RESEARCH IN OCCUPATIONAL STRESS AND WELL BEING

VOLUME 7

CURRENT PERSPECTIVES ON JOB-STRESS RECOVERY

SABINE SONNENTAG
PAMELA L. PERREWÉ
DANIEL C. GANSTER

Editors

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EDITED BY

SABINE SONNENTAG
University of Konstanz, Germany

PAMELA L. PERREWÉ
Florida State University, USA

DANIEL C. GANSTER
University of Arkansas, USA

JAI

United Kingdom – North America – Japan
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JAI Press is an imprint of Emerald Group Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2009

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-84855-544-0
ISSN: 1479-3555 (Series)

Awarded in recognition of Emerald's production department's adherence to quality systems and processes when preparing scholarly journals for print

INVESTOR IN PEOPLE

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LIST OF CONTRIBUTORS

Torbjörn Åkerstedt	Stress Research Institute, Stockholm University and Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden
Fabienne T. Amstad	Department of Work and Organizational Psychology, University of Bern, Bern, Switzerland
Arnold B. Bakker	Institute of Psychology, Erasmus University Rotterdam, Rotterdam, The Netherlands
Shoshi Chen	Faculty of Management, Tel Aviv University, Israel
Evangelia Demerouti	Department of Social and Organizational Psychology, Utrecht University, Utrecht, The Netherlands
Dalia Etzion	Faculty of Management, Tel Aviv University, Israel
Sabine A. E. Geurts	Work and Organizational Psychology, Radboud University Nijmegen, Nijmegen, The Netherlands
Ivona Hideg	Rotman School of Management, University of Toronto, Ontario, Canada
Göran Kecklund	Stress Research Institute, Stockholm University, Stockholm, Sweden
Peter M. Nilsson	Department of Clinical Sciences, University of Lund, Malmö University Hospital, Malmö, Sweden

Norbert K. Semmer	Department of Work and Organizational Psychology, University of Bern, Bern, Switzerland
Sabine Sonnentag	Department of Psychology, University of Konstanz, Konstanz, Germany
Toon W. Taris	Work and Organizational Psychology, Radboud University Nijmegen, Nijmegen, The Netherlands
Töres Theorell	Institute for Stress Research, Stockholm University, Stockholm, Sweden
John P. Trougakos	Department of Management – Scarborough, Rotman School of Management, University of Toronto, Ontario, Canada
Mina Westman	Faculty of Management, Tel Aviv University, Israel

FOREWORD

For decades research on occupational stress and well-being has been dominated by studies that demonstrated the negative effects of job stressors and lack of resources on employee health and well-being. Although this body of research is highly important and informative, it offers only limited insight into the processes that offset and "undo" the stress process. During recent years, researchers have paid increasing attention to such processes that reduce and reverse the effects of stress (i.e., recovery processes). This 7th volume of *Research in Occupational Stress and Well Being* is devoted to this growing research area on job stress recovery. The volume includes seven excellent chapters that provide state-of-the-art overviews on this theme, identify research gaps, and provide inspiring suggestions for further research.

The first chapter of this volume by Sabine Sonnentag and Sabine A. E. Geurts discusses methodological issues in recovery research. These authors explain why it is important to differentiate between recovery settings (e.g., work breaks, free evenings, vacations), recovery processes (i.e., activities and experiences), and recovery outcomes (e.g., affect, job-performance). They describe how to design and conduct various types of recovery studies, including (quasi-)experiments, diary studies, and longitudinal studies.

In the second chapter, John P. Trougakos and Ivona Hideg focus on momentary work recovery that takes place during breaks within workdays. The authors argue that work breaks affect psychological resources, particularly regulatory and affective resources that, in turn, influence workplace outcomes. They further suggest that workplace factors (job demands and job control) and individual difference variables (extraversion and neuroticism) moderate the relationship between work breaks and the resulting resource level.

The next chapter, authored by Evangelia Demerouti, Arnold B. Bakker, Sabine A. E. Geurts, and Toon W. Taris, deals with recovery at the day level. These authors summarize the empirical literature on diary studies of recovery and relate these studies to research on need for recovery. They propose that the recovery potential of activities pursued at home after work affect employees' psychological and energetic state at bedtime. Specifically, the recovery potential of activities should buffer the relationship between job-induced strain and a person's recovery state at bedtime.

The fourth chapter, authored by Fabienne T. Amstad and Norbert K. Semmer, discusses recovery in the specific context of the work–family interface. Amstad and Semmer start with an overview of the work and family literature from a macro (i.e., mainly person level) perspective. The core of their chapter then focuses on a micro-level perspective that describes transitions from one life domain (e.g., work) to the other life domain (e.g., family) over the course of a day. The authors suggest that recovery processes influence coping with stressful events within each life domain and at the transition point between the two domains.

In the fifth chapter, Mina Westman, Dalia Etzion, and Shoshi Chen examine business trips from a recovery perspective. They discuss business trips within a stress framework and describe in detail how business trips might impact travelers and their families. By differentiating among various phases (before, during, and after the trip), these authors delineate both the positive and negative outcomes of business trips.

The next chapter by Torbjörn Åkerstedt, Peter Nilsson, and Göran Kecklund reviews sleep as a crucial recovery process. The authors explain why sleep is important for the restoration of basic processes of the central nervous system, and they describe factors that affect the regulation of sleep and sleepiness. They summarize empirical evidence on the physiological consequences of sleep. Their chapter puts sleep in a broader societal context and discusses causes and consequences of sleep disturbances in modern societies.

The final chapter, authored by Töres Theorell, discusses recovery in the context of basic anabolic and catabolic processes at work. This chapter provides research evidence on the physiology of anabolic processes and their consequences. It demonstrates how recovery can influence basic bodily functions (including at the cell level) and how lack of recovery can impair such basic processes. Theorell summarizes findings from a broad range of empirical studies that illustrate the core propositions of his chapter.

As a whole, these chapters demonstrate the importance and the viability of this emerging research area on job stress recovery. They illustrate that knowledge on recovery processes helps us to better understand the work stress process and its consequences. We hope that you enjoy volume 7 of *Research in Occupational Stress and Well Being* and that it inspires you to think in a new way about job stress and how to reduce its damaging effects.

Sabine Sonnentag
Pamela L. Perrewé
Daniel C. Ganster
Editors

METHODOLOGICAL ISSUES IN RECOVERY RESEARCH

Sabine Sonnentag and Sabine A. E. Geurts

ABSTRACT

This chapter describes methodological issues that are relevant for research on recovery. We aim to provide an overview of methodological approaches that have been or can be used in recovery research, and to provide methodological guidelines that researchers may use in assessing the process of recovery. We argue that studies on recovery must be explicit about recovery settings, recovery processes (i.e., activities and experiences) and recovery outcomes. We describe typical operationalizations of these three perspectives and focus in more detail on potential measures of recovery outcomes. We give an overview of research designs including experiments and quasi-experiments, diary studies, and longitudinal field studies. We conclude by pointing to remaining challenges for researchers in the area of recovery.

INTRODUCTION

Research in the field of work and health has consistently demonstrated the adverse impact of psychosocial job stressors on individuals' health and well-being. Longitudinal research guided by the influential Job Demand–Job

Current Perspectives on Job-Stress Recovery
Research in Occupational Stress and Well Being, Volume 7, 1–36

ISSN: 1479-3555/doi:10.1108/S1479-3555(2009)0000007004

Control model has demonstrated that being exposed to psychosocial risk factors at work (i.e., high psychological demands and low job control) is associated with increased levels of physical and psychological health problems across time (Belkic, Landsbergis, Schnall, & Baker, 2004). Research inspired by the Effort–Reward Imbalance model provided evidence that a combination of high effort expended at work and low job rewards (e.g., low career prospects, poor job security) is related to subjective health complaints, coronary heart disease, and absenteeism (Van Veghel, De Jonge, Bosma, & Schaufeli, 2005).

In the past decade, the awareness has risen that *recovery* plays a crucial intervening role in the relationship between stressful work characteristics on the one hand, and health, well-being and performance capability on the other hand, and that stress-related psychophysiological processes are important ingredients of the recovery process. Geurts and Sonnentag (2006) propose that the essence of recovery is that "the 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" (p. 483). Accordingly recovery is a process of psychophysiological unwinding that is the opposite of the activation of psychophysiological systems that has occurred during exposure to stressful work conditions. Exposure to high job demands or stressors activates several bodily stress systems, in particular the Sympathetic–Adrenal–Medullary (SAM) system and the Hypothalamic–Pituitary–Adrenal (HPA) system, resulting in neuroendocrine responses (e.g., elevated excretion levels of catecholamines and cortisol) and cardiovascular responses (e.g., elevated blood pressure (BP) and heart rate (HR) levels). As the occurrence of these stress-related physiological reactions is normally adaptive and short-lived, it does not necessarily pose a serious risk for health and well-being. However, when these physiological stress reactions occur repeatedly or over prolonged times, and no longer return to their baseline levels after exposure to the immediate stressor has ended, they become potentially harmful as they may disturb the organism's precarious homeostatic balance. This homeostatic balance (also called "allostasis"; McEwen, 1998) refers to the balance between the sympathetic nervous system being dominant during the mobilization of energy (e.g., in response to stressors) and the parasympathetic nervous system being in control during rest and relaxation (e.g., sleep). Parasympathetic activity has the important aim to restore the undesirable and potentially destructive effects of sympathetic arousal (e.g., by slowing down the HR). A disturbed

sympathetic–parasympathetic balance will manifest itself in chronic over-activity or inactivity of crucial bodily systems (e.g., the immune system; McEwen (1998) refers to this pathological outcome as "allostatic load"), as well as in disturbed affective processes and deteriorated performance capabilities. Health, well-being, and performance are, thus, seriously at risk when individuals do not completely recover from acute stress-related physiological reactions.

Earlier research and practical interventions addressing rest breaks (Tucker, 2003), work hours (Harma, 2006), shift work (Smith, Folkard, & Fuller, 2003), and work-life balance (Geurts & Demerouti, 2003) have – at least implicitly – acknowledged the important role of recovery in protecting employee health, well-being, and performance capabilities. However, as yet, the topic of recovery has received only limited scientific attention. As far as research on this topic exists, it is characterized by a wide variety of perspectives and measurements. As a consequence, the process of recovery is not yet well understood (Geurts & Sonnentag, 2006; Zijlstra & Sonnentag, 2006).

The focus of this contribution is on methodological issues that are relevant for recovery research. We aim to provide an overview of methodological approaches that have been or can be used in recovery research, and to provide methodological guidelines that researchers may use in assessing the process of recovery. In the next section on measurement issues, we will first discuss various perspectives on recovery. More concretely, we will discuss the various recovery settings (e.g., free evenings, free weekends, vacations), and the perspective on recovery as a process and as an outcome. In this section, we will also discuss the various types of recovery outcomes (i.e., psychological (self-reported) outcomes, physiological outcomes, and behavioral outcomes). In the next section, we will present possible study designs (i.e., (quasi-)experimental, diary studies, and longitudinal surveys). We will finish this chapter with some conclusions about future research on recovery.

MEASUREMENT ISSUES

In this section, we will describe how to assess recovery. As the recovery phenomenon can be approached from different angles, we will first characterize these different perspectives. Then, we will present specific measures and measurement approaches for assessing the outcomes of recovery processes.

Perspectives on Recovery

Studies on recovery can assess various facets of recovery, namely the recovery settings, recovery as a process, and recovery as an outcome.

Recovery Settings

Recovery researchers may want to assess the temporal and situational *settings* in which recovery is assumed to occur. Such settings include work breaks (see Trougakos and Hideg in this volume), free evenings (Sonnentag, 2001), weekends (Fritz & Sonnentag, 2005), vacations (Westman & Eden, 1997), and sabbaticals (Davidson, 2006). Typical studies on recovery settings compare a person's state while (or after) being in such recovery situation with their states outside (or before) such a situation. For example, a study by Westman and Eden (1997) compared employees' burnout scores before, during, and after a two-week vacation. Although, in general, research on vacation as a recovery setting is scarce, some studies compared job stress indicators (e.g., work demands), health indicators (e.g., psychosomatic complaints), and job attitudes (e.g., job satisfaction) before and after a vacation period (for a systematic review on vacation studies, cf. De Bloom et al., 2009). In a similar vein, Fritz and Sonnentag (2005) compared health and performance indicators across a weekend period. Research using physiological indicators, for instance, compared urinary cortisol levels in truck drivers during working days and during rest days (Kuiper, Van der Beck, & Meijman, 1998). Variants of this approach may not only compare a vacation situation with a nonvacation situation, but might also want to distinguish between various types of vacations, for example, with respect to location or geographical region (Strauss-Blasche et al., 2004; Strauss-Blasche, Reithofer, Schobersberger, Ekmekcioglu, & Marktl, 2005).

Recovery as a Process

Studies focusing on recovery as a *process* aim at the assessment of the mechanisms assumed to underlie the recovery phenomenon. The most basic distinction refers to passive versus active mechanisms underlying the recovery process. A perspective focusing on passive recovery refers to relief from job demands and other stressors. A more active perspective on recovery addresses processes other than just the absence of demands or stressors crucial for recovery to occur. It reflects the active engagement in potentially recovering activities and experiences (Geurts & Sonnentag, 2006).

With respect to activities that are assumed to support the recovery process, studies have assessed how much time individuals have spent on specific and potentially recovering activities such as hobbies, sport, socializing, and low-effort activities (Rook & Zijlstra, 2006; Sonnentag, 2001; Van Hooff, Geurts, Kompier, & Taris, 2007a; Winwood, Bakker, & Winefield, 2007). Also studies that measure the amount of sleep individuals get regularly or during particular nights fall into this category (Cropley, Dijk, & Stanley, 2006; Van Hooff et al., 2007a). Studies that assess hours of overtime (i.e., during time that "should" be devoted to recovery) indirectly provide information on (lack of) recovery. For instance, a recent study among a large-sized heterogeneous sample of Dutch full time employees showed that involuntary overtime work was associated with relatively high fatigue and low satisfaction (Beckers et al., 2008). Similarly, research on the use of job-related communication technologies adds to our understanding of factors that might impede recovery processes (Boswell & Olson-Buchanon, 2007; Eden, 2001).

When interested in recovery as a process, researchers might not only be interested in activities but also in specific attributes associated with these activities. It has been argued that it is not the activities themselves, but the psychological experiences attached to these activities that are relevant for recovery (Sonnentag & Fritz, 2007). For example, one person likes to play soccer with a group of friends, whereas the other person prefers to watch a movie, but both "switch off" from their work while engaging in these activities and feel refreshed afterwards.

Sonnentag and Fritz (2007) distinguished between four distinct recovery experiences: psychological detachment from work, mastery, relaxation, and experiencing control. Psychological detachment from work implies to gain mental distance from one's job. When detaching oneself psychologically from one's job one refrains from job-related activities and job-related thoughts. In people's everyday experience, psychological detachment is often experienced as "switching off." Mastery experiences imply to address new challenges (e.g., doing a hiking tour in the mountains), to learn something new (e.g., practicing a new language), or to broaden one's horizon (e.g., traveling to a foreign country). Mastery experiences refer to the notion that recovery processes are not necessarily effortless. Recovery may require some kind of effort investment, but the demands are different from the demands one is facing at the job. Relaxation refers to processes characterized by low sympathetic activation. It can occur both at a physical level (e.g., by reducing one's physical activity) or at a mental level (e.g., by engaging in a kind or purposeful relaxation exercise such as meditation).

Relaxation experiences are also possible when listening to music, reading a novel etc. Control refers to self-determination during off-job time. It implies that one experiences discretion in the choice of one's activities. For example, deciding about when and how to do a specific activity can result in recovery.

Studies using between-person and within-person data showed that the four recovery experience dimensions can be clearly differentiated empirically (Sonnentag, Binnewies, & Mojza, 2008; Sonnentag & Fritz, 2007). Closely related – but not identical – to lack of psychological detachment are processes such as worry (Brosschot, Van Dijk, & Thayer, 2007) and rumination (Cropley & Purvis, 2003).

In addition to the four dimensions suggested by Sonnentag and Fritz (2007), one can think of other experiences that are helpful for recovery to occur. Such experiences may include the experience of pleasure or the experience of meaning, or lack of experiences that may negatively affect the recovery process such as experiences of effort. For instance Van Hooff et al. (2007a) showed among faculty members that those who experienced their work activities as effortful, also experienced their nonwork activities as effortful, and showed significantly higher levels of fatigue and more sleep complaints than individuals who did not experience their work and home activities as effortful. In addition, one could argue that the dimensions proposed so far may be too broad, and that, for example, it may be useful to distinguish between physical and mental relaxation. Also further refinement might be needed with respect to the concept of psychological detachment. For example, one might argue that lack of psychological detachment impairs well-being but only if job-related thoughts have a negative valence (e.g., when thinking about negative events that happened at work). Job-related thoughts with a positive valence (e.g., when thinking about a recent success at work) may help to improve one's well-being (Fritz & Sonnentag, 2005).

During sleep fatigue is reduced and resources are restored (see also Åkerstedt, Nilsson, and Kecklund in this volume). Therefore, studies that focus on sleep and do not only assess sleep duration, but also sleep quality, measure process aspects of recovery (Scott & Judge, 2006; Van Hooff et al., 2007a). At the same time, sleep duration and sleep quality can also be seen as an outcome of recovery (see next section).

Also environmental psychology has developed theoretical frameworks that are specific about the experiences that provide opportunities for recovery and restoration. Kaplan (1995) described restorative environments as environments that offer – among other aspects – fascination, a feeling of being away, and compatibility between the features of the environment and

one's own preferences. Research has shown that natural environments (i.e., nature areas) largely meet the requirements for such restorative environments (Kaplan, 1995), but that also other environments such as museums have a restorative potential (Hartig, Mang, & Evens, 1991; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Kaplan, Bardwell, & Slakter, 1993).

Recovery as an Outcome

Recovery may not only be studied in terms of the specific setting, regarding when and where it occurs, or in terms of the processes that eventually lead to a state of being recovered. Researchers may also want to examine recovery as an outcome. This perspective focuses on recovery as the result of a successful or less successful recovery process. For example, a person's affective state, specific physiological parameters (e.g., cardiovascular parameters such as BP or HR, and neuroendocrine parameters such as catecholamines or cortisol), and also performance scores are typically used as outcomes of recovery (these outcomes will be discussed in more detail in the next section).

One important issue with respect to recovery as an outcome refers to the differentiation between absolute levels versus relative levels of the recovery outcomes. When one is interested in a specific recovery outcome (e.g., a person's affective state before starting a new working day), one may assess the absolute level of this outcome (e.g., level of state positive and negative affect in the morning) or a relative level of this outcome. Such a relative score might capture the change in the outcome variable since the stressor ended (e.g., increase in state positive affect since the end of the last working day) or an outcome score relative to a person-specific comparison value (e.g., state affect during a typical off-job situation such as the weekend or a vacation).

Whereas absolute levels are often easier to obtain and may incorporate valuable information about a person's affective, cardiovascular or neuroendocrine state at a given moment, they are rather far away from the conceptual core of recovery – defined as a process opposite to the strain process during which important indicators of the organism's functioning return to their baseline levels (Craig & Cooper, 1992). Moreover, absolute levels of affect and physiological data may be influenced by all kinds of other variables that have nothing to do with recovery (e.g., a person's dispositional affectivity or health status).

Change scores that represent the difference in affective or physiological states between the start of a recovery period (e.g., end of a working day or the first day of a vacation) and the end of a recovery period (e.g., the morning before heading off for work or days in the second half of the vacation) reflect more closely the core of the recovery concept, namely the

"undoing" of the strain process. In practical terms, such change scores can be attained by using difference scores or residuals in a multiple regression equation. For example, one could assess a person's level of fatigue before and after a recovery period and then subtract the postrecovery fatigue score from the prerecovery score (fatigue recovery = $\text{fatigue}_{\text{pre}} - \text{fatigue}_{\text{post}}$) or by regressing the postrecovery fatigue score on the prerecovery fatigue score and regarding the residual as an indicator of recovery. Of course, it has to be taken into account that such change scores can also be influenced by factors other than recovery (e.g., circadian rhythm). Whenever possible, these other factors should be controlled for.

Another way to conceptualize relative recovery scores refers to the discrepancy between the recovery outcome (e.g., affective or physiological states) at the end of the recovery period and a baseline level of affect or physiological indicators. Thus, here the recovery score is expressed relative to the baseline level of the respective indicator. This perspective on recovery measures is most closely linked to the conceptualization of recovery as "return to the baseline." However, in practical terms, it is very difficult to assess a person's baseline level of the respective indicator. For example, with respect to some physiological data (e.g., HR) one might want to assess the level immediately after a person's awakening. This approach, however, assumes that the HR in the early morning before getting up reflects the true baseline, in other words, that full recovery occurred during the night. This is an assumption that is often not warranted.

Considering the practical problems in assessing a true baseline, most recovery studies might want to opt for a recovery score that relates the recovery outcome after the recovery period to the respective measure before the onset of the recovery period, for example, by using difference scores or residuals. In addition, one could also opt to assess within-person effects in a repeated measures design.

Combinations of Context, Process, and Outcomes

Of course, researchers might also want to combine these various perspectives (setting, process, outcomes) into one single study. For example, one might want to examine if the recovery experiences differ between weekends and vacations and if these differences result in differences with respect to affective states, physiological outcomes or performance outcomes. In fact, most studies on recovery incorporate a combination of two or more facets. When combining the various facets, however, it is important to clearly distinguish among them and not to blur setting with process or process with outcome. For example, in a recent study on recovery during a

short respite such as a long weekend, Kühnel, Sonnentag, and Westman (in press) analyzed (i) if work engagement increased after the respite, and (ii) if psychological detachment from work during the weekend played a role in the degree to which work engagement increased after the respite. In this particular study, the weekend period refers to the setting dimension, work engagement can be considered an outcome of the recovery process, and psychological detachment refers to "recovery as a process."

Types of Recovery Outcomes

Various outcome variables can be used as indicators of a successful or less successful recovery process. Globally, we can distinguish among three types of recovery outcomes: psychological (e.g., fatigue, affect, sleep quality), physiological (e.g., cardiovascular and neuroendocrine) and behavioral (e.g., performance). To adequately capture the outcomes of the recovery process, we should use measurements that are sensitive for subtle fluctuations in the recovery process across time. In recovery research, the observation period sometimes covers a relatively long period (e.g., months or years), for instance, when the long-term impact of high strain jobs and incomplete recovery on health and well-being is investigated (Gump & Matthews, 2000; Kivimäki et al., 2006; Van Hooff et al., 2005). For instance, Kivimäki et al. (2006) showed in a prospective cohort study that industrial workers (initially free of overt cardiovascular disease), who reported insufficient recovery during free weekends, showed an elevated risk of cardiovascular death more than 20 years later. However, in recovery research observation periods are often shorter covering a period of several weeks, for instance, across a vacation period (Westman & Eden, 1997), or of several hours or days, for instance, when recovery from a stressful workday or workweek is studied (Sonnentag, 2001; Van Hooff et al., 2007a). A general guideline is that when observation periods are short, researchers should utilize "momentary" measures of recovery or adapt more general recovery measures in such a way that they become appropriate for day-level research. In the next paragraphs, we will elaborate on each category of recovery outcomes.

Psychological Recovery Outcomes

Many researchers assess individuals' level of recovery directly by asking the individuals themselves how they feel after a (stressful) work period and after a recovery period. Individuals may respond in terms of, for instance,

their state of recovery, their level of fatigue, other affective states, and their sleep quality.

Recovery State. A measure that is widely used to assess the present recovery state is the *Need for Recovery scale* (De Croon, Sluiter, & Frings-Dresen, 2006; Van Veldhoven & Broersen, 2003). This questionnaire assesses a person's wish for being – temporarily – relieved from any demands in order to replenish his or her energy resources. Need for recovery is experienced as "feelings of 'wanting to be left in peace for a while', or 'wanting to lay down for a while'" (Sluiter, Frings-Dresen, Van der Beek, & Meijman, 2001, p. 29). The *Intershift recovery scale* taps a similar experience (Winwood, Winefield, Dawson, & Lushington, 2005). As these recovery measures were originally not developed for day-level purposes, adjustments for capturing day-level fluctuations in need for recovery have been proposed (Sonnentag & Zijlstra, 2006). In addition to a person's need for recovery, the state of feeling actually recovered can also be assessed more directly ("This morning, I feel well rested"; Binnewies, Sonnentag, & Mojza, 2009).

Fatigue Level. Conceptually, "fatigue" is inversely related to "recovery state" and often similar items are used to capture it. Research, however, indicates that fatigue is still distinct from recovery (Jansen, Kant, & van den Brandt, 2002). Fatigue is often measured in a way that reflects how fatigued people generally feel. Examples are the *Fatigue Assessment Scale* (FAS, example item: "I am bothered by fatigue"; Michielsen, De Vries, & Van Hecke, 2003) and the exhaustion subscale of the *Utrecht Burnout Scale* (UBOS; Schaufeli & van Dierendonck, 2000). However, such general measures are not suitable to capture a person's current recovery state, unless they are adapted for day-level measurement (e.g., "Today I experienced fatigue"). The *Experienced Load Scale* (Van Veldhoven, De Jonge, Broersen, Kompier, & Meijman, 2002) was developed as a momentary measure of fatigue by asking workers, for instance, to what extent they felt mentally tired during the first and last hour of a specific working day. Recently, Van Hooff, Geurts, Taris, and Kompier (2007b) tested the validity of a *single-item fatigue measure* on the day level (respondents answered with a report mark to the question "How fatigued do you currently feel") by relating it to the well-validated six-item fatigue measure of the *Profile of Mood States* (POMS; McNair, Lorr, & Droppelman, 1971). They concluded that the single-item fatigue measure was psychometrically equivalent to the multiple-item fatigue measure, and thus, that the report mark is a valid and useful tool to measure day-level fatigue.

Other Affective States. Because stressful work conditions often lead to impaired mood, restoration of the disturbed emotional state is one of the core functions of recovery. However, the precise role of affective states in the recovery process is not yet disentangled. High positive and low negative affective states may be considered outcomes of a successful recovery process with a favorable change in affective state demonstrating that recovery has occurred. However, we might as well consider affective state as an antecedent or a facilitator of the recovery process. For instance, Fredrickson, Mancuso, Branigan, and Tugade (2000) provided evidence, in line with the broaden-and-build theory of positive emotions (Fredrickson, 1998), that positive emotions facilitate the recovery process by downregulating cardiovascular reactivity that was triggered by negative emotions. In this particular study (Fredrickson et al., 2000), negative and positive affect appeared to be an antecedent and a facilitator of cardiovascular recovery outcomes, respectively (see further explanation below).

A widely used measure of negative and positive affect is the *Positive and Negative Affect Schedule* (PANAS; Watson, Clark, & Tellegen, 1988). Watson and his coworkers propose that Negative Affect and Positive Affect are two broad, general, and only weakly related dimensions that are each composed of various, related, but differentiable, emotions with, for instance, fear, sadness, hostility, and guilt as negative emotions, and with, for instance, joviality, self-assurance, and attentiveness as positive emotions. Although the PANAS is often used as a trait measure of Negative Affect and Positive Affect (''Thinking about yourself and how you normally feel, to what extent do you generally feel . . . ''), it can also be applied as a state measure (e.g., ''To what extent do you feel . . . at this moment''). In addition to positive and negative affect as broad affective dimensions, one could also assess the discrete emotions as recovery outcomes. For example, Watson and Clark (1994) suggest fear, hostility, guilt, and sadness to be basic negative emotions, and joviality, self-assurance, and attentiveness to be basic positive emotions. In addition, they differentiate between four other affective states namely shyness, fatigue, serenity, and surprise.

A related measure of affective states is the earlier discussed POMS. The POMS covers, besides ''fatigue'' (feeling tired), other dimensions of mood, that is, ''depression,'' ''anger,'' ''(loss of) vigor,'' and ''tension.'' Also the POMS has been used both as a trait measure (e.g., ''To what extent do you [feel tired] over the last few days including today,'' supposedly reflecting how people generally feel, although the period of reflection is still relatively short) and as a state measure (e.g., ''To what extent do you [feel tired] at this moment?'').

Sleep Quality. Sleep quality can be conceptualized both as a recovery process (i.e., a mechanism that reduces fatigue and supports restoration of resources; see previous section) and as a recovery outcome. Most obviously, successful recovery during a free evening should improve sleep quality. Sleep quality covers various aspects such as difficulties with falling asleep, difficulties with sleeping through, and early awakening. Adequate sleep scales for day-to-day measurements are the *Sleep Quality Scale* (Van Veldhoven, De Jonge, Broersen, Kompier, & Meijman, 2002; Van Hooff et al., 2007a; e.g., "Last night I woke up several times") and a *subjective sleep scale* (Åkerstedt, Hume, Minors, & Waterhouse, 1994; slightly adapted by Cropley et al., 2006; e.g., "Did you sleep throughout the night"). The *Sleep Wake Experience List* (SWEL; Van Diest, 1990) has been used to measure both the incidence and the severity of sleep complaints over the last three months. Also other measures of sleep quality as the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) can be adapted for use in day-level studies (Sonnentag et al., 2008).

Physiological Recovery Outcomes

Recovery is an important part within the field of physiological research on stress. Usually a differentiation is made between two physiological phenomena related to the stress process: reactivity and recovery (Linden, Earle, Gerin, & Christenfeld, 1997). Reactivity refers to the physiological responses that occur while the stressful event is actually occurring. Recovery refers to processes during the poststressor period, when physiological strain indicators return to their baseline levels. As we discussed earlier, slow recovery may manifest itself in the prolonged elevation of physiological indicators after the stressor has ended (a phenomenon also known as the "slow unwinding"). In this section, we will first discuss the neuroendocrine measures, that is, catecholamines (noradrenaline and adrenaline as main outcomes of the SAM system) and cortisol (as main actor of activity of the HPA system). Next, we will discuss cardiovascular indicators, that is, HR and BP, which can be considered more secondary and manifest outcomes of activity of the SAM system. We will discuss the use of these measures both in laboratory and field settings. Neuroendocrine measures are taken generally through (intrusive) blood samples and urinary samples (with the latter, of course, being less inconvenient for participants). Cortisol can be derived, in addition to blood and urinary samples, more easily through saliva samples.

Neuroendocrine Measures. Catecholamine and cortisol levels are extensively studies in laboratory settings, mostly in response to a stressful

task or event (see Sonnentag & Fritz, 2006, for a review). As catecholamines are secreted very instantly through the SAM system in response to a stressor, catecholamine recovery also may occur relatively quickly, that is, a few minutes after termination of the stressor (Linden et al., 1997). However, there are indications that after exposure to a stressful task or event (in particular, anger-provoking situations), catecholamine levels (and particularly adrenaline) remain elevated for quite some time (e.g., for 1 or 2 h) after the stressor has ended (Linden et al., 1997). As cortisol is the main stress indicator in the somewhat slower operating HPA system, it takes normally 20 min after exposure to the stressor before cortisol can be observed in saliva, and it takes 40–60 min before elevated levels have returned to their baseline or prestressor levels (with the higher the cortisol reactivity, the longer it takes before cortisol levels have stabilized; Dickerson & Kemeny, 2004). The use of cortisol measures as outcomes of recovery might be problematic because the return to prestressor levels seems to be depend on very stable (individual) characteristics (Pruessner, Hellhammer, & Kirschbaum, 1999).

Also field studies examined catecholamine and cortisol recovery (for a review, see Sonnentag & Fritz, 2006). In field research, neuroendocrine measures are generally taken during (work) load at daytime and during recovery at evening/night time. Catecholamine and cortisol levels are generally higher during daytime (as compared to evening time) and during working days (as compared to rest days). Of particular interest is to what extent catecholamine and cortisol levels remain elevated during free periods (e.g., free evenings or free weekends) after a work period (e.g., a day or a week), indicating incomplete recovery. Again, one might assume that it is difficult to use cortisol as an outcome indicator of recovery as cortisol secretion follows a strong circadian rhythm (high and rising levels in the early morning, a gradual decrease during the day and the lowest levels in the first part of the night) and therefore the impact of relief from daily stressors on this circadian rhythm can hardly be detected. A recent study, however, demonstrated that decline in cortisol across the day can be used as a recovery indicator, at least in women (Saxbe, Repetti, & Nishina, 2008).

Cardiovascular Measures. Physiological reactivity to and recovery from stressors may also manifest itself in cardiovascular outcomes. Prolonged elevated HR and BP levels indicate sustained sympathetic activation and, thus, delayed or incomplete recovery (Rau, Georgiades, Fredrikson, Lemne, & de Faire, 2001; Rau & Triemer, 2004). Information about parasympathetic activation and its crucial function of restoring the negative effects of

sympathetic arousal can also be deduced from the HR, namely from the Heart Rate Variability (HRV) which is associated with respiration. During inhaling HR increases, whereas during exhaling HR decreases (the so-called "Respiratory Sinus Arrhythmia," RSA). The difference between the maximum HR during inhaling and the minimum HR during exhaling is a measure of parasympathetic activation with high differences (high HRV) indicating stronger parasympathetic and thus restorative activation. Low HRV is considered a marker of low parasympathetic activation and thus indicative of disturbed restorative functions and incomplete recovery (Gerin, Davidson, Christenfeld, Goyal, & Schwartz, 2006). Both in field and laboratory settings, HR and HRV (together with motor activity) can be recorded continuously by ambulatory monitoring (e.g., De Geus, Willemsen, Klaver, & Van Doornen, 1995). Systolic and diastolic BPs can be measured on an interval basis (e.g., every 15 min), for instance with a BP monitor on the nondominant arm (e.g., Vrijkotte, Van Doornen, & De Geus, 2000) or by continuous beat-to-beat measures, for instance, by using the Finapres, a noninvasive method using an inflatable finger cuff on the third finger of the nondominant hand (e.g., Gerin et al., 2006). In both the laboratory and field setting, one way to analyze HR, HRV and BP data is to average these parameters over the baseline period, the stress period and the recovery period (for a detailed discussion on the measurement and analysis of cardiovascular recovery measures, see Linden et al. (1997)).

Other Physiological Measures. Of course, one might also think of other physiological measures such as electromyographic indicators (EMG), skin conductance or assessment of skin temperature (Burns, 2006; Veldhuizen, Gaillard, & de Vriese, 2003). However, these measures are not so often used in applied settings.

Behavioral Recovery Outcomes

One behavioral outcome of a successful recovery process is that workers perform adequately when returning back to work after a period of rest. During free time, individuals do not only recover from strain build up at work, but may reload their "personal batteries" (i.e., psychological resources) as well, which may manifest itself in higher job performance after the free period. Job performance can be seen as a multidimensional concept (Campbell, McCloy, Oppler, & Sager, 1993). For instance, Fritz and Sonnentag (2005) focused on task performance (i.e., behaviors that are recognized by formal reward systems and are part of the formal job requirements) and proactive behaviors at work, that is, taking personal

initiative (e.g., taking initiative in improving the work circumstances; Frese, Fay, Hilburger, Leng, & Tag, 1997) and pursuit of learning (e.g., searching for situations in which one can develop new knowledge and skills; Sonnentag, 2003).

A recent study examined job performance following work breaks in a very specific sample, namely cheerleader instructors (Trougakos, Beal, Green, & Weiss, 2008). Trougakos and his coworkers conceptualized "affective delivery" (i.e., acting with spirit/enthusiasm, energy, alertness and sincerity) as a core aspect of job performance in this sample and used ratings of video recordings as the performance indicator. This study showed that the quality of affective delivery after work breaks increased when these cheerleader instructors had engaged in respite break activities (e.g., napping, relaxing, socializing) as opposed to chore activities (e.g., working with customers, running errands).

Particularly with respect to task performance one should carefully choose the performance indicators that allow the detection of even minimal changes in performance. As completing work tasks is a high priority in many jobs, people most probably try to uphold their performance level even when they are not optimally recovered. For example, when workers are not in a fully recovered state, they may use compensatory effort in order to not fall behind in their performance (Binnewies et al., 2009; Hockey, 1997). Therefore, the effects of recovery on task performance are quite difficult to detect, and manifestations of compensatory effort or strain should be simultaneously taken into account. Thus, task performance as such might not always be a good outcome indicator of recovery.

STUDY DESIGNS

Recovery research can be done with various study designs. In this section, we will discuss how to implement recovery studies by following (quasi-) experimental designs, diary study approaches and longitudinal designs.

Quasi-Experimental and Experimental Designs

For examining the "outcomes" of recovery occasions, quasi-experimental and particularly experimental designs are rather straightforward study-design options. Shadish, Cook, and Campbell (2001) define an experiment as "a study in which an intervention is deliberately introduced to observe

its effects'' (p. 12). True or randomized experiments are experiments in which study participants are randomly assigned to two or more study conditions. Quasi-experiments are experiments where such a random assignment is lacking.

With respect to recovery research, true experiments are rather rare – but not impossible. Quasi-experiments are much more common. In typical quasi-experimental recovery research, study participants are observed (or more often: surveyed) during a recovery episode and during a nonrecovery episode. Because of their more frequent use in recovery research, we will first discuss quasi-experimental designs and then move to experimental designs.

Quasi-Experiments

In the context of recovery research, quasi-experimental studies typically examine affect, (mental) health, or attitudes before, during and after a recovery episode, for example, a free weekend, a vacation, or even a sabbatical. In addition, before and after the recovery episode, job performance measures also can be assessed. Typical examples of such quasi-experimental studies comprise a study by Fritz and Sonnentag (2005) examining recovery during the weekend, the vacation study by Westman and Eden (1997) mentioned earlier in this chapter and an impressive study on recovery during sabbaticals (Davidson, 2006).

Quasi-experimental designs are not limited to just one measurement point before, during and after a recovery episode. More comprehensive designs may include even more measurement points. For example, Westman and Eden (1997) realized two measurement points before a vacation, one during the vacation and two after the vacation. Using several measurement points before the recovery episode allows for the investigation of potential anticipation effects, using two or three measurement points after the recovery episode enables the researchers to address potential fade-out effects over time.

For drawing conclusions based on these types of quasi-experimental designs with just one study group that spent time on the recovery episode, it may be useful to not just collect data from the persons who spent time on the recovery episode, but also from persons in a control group that continued to work during the same period of time. Otherwise, it is difficult to conclude that positive changes after the recovery episode happened because of the recovery episode. For example, changes on study participants' outcomes might have occurred because of a change in weather (or other processes unrelated to the recovery episode) or because of methodological artifacts. For example, Etzion and her coworkers conducted

a quasi-experimental study with two measurement points and two study groups (Etzion, Eden, & Lapidot, 1998). However, the inclusion of a control group in recovery research also encounters problems. As the recovery process may be influenced by a wide variety of variables (i.e., personality, work and family situation), it is very difficult to standardize these variables for the recovery group and the control group. In other words, it is very likely that the two groups may differ on variables that may be relevant in the recovery process. It may be for this reason that recovery studies, which are using control groups, are very rare overall. For example, De Bloom et al. (2009) conducted a systematic review of vacation studies and found that only two out of eight vacation studies used a control group. With respect to other recovery settings (i.e., weekend or free evenings) control groups are even more difficult to study.

Strictly speaking, strong causal interferences can only be drawn from a true experimental procedure that randomly assigns study participants to the various study groups – a condition that might be very difficult to implement with respect to typical recovery episodes such as vacations. We will discuss true experimental designs later in this section.

When planning recovery studies with measurement points before and after a recovery episode, decisions have to be made with respect to the exact timing of the measurements. When should the premeasures, and when should the postmeasures be taken? The premeasure has to be scheduled at a time when affect (or other outcome measures) is not yet potentially influenced by the recovery episode to come. For example, with respect to a vacation study, it should be ruled out that study participants are already in a good mood because they are looking forward to going on vacation – or that they are fatigued and stressed because they have to prepare many things before the beginning of the vacation (e.g., finishing work tasks, packing the bags). Thus, in order to get an idea of a person's recovery state in a normal (regular) workweek, a measurement point somewhat distal to the vacation might be preferable over a measurement point immediately before the vacation. Measurements during a normal workweek relatively long before the vacation period can then be considered baseline measures. Effects of vacation itself as well as potential anticipation and fade-out effects can be detected by making within-person comparisons with this baseline measure. This approach would make the use of a control group not necessary as each person is compared to his or her own baseline level (keeping most potentially disturbing variables like personality, family situation and nature of work under control). Similarly, when examining recovery during weekends, measurements at Friday afternoons might not represent the best

preweekend measures as then weekend anticipation might already play a role. Instead measurements at a regular workday somewhere in the middle of the workweek would provide the best baseline with which to compare the weekend effects.

However, when explicitly interested in vacation (or weekend) anticipation, a measurement point rather close to the recovery episode is important. For example, Westman and Eden (1997) realized two prevacation measurement points, one six weeks before the vacation (in order to assess "true" prevacation states) and three days before the vacation (to test vacation anticipation).

With respect to postrecovery measures, the timing of the assessment is also crucial. Often, one is interested in the immediate outcomes of the recovery episode, and in such cases it is recommended to assess affect, performance, or other outcomes just after the termination of the recovery episode and before potential daily (job) stressors start to exert their influence on the person again. However, one might argue that at the end of the recovery period, one already anticipates the next working days or weeks and that this anticipation already reduces the recovery effect. For instance, Rook and Zijlstra demonstrated that sleep quality already decreased on Sunday nights. Similarly, Van Hooff et al. (2007a) showed among faculty members that those who experienced their work activities as effortful, reported lower motivation to start the next working week after a free weekend. Therefore, one might consider measuring the outcomes of the recovery processes even before anticipation of work takes place. Moreover, one might also be interested in long-term outcomes of recovery processes and might want to examine how long recovery effects persist. Particularly with respect to recovery during vacations, fade-out processes have been proposed (Westman & Eden, 1997). To capture vacation fade-out, it is useful to assess the outcome measure two to four weeks after the end of the vacation.

Another important decision to be made refers to the question of whether measures should be taken during the recovery episode (e.g., vacation or a free weekend). To assess whether changes in affect, well-being and similar outcome variables may be caused by the recovery episode, it is useful to have an indication if affect, well-being and such outcomes changed during the recovery episode. For example, if one assumes that levels of exhaustion are reduced after a recovery episode, exhaustion should most probably already show a reduction during the recovery episode. However, it might be difficult to draw inferences from such an approach. In addition to the fact that no causal conclusion can be drawn from nonexperimental studies, it has

to be considered that recovery might not be reflected in an immediate decrease in exhaustion. It may be that feelings of exhaustion remain high during the first phase of the vacation, but decline towards the end of a vacation. Then, high exhaustion scores would be observed when taking the measures during the first days of the vacation. Moreover, not all recovery outcomes can be adequately measured during a recovery episode. For example, it does not make much sense to assess job-related tension during a vacation. However, when researchers are interested in affective states, in the activities people engage in, or in the specific experiences they have during a recovery episode, it is useful to assess these affective states, activities and experiences during the recovery episode (Fritz & Sonnentag, 2006), thereby facing the challenge of not putting a burden on the participants during the recovery episode.

It is important to note that the setting and other conditions for completing the measures should be identical before and after the recovery episode. For example, study participants should respond to surveys either at the workplace or at home before and after the recovery episode. When it comes to the assessment of physiological data, comparability of the measurement situation is particularly critical. Also the time of the day of data collection should be identical before and after the recovery episode not only for physiological measures as they follow a strong circadian rhythm, but also for psychological measures (people are generally in different moods immediately after awakening than when they come home from work or just before going to bed). Consequently, not all types of recovery settings can be equally well examined with a quasi-experimental pre–post design. Since one cannot simply compare affect or physiological parameters immediately after work (prerecovery) with affect or physiological parameters at bedtime or in the next morning (postrecovery), this approach is less suitable for addressing recovery during free evenings of regular work weeks.

Experiments

Recovery research can also build on true experiments with random assignment of study participants to study conditions. In fact, true experiments would be highly needed in recovery research in order to establish causality. However, true experiments are (still) rather rare. Random assignment of study participants to various experimental conditions is most feasible in a laboratory research context, but also field experiments are an option.

An experimental research tradition relevant for recovery is sleep research (see also Åkerstedt, Nilsson, and Kecklund in this volume). To gain a better