DAILY RECOVERY FROM WORK-RELATED EFFORT DURING NON-WORK TIME

Evangelia Demerouti, Arnold B. Bakker, Sabine A. E. Geurts and Toon W. Taris

ABSTRACT

The aim of this chapter is to provide a literature review on daily recovery during non-work time. Specifically, next to discussing theories that help us understand the process of recovery, we will clarify how recovery and its potential outcomes have been conceptualized so far. Consequently, we present empirical findings of diary studies addressing the activities that may facilitate or hinder daily recovery. We will pay special attention to potential mechanisms that may underlie the facilitating or hindering processes. Owing to the limited research on daily recovery, we will review empirical findings on predictors and outcomes of a related construct, namely need for recovery. We conclude with an overall framework from which daily recovery during non-work time can be understood. In this framework, we claim that daily recovery is an important moderator in the process through which job characteristics and their related strain may lead to unfavorable states on a daily basis.

Current Perspectives on Job-Stress Recovery
Research in Occupational Stress and Well Being, Volume 7, 85–123

ISSN: 1479-3555/doi:10.1108/S1479-3555(2009)0000007006

INTRODUCTION

Job demands have shown a tendency to increase, to such a degree that work-related stress and burnout have become a serious and pervasive problem in many countries. Whereas there is a considerable literature on the consequences of high demands within the workplace (among others, Bakker & Demerouti, 2007; Lee & Ashforth, 1996), there has been less emphasis on the role of *recovery* from the associated strain during non-work time. In particular, few studies have examined the significance of different types of behavior during non-work time and its relative contribution to recovery from work strain. This is surprising because, all other things being equal, it is plausible that a worker who is well (versus poorly) recovered from a previous work period is more likely to be engaged with work in a subsequent work period, with presumed benefits in improving employee performance at work (Bakker, 2009; Demerouti & Cropanzano, 2009).

In this chapter, we argue that adequate recovery on a daily basis is crucial for the maintenance of well-being and job performance. Recovery may occur in the context of work and non-work (Geurts & Sonnentag, 2006). The first is referred to as *internal* recovery and occurs during short breaks from work. The second is called *external* recovery and may occur during after-work hours, during weekends, and during longer periods of respite like vacation. In the present chapter, we focus specifically on external recovery. Although many European employees have long recovery time during vacations, it seems that daily recovery is more crucial for health and well-being. The point is that the salutary effects of vacations fade out quickly (De Bloom et al., 2009). Specifically, levels of burnout and well-being have been found to return rapidly to prevacation levels after returning to work (Westman & Eden, 1997; Westman & Etzion, 2001). Therefore, recovery that takes place daily after work or during the weekend may well be more important for protecting well-being and performance (Sonnentag, 2001, 2003).

The goal of this chapter is to provide insight in the process of daily recovery by discussing (i) theories that help us understand the process of recovery, (ii) the concept of recovery and its potential outcomes, (iii) empirical studies addressing activities that may facilitate or hinder daily recovery, (iv) potential mechanisms that may underlie the facilitating or hindering processes, and (v) empirical findings on predictors and outcomes of need for recovery. We conclude with an overall framework from which daily recovery during non-work time can be understood.

THEORETICAL FRAMEWORK

It has been well-established that unfavorable work situations adversely affect individuals' health and well-being. Particularly work situations characterized by high job demands and low job resources (e.g., low job control) are associated with the development of physical and psychological health complaints across time (for reviews, see Belkic, Landsbergis, Schnall, & Baker, 2004; De Lange, Taris, Kompier, Houtman, & Bongers, 2003). In the linkage between exposure to unfavorable work situations and adverse health and well-being, stress-related physiology seems to play a crucial mediating role (Geurts & Sonnentag, 2006). In principle, stress-related physiological activation in response to job stressors is reversible and short-lived, and is, therefore, not harmful for employee health. However, when stress-related activation occurs repeatedly or prolongs during potential recovery time, relationships with serious disease (e.g., hypertension) across time and overall mortality have been demonstrated (among others, Stewart, Janicki, & Kamarack, 2006). Unfortunately, our knowledge about how to undo these negative "short-term" effects in order to prevent negative long-term consequences is still limited. Geurts and Sonnentag (2006) recently argued that recovery may help to explain how stressfull working conditions and the related acute load reactions of employees may impair their health in the long run. Later, we briefly discuss three models that may explain the role of recovery.

Effort-Recovery Model

The crucial role of incomplete recovery from stress can be understood from the perspective of Effort-Recovery theory (E-R theory, Meijman & Mulder, 1998). Its core assumption is that effort expenditure at work is unavoidably associated with, in principle adaptive, acute load reactions (e.g., accelerated heart rate, elevated blood pressure levels, and fatigue). Effort is mobilized by activation of the Sympathetic–Adrenal–Medullary (SAM) system which – by secretion of catecholamines (adrenalin and noradrenalin) – regulates cardiovascular activity (i.e., sympathetic activation). Under very stressful circumstances, the Hypothalamic–Pituitary–Adrenal (HPA) system with the "stress hormone" cortisol as its main actor, may be activated as well in order to mobilize supplementary effort needed to deal with the stressful situation (Clow, 2001). Under optimal circumstances, the stress-related acute load reactions return to prestressor levels during after-work hours, and recovery is completed before the next working period starts. In this situation health is not at risk. However, when the stress-related acute load

reactions prolong or re-occur during after-work hours (i.e., sustained sympathetic activation), recovery is incomplete (Geurts & Sonnentag, 2006). As a consequence, the worker will start the next working period while being in a suboptimal condition, and will have to invest compensatory effort in order to perform adequately at work. The resulting increased intensity of load reactions will in turn initiate an even higher demand on the subsequent recovery process, and thus result in an accumulative process developing into chronic load reactions (or "allostatic load" according to McEwen's (1998) allostatic load theory), such as chronically elevated heart rate, hypertension, chronic fatigue, and persistent sleep problems (Sluiter, Frings-Dresen, Van der Beek, & Meijman, 2001).

An important question is under what circumstances the crucial process of daily recovery is hampered by prolongation or re-occurrence of stress-related acute load reactions during after-work hours. One condition is the prolonged exposure to work demands or the new exposure to effortful demands. According to Geurts and Sonnentag (2006), particularly the prolonged exposure to work demands (e.g., daily overtime work) is a risk factor as a demand is made on the *same* psycho-physiological systems that were already activated on the job. Particularly these systems should unwind and return to their baseline levels. In addition, the continued exposure to stressful demands (irrespective of being work-related or not) is a serious risk because of the high sympathetic (cardiovascular) activation associated with the stress exposure. From the perspective of recovery after work, it seems important that people engage in activities that appeal to other systems than already used during work, and that are not (again) stressful. Another condition that hampers the quality of recovery after work is the difficulty to psychologically detach from job stressors. Even when people are not exposed to (new) stressful demands after work, cognitive processes may be responsible for the prolongation or reactivation of stress-related physiological activation, such as rumination about past stressors and anticipation of future stressors, a phenomenon referred to as "perseverative cognition" (Brosschot, Pieper, & Thayer, 2005).

Conservation of Resources Theory

A second theory that may be helpful to describe how people may act during after-work hours in order to recover from stressful work is *Conservation of Resources* (COR) theory (Hobfoll, 1998, 2002). Its core assumption is that people strive to obtain, retain, protect, and build resources that are

important to them, and that stress develops when valued resources are threatened, lost, or not gained after having invested in them. Resources refer here to a heterogeneous category including personal characteristics (e.g., self-esteem), object resources (e.g., clothing), condition resources (e.g., a good marriage), and energy resources (e.g., the level of vigor) that are either valued in themselves, or that serve as a means of obtaining other valued resources. Since resources such as self-esteem and vigor may be lost or threatened in an unfavorable work situation, employees will attempt to restore their resources during after-work hours. This can be realized, for instance, by engaging in leisure activities that may refill their batteries (energy) or will contribute to their self-esteem. After discussing the concept of recovery (third section), we discuss activities and experiences (fifth section) during after-work hours that may hamper or facilitate the recovery process.

Bakker, Van Emmerik, Geurts, and Demerouti (2008) conducted a diary study to test the predictions of the E-R and COR theories. Specifically, they investigated the role of daily recovery in the relationship between daily job demands, work engagement, and performance. Data were collected among 53 fulltime working assembly line employees through daily surveys over two consecutive working weeks (10 working days) that were interrupted by a two-day weekend period. Recovery was assessed in the morning before participants went to work. Job demands, work engagement, and performance were assessed immediately after work. Results revealed that daily work engagement is a function of recovery in-between working days, and that daily work engagement, in turn, is a predictor of daily performance. Additionally, results suggest that recovery turns job demands into challenges: only if employees recovered sufficiently in-between work periods, daily job demands were positively related to work engagement. Thus, recovery moderated the relationship between job demands and work engagement. This study nicely illustrates the principles of E-R and COR theories, and emphasizes the importance of recovery for work engagement and performance, on a day-to-day basis. High effort expended at work is not damaging for health or well-being as long as employees have the opportunity to recover from load effects built up during the working day (see also Geurts & Sonnentag, 2006; Totterdell, Spelten, Smith, Barton, & Folkard, 1995).

Allostatic Load Model

In ergonomics, cardiovascular parameters have been introduced to evaluate the consequences of having been exposed to workload and strain (e.g.,

Luczak, 1987; Schnall, Schwartz, Landsbergis, Warren, & Pickering, 1992; Theorell, Ahlberg-Hulten, Jodko, Sigala, & Torre, 1993; Theorell et al., 1991). To use cardiovascular parameters as an indicator of health, both the situation of exposure to workload and the process of recovery after exposure to workload should be taken into account. The process of recovery can be considered as an indicator of good health. An indication of good health is when a person can recover completely from workload within the timeframe between two working days (Rau, 2004). This definition is supported by the model of allostasis and allostatic load (McEwen, 1998; Sterling & Eyer, 1988). Allostasis describes the process of how the physiological system adjusts from one level of activation to the other, including the change from activity to rest (Sterling, 2004). The physiological system is continuously changing in order to adapt to the change in circumstances. Through this continuous change, the system tries to achieve a level of stability. A healthy response of an allostatic system (such as the central and vegetative nervous system, the endocrine and immune system, the cardiovascular system etc.) to exposure of load consists of three steps (a) initiate a response to adapt to the current demanding situation, (b) sustaining this response reaction until the demanding situation comes to an end and the load ends, and (c) shutting off the response after the demand is no longer imposed on the system. The system will then enter a state of rest (McEwen, 1998). For example, an adaptive response to workload could be an increase in heart rate and blood pressure for the duration of the demanding situation. Once the demands are gone and the person no longer faces the workload, heart rate and blood pressure must be reset, i.e., enter a state of rest (Pickering, 1997). However, allostatic load situations occur when the initial adaptive response fails to be shut off after the load has gone (e.g., blood pressure remains elevated up to the late night). Allostatic load is thus considered to be a pathophysiological outcome (McEwen, 1998; Sterling & Eyer, 1988).

HOW IS RECOVERY CONCEPTUALIZED?

Recovery has been defined in several ways, but most definitions have in common that recovery occurs after strain when the stressor is no longer present (Sonnentag & Geurts, this volume). It represents the process that repairs the negative strain effects. More specifically, recovery refers to the process during which an individual's functioning returns to its pre-stressor level and in which strain is reduced (Sonnentag & Natter, 2004).

Put differently, recovery refers to activities that might reduce fatigue to restore a status of physiological and psychological performance readiness. One way in which recovery has been captured empirically is to ask participants to report their level of recovery before starting to work (Sonnentag, 2003). In this research tradition, participants respond to items like "because of the leisure activities pursued yesterday, I feel recovered/relaxed/in a good mood." This operationalization of recovery has been successful in predicting work engagement, personal initiative, and pursuit of learning as reported later that day.

Sonnentag and Natter (2004) used a more specific way to capture the *recovery experience*. Recovery experience refers to the degree to which the individual perceives that the activities he/she pursues during non-work time helps him/her to restore energy resources (Sonnentag & Natter, 2004). Participants had to indicate next to the amount of time they spent one specific evening on off-job time activities, also the degree to which they felt recovered after having performed these activities. In this respect, recovery experiences indicate the strategies that people use to avoid negative effects of stressful situations (Sonnentag & Fritz, 2007). The advantage of this method is that it refers to the recovery effect of each activity separately, providing rich information about what activities potentially enhance recovery. Moreover, these specific (versus global) reports on recovery are provided the same evening as the activity was carried out. Therefore, recalling errors are minimized. However, what is still missing is information about sleep.

Yet another way to operationalize recovery is to use self-report measures of fatigue as a proxy (Rook & Zijlstra, 2006; Sonnentag & Geurts, this volume). The assumption is that elevated levels of fatigue can be used to identify individuals who have failed to recover from the short-term effects of a workday. Therefore, also reductions in the level of fatigue may indicate recovery. Because subjective experiences of fatigue are believed to encompass a strong motivational component rather than feelings of physical fatigue (Meijman, 1991; Rook & Zijlstra, 2006), it is questionable whether such measures really capture the unwinding component and the replenishing of resources which is crucial for recovery. Moreover, fatigue and lack of recovery are related but not identical constructs. According to Sonnentag and Zijlstra (2006), "fatigue is a *state* that results from being active in order to deal with the work demands, and recovery is the *process* of replenishing depleted resources or rebalancing suboptimal systems" (p. 331). Thus, fatigue is more a consequence of lack of recovery, rather than a concept referring to the recovery process or problems within the recovery process.

When fatigue builds up people feel a sense of urgency to take a break from the demands. This sense of urgency is called *need for recovery* (Sonnentag & Zijlstra, 2006) and has also been used as an indicator of (in)sufficient recovery. Need for recovery is an emotional state characterized by a reluctance to continue the present demands or to accept new demands. Owing to conceptual similarity with fatigue and psychological distress researchers have tried to show that need for recovery is something different than these other established constructs. The study of Jansen, Kant, and van den Brandt (2002) on a large Dutch population ($N > 12{,}000$) showed that although need for recovery, fatigue, and psychological distress were frequently co-morbid, they also clearly occurred as separate entities.

Poor recovery may also manifest itself in elevated levels of neuroendocrine activity during non-work time, such as elevated levels of catecholamines (adrenaline and noradrenaline) and cortisol during after-work hours (Sonnentag & Geurts, this volume). A recent systematic literature review (Sonnentag & Fritz, 2006) has shown that after highly intensified work periods, catecholamine levels remain elevated, indicating poor physiological recovery. For instance, in a classic field experiment among driving examiners with varying degrees of workload, elevated adrenaline levels persisted during after-work hours on workdays with intensive workload, whereas on workdays with relatively low or medium workload, adrenaline levels returned to predemand levels within a few off-job hours (Meijman, Mulder, van Dormolen, & Cremer, 1992). As these neuroendocrine hormones initiate sympathetic activation, elevated cardiovascular activation (accelerated heart rate and elevated blood pressure levels) after exposure to job stressors may also be used as indicators of poor physiological recovery after work. For instance, in an experimental study, Glynn, Christenfeld, and Gerin (2002) provided evidence for poor cardiovascular recovery (i.e., delayed blood pressure recovery) after exposure to an emotional stressor.

In a recent study among couples, Saxbe, Repetti, and Nishina (2008) examined after-work recovery, by exploring associations between self-reported daily work stress and evening cortisol levels. Participants sampled saliva four times per day during three days. Wives who had less satisfying marriages excreted higher evening cortisol at home following days with higher than usual afternoon cortisol, but this continuation of elevated cortisol from work to home was not observed in women with higher levels of marital satisfaction. For both men and women, evening cortisol was lower than usual on higher-workload days, and marital satisfaction augmented

this association among women. Men showed higher evening cortisol after more distressing social experiences at work, an association that was strongest among men with higher marital satisfaction.

OUTCOMES OF (LACK OF) RECOVERY

As indicated above, recovery refers to the process during which an individual's functioning returns to its prestressor level and in which strain is reduced. Several studies have examined the outcomes of (lack of) recovery on a day-to-day basis, comparing levels of recovery indicators at a later point in time (typically before going to bed or after waking up in the morning) to scores on the same variables at an earlier point in time (e.g., after waking up in the morning or the previous day, before going to bed). In this section, we provide a short overview of these studies and discuss their main findings in relation to the type of outcome studied. Our aim is to (i) emphasize the importance of recovery in predicting valuable outcomes for organizations, individuals, and families, and (ii) show the differences between recovery processes and outcomes that seem conceptual similar to recovery (e.g., fatigue).

Study selection. As a first step, we conducted an automated search in the PsycInfo and MedLine databases. We searched for entries that met the criterion that the abstract or title of papers include the following terms: (i) either "Day," "Diary," or "Daily," in combination with (ii) "recovery" or "fatigue" and (iii) either "work," "worker(s)," "working," "employed," or "employment." In this way, we aimed to retrieve studies that studied daily recovery in a work context. This search returned 388 potentially relevant studies.

The abstract of these 388 studies were examined by one of the authors for relevance. Oftentimes, the abstract revealed that studies were irrelevant, for example, that they did not study recovery in the work context or on a day-to-day basis, or because the antecedents, rather than the consequences of recovery were studied. Further, studies had to present original empirical evidence on the relationship between recovery and outcomes thereof. Review papers and conceptual papers were excluded. In all, 35 studies were retained. These studies were read in detail by one of the authors, after which six studies remained. This number is fairly small, but our inclusion criteria were rather narrow, explicitly focusing on research that considered research

that examined the consequences of *recovery* or lack thereof. This means that research examining the same consequences within related but different theoretical frameworks (e.g., research on the effects of working overtime, shift work, or sleep deprivation) was not included.

Description of studies. Table 1 presents descriptive information on the studies included in our overview. As regards the samples used, these were usually small, ranging from 19 to 166. This may be due to the fact that data collection was quite demanding: all six studies employed some form of diary design, in which participants completed diaries at several occasions during the study. The studies covered up to five consecutive work days (usually a working week).

As regards the recovery indicators included in these studies, five of these (Studies 2–6) focused on the activities conducted after work and before going to bed, e.g., in the form of the time spent on these activities, the subjective experience of these activities, or the degree to which one felt recovered due to doing these activities. Study 5 included a measure of sleep quality, whereas Study 1 considered the length of the layover time between two consecutive flights among airline pilots; what these pilots did during this time was not recorded in detail (it seems likely that they will have spent at least part of this time sleeping). In fourth section, we discuss these activities in more detail, in relation to the outcomes thereof.

The outcomes considered in the six studies vary considerably, and may be roughly classified as either covering motivation and performance, or health and well-being. All outcomes were measured after a period of recovery, e.g., before going to bed (Studies 2, 4, 6), after a night's sleep (Studies 3 and 5), or after a period of inactivity in-between two work shifts (Study 1). As regards *motivation and performance*, one study (Study 1) focused on an objective performance measure, namely response time during playing a game on a hand-held computer. All other recovery outcomes were measured through self-reports. Study 3 examined personal initiative and pursuit of learning as recovery outcomes. With respect to *health and well-being*, fatigue and mood were relatively often examined (fatigue: Studies 4–6; mood: Studies 2–5). Two other studies examined one dimension of engagement: Studies 3 and 6 (both focusing on vigor, i.e., energy – this concept may be considered an alternative way of tapping fatigue as well). Finally, Study 6 employed feelings of depression as the focal variable. All in all, it seems that subjective well-being (especially mood and fatigue) has relatively often been examined in diary research on the effects of recovery, whereas especially studies examining performance are rare.

Table 1. Description of Studies on the Effects of Day-to-Day Recovery.

	Study	Sample	Design	Recovery Indicator	Recovery Outcome
(1)	Lamont, Dawson, and Roach (2006)	19 international airline pilots	Diary study (2 consecutive flights)	Layover time between flights (sleep)	Computerized psychomotor vigilance task: response time
(2)	Sonnentag (2001)	100 teachers	Diary study (5 consecutive work days)	Evening activities: work-related, household chores, low-effort, social, physical	Well-being before going to sleep: feeling tense, mood
(3)	Sonnentag (2003)	147 employees of public service organizations	Diary study (5 consecutive work days)	Feelings of being recovered due to leisure activities	Work engagement, personal initiative, pursuit of learning
(4)	Sonnentag and Bayer (2005)	87 workers, various occupations	Diary study (3 consecutive work days)	Psychological detachment during five evening activities: work-related, household chores, low-effort, social, physical; General psychological detachment	Well-being before going to sleep: fatigue, mood
(5)	Sonnentag, Binnewies, and Mojza (2008)	166 public administration employees	Diary study (5 consecutive work days)	Psychological detachment, relaxation; Mastery experiences, sleep quality	Morning affect: (i) positive effect, (ii) negative effect, (iii) serenity, (iv) fatigue
(6)	Sonnentag and Natter (2004)	47 flight attendants	Diary study (4 work days)	Time spent on five activities before going to bed: work-related, household chores, low-effort, social, physical; Feelings of recovery	Well-being before going to sleep: vigor, depression, fatigue

ACTIVITIES DURING RECOVERY

Activities with a Potential for Recovery

Basically, the present chapter assumes that what one does after work may affect the degree to which one recovers from the effort expended at work. On the basis of the work of Sonnentag and colleagues (e.g., Sonnentag, 2001; Sonnentag & Bayer, 2005), we distinguish among activities promoting (see section "Activities with a potential for recovery") and activities impeding recovery (see section "Activities potentially inhibiting recovery"). Table 2 presents the findings of the six studies discussed in the previous section. These are discussed hereafter.

Table 2. Findings of Studies on the Effects of Day-to-Day Recovery.

	Study	Recovery Indicator	Effects
(1)	Lamont et al. (2006)	Layover time between flights (sleep)	Response time (−)
(2)	Sonnentag (2001)	Work-related activities	Well-being (−)
		Low-effort, social, physical activities	Well-being (+)
(3)	Sonnentag (2003)	Feelings of being recovered due to various activities	Engagement (+), personal initiative (+), pursuit of learning (+)
(4)	Sonnentag and Bayer (2005)	Psychological detachment during social activities	Mood (+)
		Psychological detachment during physical activities	Mood (+), fatigue (−)
		General psychological detachment	Mood (+), fatigue (−)
(5)	Sonnentag et al. (2008)	Sleep quality	Positive activation (+), serenity (+), negative activation (−), fatigue (−)
		Feelings of mastery	Positive activation (+)
		Relaxation	Serenity (+)
		Psychological detachment	Negative activation (−), morning fatigue (−)
(6)	Sonnentag and Natter (2004)	Feelings of recovery	Vigor (+), depression (−), fatigue (−)
		Time spent on social activities	Depression (+)
		Time spent on physical activities	Vigor (+), depression (−)

Note: "+" denotes a positive effect (more of A is associated with more of B); "−" denotes a negative effect.

Sleep

Studies on daily recovery have consistently ignored the role of sleep as an activity important for recovery in its own right. Because sleep has a restorative function and maintains performance (Campbell, 1992; Horne, 2001), it is necessary to consider sleep in the phenomenon of daily recovery. Research by Zijlstra and de Vries (2000) has indicated that sleep is important for recovery. Van Hooff, Geurts, Kompier, and Taris (2007) found among faculty members that those who invested much effort in their work during work hours did not differ in sleep time from those expending less effort on work, but reported more sleep complaints during the workweek, indicating poor recovery. Individuals with high levels of fatigue typically have fewer hours of sleep and require extra effort to conduct their work in comparison to individuals with low levels of fatigue. Moreover, there is strong evidence that cognitive arousal at bedtime is associated with increased sleep disturbance. For instance, Cropley, Dijk, and Stanley (2006) found that ruminating about work issues in the hour preceding bedtime was associated with greater sleep disturbance.

Adults need on average 7–9 h sleep per night, whereas children need about 9–10 h per night (Carskadon & Dement, 2005). Several studies have shown that a day nap of 15–20 min is very beneficial for recovery (Takahashi, Fukuda, & Arito, 1998). However, too much or too little sleep can affect performance in a negative way. Moreover, not only the quantity but also the quality of sleep is important for recovery and performance (e.g., Craig & Cooper, 1992). It has been shown that deep sleep (75–80%) has a positive influence on growth and repair, whereas rapid eye movement (REM) sleep (20–25%) has a neutral function. These impressions are confirmed by the findings presented in Table 2. Lamont et al. (2006; Study 2) reported that layover time between flights positively affected the performance (i.e., response time on a computer game) of flight attendants, whereas Sonnentag et al. (2008; Study 6) found that sleep quality was positively associated with mood (positive affect, serenity) and negatively with negative effect and fatigue.

Low-Effort Activities

Low-effort activities represent passive activities that by definition require hardly any effort on the part of the individual and therefore pose no demands on the psychobiological system (Sonnentag, 2001; Sonnentag & Natter, 2004). Examples of such activities are watching television, listening to music, or just relaxing on the sofa and doing nothing (Kleiber, Larson, & Csikszentmihalyi, 1986). These activities have a recovery function because they do not occupy resources that are normally required to accomplish work

tasks (Sonnentag, 2001). Consequently, psychobiological systems will return to their normal prestressor state (Meijman & Mulder, 1998). Although it seems plausible that low-effort activities will have a recovery effect, some authors have doubted such an effect. Accordingly, low-effort activities mean that people spend their time in passive leisure activities and passive activities are detrimental for well-being because they are related to free-time boredom and apathy (cf. Iso-Ahola, 1997). However, according to Sonnentag (2001), such a relationship between passive leisure activities and poor well-being might be a spurious one that can be explained by third variables. One such a third variable could be the work environment, for example, a job with low demands and low autonomy (or passive jobs in terms of Karasek (1998)).

Empirical findings regarding the effect of low-effort activities on daily recovery and well-being have been mixed (cf. Table 2). Consistent with the predictions of the effort-recovery model, Sonnentag (2001) found that time spent on low-effort activities was favorably related to well-being at bedtime among teachers. However, Sonnentag and Natter (2004) found that low-effort activities had no effect on well-being (operationalized as recovery experience, fatigue, vigor, and depression) during bedtime among flight attendants. In a similar vein, Rook and Zijlstra (2006) showed that low-effort activities had little or no effect on recovery.

Relaxation Activities

A related category of activities are those that enhance relaxation (Sonnentag & Fritz, 2007). Relaxation can also be viewed as a state which is characterized by positive affect and low activation. In the present section, however, we review activities that may lead to relaxation rather than the state of relaxation. Examples of such relaxation activities are meditation (Grossman, Niemann, Schmidt, & Walach, 2004), yoga (Oken et al., 2004), listening to music (Pelletier, 2004), taking a walk in a natural environment (Hartig, Evans, Jamner, Davis, & Gärling, 2003), taking a long-hot bath (Bourne, 2000), progressive muscle relaxation, and breathing exercises (Calder, 2003a, 2003b). These activities have in common that they are not demanding and do not require any kind of effort from the individual. However, the individual is actively involved in a pleasurable activity. The role that relaxation plays to increase recovery is according to Sonnentag and Fritz (2007) two-fold. First, because relaxation experiences reduce psychophysiological activation, sustained activation is inhibited, and the psychobiological system can return to the prestressor state. This helps that the stressor does not translate into illnesses. Second, the fact that the relaxation activities are pleasurable and can increase positive effects has also favorable

effects on the individual's well-being. According to Fredrickson (2001), positive emotions help individuals to build resources including energy which they can use in the future to minimize the influence of negative emotions and stress.

There is indeed some evidence for the recovery function of relaxation (Table 2), although the relationship between relaxation and recovery has been more extensively studied among athletes (Calder, 2003a, 2003b). In the study of Sonnentag and Fritz (2007), relaxation was negatively correlated with health complaints, exhaustion, sleep problems, and need for recovery, and positively correlated with life satisfaction. Furthermore, in their seven-day diary study among workers from an Australian supermarket, Garrick, Winwood, and Bakker (2008) found that previous day meditation/prayer increased sleep quality and inter-shift recovery. Moreover, they found that daily recovery mediated the relationship between meditation/prayer and acute fatigue. This means that meditation and prayer had a favorable impact on recovery. Finally, Sonnentag et al. (2008) reported that relaxation had a positive effect on mood (specifically, serenity).

Social Activities

Social activities refer to activities that focus on social contact including going to a party, dining, or phoning other people (Sonnentag, 2001). During such activities people meet and spend time with others that they like such as family members, friends, or other individuals or groups (Fritz & Sonnentag, 2005; Sonnentag, 2001). Sonnentag (2001) proposes two mechanisms through which social activities can have a recovery function. The first possible function of social activities is that by meeting other people we open channels of social support. Social support has been found to reduce the negative influence of job demands on well-being (e.g., Bakker, Demerouti, & Euwema, 2005). The second possible function is that social activities draw on different resources than those necessary for work-related tasks. Consequently, recovery processes can take place. Note that there is a difference between the social contact we have when employed in human service occupations and the social contacts during leisure time. Work-related social interactions, e.g., with customers, often require emotion regulation or "emotion work" (Zapf, 2002). Emotion regulation is an effortful process in which employees have to show emotions that do not feel but that are according to the rules of the organization. That kind of emotion regulation may not be necessary for social interactions during leisure time (Sonnentag, 2001).

There is some evidence that engagement in social activities has a beneficial effect on recovery (Table 2). Sonnentag and Zijlstra (2006) found in their

dairy study that social activities were positively related to well-being at bedtime and negatively related to need for recovery. In contrast, the study of Sonnentag and Bayer (2005) found that social activities were unrelated to positive mood as well as to fatigue at bedtime. Moreover, Sonnentag and Natter (2004) found that involvement in social activities was related to *higher* feelings of depression at bedtime. An explanation that these authors offered is that social activities might include deliberate preoccupation with job-related thoughts as is the case when meeting friends and talking with them about work. Another possible explanation could be that social activities are relaxing for some people but not for everybody. For instance, extraverts might profit more from social activities in terms of unwinding than introverts (Trougakos & Hideg, this volume).

Physical Activities

Physical activities refer to behaviors including exercise, physical training, sports etc. Physical exercise is important to maintain fitness and is found to contribute to physical and mental health (McAuley, Kramer, & Colcombe, 2004). It seems a paradox to claim that physical activity during leisure time can promote recovery. Both physiological and psychological explanations have been suggested to account for the recovery enhancing effects of exercise (Sonnentag, 2001; Yeung, 1996). Of the physiological mechanisms, most attention has been given to the action of endorphins within the central nervous system. Numerous studies have shown that levels of endorphins are elevated following exercise (Grossman et al., 1984), but attempts to relate endorphin levels to positive mood changes have generally failed – probably due to methodological problems of these studies (Thoren, Floras, Hoffman, & Seals, 1990). A second physiological explanation is the thermogenic hypothesis of exercise suggesting that an elevation of body temperature is responsible for subjectively increased mood following exercise (Raglin & Morgan, 1985). The monoamine hypothesis is a third physiological explanation referring to the enhanced secretion of noradrenalin, serotonin, and dopamine that have an antidepressant effect (for an overview, see Cox, 2002). Next to these physiological mechanisms, the distraction hypothesis asserts that it is not the exercise as such that enhances mood and recovery, but rather the respite or ''time out'' that it provides from worrisome thoughts and daily stressors (Raglin & Morgan, 1985; Yeung, 1996). Finally, the completion of an important and effortful task (including exercise) brings about a sense of mastery or achievement and self-efficacy beliefs, thereby enhancing positive mood and well-being.

As Table 2 shows, there is consistent evidence supporting that well-being at bedtime is improved on days when individuals spend time on physical activities (Sonnentag, 2001; Sonnentag & Bayer, 2003; Sonnentag & Natter, 2004). More specifically, physical activities have a positive effect on vigor and mood, and a negative effect on depression. However, physical activities were unrelated to fatigue experienced at bedtime in each of these studies. This can be explained by the fact that physical activities increase physical fatigue, which may mask the positive effects on other aspects of fatigue (Sonnentag & Natter, 2004).

Creative Activities

Hobbies, or creative activity, have received very little research in the field of work fatigue and recovery, but initial studies suggest that they can have an important restorative function. Hobbies provide opportunities for personal fulfillment, skills acquisition, and emotionally rewarding "mastery" experiences. In addition, these activities arguably stimulate the pleasure/reward brain center (Winwood, Bakker, & Winefield, 2007). We could locate only two studies that examined the relationship between hobbies and recovery. In their study among a heterogeneous sample of workers, Winwood et al. (2007) found that employees reporting higher levels of creative (hobby) activity reported significantly better sleep, recovery between work periods, and lower chronic maladaptive fatigue. In addition, in their diary study, Garrick et al. (2008) found that engagement in hobbies increased recovery, which in turn had a positive effect on next days' work engagement.

Psychological Experiences with a Potential for Recovery

In this section, we review two psychological experiences that can enhance recovery, namely psychological detachment from work and humor. These do not represent activities per se but are merely ways of thinking that, as we will see in the review, facilitate daily recovery.

Psychological Detachment

Psychological detachment is used to describe individual's sense of being away from work (Etzion, Eden, & Lapidot, 1998). Detachment implies more than just being away from work physically. In contrast to the activities mentioned in the previous section, psychological detachment does not represent an activity but is psychological in nature. It suggests that the

individual stops thinking about work and disengages his/herself mentally from work (Sonnentag & Bayer, 2005; Sonnentag & Fritz, 2007; Sonnentag & Kruel, 2006). Further, it suggests that the individual switches off from work-related matters and problems but also from positive aspects of work. Thus, just being physically away from work is not sufficient to experience *psychological* detachment. The underlying mechanisms that explain why psychological detachment helps to recover has to do with whether resources that people use when they are active at work are still occupied while at home. When individuals do not detach and thus think about their work issues during non-work time (negative or positive), they are cognitively aroused (cf. Cropley et al., 2006). Therefore, the functional systems that are activated during work are still activated during non-work time in this way inhibiting the recovery process. In contrast, when individuals detach psychologically from their work, no further functional demands tax their psychobiological system (Sonnentag & Fritz, 2007).

The results of diary studies (Table 2) suggest that individuals who experienced psychological detachment from work during leisure time reported better mood, less negative effect, and less fatigue at the end of the evening and in the next morning (Sonnentag & Bayer, 2005; Sonnentag et al., 2008) and had more sleep disturbances (Cropley et al., 2006). It is important to note that psychological detachment is particularly useful after stressful and demanding working days (Sonnentag & Bayer, 2005). During such days, individuals might continue working at home, might continue thinking about the tasks that remained unfinished, or they might anticipate the workload of the next day. Thus, it appears that experiences on the job and the nature of job-related cognitions when being off work determines the level of recovery and recovery-related outcomes.

Humor

It has been demonstrated that humor states and associated laughter can benefit stress and coping, as well as various other health-related outcomes, such as cardiac rehabilitation and pain threshold (Healy & McKay, 2000). Hence, engagement in humorous activities outside of work can be expected to result in decreased fatigue, increased recovery and higher subsequent work engagement. This hypothesis was tested in the diary study of Garrick et al. (2008). They found that time spent laughing or being engaged in humor stimulating activities inducing laughter was significantly related to inter-shift recovery and sleep quality. However, laughing did not influence next day's levels of fatigue and work engagement.

Activities Potentially Inhibiting Recovery

Work-Related Activities

The traditional work–rest cycle including 8 h work, 8 h time for personal needs and free time, and 8 h sleep is based on the idea that the time between two work periods is sufficient to recover from work. Normally people feel fatigued after work, but this fatigue is not a problem since it is reversible by changing tasks or by stopping the fatigue-inducing activity (Meijman & Mulder, 1998). If the psychobiological systems used during work are activated during recovery time, a cumulative process involving prolonged fatigue, sleep, and psychosomatic complaints may ensue (Rook & Zijlstra, 2006). Work-related activities refer not only to activities related to work but also to other task-related activities similar to those conducted at work like paying bills or arranging private bureaucracy. Such activities have an compulsory character (they have to be done) and they draw on resources similar to those already called on during working time (Sonnentag & Natter, 2004). Continuously drawing on the same resources during the evening can empty the resource reservoir and increase strain. Therefore, work-related activities carried out after work can impair recovery (e.g., overtime work; for a review, see Taris, Beckers, Dahlgren, Geurts, & Tucker, 2007).

Sonnentag and Natter (2004) found in their diary study that time spent on work-related activities resulted in somewhat lower levels of vigor and higher levels of fatigue at bedtime, although the effects were marginal. Similarly, Sonnentag and Zijlstra (2006) found that the time individuals devoted to work-related activities during off-work time was positively related to their need for recovery and negatively to their well-being during bedtime. As Table 2 shows, Sonnentag (2001) reported similar findings.

Household and Child-Care Activities

Household and child-care activities normally draw on different resources than those needed for work, except for occupations in the cleaning services industry or child care (Sonnentag, 2001). Therefore, it could be assumed that these activities offer the possibility to recover from work-related demands. However, another aspect of household and child-care activities is that they require physical and psychological effort and that they have an obligatory character since most of these activities cannot be skipped or postponed. Thus, while the nature of household and child-care activities could facilitate recovery, their obligatory character inhibits recovery. This is because people must accomplish these tasks and spend effort on them when they are already fatigued after a working day.

The suggested detrimental effect of household and child-care activities on recovery has however not been confirmed empirically (cf. Table 2). Time spent on household and child-care activities was unrelated to fatigue and well-being at bedtime in the diary studies of Sonnentag (2001) and Sonnentag and Bayer (2005). Similar findings were reported by Sonnentag and Zijlstra (2006) as well as by Sonnentag and Natter (2004). Several explanations have been provided for the zero effects of household and child-care activities on the recovery process and outcomes. One explanation is that these activities are always studied together making it difficult to separate their unique effect. For instance, it is conceivable that household activities impede recovery and that child-care activities facilitate recovery. Another explanation is that there might be individual differences suggesting that some individuals experience these as positive and other individuals as negative (Sonnentag, 2001). Rook and Zijlstra (2006) (who also found no effect of such activities on subjective fatigue) suggest that because household activities and in particular caring for children require active involvement they help individuals to disengage from the daily strains at work. Therefore, they might be even beneficial for recovery.

FACTORS FACILITATING RECOVERY

Although work generally depletes the energy reserves of employees, it may also contain aspects that minimize the detrimental effects of work. These concern mainly job resources such as job control, feedback, and learning opportunities. Why can such aspects at work help recovery when being at home? This is well illustrated by Rau (2006), who examined the influence of learning opportunities at work on recovery. Learning opportunities included procedural and temporal degrees of freedom, decision authority, responsibility, information about results and feedback. Note that these aspects were measured independent of the job incumbent's perception, by means of a job analysis instrument filled in by an expert analyst. Moreover, recovery was measured using physiological (blood pressure and heart rates) and psychological (self-rated ability to relax) indicators. The findings of the 24-h measures indicated that learning opportunities were favorably associated with nocturnal recovery of heart rate and blood pressure but unrelated with self-rated assessments of recovery. According to Rau (2006), the underlying mechanism for these relationships is that jobs with learning opportunities can be considered as intrinsically motivating and positively challenging for employees (Csikszentmihalyi, 1990). People in such jobs usually are highly

activated, but not stressed (Karasek, 1998; Taris & Kompier, 2005) – a state that Dienstbier (1989) calls toughening. When employees have control over their work, they can decide themselves how to deal with problems, and when to stop working. Apparently this helps them to better switch off from work (Cropley et al., 2006), and consequently to unwind.

This positive influence of in particular job control on recovery was confirmed in another diary study by Sonnentag and Zijlstra (2006). They found that next to job demands, job control contributed to explaining variance in need for recovery at bedtime – beyond the effect of negative affectivity and the particularly strong effect of well-being when returning home from work.

Everybody would agree that recovery mainly takes place after work when people are at home. Therefore, it is ironical that we could find no study that examined factors from the home situation that can facilitate recovery. Our expectation is that home resources like autonomy, social support, and feedback will facilitate recovery just like job resources do. However, there is no evidence to support this assumption. Future research should strive to provide more insight into such factors. It should be noted here that in order to achieve this, future research should improve the conceptualization and measurement of the characteristics of the home domain (Geurts & Demerouti, 2003).

FACTORS INHIBITING RECOVERY

Work-Related

Every working day, employees are exposed to a certain amount of *job demands*. These job demands (particularly workload) often vary from day to day (Butler, Grzywacz, Bass, & Linney, 2005), and may determine our daily mood or effect (Zohar, Tzischinski, & Epstein, 2003). Studies using a within-person design have shown that periods of high workload coincide with impaired well-being, suggesting a depletion of employees' energy resources during high workload periods (Teuchmann, Totterdell, & Parker, 1999; Totterdell, Wood, & Wall, 2006).

The diary study by Sonnentag and Bayer (2005) suggests that with high demands on a specific day the risk of not being able to relax and detach from work increases. This result is in line with findings by Cropley and Purvis (2003), who found in their diary study a positive relationship between job demands and rumination, and by Appels (1997), who demonstrated that high demands are related to inability to relax and to exhaustion. Also,

Rau (2006) found that job demands were related to disturbed ability to relax at home although they were not related to blood pressure during night.

Another important work characteristic that influences daily recovery is *overtime*. As Rau and Triemer (2004) argue, overtime acts as a stressor because it increases the demands on employees attempting to maintain their performance levels in the face of increasing fatigue. Additionally, employees working longer hours are exposed to other sources of workplace stress for a greater amount of time. Because working overtime implies that the working day is prolonged, whereas the time left for recovery is curtailed, a large proportion of overtime research has concentrated on poor recovery (e.g., Van der Hulst & Geurts, 2001).

Rau and Triemer (2004) followed participants for 24 h with a computerized diary and ambulant monitoring of blood pressure to test the relationship between overtime and recovery. As expected, overtime impacted both the organization of after-work activities and nocturnal recovery. Men and women working overtime had less leisure time, and men also reported less time for household, childcare etc. than those working regular hours. Although those working overtime had higher systolic and diastolic blood pressure during work than those working regular times, it was unrelated to blood pressure during non-work time. Significantly more participants in the group of men and women working overtime were found to have a disturbed ability to recover and to display clinically relevant sleep disturbances than in the group working regular hours. Furthermore, working overtime was associated with less positive effect after work in men, and with more negative effect during work and before going to bed in men and women.

Non-Work Hassles

Non-work hassles refer to on-going stressors experienced in day-to-day life (Lepore & Evans, 1996). Such stressors are positioned in the private life domain and concern situations that deviate from the normal state like sudden problems with the car, conflicts with a family member, accumulated household duties, moving to another house or repairing one's own house. As the diary study of Bolger, DeLongis, Kessler, and Schilling (1989) showed, such hassles appear regularly and therefore they can influence individual's daily recovery. In addition to hindering the replenishment of resources because they interrupt the recovery process, non-work hassles may also drain emotional resources because they put additional load on the individual (Fritz & Sonnentag, 2005). Thus, non-work hassles represent

additional demands for individuals because they have to invest effort to deal with them. Another reason why non-work hassles are demanding is that they are unpredictable and unexpected and therefore individuals do not necessarily know to deal adequately with them (cf. Taris & Kompier, 2005). This means again that the recovery during non-work time is disturbed.

Bolger et al. (1989) found that non-work hassles including transportation, financial problems, and interpersonal conflict with people at home explained about 20% of the variance in daily mood. Interestingly, interpersonal conflicts, because of their emotional impact were far most important in explaining variance in daily mood. Further, Fritz and Sonnentag (2005) found in their diary study that non-work hassles during the weekend significantly contributed to poor general well-being, poor task performance, higher disengagement from work, lower levels of personal initiative, and lower pursuit of learning after the weekend.

NEED FOR RECOVERY

Results for Need for Recovery: Predictors

Although working toward a conceptual model of daily recovery, we reviewed several diary studies that examined relationships between aspects involved in the process of recovery. Because there are not so many diary studies that examined the process of recovery on a daily level and in order to make a more inclusive picture of recovery, we reviewed studies on need for recovery as well. Thus, the aim of this section is to present findings on need for recovery such that we can conclude whether these parallel the findings of daily recovery.

Need for recovery is the *sense of urgency* that people feel to take a break from their demands, when fatigue builds up. Inherent in the experience of need for recovery is a temporal reluctance to continue with the present demands or even to accept new demands (Schaufeli & Taris, 2005). Therefore, need for recovery from work can be viewed as an early stage of a long-term strain process leading to prolonged fatigue, psychological distress, and cardiovascular complaints (e.g., Jansen et al., 2002; Kivimaki et al., 2006). Typical examples of need for recovery experiences are that employees find it difficult to relax at the end of a working day, cannot concentrate during their free time after work, need free days to rest, and feel tired when they start a new work day (cf. Van Veldhoven & Meijman, 1994; Winwood, Winefield, & Lushington, 2006).

High need for recovery during non-work time implies that employees are strained due to dealing with work demands; otherwise recovery would not be necessary. When people have the time and the opportunity to satisfy their need for recovery (by resting or by engaging in appropriate leisure activities), their need for recovery will be fulfilled (Sonnentag & Zijlstra, 2006). This will be the case in the absence of work demands during a respite, which allows one to invest in new resources and to initiate a resource gain (Eden, 2001).

Several studies have examined the relationship between job demands and need for recovery. Job demands refer to those physical, social, or organizational aspects of the job that require sustained physical and mental efforts and are therefore associated with certain physiological and psychological costs (e.g., fatigue; Demerouti, Bakker, Nachreiner & Schaufeli, 2001). To avoid these costs or the negative consequences of demands individuals need to recover (Meijman & Mulder, 1998). Therefore, individuals exposed to highly demanding work situations experience higher need for recovery than those who have not been exposed to these situations (Sonnentag & Zijlstra, 2006). The same kind of argumentation applies to home demands since they also require the investment of effort in order to fulfill them.

Results confirm that there is a positive relationship between demands and need for recovery. In the diary study of Sonnentag and Zijlstra (2006), chronic job demands significantly predicted need for recovery during bedtime. In a longitudinal study, De Raeve, Vasse, Jansen, van den Brandt, and Kant (2007) found that increasing job demands were a significant predictor of a subsequent increase in need for recovery. Similarly, De Croon, Sluiter, Blonk, Broersen, and Frings-Dresen (2004) found in a two-year follow-up study among truck drivers that physical, psychological, and supervisor demands were positively related to need for recovery. Work schedule is considered to be an important factor influencing need for recovery. Using a 32-months follow up study, Van Amelsvoort, Jansen, Swaen, van den Brandt, and Kant (2004) found that backward rotation (night–evening–morning) shift schedule was prospectively related to an increased need for recovery. Additionally, Jansen et al. (2002) found that higher working hours a day and working hours a week coincided with more need for recovery from work. However, it seemed that the effect of working hours and overtime were interrelated with other work-related factors like demanding working conditions. Moreover, in a cross-sectional study in a representative sample of the Dutch working population, Sonnentag and Zijlstra (2006) found that quantity of work, responsibility, temporal

demands, overtime, and hazards were positively related, whereas household and care responsibilities were unrelated to need for recovery. Similar findings have been reported by other cross-sectional studies using comparable job demands among specific occupational groups (e.g., Eriksen, Ihlebaek, Jansen, & Burdorf, 2006).

Next to job demands also job resources like job control and social support have been related to need for recovery. Job resources refer to those physical, psychological, social, or organizational aspects of the job that are functional in achieving work goals or reducing job demands at the associated physiological and psychological costs (Demerouti et al., 2001). Since job resources per definition help individuals during their task execution such that they will achieve their work goals and reduce the unfavorable impact of demands on them, they will have to exert low levels of effort. Consequently, need for recovery will not increase.

Several studies found that job resources are indeed negatively related to need for recovery. Specifically, job control was significantly related to lower need for recovery during bedtime in the diary study of Sonnentag and Zijlstra (2006). The longitudinal study of De Raeve et al. (2007) confirmed that an increase in decision latitude predicted a subsequent decrease in need for recovery. Similarly, de Croon et al. (2004) found a negative relationship between job control and need for recovery over time.

Moreover, negative affectivity and well-being when returning home were significant predictors of need for recovery during bedtime. Additionally, daily activities have also been found to influence daily need for recovery. People who spent a high amount of time on work-related activities had a stronger need for recovery at bedtime, whereas high amounts of time spent on social activities and physical activities had negative effects on need for recovery (Sonnentag & Zijlstra, 2006).

Results for Need for Recovery: Outcomes

Daily need for recovery has been found a highly significant predictor of daily well-being at bedtime (Sonnentag & Zijlstra, 2006). Need for recovery was also positively related to employee voluntary turnover in a two-year follow-up study among truck drivers (De Croon et al., 2004), whereas the longitudinal study of Swaen, Kant, Van Amelsfoort, and Beurskens (2002) showed that changing jobs led among others to reduced need for recovery. In the longitudinal study of van Amelsvoort et al. (2004), high levels of need for recovery were associated with an increased risk of leaving shift work

during the follow-up two years later. High need for recovery after work increased the risk of subsequent sickness absence that is not explained by relevant (non-) work-related factors in the longitudinal study of De Croon, Sluiter, and Frings-Dresen (2003). Finally, Sluiter, Van der Beek, and Frings-Dresen (1999) found that need for recovery was a major predictor of psychosomatic complaints, sleep complaints, and complaints of emotional exhaustion in coach drivers. Need for recovery was found in this study to be even more important in predicting health problems than job demands and job control. These findings draw attention to the role of need for recovery as a sign of occupationally induced fatigue and predictor of health complaints.

Taken together, need for recovery has been suggested to represent a mediator in the relationship between demanding working conditions and health problems (De Croon et al., 2004). However, the results did not testify that need for recovery after work mediates between the exposure to stressful working conditions and the subsequent occurrence of sickness absence in this study.

RECOVERY MODEL

Fig. 1 displays our model on the process of daily recovery from work. The model departs from the work domain because we found several studies

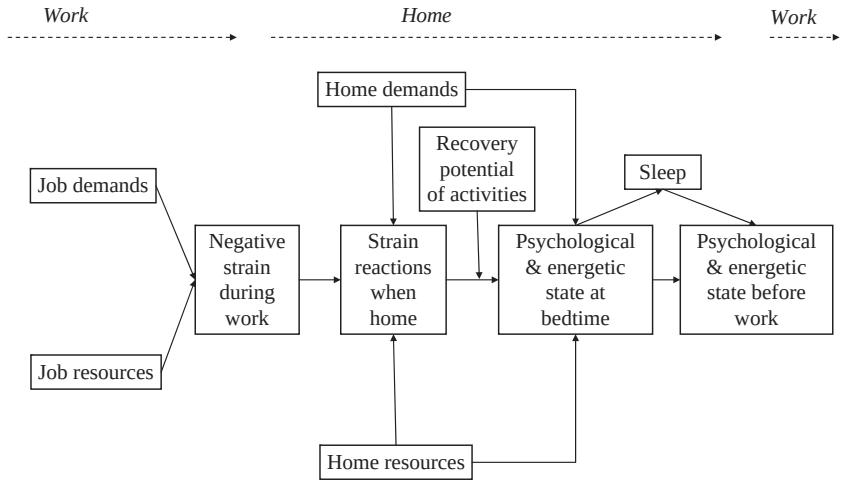

Fig. 1. The Model of Daily Recovery from Work.

suggesting that what happens at work largely influences the recovery process during non-work time. Similar to the effort-recovery model (Meijman & Mulder, 1998), job demands are crucial factors for recovery because they represent the external load that causes load reactions within individuals (i.e., negative strain during and after work). It is these load reactions that need to be alleviated during non-work time. Although job demands will be positively related to negative strain during and after work, job resources will be negatively related to strain: the more resources, the less negative strain. Such relationships have been confirmed in the diary studies included in the present review (e.g., Sonnentag & Zijlstra, 2006) as well as studies beyond the daily level (e.g., Demerouti et al., 2001). An additional function of job resources (not displayed in the figure for simplicity) is that they may moderate the relationship between job demands and negative strain, such that job demands are more strongly related to negative strain when resources are low than when they are high (e.g., Bakker et al., 2005).

When conditions at work are such that employees develop negative strain (e.g., fatigue which builds up when demands are high), they will be inclined to react to this strain when they are at home. Think for instance of a day that you came home disappointed because of a critical remark made by your supervisor. The more disappointed you are the more likely it is that you will talk about it with your partner or the stronger your inclination to behave distant from family contact. Irrespectively of what the reaction will be, it can be assumed that the higher the level of negative strain after work, the higher the level of strain reactions at home. In support with this contention, Ilies et al. (2007) found in an experience sampling study that workload influenced affective states at work and consequently at home which eventually led to reduced social activities with the spouse and children through work–family conflict. The type of reaction or activity that people will be involved in will also depend on the existing demands and resources in the home domain. In principle, demands and resources in the home domain may have a similar function as demands and resources in the work domain; in both domains demands will inhibit recovery, whereas resources will facilitate it. Note that these hypotheses still need empirical testing because we have seen, for instance, that household and child-care activities did not have a deteriorating impact on the recovery process. Moreover, we found no study examining home characteristics with a facilitating effect on recovery. Similar to the function of demands and resources at work, we expect that demands and resources in the home domain will be directly related to the psychological and energetic state at bedtime, such that demands will have detrimental and resources will have favorable effects.

Now the question is whether the activities that people engage in when at home will lead to the recovery experience. As the review showed and as displayed in the figure, the type of activities will moderate the relationship between the strain reactions and the psychological and energetic state at bedtime. For instance, when a person is involved in activities with potential for recovery (e.g., physical or social activities) the unfavorable effect of strain reactions on psychological and energetic state at bedtime will be weaker than when one is not involved in such activities. In contrast, when a person is involved in activities inhibiting recovery (e.g., work-related activities), conducting such activities will have detrimental effects on psychological and energetic state compared to when one is not involved in such activities.

Note that what is crucial for the state at bedtime is not that the person is necessary fit to work again, but rather that the person has increased his/her ability to relax and to recover from work. In terms of physiological indicators, it means that blood pressure and heart rate are reduced in the evening (Rau, 2006). In terms of psychological indicators, the recovery process during non-work time has to do with less rumination (Cropley et al., 2006), or better well-being before going to bed (Sonnentag, 2001). Of course, it has to be taken into account that the constructs of rumination and situational well-being before going to bed are related to the ability to relax, but they are not similar. What is important for recovery though is that after the non-work activities the person feels ready and able to sleep. The better an individual's physiological and psychological state at bedtime, the longer and better the quality of sleep she/he will have. A better quality and quantity of sleep in turn leads to a better psychological and energetic state the next morning before going to work.

SUGGESTIONS FOR FUTURE RESEARCH

As the present chapter demonstrated, the phenomenon of daily recovery from work stress is a highly complex phenomenon that can be linked to a wide variety of antecedents (both in the work and home domains), processes (both psychological and physiological), and outcomes (including subjective experiences, but also behavior/performance). Empirical studies examining recovery vary strongly in their scope, theoretical bases, methodological approaches, and types of outcomes studied. To shed some light in this somewhat confusing findings, ideas and (methodological) approaches, it is desirable that these are integrated in an overarching theoretical framework.

An attempt to develop such a model has been presented in this chapter. We suggest a model including work and home characteristics that facilitate or inhibit recovery, type of activities with recovery potential and experienced states. These activities and states may affect recovery in two ways, i.e., a behavioral pathway (referring to after-work activities) and a psychological pathway (referring to the degree to which detaches psychologically from work). However, this model is still preliminary and tentative, and primarily intends to serve as a heuristic framework within which follow-up research on recovery can be conducted. On the basis of this model, we offer here a number of suggestions and directions for future research.

1. First, the *behavioral* pathway that links work experiences/effort to recovery draws on the type of activities people pursue after work. The recovering potential of these activities depends on the degree to which they draw on the same resources used during the workday. Basically, working overtime should not contribute to recovery, as it will deplete the same energetic resources as those used during the workday. Conversely, active leisure activities or relaxation draw on different resources, meaning that engaging in such activities should enhance recovery from work. However, at present it is unknown whether and how the *quality* of these after-work activities is related to their potential for recovery. For example, previous research has revealed that working a moderate amount of overtime does not necessarily coincide with negative load effects; rather, it seems that working overtime may well coincide with relatively *low* levels of fatigue, contingent on the degree to which these after-work activities are considered pleasurable and rewarding (Beckers et al., 2008). Conversely, it is conceivable that engaging in particular leisure activities is not found to be rewarding or pleasurable, and it is possible that in such cases these activities will not contribute to recovery. Thus, it seems that the recovery potential of after-work activities may not only depend on what one does, but also on one's subjective evaluation of these activities. A tentative hypothesis to be addressed in future research could be that any type of after-work activity could contribute to recovery, as long as these activities are conducted voluntarily and do not involve unpleasant effect (Van Hooff et al., 2007).
2. Similarly, the *psychological* pathway that links effort expenditure at work to recovery involves the degree to which workers can disengage psychologically from work. Ruminating about unpleasant experiences and events at work in the evening does obviously not promote the recovery process. Interestingly, it appears that thinking about positive

work experiences *does* have the potential to contribute to recovery from work (Fritz & Sonnentag, 2005). Thus, not detaching psychologically from the job during leisure time does not always impede recovery; this also depends on the quality of one's experiences at work. Indeed, it seems possible that not detaching psychologically from work can contribute to recovery, as long as the associated thoughts are positive and involve pleasant mood states.

3. Previous research on day-to-day recovery has primarily focused on affective states, mood, and fatigue. However, the practical relevance of this research could be greatly enhanced if it were possible to show that motivation and job performance depends substantially on the degree to which one has recovered from the previous workday. There is some research that indicates that recovery covaries positively with self-reported job performance (e.g., Binnewies, Sonnentag, & Mojza, 2009). However, self-reported performance may not be a valid indicator of objective performance (cf. Taris, 2006), meaning that it is imperative to validate and extend this research using objective measures of job performance.
4. Recovery from physical strain within the musculoskeletal system begins as soon as the physical stress demands are removed. Thereafter, rest and adequate nutrition alone, i.e., an essentially spontaneous and passive process, is sufficient to allow full recovery to baseline levels of physical strength. Although we have proposed an equivalency of this process for psycho-social strain recovery, such strain shows a pronounced tendency to *spill over* into the non-work time recovery period between work sequences. For example, co-worker conflict, bullying, anxieties about job security, and worry about the management of anticipated work problems in the next work period may all result in the continued activation of the stress response mechanism well into the non-work time period. This has been shown compellingly to affect sleep quality adversely, thereby diminishing spontaneous recovery obtainable from this source (Garrick et al., 2008). It would be interesting and important to examine which types of daily work-related stressors have the strongest tendency to spill over to the home domain, since strain-based work–family conflict seems an important barrier to daily recovery.
5. One intriguing finding in the recovery literature is the zero effects of household and child-care activities on the recovery process and outcomes. Rook and Zijlstra (2006) have suggested that because household activities and caring for children require active involvement, they help individuals to disengage from the daily strains at work. Therefore, although these

activities demand effort, they might be beneficial for recovery. This suggests that it would be important for future research on recovery to simultaneously consider energy replenishment and psychological detachment from work. Again, such research should consider the degree to which household and child-care activities are considered pleasurable (cf. suggestions 1 and 2 earlier).

6. What constitutes successful recovery may ultimately differ across individuals (Rook & Zijlstra, 2006). Indeed, Selye (1976, p. 413) argued that "Activity and rest must be judiciously balanced, and every person has his own characteristic requirements for rest and activity." This means that individuals need to discover their own thresholds and live at a pace of life suited to their personal needs. Some individuals may maintain health and avoid deleterious outcomes by taking regular short breaks or holidays (Cartwright & Cooper, 1997); others may require episodes of recovery on a daily basis involving physical activity (Rook & Zijlstra, 2006). This links to our suggestions 1 and 2; basically, this reasoning suggests that the recovery potential of after-work activities depends on personal characteristics and preferences. It would be an interesting and challenging task for future research to identify these characteristics and preferences; yet, it would seem that doing so would greatly enhance our understanding of the recovery process.
7. Finally, much research on daily recovery draws on diary designs, i.e., study designs in which the participants must provide data on their feelings, moods and activities at least once a day during a series of consecutive days. Although such a design is imperative for mapping day-to-day variations in health and well-being and for linking these variations to daily experiences, it is difficult to connect these (typically minor) day-to-day variations to serious health problems. For example, it is interesting to see that expending much effort at work may lead to sleep problems during the following night, but practically and scientifically it would be at least as important to see how these day-to-day experiences and activities contribute to, say, mental health problems such as burnout or depression. Such problems typically evolve during a longer period, and it is difficult to capture this period using a standard diary design. Thus, at present the link between serious illness and day-to-day recovery is still to be established. It appears that long-term diary designs, covering several months or even years, are needed to establish this link. Of course, the effort investment asked from the participant should be reduced accordingly; few people will be willing to take the trouble to complete

even a short diary every day for several months. It may be more feasible to ask the participants to provide diary-like data for a limited number of instances (e.g., once every month). This would allow researchers to establish typical individual-level patterns of after-work activities, and these could be linked to major changes of status in health and well-being.

CONCLUSION

The goal of this chapter was to provide insight in the process of daily recovery by discussing theories and research that help us understand the process of recovery, and its outcomes. On the basis of our literature review, we proposed an overall framework from which daily recovery during non-work time can be understood. We hope that this framework will encourage researchers to conduct the diary studies necessary to further increase our understanding of recovery and its effects.

REFERENCES

*Studies denoted with an asterisk have been included in the review.

Appels, A. (1997). Exhausted subjects, exhausted systems. *Acta Physiologica Scandinavica, Supplementum*, *640*, 153–154.

Bakker, A. B. (2009). Building engagement in the workplace. In: C. Cooper & R. Burke (Eds), *The peak performing organization* (pp. 50–72). London: Routledge.

Bakker, A. B., & Demerouti, E. (2007). The job demands-resources model: State of the art. *Journal of Managerial Psychology*, *22*, 309–328.

Bakker, A. B., Demerouti, E., & Euwema, M. C. (2005). Job resources buffer the impact of job demands on burnout. *Journal of Occupational Health Psychology*, *10*, 170–180.

Bakker, A. B., van Emmerik, IJ. H., Geurts, S. A. E., & Demerouti, E. (2008). *Recovery turns job demands into challenges: A diary study on work engagement and performance*. Working paper. Erasmus University Rotterdam.

Beckers, D. G. J., Van der Linden, D., Smulders, P. G. W., Kompier, M. A. J., Taris, T. W., & Geurts, S. A. E. (2008). Voluntary or involuntary? Control over overtime and rewards for overtime in relation to fatigue and work-satisfaction. *Work & Stress*, *22*, 33–50.

Belkic, K. L., Landsbergis, P. A., Schnall, P. L., & Baker, D. (2004). Is job strain a major source of cardiovascular disease risk? A critical review of the empirical evidence, with a clinical perspective. *Scandinavian Journal of Work, Environment & Health*, *30*, 85–128.

Binnewies, C., Sonnentag, S., & Mojza, E. (2009). Daily performance at work: Feeling recovered in the morning as a predictor of day-level job performance. *Journal of Organizational Behavior*, *30*, 67–93.

Bolger, N., DeLongis, A., Kessler, R. C., & Schilling, E. A. (1989). Effects of daily stress on negative mood. *Journal of Personality and Social Psychology*, *57*, 808–818.

Bourne, E. J. (2000). *The anxiety and phobia work book* (3rd ed.). Oakland, CA: New Harbinger.

Brosschot, J. F., Pieper, S., & Thayer, J. F. (2005). Expanding stress theory: Prolonged activation and perseverative cognition. *Psychoneuroendocrinology*, *30*, 1043–1049.

Butler, A. B., Grzywacz, J. G., Bass, B. L., & Linney, K. D. (2005). Extending the demands-control model: A daily diary study of job characteristics, work–family conflict and work–family facilitation. *Journal of Occupational and Organizational Psychology*, *78*, 155–169.

Calder, A. (2003a). Recovery. In: M. Reid, A. Quinn & M. Crespo (Eds), *Strength and conditioning for tennis* (Chapter 14). Roehampton, London: International Tennis Federation.

Calder, A. (2003b). Recovery strategies for sports performance. *USOC Olympic Coach E-magazine*, September 2003. Available at http://coaching.usolympicteam.com/coaching/kpub.nsf/v/3Sept03. Retrieved on June 4, 2008.

Campbell, S. S. (1992). Effects of sleep and circadian rhythms of performance. In: A. P. Smith & D. M. Jones (Eds), *Handbook of human performance: Vol. 3. State and trait* (pp. 195–235). London: Academic Press.

Carskadon, M. A., & Dement, W. C. (2005). Normal human sleep overview. In: M. H. Kryger, T. Roth & W. C. Dement (Eds), *Principles and practice of sleep medicine* (4th ed., pp. 13–23). Philadelphia, PA: Elsevier/Saunders.

Cartwright, S., & Cooper, C. L. (1997). *Managing workplace stress*. London: Sage.

Clow, A. (2001). The physiology of stress. In: F. Jones & J. Bright (Eds), *Stress, myth, theory, and research* (pp. 47–61). Harlow, UK: Prentice Hall.

Cox, R. C. (2002). Exercise psychology. In: R. C. Cox (Ed.), *Sports psychology, concepts and applications* (5th ed, pp. 366–389). Boston: McGraw Hill.

Craig, A., & Cooper, R. E. (1992). Symptoms of acute and chronic fatigue. In: A. P. Smith & D. M. Jones (Eds), *Handbook of human performance: Vol. 3. State and trait* (pp. 289–339). London: Academic Press.

Cropley, M., Dijk, D.-J., & Stanley, N. (2006). Job strain, work rumination and sleep in school teachers. *European Journal of Work and Organizational Psychology*, *15*, 181–196.

Cropley, M., & Purvis, L. J. (2003). Job strain and rumination about work issues during leisure time: A diary study. *European Journal of Work and Organizational Psychology*, *12*, 195–207.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: HarperCollins.

De Bloom, J., Kompier, M. A. J., Geurts, S. A. E., De Weerth, C., Taris, T. W., & Sonnentag, S. (2009). Do we recover from vacation? Meta-analysis of vacation effects on health and well-being. *Journal of Occupational Health*, *51*, 13–25.

De Croon, E. M., Sluiter, J. K., & Frings-Dresen, M. H. (2003). Need for recovery after work predicts sickness absence: A 2-year prospective cohort study in truck drivers. *Journal of Psychosomatic Research*, *55*, 331–339.

De Croon, E. M., Sluiter, J. K., Blonk, R. W. B., Broersen, J. P. J., & Frings-Dresen, M. H. W. (2004). Stressful work, psychological strain, and turnover: A 2-year prospective cohort of truck drivers. *Journal of Applied Psychology*, *89*, 442–454.

De Lange, A. H., Taris, T. W., Kompier, M. A. J., Houtman, I. L. D., & Bongers, P. M. (2003). The very best of the millennium: Longitudinal research and the demand-control(-support) model. *Journal of Occupational Health Psychology*, *8*, 282–307.

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

Demerouti, E., & Cropanzano, R. (2009). From thought to action: Employee work engagement and job performance. In: A. B. Bakker & M. P. Leiter (Eds), *Work engagement: A handbook of essential theory and research*. New York: Psychology Press.

De Raeve, L., Vasse, R. M., Jansen, N. W. H., van den Brandt, P. A., & Kant, I. (2007). Mental health effects of changes in psychosocial work characteristics: A prospective cohort study. *Journal of Occupational Environmental Medicine*, *49*, 890–899.

Dienstbier, R. A. (1989). Arousal and physiological toughness: Implications for mental and physical health. *Psychological Review*, *96*, 84–100.

Eden, D. (2001). Vacations and other respites: Studying stress on and off the job. In: C. L. Cooper & I. T. Robertson (Eds), *Well-being in organisations: A reader for students and practitioners* (pp. 121–146). Chichester, UK: Wiley.

Eriksen, H. R., Ihlebaek, C., Jansen, J. P., & Burdorf, A. (2006). The relations between psychosocial factors at work and health status among workers in home care organizations. *International Journal of Behavioral Medicine*, *13*, 183–192.

Etzion, D., Eden, D., & Lapidot, Y. (1998). Relief from job stressors and burnout: Reserve service as a respite. *Journal of Applied Psychology*, *83*, 577–585.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, *56*, 218–226.

Fritz, C., & Sonnentag, S. (2005). Recovery, health, and job performance: Effects of weekend experiences. *Journal of Occupational Health Psychology*, *10*, 187–199.

Garrick, A. J., Winwood, P. C., & Bakker, A. B. (2008). *Leisure-time activities, recovery, and fatigue: A diary study*. Internal Report, University of South Australia, Adelaide.

Geurts, S. A. E., & Demerouti, E. (2003). Work/non-work interface: A review of theories and findings. In: M. Schabracq, J. Winnubst & C. L. Cooper (Eds), *The handbook of work and health psychology* (2nd ed., pp. 279–312). Chichester: Wiley.

Geurts, S. A. E., & Sonnentag, S. (2006). Recovery as an explanatory mechanism in the relation between acute stress reactions and chronic health impairment. *Scandinavian Journal of Work, Environment & Health*, *32*, 482–492.

Glynn, L. M., Christenfeld, N., & Gerin, W. (2002). The role of rumination in recovery from reactivity: Cardiovascular consequences of emotional states. *Psychosomatic Medicine*, *64*, 714–726.

Grossman, A., Bouloux, P., Price, P., Drury, P. L., Lam, K. S., Turner, T., Thomas, J., Besser, G. M., & Sutton, J. (1984). The role of opioid peptides in the hormonal responses to acute exercise in man. *Clinical Science*, *67*, 483–491.

Grossman, P., Niemann, L., Schmidt, S., & Walach, H. (2004). Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of Psychosomatic Research*, *57*, 35–43.

Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology*, *23*, 109–123.

Healy, C. M., & McKay, M. F. (2000). Nursing stress: The effects of coping strategies and job satisfaction in a sample of Australian nurses. *Journal of Advanced Nursing*, *31*, 681–688.

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

Hobfoll, S. E. (2002). Social and psychological resources and adaptation. *Review of General Psychology*, *6*, 307–324.

Horne, J. A. (2001). State of the art: Sleep. *The Psychologist*, *14*, 302–306.

Ilies, R., Schwind, K. M., Wagner, D. T., Johnson, M. D. D., DeRue, S., & Ilgen, D. R. (2007). When can employees have a family life? The effects of daily workload and affect on work–family conflict and social behaviors at home. *Journal of Applied Psychology*, *92*, 1368–1379.

Iso-Ahola, S. (1997). A psychological analysis of leisure and health. In: J. Haworth (Ed.), *Work, leisure and well-being* (pp. 131–144). London, UK: Routledge.

Jansen, N. W. H., Kant, I. J., & van den Brandt, P. A. (2002). Need for recovery in the working population: Description and associations with fatigue and psychological distress. *International Journal of Behavioral Medicine*, *9*, 322–340.

Karasek, R. A. (1998). Demand/control model: A social, emotional, and psychological approach to stress risk and active behaviour development. In: J. M. Stellman (Ed.), *Encyclopaedia of occupational health and safety* (pp. 34.6–34.14). Geneva, Switzerland: International Labour Office.

Kivimaki, M., Leino-Arjas, P., Kaila-Kangas, L., Luukkonen, R., Vahtera, J., Elovainio, M., Härmä, M., & Kirjonen, J. (2006). Is incomplete recovery from work a risk marker of cardiovascular dealth? Prospective evidence from industrial employees. *Psychosomatic Medicine*, *68*, 402–407.

Kleiber, D., Larson, R., & Csikszentmihalyi, M. (1986). The experience of leisure in adolescence. *Journal of Leisure Research*, *18*, 169–176.

*Lamont, N., Dawson, D., & Roach, G. D. (2006). Do short international layovers allow sufficient opportunity for pilots to recover? *Chronobiology International*, *23*, 1285–1294.

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

Lepore, S. J., & Evans, G. W. (1996). Coping with multiple stressors in the environment. In: M. Zeidner & N. Endler (Eds), *Handbook of coping: Theory, research and applications* (pp. 350–377). New York: Wiley.

Luczak, H. (1987). Psychophysiologische Methoden zur Erfassung psychophysischer Beanspruchungszustaende. [Psychophysiological methods for the assessment of psychophysical strain.] In: U. Kleinbeck & J. Rutenfranz (Eds), *Enzyklopaedie der Psychologie*, Themenbereich D, Praxisgebiete, Serie III, Wirtschafts-, Organisations- und Arbeitspsychologie, Band 1 (pp. 185–259). Göttingen, Germany: Hogrefe.

McAuley, E., Kramer, A. F., & Colcombe, S. J. (2004). Cardiovascular fitness and neurocognitive function in older adults: A brief review. *Brain, Behavior, & Immunity*, *18*, 214–220.

McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York Academy of Science*, *840*, 33–44.

Meijman, T., Mulder, G., van Dormolen, M., & Cremer, R. (1992). Workload of driving examiners: A psychophysiological field study. In: H. Kragt (Ed.), *Enhancing industrial performance* (pp. 245–259). London: Taylor & Francis.

Meijman, T. F. (1991). *Over vermoeidheid: Arbeidspsychologische studies naar de beleving van belastingseffecten. [Fatigue: Studies on the perception of workload effects.]* (Doctoral dissertation, University of Groningen, Groningen, The Netherlands).

Meijman, T. F., & Mulder, G. (1998). Psychological aspects of workload. In: P. J. D. Drenth & H. Thierry (Eds), *Handbook of work and organizational psychology* (Vol. 2, pp. 5–33). Hove: Psychology Press.

Oken, B. S., Kishiyama, S., Zajdel, D., Bourdette, D., Carlsen, J., Haas, M., Hugos, C., Kraemer, D. F., Lawrence, J., & Mass, M. (2004). Randomized controlled trial of yoga and exercise in multiple sclerosis. *Neurology*, *62*, 2058–2064.

Pelletier, C. L. (2004). The effect of music on decreasing arousal due to stress: A meta-analysis. *Journal of Music Therapy*, *41*, 192–214.

Pickering, T. (1997). Cardiovascular measures of allostatic load. In: J. D. MacArthur & C. T. MacArthur (Eds), *Research network on socioeconomic status and health*. Available at http://www.macses.ucsf.edu/Research/Allostatic/notebook/allostatic.html. Retrieved on June 6, 2008.

Raglin, J. S., & Morgan, W. P. (1985). Influence of vigorous exercise on mood state. *Behavior Therapy*, *8*, 179–183.

Rau, R. (2004). Job strain or healthy work: A question of task design. *Journal of Occupational Health Psychology*, *9*, 322–338.

Rau, R. (2006). Learning opportunities at work as predictor for recovery and health. *European Journal of Work and Organizational Psychology*, *15*, 181–196.

Rau, R., & Triemer, A. (2004). Overtime in relation to blood pressure and mood during work, leisure, and night time. *Social Indicators Research*, *67*, 51–73.

Rook, J., & Zijlstra, F. (2006). The contribution of various types of activities to recovery. *European Journal of Work and Organizational Psychology*, *15*, 218–240.

Saxbe, D. E., Repetti, R. L., & Nishina, A. (2008). Marital satisfaction, recovery from work, and diurnal cortisol among men and women. *Health Psychology*, *27*, 15–25.

Schaufeli, W. B., & Taris, T. W. (2005). Conceptualization and measurement of burnout: Common ground and worlds apart. *Work & Stress*, *19*, 256–262.

Schnall, P. L., Schwartz, J. E., Landsbergis, P. A., Warren, K., & Pickering, T. G. (1992). Relation between job strain, alcohol, and ambulatory blood pressure. *Hypertension*, *19*, 488–494.

Selye, H. (1976). *The stress of life* (Revised Edition). New York: McGraw-Hill.

Sluiter, J. K., Frings-Dresen, M. H. W., van der Beek, A. J., & Meijman, T. F. (2001). The relation between work-induced neuroendocrine reactivity and recovery, subjective need for recovery, and health status. *Journal of Psychosomatic Research*, *50*, 29–37.

Sluiter, J. K., Van der Beek, A. J., & Frings-Dresen, M. H. W. (1999). The influence of work characteristics on the need for recovery and experienced health: A study on coach drivers. *Ergonomics*, *42*, 573–583.

*Sonnentag, S. (2001). Work, recovery activities, and individual well-being: A diary study. *Journal of Occupational Health Psychology*, *6*, 196–210.

*Sonnentag, S. (2003). Recovery, work engagement, and proactive behavior: A new look at the interface between nonwork and work. *Journal of Applied Psychology*, *88*, 518–528.

*Sonnentag, S., & Bayer, U. V. (2005). Switching off mentally: Predictors and consequences of psychological detachment from work during off-job time. *Journal of Occupational Health Psychology*, *10*, 393–414.

*Sonnentag, S., Binnewies, C., & Mojza, A. J. (2008). Did you have a nice evening? A day-level study on recovery experiences, sleep, and affect. *Journal of Applied Psychology*, *93*, 674–684.

Sonnentag, S., & Fritz, C. (2006). Endocrinological processes associated with job stress: Catecholamine and cortisol responses to acute and chronic stressors. In: P. L. Perrewé & D. C. Ganster (Eds), *Research in organizational stress and well-being: Employee health, coping, and methodologies* (pp. 1–59). Amsterdam: Elsevier.

Sonnentag, S., & Fritz, C. (2007). The recovery experience questionnaire: Development and validation of a measure for assessing recuperation and unwinding from work. *Journal of Occupational Health Psychology*, *12*, 204–221.

Sonnentag, S., & Geurts, S. A. E. (this volume). Methodological issues in recovery research. In: P. Perrewé, D. Ganster & S. Sonnentag (Eds), *Research in occupational stress and well being* (Vol. 7). US: JAI Press/Elsevier.

Sonnentag, S., & Kruel, U. (2006). Psychological detachment from work during off-job time: The role of job stressors, job involvement, and recovery-related self-efficacy. *European Journal of Work and Organizational Psychology*, *15*, 197–217.

*Sonnentag, S., & Natter, E. (2004). Flight attendants' daily recovery from work: Is there no place like home? *International Journal of Stress Management*, *11*, 366–391.

Sonnentag, S., & Zijlstra, F. R. H. (2006). Job characteristics and off-job activities as predictors of need for recovery, well-being, and fatigue. *Journal of Applied Psychology*, *91*, 330–350.

Sterling, P. (2004). Principles of allostasis: Optimal design, predictive regulation, pathophysiology and rational therapeutics. In: J. Schulkin (Ed.), *Allostasis, homeostasis, and the costs of adaptation* (pp. 2–36). Cambridge, UK: Cambridge University Press.

Sterling, P., & Eyer, J. (1988). Allostasis: A new paradigm to explain arousal pathology. In: S. Fisher & J. Reason (Eds), *Handbook of life stress, cognition and health* (pp. 629–649). New York: Wiley.

Stewart, J. C., Janicki, D. L., & Kamarck, T. W. (2006). Cardiovascular reactivity to and recovery from psychological challenge as predictors of 3-year change in blood pressure. *Health Psychology*, *25*, 111–118.

Swaen, G. M. H., Kant, I. J., Van Amelsfoort, L. G. P. M., & Beurskens, A. J. H. M. (2002). Job mobility, its determinants, and its effects: Longitudinal data from the Maastricht Cohort Study. *Journal of Occupational Health Psychology*, *7*, 121–129.

Takahashi, M., Fukuda, H., & Arito, H. (1998). Brief naps during post-lunch rest: Effects on alertness, performance, and autonomic balance. *European Journal of Applied Physiology and Occupational Physiology*, *78*, 93–98.

Taris, T. W. (2006). Burnout and objectively recorded performance: A critical review of 16 studies. *Work & Stress*, *20*, 316–334.

Taris, T. W., Beckers, D. G. J., Dahlgren, A., Geurts, S. A. E., & Tucker, P. (2007). Overtime work and well-being: Prevalence, conceptualization and effects of working overtime. In: S. McIntyre & J. Houdmont (Eds), *Occupational health psychology: European perspectives on research, education and practice* (Vol. 2, pp. 21–40). Maia, Portugal: ISMAI.

Taris, T. W., & Kompier, M. A. J. (2005). Job characteristics and learning behavior. In: P. L. Perrewé & D. C. Ganster (Eds), *Research in occupational stress and well-being: Exploring interpersonal dynamics* (Vol. 4, pp. 127–166). Amsterdam: JAI Press.

Teuchmann, K., Totterdell, P., & Parker, S. K. (1999). Rushed, unhappy, and drained: An experience sampling study of relations between time pressure, perceived control, mood, and emotional exhaustion in a group of accountants. *Journal of Occupational Health Psychology*, *4*, 37–54.

Theorell, T., Ahlberg-Hulten, G., Jodko, M., Sigala, F., & de la Torre, B. (1993). Influence of job strain and emotion on blood pressure in female hospital personnel during work-hours. *Scandinavian Journal of Work Environment and Health*, *19*, 313–318.

Theorell, T., de Faire, U., Johnson, J., Hall, E., Perski, A., & Stewart, W. (1991). Job strain and ambulatory blood pressure profiles. *Scandinavian Journal of Work, Environment and Health*, *17*, 380–385.

Thoren, P., Floras, F. S., Hoffman, P., & Seals, D. R. (1990). Endorphins and exercise: Physiological mechanisms and clinical implications. *Medicine & Science in Sports & Exercise*, *22*, 417–428.

Totterdell, P., Spelten, E., Smith, L., Barton, J., & Folkard, S. (1995). Recovery from work shifts: How long does it take? *Journal of Applied Psychology*, *80*, 43–57.

Totterdell, P., Wood, S. J., & Wall, T. D. (2006). An intra-individual test of the demands-control model: A weekly diary study of job strain in portfolio workers. *Journal of Occupational and Organizational Psychology*, *78*, 1–23.

Trougakos, J. P., & Hideg, I. (this volume). Momentary work recovery: The role of within-day work breaks. In: P. Perrewé, D. Ganster & S. Sonnentag (Eds), *Research in occupational stress and well being* (Vol. 7). US: JAI Press/Elsevier.

Van Amelsvoort, L. G., Jansen, N. W., Swaen, G. M., van den Brandt, P. A., & Kant, I. (2004). Direction of shift rotation among three-shift workers in relation to psychological health and work–family conflict. *Scandinavian Journal of Work, Environment and Health*, *30*, 149–156.

Van der Hulst, M., & Geurts, S. A. E. (2001). Associations between overtime and psychological health in high and low reward jobs. *Work & Stress*, *15*, 227–240.

Van Hooff, M. L. M., Geurts, S. A. E., Kompier, M. A. J., & Taris, T. W. (2007). Workdays, in-between workdays, and the weekend: A diary study on effort and recovery. *International Archives of Occupational and Environmental Health*, *80*, 599–613.

van Veldhoven, M., & Meijman, T. F. (1994). *Het meten van psychosociale arbeidsbelasting met een vragenlijst: de vragenlijst beleving en beoordeling van de arbeid (VBBA). [The measurement of psychosocial job demands with a questionnaire: The questionnaire on the experience and evaluation of work (QEEW).]*. Amsterdam: Nederlands Instituut voor Arbeidsomstandigheden.

Westman, M., & Eden, D. (1997). Effects of a respite from work on burnout: Vacation relief and fade-out. *Journal of Applied Psychology*, *82*, 516–527.

Westman, M., & Etzion, D. (2001). The impact of vacation and job stress on burnout and absenteeism. *Psychology and Health*, *16*, 595–606.

Winwood, P. C., Bakker, A. B., & Winefield, A. H. (2007). An investigation of the role of non-work-time behavior in buffering the effects of work-strain. *Journal of Occupational and Environmental Medicine*, *49*, 862–871.

Winwood, P. C., Winefield,, A. H., & Lushington, K. (2006). The contribution of age, domestic responsibilities and shiftwork to work-related fatigue and recovery within a sample of full-time Australian nurses. *Journal of Advanced Nursing*, *56*, 438–449.

Yeung, R. R. (1996). The acute effects of exercise on mood state. *Journal of Psychosomatic Research*, *40*, 123–141.

Zapf, D. (2002). Emotion work and psychological well-being. A review of the literature and some conceptual considerations. *Human Resource Management Review*, *12*, 237–268.

Zijlstra, F. R. H., & de Vries, J. (2000). Burnout en de bijdrage van socio-demografische en werkgebonden variabelen. [Burnout and the contribution of socio-demographic and

work related variables.]. In: I. L. D. Houtman, W. B. Schaufeli & T. Taris (Eds), *Psychische vermoeidheid en werk: Cijfers, trends en analyses* (pp. 83–95). Alphen a/d Rijn, The Netherlands: Samsom.

Zohar, D., Tzischinski, O., & Epstein, R. (2003). Effects of energy availability on immediate and delayed emotional reactions to work events. *Journal of Applied Psychology*, *88*, 1082–1093.