHI and daily work-related effort are positively related to health complaints indicative of a lack of recovery (chapters 3 and 4). Finally, we find support for the validity of a single-item measure of daily fatigue (chapter 5).

From a practical viewpoint, this thesis highlights the importance of preventing high levels of WHI, and advocates an activity pattern that avoids excessive overtime work and allows for engagement in (active and low-effort) leisure activities. Finally, the support for the validity of a single-item measure of daily fatigue may be useful for future diary research. All in all, we hope this thesis will inspire future research on the relevant and dynamic theme of how employees combine their work and family lives.

Samenvatting

Door veranderingen op de arbeidsmarkt (toegenomen arbeidsparticipatie van vrouwen, groei van het aantal tweeverdieners) en in de aard van het werk (toegenomen werkintensiteit, hogere eisen aan de flexibiliteit van werknemers) is het afstemmen van werk en privé voor veel werknemers een belangrijk onderwerp geworden. Soms kan het combineren van beide domeinen gepaard gaan met conflicten of problemen. Het proces waarbij het functioneren thuis negatief wordt beïnvloed door de eisen die het werk stelt ('werk-thuis interferentie', WTI) komt daarbij vaker voor dan het proces van interferentie in de omgekeerde richting ('thuis-werk interferentie', TWI). Vanwege dit verschil in prevalentie richt dit proefschrift zich uitsluitend op WTI.

De twee belangrijkste componenten van WTI zijn tijdsgerelateerde WTI (ontstaat als de tijd die aan het werk besteed wordt het fysiek onmogelijk maakt om aan verplichtingen thuis te voldoen) en spanningsgerelateerde WTI (ontstaat als spanning die op het werk is opgebouwd het functioneren thuis negatief beïnvloedt). Onderzoek naar dit onderwerp heeft tot nu toe laten zien dat werkkenmerken (zoals werkuren) als antecedenten van WTI beschouwd kunnen worden en dat WTI vooral gerelateerd is aan stress-gerelateerde uitkomsten (zoals burnout).

Dit proefschrift heeft tot doel om meer inzicht te verschaffen in de (lange- en korte-termijn) processen die aan de relatie tussen WTI en zijn veronderstelde oorzaken en gevolgen ten grondslag liggen. Met behulp van verschillende tijdsperspectieven (namelijk een éénjarig longitudinaal onderzoek met twee metingen en gedetailleerde dag-tot-dag vragenlijsten) onderzoeken we de relaties tussen WTI enerzijds, en de activiteitenpatronen van werknemers en hun welzijn en gezondheid anderzijds.

Het theoretische kader van dit proefschrift wordt gevormd door het Inspanning-Herstel Model. De centrale assumptie in dit model is dat een periode waarin inspanning geleverd wordt (vb. een werkdag) gevolgd moet worden door een periode van herstel. Tijdens deze herstelperiode kunnen de psychofysiologische systemen die tijdens de voorafgaande inspanning geactiveerd waren weer terugkeren tot hun basale rustniveaus. Een gebrek aan herstel zal op de lange termijn negatieve gevolgen hebben voor de gezondheid van werknemers.

Gebaseerd op dit model kan WTI gedefinieerd worden in relatie tot (gebrek aan) herstel: Een hoog niveau van WTI betekent dat herstel tijdens niet-werktijd wordt gehinderd door onvoldoende hersteltijd (tijdsgerelateerde WTI) en/of door op het werk opgebouwde spanning (spanningsgerelateerde WTI).

Met het Inspanning-Herstel model als achtergrond behandelt dit proefschrift drie vragen die tot nu toe onbeantwoord zijn gebleven in het onderzoek naar WTI, namelijk de vraag naar 1) de lange-termijn causale relatie tussen WTI en de gezondheid van werknemers, 2) de relatie tussen WTI enerzijds en de dagelijkse activiteiten en de dagelijkse gezondheid/het dagelijkse welbevinden van werknemers anderzijds, 3) de relatie tussen enerzijds werkgerelateerde inspanning en anderzijds de dagelijkse activiteiten van werknemers en hun dagelijkse gezondheid, zowel door de week als in het weekend. Door ten slotte de validiteit van een één-item maat voor dagelijkse vermoeidheid te onderzoeken, besteedt dit proefschrift tevens aandacht aan een methodologische onopgeloste vraag die niet specifiek is voor WTI, maar die van belang is voor dagboekonderzoek in het algemeen.

Vraag 1: Wat zijn de langere termijn causale relaties tussen WTI en de gezondheid van werknemers?

In hoofdstuk 2 onderzoeken we met behulp van een éénjarig longitudinaal full-panel design met twee meetmomenten bij 730 politiemedewerkers welk type causale relatie er bestaat tussen WTI en de gezondheid (vermoeidheid, depressieve klachten) van werknemers: een 'normale' causale relatie (WTI → gezondheid), een 'tegengestelde' causale relatie (gezondheid → WTI) of een 'reciproque' causale relatie (WTI → gezondheid en gezondheid → WTI). Tevens brengen we in kaart hoe gezondheidsklachten zich over de tijd ontwikkelen als functie van stabiele en veranderende niveaus van WTI. Hiertoe creëren we vier subgroepen van werknemers (een groep met lage WTI op beide meetmomenten, een groep met hoge WTI op het eerste en lage WTI op het tweede meetmoment, een groep met lage WTI op het eerste en hoge WTI op het tweede meetmoment en een groep met hoge WTI op beide meetmomenten). In overeenstemming met wat op basis van het Inspanning-Herstel model verwacht mag worden, laten de resultaten zien dat (spanningsgerelateerde) WTI een predictor is van vermoeidheid en depressieve klachten een jaar later en dat zowel een stabiel hoog niveau van WTI als een toename in WTI gepaard gaan met een toename in deze gezondheidsklachten gedurende de periode van een jaar.

Op basis van deze resultaten luidt het antwoord op bovenstaande onderzoeksvraag dat er een normale causale relatie bestaat tussen WTI en gezondheid. Hierbij dient echter opgemerkt te worden dat het bestaan van een 'tegengestelde' causale relatie niet uitgesloten kan worden omdat aan dit onderzoek uitsluitend politiemedewerkers deelnamen die geen ernstige burnoutklachten rapporteerden tijdens het tijdstip van de eerste meting.

Vraag 2: Hoe manifesteert een globale maat van WTI zich van dag tot dag?
In hoofdstuk 3 onderzoeken we hoe een globale maat van WTI gerelateerd is aan 1) dagelijkse indicatoren van het welzijn en de gezondheid van werknemers (vermoeidheid, slaapklachten), 2) de tijd die dagelijks besteed wordt aan (inspannende) werkactiviteiten en 3) de tijd die dagelijks besteed wordt aan thuisactiviteiten (huishoudelijke- en zorgtaken, niet-inspannende vrijetijdsactiviteiten, actieve vrijetijdsactiviteiten en overwerk). Het onderzoek vond plaats onder 120 wetenschappelijk medewerkers van een universiteit die een algemene vragenlijst invulden (om globale WTI te meten) en ongeveer tien dagen later deelnamen aan een vijf dagen durende dagboekstudie (maandag – vrijdag, drie metingen per dag). De resultaten laten zien dat een globale maat van WTI 1) positief gerelateerd is aan dagelijkse vermoeidheid en slaapklachten, 2) geen relatie vertoont met de tijd die dagelijks besteed wordt aan (inspannende) werkactiviteiten en 3) positief geassocieerd is met de tijd die dagelijks aan overwerk wordt besteed, en negatief met de tijd die dagelijks aan niet-inspannende vrijetijdsactiviteiten wordt besteed. Geen relaties worden gevonden met de tijd die aan actieve vrijetijdsbesteding en aan huishoudelijke- en zorgtaken wordt besteed.

We kunnen concluderen dat globale WTI positief gerelateerd is aan de hoeveelheid inspanning die van dag tot dag geleverd wordt (namelijk de positieve associatie tussen globale WTI en de tijd die aan overwerk besteed wordt), en negatief aan mogelijkheden om te herstellen van het werk (de negatieve relatie tussen globale WTI en de tijd die besteed wordt aan niet-inspannende vrijetijdsactiviteiten). Ook vertoont globale WTI een positief verband met zelfrapportages die indicatief zijn voor een gebrek aan herstel (slaapklachten, vermoeidheid). Op basis van deze resultaten luidt het antwoord op bovenstaande vraag dan ook dat globale WTI gereflecteerd wordt in diverse aspecten van het dagelijks leven.

Vraag 3: Wat is de relatie tussen werkgerelateerde inspanning en 1) de activiteitenpatronen en 2) de gezondheid en het welbevinden van werknemers tijdens werktijd en tijdens (potentiële) hersteltijd, zowel door de week als in het weekend?
Deze derde vraag staat centraal in hoofdstuk 4. Om deze te beantwoorden vergeleken we twee groepen werknemers met betrekking tot hun activiteitenpatronen (werk en thuis) en hun gezondheid/welzijn tijdens werktijd en tijdens (potentiële) hersteltijd, zowel door de week als in het weekend. Eén groep bestond uit werknemers die tijdens een reguliere werkweek relatief weinig werkgerelateerde inspanning rapporteerden (de laag-groep, n = 27) en de tweede groep uit werknemers die tijdens deze periode juist relatief veel werkgerelateerde inspanning

rapporteerden (de hoog-groep, n = 24). De respondenten (allen wetenschappelijk medewerkers) vulden een algemene vragenlijst in (om achtergrondkenmerken te meten) en participeerden in een zeven dagen durende dagboekstudie (maandag – zondag, drie metingen per dag).

De resultaten laten zien dat de twee groepen vergelijkbaar zijn wat betreft hun achtergrond (zoals negatief affect, algemene werkkenmerken en algemene gezondheid). Er zijn geen verschillen in het type werkactiviteiten dat men tijdens werktijd uitvoert. Ook blijkt er geen verschil te zijn in het plezier dat men heeft bij het uitvoeren van elk van deze activiteiten. Wel kost elke werkactiviteit afzonderlijk de hoog-groep meer inspanning. In vergelijking met de laag-groep laat deze groep tevens een sterkere toename zien in werkgerelateerde vermoeidheid tijdens de werkdag.

Voor de periode tussen werkdagen vinden we dat werknemers in de hoog-groep minder vaak tijd besteden aan actieve vrijetijdsactiviteiten en dat de activiteiten in het thuisdomein hen meer inspanning kosten. Ook rapporteren werknemers in de hoog-groep meer vermoeidheid en slaapklachten en zijn zij thuis in gedachten nog meer met het werk bezig. Er zijn geen verschillen tussen de groepen voor werkmotivatie, het plezier dat ervaren wordt bij het uitvoeren van thuisactiviteiten en de mate waarin de respondenten tijd besteden aan huishoudelijke taken, niet-inspannende vrijetijdsactiviteiten en overwerk.

Voor het weekend, ten slotte, vinden we dat de hoog-groep meer tijd besteedt aan overwerk, dat de thuisactiviteiten deze groep meer inspanning kosten en dat deze groep meer vermoeidheid rapporteert. Tevens rapporteert de hoog-groep minder werkmotivatie met betrekking tot de komende werkweek. Er zijn geen relaties met de tijd die gespendeerd wordt aan huishoudelijke, actieve en niet-inspannende vrijetijdsactiviteiten, met het plezier dat beleefd wordt aan thuisactiviteiten en met de mate waarin respondenten thuis in gedachten met het werk bezig zijn.

Als antwoord op bovenstaande onderzoeksvraag kunnen we aan de hand van deze resultaten dus stellen dat werkgerelateerde inspanning inderdaad duidelijke relaties vertoont met diverse aspecten van de werktijd en (potentiële) hersteltijd tussen werkdagen en in het weekend. Een hoog niveau van werkgerelateerde inspanning gaat gepaard met een activiteitenpatroon dat niet bevorderlijk is voor herstel (meer overwerk, minder vaak actieve vrijetijdsbesteding), met een hogere inspanning tijdens en na werktijd, en met een verminderde gezondheid (slaapklachten, vermoeidheid) en een verminderd welzijn (in gedachten met werk bezig zijn, motivatie).

Vraag 4: Is het in een dagelijks dagboekonderzoek mogelijk om gebruik te maken van een valide één-item maat voor vermoeidheid?

In hoofdstuk 5 onderzoeken we de convergente en discriminante validiteit van een één-item maat ('Hoe moe voelt u zich op dit moment?') om dagelijkse vermoeidheid te meten. Om de convergente validiteit te onderzoeken, relateren we deze één-item maat aan een al gevalideerde vermoeidheidsmaat met meerdere items (de Profile Of Mood States, POMS) en aan diverse globale (algemene vermoeidheid, gezondheidsklachten, werk-thuis interferentie, werkdruk) en dagelijkse (werk-thuis interferentie, slaapklachten, werkgerelateerde inspanning) maten waarvan op theoretische gronden verondersteld wordt dat ze samenhangen met vermoeidheid. De discriminante validiteit wordt onder de loep genomen door de relaties te onderzoeken tussen onze één-item maat en globale (autonomie, sociale steun, motivatie om te leren) en dagelijkse (plezier in het werk) constructen die conceptueel verschillend zijn van vermoeidheid. Het onderzoek werd wederom uitgevoerd bij 120 wetenschappelijk medewerkers die een algemene vragenlijst invulden (waarin de globale maten aan bod kwamen) en deelnamen aan een negen dagen durende dagboekstudie (zaterdag – zondag een week later, 3 metingen per dag). De resultaten laten zien dat de één-item vermoeidheidsmaat inderdaad sterk samenhangt met de variabelen die op theoretische gronden gerelateerd zouden moeten zijn aan vermoeidheid (voornamelijk met de POMS), wat ondersteuning biedt voor de convergente validiteit van onze maat. Ook vertoont onze vermoeidheidsmaat slechts een beperkte samenhang met variabelen die conceptueel verschilden van vermoeidheid, waardoor de discriminante validiteit van onze maat eveneens ondersteund wordt. Samen laten deze resultaten zien dat dagelijkse vermoeidheid daadwerkelijk op een valide manier met één-item in kaart gebracht kan worden.

De sterke punten van dit onderzoek en de theoretische en praktische implicaties ervan staan centraal in het afsluitende hoofdstuk 6. Samenvattend kan gesteld worden dat de sterke punten van dit onderzoek zijn dat

1) het gebruik maakt van een sterk theoretisch kader dat verklaart waarom en hoe WTI gerelateerd is aan activiteitenpatronen in het werk- en thuisdomein en aan de gezondheid en het welzijn van werknemers,

2) het gebruik maakt van verschillende tijdsintervallen (éénjarig longitudinaal onderzoek met twee metingen en een dagelijks dagboekonderzoek) dat ons in staat stelt om aan te tonen dat

WTI en de samenhang met theoretisch relevante variabelen zowel op lange als op korte termijn zichtbaar is in het leven van werknemers,
3) het de activiteitenpatronen van werknemers in zowel het werk- als thuisdomein gedetailleerd in kaart te brengt en zo aantoont dat WTI en werkgerelateerde inspanning geassocieerd zijn met de dagelijkse tijdsbesteding van werknemers, en
4) het ondersteuning vindt voor de validiteit van een één-item maat om dagelijkse vermoeidheid te meten.

Vanuit een theoretisch oogpunt geven de resultaten van dit proefschrift aan dat er een normale causale relatie bestaat tussen WTI en zelfrapportages die wijzen op gezondheidsklachten (hoofdstuk 2) en dat zowel een stabiel hoog niveau van WTI als een toename in WTI gepaard gaan met een toename in gezondheidsklachten (hoofdstuk 2). Ze laten verder zien dat zowel globale WTI en werkgerelateerde inspanning positief gerelateerd zijn aan activiteiten die het herstel bemoeilijken, en dat deze negatief gerelateerd zijn aan activiteiten die bijdragen aan herstel (hoofdstukken 3 en 4). Tevens blijkt er een positieve relatie te bestaan tussen globale WTI en werkgerelateerde inspanning enerzijds en gezondheidsklachten die wijzen op gebrek aan herstel anderzijds (hoofdstukken 3 en 4). Ten slotte vinden we ondersteuning voor de validiteit van een één-item maat om dagelijkse vermoeidheid te meten.

Praktisch gezien benadrukt dit proefschrift het belang van het voorkómen van hoge niveaus van WTI, en raadt het een activiteitenpatroon aan waarin buitensporig overwerk wordt vermeden en waarin tijd wordt ingeruimd voor (zowel actieve als niet-inspannende) vrijetijdsactiviteiten. De gevonden steun voor de validiteit van een één-item maat voor vermoeidheid kan nuttig zijn voor toekomstig dagboekonderzoek. Al met al hopen we dat dit proefschrift een inspiratiebron is voor toekomstig onderzoek naar de belangrijke vraag hoe werknemers hun werk en privé-leven combineren.

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Madelon van Hooff
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About the Author

Madelon van Hooff was born on 13 juni 1979 in Heerlen. In 1997 she finished grammar school at the Jeanne d'Arc College in Maastricht and continued to study psychology in Leuven (Belgium) and Leiden. She graduated as a social and organizational psychologist in 2002 and worked as a Ph.D. student at the department of Work and Organizational Psychology of the Radboud University in Nijmegen. Since August 2006 she has been employed as a researcher at TNO Qualitiy of Life in Hoofddorp.