Chapter 12
Recovery from Work During Off-Job Time

Sabine A.E. Geurts

Abstract Recovery from work is crucial to protect employee health and well-being. This chapter aims at illuminating the processes underlying recovery from work, focusing on recovery during off-job time. First, I present theoretical arguments and empirical evidence that recovery from work is a process of unwinding that is the opposite of psychophysiological activation during effort expenditure under demanding and stressful conditions. Next, I discuss cognitive, affective, and behavioral processes that influence recovery from work either negatively or positively. With regard to recovery-hampering processes, stressor-related thoughts, negative affective states, and prolonged exposure to work or similar demands are discussed. With regard to recovery-promoting processes, psychological detachment from work, positive affective states, and active leisure and behavioral control are considered. Based on this overview of recovery research, a number of directions for future research are suggested.

Keywords Effort • Stress • Perseverative cognition • Affect • Overtime • Psychological detachment • Leisure activities • Control

12.1 Introduction

Research in the field of occupational health psychology has established that stressful work is associated with adverse effects on employee health and well-being. Longitudinal research has demonstrated that being exposed to stressful psychosocial work characteristics (e.g., high job demands, low job control, high job insecurity) is

S.A.E. Geurts (✉)
Radboud University Nijmegen, Behavioural Science Institute,
P.O. Box 9104, 6500 HE Nijmegen, The Netherlands
e-mail: s.geurts@psych.ru.nl

G.F. Bauer and O. Hämmig, *Bridging Occupational, Organizational and Public Health: A Transdisciplinary Approach*, DOI 10.1007/978-94-007-5640-3_12,

associated with an increase in psychological and cardiovascular health problems across time (for reviews, see Belkic, Landsbergis, Schnall, & Baker, 2004; Bonde, 2008; De Lange, Taris, Kompier, Houtman, & Bongers, 2003).

Results from the fifth European Working Conditions Survey revealed that a quarter of European workers state that their health is at stake because of their work (European Foundation for the Improvement of Living and Working Conditions, 2010). This seems to manifest primarily in stress-related and musculoskeletal symptoms (Parent-Thirion, Fernández Macías, Hurley, & Vermeylen, 2007). Statistics indicate that 60 % of European workers work regularly at very high speed and with tight deadlines. In modern working life, characterized by a 24-h economy, swift developments in information communication technology (ICT), and a rapidly changing nature of work, we can expect job demands to further intensify, evening and weekend work to increase, and boundaries between work and private life to evaporate. Stressful work will be an inescapable outcome, and sufficient recovery will be one of the main future challenges. Hence, recovery from work as a preventive or protective mechanism in the work-stress-health relationship deserves special research attention.

In this chapter, I will demonstrate that recovery from work is a crucial mechanism in the work-stress-health relationship (Geurts & Sonnentag, 2006).

My aim is to pay special attention to the psychophysiological processes underlying the recovery process. First, I will discuss the role of stress physiology in the relation between work and health and provide a definition of recovery from work. Second, I will explain why insufficient recovery is a serious health risk by drawing on Effort-Recovery Theory (Meijman & Mulder, 1998) and Allostatic Load Theory (McEwen, 1998). Next, I will discuss cognitive, affective, and behavioral processes that may hamper and promote recovery from work, focusing on recovery during off-job time. With regard to recovery-hampering processes, I will consider stressor-related thoughts, negative affective states, and prolonged exposure to work or similar demands. With regard to recovery-promoting processes, I will discuss psychological detachment from work, positive affective states, active leisure, and behavioral control. I will finish up with concluding remarks and suggestions for future research.

12.2 The Concept of Recovery and the Role of Stress Physiology

In order to understand the concept of recovery from work, we need to understand the role of stress physiology in the relation between work and health. There are two main psychophysiological stress systems that work together closely in response to a potential threat (a stressor): the sympathetic-adrenal-medullary (SAM) system and the hypothalamic-pituitary-adrenal (HPA) system (Clow, 2001). The SAM system is responsible for direct cardiovascular activity. Through production of catecholamines (adrenaline and noradrenalin), accelerated heart rate and elevated blood pressure

levels instantly provide the brain and muscles with energy. In general, the SAM system enables body and mind to expend effort, not per se under stressful conditions. The HPA system is more strongly linked to stressful experiences. Through production of cortisol, which is called the 'stress hormone,' extra energy is mobilized to deal with the stressor.

As these stress reactions are in principle adaptive, short-lived, and reversible, one might ask how stressors and stress reactions can have adverse effects on health. For a long time, the 'stress reactivity hypothesis' aimed to answer this question (Linden, Earle, Gerin, & Christenfeld, 1997). Based on animal research, it was hypothesized that very intense physiological reactions during exposure to a stressful situation would adversely affect health. However, recent evidence suggests that prolongation of physiological stress responses after the stressor has ended is more predictive of ill health (Brosschot, Gerin, & Thayer, 2006; Verkuil, Brosschot, Gebhardt, & Thayer, 2010). In other words, health is primarily at stake when prolonged psychophysiological stress reactions hamper the recovery process.

This novel insight has shifted the emphasis of research on the work-stress-health relationship from 'stress reactivity' to 'stress recovery.' Geurts and Sonnentag (2006, p. 483) argued that "the essence of recovery is that psychophysiological systems that were activated during work will return to and stabilize at a baseline level, that is, a level that appears in a situation in which no special demands are made on the individual." Accordingly, recovery is considered to be a process of psychophysiological unwinding that is the opposite of the activation of psychophysiological systems during effort expenditure particularly under stressful conditions.

12.3 Insufficient Recovery from Work and Health Consequences

The crucial role of incomplete recovery from work can be understood from the perspective of Effort-Recovery Theory (Meijman & Mulder, 1998). The core assumption is that after a demanding or stressful workday, individuals require a period of recuperation to restore energy and to allow the negative after-effects of work to wear off. If load reactions (e.g., fatigue or accelerated heart rate), that have unavoidably built up while working spill over to the non-work domain and continue in the free evenings and on weekends, a negative accumulative process will be started that in the long run may result in poor health.

Indeed there is broad empirical evidence that demanding and stressful work is associated with slow psychophysiological unwinding and, thus, incomplete recovery. Results from a diary study with university staff members in the Netherlands showed that expending high effort during the workday was associated with negative after-effects such as fatigue, cognitive preoccupation with work, inactive behavior during free time in the evening, and low sleep quality (Van Hooff, Geurts, Kompier, & Taris, 2007). In a similar vein, white-collar workers in Sweden reported higher

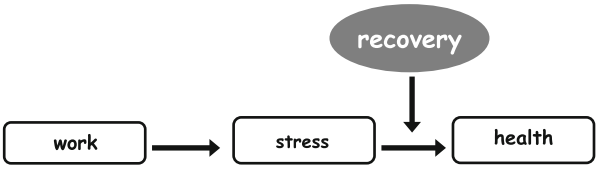

Fig. 12.1 Model of work, recovery, and health

levels of restlessness and sleepiness at bedtime and showed a decrement in their total sleep time during a stressful work week as compared to a work week that was not stressful (Dahlgren, Kecklund, & Åkerstedt, 2005). Slow unwinding may also manifest itself in neuroendocrine indicators (for reviews, see Sluiter, Frings-Dresen, Meijman, & Van der Beek, 2000; Sonnentag & Fritz, 2006). Results from a classic field experiment with Dutch driving examiners revealed that a very intensive workday resulted in higher adrenaline levels that persisted until bedtime (Meijman, Mulder, Van Dormolen, & Cremer, 1992).

McEwen's (1998) Allostatic Load Theory accentuates the negative long-term health consequences of incomplete day-to-day recovery. Here, the core assumption is that chronic activation of initially protective 'allostatic systems' (e.g., SAM system, HPA system, and immune system) will result in 'allostatic load'. This refers to either over activity or inactivity of allostatic systems, which in turn manifests in chronic sleep problems, burnout, and cardiovascular disease (Sluiter, Frings-Dresen, Van der Beek, & Meijman, 2001). Various longitudinal studies have substantiated these long-term adverse health effects of incomplete day-to-day recovery. Dutch police officers who experienced a chronic situation of negative work-home spillover showed an accumulation of subjective health complaints (e.g., fatigue) 1 year later (Van Hooff et al., 2005). Kivimäki et al. (2006) showed that initially healthy industrial employees who reported incomplete recovery during free weekends, suffered from serious cardiovascular health problems 20 years later. Similarly, chronically elevated blood pressure levels were observed among initially healthy adults who showed slow physiological recovery from a stressful task 3 years earlier (Stewart, Janicki, & Kamarck, 2006; see also Steptoe & Marmot, 2005).

Taken together, recovery appears to be an essential explanatory mechanism in the relation between work, stress, and impaired health (Geurts & Sonnentag, 2006) (see Fig. 12.1). Therefore, we need to pay attention to psychological processes that may hamper or facilitate recovery from work to prevent adverse health effects in the long run. For the purpose of this chapter, I will focus on recovery during off-job time (i.e., external recovery), that is, recovery during after-work time, on weekends, and during longer periods of not working (vacations). However, we should also recognize the importance of recovery opportunities during working time (i.e., internal recovery). A well-designed job providing, for instance, job control, job support, and job variety will enable workers to align their work behavior and strategies with their current need for recovery (e.g., by switching from complex to easier tasks, by conducting tasks on a more routine basis, or by asking co-workers for help). Thus, a well-designed job will prevent a high need for recovery at the end of the workday. But what if intense load effects develop during working time and spill over to employees' non-work domain? What processes may hamper and facilitate recovery after work?

12.4 What Processes May Hamper Recovery During Off-Job Time?

To answer this question, it is useful to distinguish among three interrelated psychological processes that influence (and are influenced by) recovery – namely, cognitive processes (what people think), affective processes (what people feel), and behavior (how people act). From this triangle of cognition, affect, and behavior, I will discuss stressor-related thoughts, negative affective states, and prolonged exposure to work or similar demands (see Fig. 12.2).

12.4.1 Stressor-Related Thoughts

Various theories posit that cognitive processes, like negative thoughts about stressors, may extend the duration of physiological stress responses. Ursin and Eriksen's (2004) Cognitive Activation Theory of Stress (CATS) argues that physiological stress reactions do not fade out if coping options for dealing effectively with the stressor are not perceived ('helplessness') or are expected to be unsuccessful ('hopelessness'). Both of these situations of 'negative outcome expectancy' are indicative of lack of control. Building on this idea of prolonged cognitive activation after stress exposure, Brosschot, Pieper, and Thayer's (2005) Prolonged Activation Model posits that physiological activity will extend after or occur before a real stress situation due to "repeated or chronic activation of the cognitive representation of one or more psychological stressors" (Brosschot et al., 2006, p. 114). This phenomenon, called 'perseverative cognition' can take two (related) forms: Worrying involves negative future-oriented thoughts about potential stressors (anticipation), and rumination refers to negative thoughts about stressful events in the present or past. Both manifestations of 'perseverative cognition' share the same mechanism of relatively uncontrollable and unpleasant repetitive thoughts.

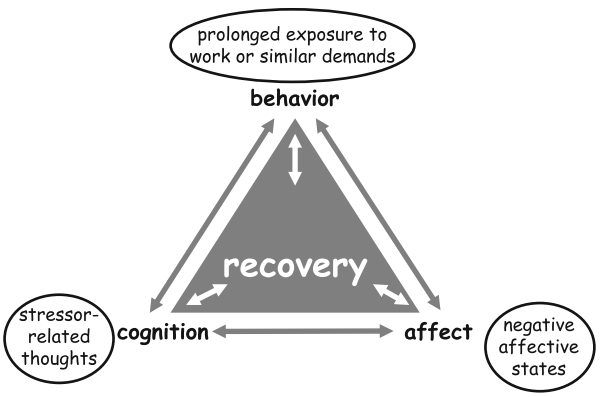

Fig. 12.2 Processes hampering recovery during off-job time

Results from various laboratory studies have indeed suggested that ruminative and anticipatory thoughts about stressors are accountable for prolonging physiological stress responses. For instance, individuals who ruminated more after exposure to a stressful mental arithmetic task showed slower blood pressure recovery (Glynn, Christenfeld, & Gerin, 2002; Radstaak, Geurts, Brosschot, Cillessen, & Kompier, 2011), whereas distraction from stressor-related thoughts accelerated cardiovascular recovery (Neumann, Waldstein, Sollers, Thayer, & Sorkin, 2004). Hall et al. (2004) demonstrated that stressor-related anticipatory thoughts at bedtime caused prolonged physiological activity even during sleep.

These laboratory findings are corroborated by results from various field studies. Fritz and Sonnentag (2006) showed in a diary study that thinking negatively about one's job ('negative work reflection') during vacation was associated with increased feelings of exhaustion after the vacation period. Results from other diary and cross-sectional studies showed that employees who were negatively preoccupied with work during off-job time experienced more recovery complaints (Cropley & Millward Purvis, 2003; Sonnentag & Bayer, 2005), more sleeping difficulties (Kompier, Taris, & Van Veldhoven, 2011) and prolonged cardiovascular activity (Pieper, Brosschot, Van der Leeden, & Thayer, 2010).

12.4.2 Negative Affective States

Research suggests that negative affective states are associated with prolonged psychophysiological activity and thus may hamper the recovery process (for reviews, see Chida & Hamer, 2008; Pieper & Brosschot, 2005). In two field studies, cardiovascular activity was prolonged between 5 and 45 min after negative emotional episodes, independently of various biobehavioral variables (Brosschot & Thayer; 2003; Kamarck et al., 1998). Recently, Radstaak et al. (2011) investigated the extent to which affective processes influenced cardiovascular recovery after stress exposure. Participants performed a stressful laboratory task that increased cardiovascular activity and elicited negative affect. After stress exposure, participants' affective state was manipulated by showing them a negative, a neutral, or a positive scene from a movie. Results showed that blood pressure recovery was slower for participants who watched a negative movie scene as compared to participants who watched a positive or a neutral movie scene. These findings indicate that recovering from stress is hampered by prolongation of negative affect after stress exposure.

12.4.3 Prolonged Exposure to Work or Similar Demands

Due to developments in ICT, flexibilization of work hours and workplaces, and fading boundaries between 'work' and 'non-work', prolonged exposure to work demands is common (Kompier, 2006). Working long hours and working overtime on a regular basis may seriously hamper the recovery process, not only because they

are directly at the cost of potential recovery time but also because an incessant demand is being made on the same (cognitive, affective, and/or physical) abilities and skills (called 'resources') that were already drawn on at work. The same is true when during off-job time workers are exposed to demands that are similar to their work demands. Picture a job that incessantly puts high demands on an individual's affective resources – for instance, the job of social worker. If people who work as social workers come home tired after an emotionally demanding workday, we can imagine that they will feel resistance if confronted with new emotional demands during their off-job time, due to already depleted affective resources. However, social workers may be well able to expend physical effort during off-job time, since physical resources may still be available. To recover sufficiently from work demands, it seems important that people engage in off-job activities that utilize resources other than those already drawn on during the workday.

This reasoning may not hold in every situation, however. If a worker is extremely exhausted after a demanding workday, any new demand that necessitates effort may run up against resistance, irrespective of the type of effort involved. This idea fits Muraven and Baumeister's (2000) Limited Resource Model of behavior regulation. This model assumes that people draw from one central and limited psychological resource to initiate, inhibit, and regulate behavior. When this central resource becomes worn out already during working hours, the initiation and regulation of any type of effort after working time will be too much. As Thorndike (1914) put it, the crucial principle of fatigue is "the intolerance of *any* effort." This reasoning may explain at least in part why workers show inactive behavior patterns after a highly demanding and stressful workday (Sonnentag & Jelden, 2009; Van Hooff et al., 2007).

There is ample empirical evidence that particularly excessive and frequent overtime work is associated with health problems, such as chronic fatigue, sustained increases in heart rate and blood pressure levels, and disturbances of the immune system (Van der Hulst, 2003). In terms of Allostatic Load Theory, these are obvious manifestations of allostatic load (McEwen, 1998). However, regarding moderate and incidental overtime work, harmful effects have not been consistently shown and seem to be moderated by job characteristics, worker characteristics, and specific circumstances. Moderate overtime work does not adversely affect health, if jobs are well-designed (e.g., provide sufficient job control, rewards, and rest breaks), workers experience their work as pleasant, and overtime work is not mandatory (Beckers et al., 2008; Geurts, Beckers, Taris, Kompier, & Smulders, 2009; Tucker & Rutherford, 2005; Van der Hulst & Geurts, 2001).

12.5 What Processes May Facilitate Recovery During Off-Job Time?

Now that we have discussed processes that may prolong psychophysiological activity after work, an important question is what processes may counteract these negative after-effects of work and thus facilitate recovery from work. To answer this

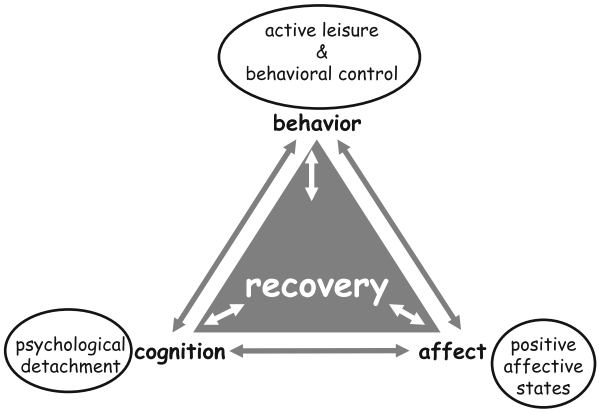

Fig. 12.3 Processes facilitating recovery during off-job time

question, I distinguish again among cognition, affect, and behavior and discuss psychological detachment from work, positive affect, active leisure, and behavioral control (see Fig. 12.3).

12.5.1 Psychological Detachment from Work

When people are free of work duties, they are supposedly released from exposure to work demands. This can be considered a passive form of recovery. However, not being exposed to work demands does not automatically mean that workers have distanced themselves from work mentally, a phenomenon called 'psychological detachment' (Etzion, Eden, & Lapidot, 1998). Detachment is more than just being away from work physically; it implies that workers are no longer cognitively occupied with work. Psychological detachment from work can counteract the phenomenon of perseverative cognition discussed earlier and thus reduce the physiological activity associated with negative work-related thoughts.

Several field diary studies have provided evidence that persons that psychologically detach from work during free evenings report better mood, less negative affect, and lower levels of fatigue at bedtime and the next morning (Sonnentag & Bayer, 2005; Sonnentag, Binnewies, & Mojza, 2008). The positive impact of psychological detachment on recovery was also supported during free weekends: Persons that experienced higher levels of psychological detachment during the weekend reported improved recovery status at the end of the weekend and at the beginning of the work week (Binnewies, Sonnentag, & Mojza, 2010; Fritz, Sonnentag, Spector, & McInroe, 2010).

12.5.2 Positive Affective States

Since stressful work conditions often impair mood, and since the prolongation of negative affect further hampers the recovery process (Radstaak et al., 2011), affect

restoration is considered an essential element of the recovery process (Sonnentag & Geurts, 2009). Positive affective states may facilitate the recovery process in at least two ways. First, the experience of positive emotions is associated with the production of certain brain hormones (i.e., dopamine and serotonin) that seem to down-regulate psychophysiological stress responses rather quickly (Esch & Stefano, 2004). Second, following Fredrickson's (2001) Broaden and Build theory, positive emotions may broaden people's thought-action repertoires, thereby encouraging novel and exploratory thoughts and actions. In contrast to negative affective states that evoke restricted and survival oriented behavior, positive affective states will help individuals to perceive coping possibilities to deal with stressors and to keep a sense of perspective. In this way, positive affect may act as buffer against future stressors.

As compared to negative affect, only few studies have examined the impact of positive affect on cardiovascular recovery from stress. Papousek et al. (2010) investigated both subjective and cardiovascular parameters of stress and recovery in students during and after exposure to academic stress in an ecologically valid setting; the study found that higher trait positive affect was associated with more complete cardiovascular and subjective recovery after stress exposure. A laboratory study conducted by Fredrickson, Mancuso, Branigan, and Tugade (2000) found that a positive affect manipulation after stress exposure facilitated cardiovascular recovery, this in contrast to a negative affect manipulation.

A recent diary study with university staff members showed that pleasure experienced during working time and during off-job time favorably affected recovery indicators (i.e., fatigue and vigor) at the end of the workday and at bedtime (Van Hooff, Geurts, Beckers, & Kompier, 2011). The researchers also found evidence for pleasure as a buffer against stress: Expending high effort at work was associated with low vigor at the end of the workday but only for staff members who experienced low pleasure at work. If persons' work pleasure was high, their level of vigor remained stable, irrespective of their expended effort during the workday. Various vacation studies also demonstrated that workers that derived more pleasure from their vacation activities showed higher levels of health and well-being during vacation (De Bloom, Geurts, Sonnentag, Taris, De Weerth, & Kompier, 2011; De Bloom, Geurts, & Kompier, 2012, 2013).

12.5.3 Active Leisure and Behavioral Control

In addition to cognitive and affective processes, recovery from work may also be influenced by the type of activities people engage in during off-job time. Various studies have investigated the recovery potential of specific leisure activities, such as physical, social, low-effort activities (Demerouti, Bakker, Geurts, & Taris, 2009). The most consistent and positive effects have been found for physical activities, like exercise and sports (Rook & Zijlstra, 2006). In a laboratory setting it was shown that exercising (walking) for 3 min after stress exposure speeded up blood pressure recovery in comparison to a non-exercising control group (Chafin, Christenfeld, & Gerin, 2008). Joosen, Sluiter, and Joling (2008) demonstrated positive effects of a

6-week exercise training period on both psychological and physiological recovery indicators in patients suffering from serious fatigue complaints. In a Cochrane systematic review, Mead et al. (2009) concluded that regular exercise had great therapeutic effects in people with mood disorders.

The impact of physical activities on recovery can be explained by psychological and neurophysiological mechanisms (Lox, Martin Ginis, & Petruzzello, 2010). First, intensive physical activities (like exercise and sports) help people to mentally switch off from work and distract them from stressor-related thoughts. Second, there is evidence that exercise and sports may elicit positive emotions quickly due to psychological factors (e.g., people feel good about themselves after having accomplished challenging tasks) and hormonal factors (the production of antidepressant hormones). Third, persons that are physically fit appear to recover more rapidly after stress exposure than persons that are less physically fit.

Findings about the recovery-promoting potential of other leisure activities are as yet inconclusive. For instance, De Bloom et al. (2011) found that engagement in passive activities was negatively associated with recovery indicators during a winter sports vacation but positively associated with the same recovery indicators during a summer vacation (De Bloom, Geurts, & Kompier, 2013). In the first setting, vacationers were forced to be passive due to negative (skiing) incidents. In the summer vacation, though, engagement in passive activities was associated with relaxation and psychological detachment and seemed to be a deliberate choice of the vacationer.

The recovering impact of a specific leisure activity may, at least partly, depend on the individual's behavioral control. Intentional engagement in activities that are valued and pleasant can be regarded an active form of recovery. According to the Self Determination Theory (Ryan & Deci, 2000), autonomy is a fundamental human need that, once fulfilled, is associated with personal growth and well-being. Control over whether, how, and when to engage in a particular leisure activity (i.e., behavioral control) will influence the pleasure that is derived from that activity and thus well-being in general. Research has shown that workers experienced more positive feelings during free weekends than during work periods on account of their higher level of control over how to spend their time (Fritz & Sonnentag, 2005; Ryan, Bernstein, & Brown, 2010).

12.6 Summarizing Conclusions and Future Research

I have tried to show that recovery from work is crucial to reduce negative aftereffects of work and to protect employee health and well-being in due course. I have argued that recovery from work is a process of psychophysiological unwinding that is the opposite of psychophysiological activation during effort expenditure under demanding and stressful conditions. My overview has shown that recovery during off-job time may be negatively and positively influenced by cognitive, affective, and behavioral processes. More specifically, recovery may be hampered by stressor-related thoughts, negative affective states, and prolonged exposure to work or similar

demands. However, recovery may be facilitated by psychological detachment from work, positive affective states, active leisure, and behavioral control.

Based on this overview of recovery research, I suggest a number of directions for future research. First, previous recovery research relies mainly on diary designs with rather limited time frames and is characterized by a focus on psychological recovery indicators. This research generally includes repeated (within-subject) self-report measures over a period of several (consecutive) days in a participant's natural environment (Bolger, Davis, & Rafaeli, 2003). Although diary designs are generally strong and methodologically adequate for investigating daily or weekly recovery cycles and for relating these cycles to daily work and non-work activities and experiences, they are not very appropriate to demonstrate health consequences of (lack of) recovery in the long run. To better substantiate long-term consequences of incomplete recovery, we need longitudinal studies covering a longer observation period of several months or several years. In addition, I believe that a combination of psychological recovery indicators (e.g., fatigue, vigor, need for recovery, affective states, sleep quality) and (neuro)physiological recovery indicators (e.g. blood pressure and cortisol levels) will help to provide a more complete picture of the recovery phenomenon (Sonnentag & Geurts, 2009). Due to traditionally different research approaches, still little is known about the interrelationship between psychological and (neuro)physiological recovery indicators.

Second, sleep is a prototypical and crucial recovery activity. During sleep, physiological processes counteract the negative effects of stress and thus have an important restoring function. Moreover, sleep disturbances yield effects that are very comparable to those of stress (Åkerstedt, Nilsson, & Kecklund, 2009). Since a strong connection between stress and sleep can be expected, it is remarkable that only few studies have investigated relationships between work stressors and sleep (Kompier et al., 2011). As far as evidence exists, it relies mainly on cross-sectional designs or, to a lesser extent, simple longitudinal (i.e., non full-panel) designs (Van Laethem, Beckers, Kompier, Dijksterhuis, & Geurts, 2013). As a consequence, the temporal dynamics between work stressors and sleep need further study. Exposure to work stressors may negatively affect sleep, but in turn, disrupted sleep may elicit work stressors, such as if it leads to poor work performance (e.g., mistakes) due to reduced alertness or to interpersonal conflicts due to irritability (stressor creation hypothesis; see Spector, Chen, & O'Connell, 2000). In addition, the role of worrying and rumination ('perseverative cognition') in the work-stress-sleep relationship deserves more research attention, as these cognitive processes may be key factors underlying sleeping problems (Åkerstedt et al., 2009). To illuminate the important role of sleep in people's everyday lives and to clarify the temporal relations among work stressors, sleep, and stressor-related cognitive processes, future researchers could use diary designs collecting day-level or week-level data. To elucidate the health consequences of (lack of) sleep in due course, strong (i.e., full-panel) longitudinal designs are needed (De Lange et al., 2009).

Third, we can imagine that recovery patterns may be influenced by personal factors (e.g., personality and temperament) and that these factors may be reflections of (lack of) recovery as well. Thus far, only a few studies have related recovery indicators

to personal factors. For instance, results from a cross-sectional field study revealed that individuals scoring high on neuroticism experienced relatively strong negative after-effects of work, such as fatigue and work-home spillover (De Vries & Van Heck, 2002; Wayne, Musisca, & Fleeson, 2004). Findings from a laboratory study showed slower cardiovascular recovery after stress exposure in persons scoring high on trait hostility as compared to persons scoring low on trait hostility (Anderson, Linden, & Habra, 2005). Still unanswered questions are what underlying cognitive, affective and behavioral mechanisms may account for different recovery patterns for workers with different personal characteristics, and to what extent person aspects (e.g., irritability) may partly be manifestations of (lack of) recovery. Various designs (short-term diary designs, longitudinal designs, and experimental designs) can be employed to provide more insight into whether and why recovery patterns unfold differently for workers with different personal characteristics.

Fourth, although numerous studies have investigated the effectiveness of stress intervention programs, such as cognitive-behavioral and relaxation techniques (e.g., Richardson & Rothstein, 2008), there is a high need for interventions and intervention studies aiming at improving recovery from work. Evidently, well-designed jobs (offering job control, job support, and job variety, for instance) and appropriate work-rest schedules are crucial to prevent a high need for recovery at the end of a workday (Kompier, 2003). Nevertheless, now that we have gained knowledge about processes that may hamper and facilitate recovery during off-job time, it is useful to develop and study interventions aiming at recovery during off-job time. Recently, free weekends and vacations (as well as activities and experiences during these episodes) have been studied as 'natural' recovery interventions (De Bloom et al., 2011; Fritz et al., 2010). Recovery interventions can also be actively implemented. A recent laboratory study showed the effectiveness of meditation as a tool to recover after stress exposure (Van Hooff & Baas, 2013). A recent intervention study by Hahn, Binnewies, Sonnentag, and Mojza (2011) revealed that workers improved their skills at detaching from work, relaxing, and deciding on their own leisure time schedule (control) during and after a 'recovery training' that also affected recovery-related variables (e.g., self-efficacy, sleep quality, and perceived stress).

In sum, future recovery research is challenged to combine findings concerning different time frames (short-term and long-term) and different recovery indicators (psychological and (neuro)physiological) into one comprehensive picture of the recovery process, and to use this knowledge to develop interventions and interventions studies aiming at facilitating recovery from daily work stress and protecting employee health and well-being in the long run.

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